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Promoting and Incentivising Federated, Trusted, and Fair Sharing and Trading of Interoperable Data ASsets

D5.1. Demonstrators Evaluation Plan and Preparation Activities Report

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Abstract	This document forms the guidelines for how the project will move forward into its demonstration and evaluation phases. The first section of the document scrutinises the most suitable available tools for carrying out a successful evaluation and draws together a set of techniques which PISTIS will subsequently utilise, forming the Evaluation Framework. This will be used to evaluate both the specific demonstration activities to be carried out, but will also take a holistic approach and look at how successful the project as a whole has been.

Executive Summary

This document forms the guidelines for how the project will move forward into its demonstration and evaluation phases.

The first section of the document scrutinises the most suitable available tools for carrying out a successful evaluation and draws together a set of techniques which PISTIS will subsequently utilise.

The second section specifies which of the mechanisms discussed in Section 1 will be utilised in PISTIS. This collection of tools and techniques forms the Evaluation Framework, which in addition to the evaluation of the specific demonstration activities to be carried out, will also take a holistic approach and look at how successful the project as a whole has been.

We considered issues such as how we would carry out measurements and what would be the metrics to adopt? What would be the evaluation criteria for different aspects of the project? And how we should engage with stakeholders?

The final two sections of the document cover how we will prepare for and subsequently conduct the demonstration activities at the various demonstration hubs. Collectively, all this work allowed us to produce a plan for coordinating the evaluation process which will evolve from the basic document presented as an Appendix to this document.

The Demonstration and Evaluation Plan itself, will become a living document online as the project progresses and it is based upon this elaborated framework. It will be strengthened, and details added to it, and it will be further influenced by the experience of using the plan and the framework, to carry out the interim and final evaluations of the platform.

Within the project, and specifically for WP5, this deliverable is significant and performs a role of knitting together all the elements of the project. It takes a holistic view and looks not simply to ensuring that the technical work is implemented successfully, but that in turn contributes to other Work Packages, including dissemination and exploitation and legal aspects. Subsequent deliverables, D5.2 and D5.3, will be based on this work, whilst informing the technical teams to assist in their future work.

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Terms and Abbreviations

ABAC	Attribute-based access control
AIA	Athens International Airport
AODB	Airport Operations Database
AOBT	Actual off-block Time
API	Application programming interface
BR	Business requirements
CIM	Common information model
D	Deliverable
DAC	Discretionary access control
DER	Distributed energy resources
DIH	Digital Innovation Hub
DLT	Distributed Ledger Technology
DoA	Description of Action
DPIA	Data protection impact assessment
DSO	Distribution service operator
EaaS	Energy as a service

EU	European Union
GDPR	General Data Protection Regulation
GIS	Geographic information system
GSE	Ground support equipment
KPI	Key performance indicator
ML	Machine learning
MO	Market operator
MOOC	Massive Open Online Courses
MoSCoW	M - Must have, S - Should have, C - Could have, W - Won't have.
MVP	Maximum/Minimum Value Product
NFT	Non-fungible token
NWP	Numerical weather prediction
OASA	Athens Public Transportation System
ODRL	Open Digital Rights Language
PoA	Proof of authority
PoW	Proof of work
PRM	Passengers with disabilities and reduced mobility
PV	Photo-voltaic
P2P	Peer-to-Peer
SLA	Service level agreement
ToC	Theory of Change
TOBT	Target off block time
WP	Work Package

1 INTRODUCTION

1.1 SHORT OVERVIEW OF PISTIS PROJECT.

The Vision for the PISTIS project is to provide a reference federated data sharing/trading and monetisation platform for secure, trusted and controlled exchange and usage of proprietary data assets and data-driven intelligence based on open APIs and standardised components of known initiatives (IDSA, Gaia-X, etc) that can be used jointly or autonomously enabling existing data space users to complement their existing services with the new methods arising from PISTIS and not forcing them to be abandoned.

It has two core parts, which are:

- The PISTIS Data Space Factory, which is deployed "locally" over each DataSpace, and which holds all the Data.
- The PISTIS FAIR Data Trading & Value Exchange Monetisation Platform, which coordinates the Interaction between the Data Space Factories and oversees all data trading transactions and contracts.

The key participants involved are the data owners, data providers (and data subjects) identified as the data-supply side on the one hand, and the data consumers and data users (data-demand side) on the other hand.

The intention is to enable richer and more robust insights, improved operations, whilst addressing concrete business problems and generating new business opportunities, through secure, seamless, and trustful data sharing among different stakeholders at a global scale.

There are four axis of innovation which are:

- Federated Data Management, Interoperability & Governance which includes:
  - Data Collection, Curation, Security and Control
  - Syntactic, Semantic, Metadata Interoperability
  - Data observability
  - Data source certification mechanisms
- Federated, Secure Data Sharing which includes:
  - Secure peer-to-peer (encrypted/unencrypted) data transfer
  - Data usage monitoring/tracking
  - Multi-party contracts
  - Contract Compliance/Enforcement
- Data Valuation and Monetisation which includes:

- articulating and recommending data value, identifying data generation cost, and probable income and market dimensions

- the PISTIS conceptual Stablecoin

- Data Sharing Skills Cultivation which includes:

  -Training material to educate stakeholders around data sharing

  - Empowerment to understand their needs and identify gaps

  - MOOC

1.1.1 What is included in PISTIS and what isn't

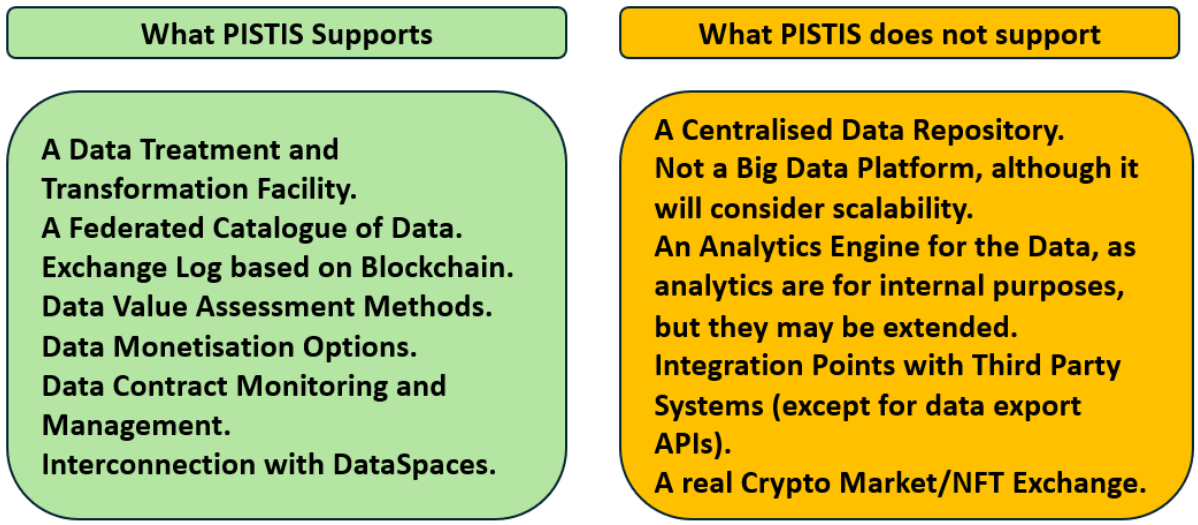

Figure 1: What PISTIS supports and doesn't support

1.2 Overview of early work planned in WP5

This is the first deliverable in a work package which is pivotal to the project. The work package covers how we will demonstrate and evaluate the results of the project.

"D5.1 Demonstrators Evaluation Plan and Preparation Activities Report" is the first of the intrinsically linked deliverables of "WP5: Multi-Layer Demonstrators Setup, Operation and Business Value Exploration".

It is the plan for assessing the impact of PISTIS in the demonstrators from a business, technical and legal perspective, and report on preparation activities.

It sets out to describe how we will evaluate both the pilots and the project as a whole. It provides the "Documentation of the evaluation framework and validation methodology, defining the various practices for recording feedback from the demonstration activities and including a set of test-cases to be executed by the demonstrator partners."

We can loosely say that as far as WP5 is concerned, the work splits into three phases, that reported in this deliverable on how we will carry out the demonstrations and evaluate them,

and then followed by two phases of evaluation at M28 and the final evaluation at M40. This deliverable covers the work prescribed in the first two tasks of WP5:

- T5.1 – Verification and Validation Framework Definition and Baseline Impact Assessment
- T5.2 - Demonstrators Use Cases Detailing and Execution Planning

T5.1 defines a verification and validation framework to measure the project's technical maturity and the results achieved at the demonstrators and has been based on previous evaluations of the projects which underpin PISTIS such as DataVaults, SafeDeed etc. It will initiate specific validation scenarios along with their specific Key Performance Indicators (KPIs) for each demonstration hub, whilst still enabling a uniform evaluation of the project results. The evaluation framework will also focus on defining additional quantified KPIs (technical, economic, environmental, social, business) to enable the holistic assessment of the project impact per demonstrator hub and in achieving higher level goals for the project. A variety of tools will be deployed to collect the necessary data.

And in parallel, preparatory activities for the launch of the demonstration activities will be performed, focusing on the creation of a realistic and accurate baseline to be used as a reference for the verification of the impact achieved.

T5.2 in the early stages of the project, will create a detailed list of the available data assets at each demonstrator for the realisation of the project's piloting activities. This will complement the data requirements identified in the initial work for the landscaping that was delivered by T1.2.

In parallel with the asset identification process, the task will also focus on refining the landscaping of the data assets involved in the project's demonstrators and their characteristics (including relevant IPR policies), to get a good understanding of the information sources that will be handled and managed during the experimentation at each data ecosystem.

Moreover, demonstrator-specific use cases will be designed based on the end-to-end usage scenarios and data trading lifecycle design identified in T1.2 and presented in D1.1 and a detailed execution plan will be provided with the demonstration activities, including processes, needed inputs and expected outputs.

The task will also perform a gap analysis at the project's demonstrator sites to define additional activities (e.g. consent collection, deployment of internal infrastructure, connections sensors, compatibility with specific APIs, resolution of network communication issues) which are necessary in order to facilitate the realisation of the project's demonstrators. Following the progressive delivery of the platform, this task will coordinate their deployment in the demonstration sites and their integration with existing data spaces.

Together the two tasks contribute in the following way:

- They elaborate the Verification and Validation Framework for the project.

- Provide a general guideline to monitor and align the demonstrators' phases within the evaluation framework.
- Guide the planning and coordination of the Demonstrators' Set-up.
- Prepare for and set-up the Demonstrators' Implementation.
- Prepare for evaluating the demonstrators and estimating their impact.
- Prepare for the Technical Verification and Validation.
- Prepare for the Business Validation.
- Prepare to document the Impact Assessment and Lessons Learned for the work to be carried out in T5.7

To assess the degree to which the elements to be developed by PISTIS can be successfully introduced to the different data spaces, they will be effectively evaluated in real-life settings supporting real-life business scenarios and within this document's all-inclusive framework for verifying, validating, and evaluating the project's outcomes (from their conception to final release and experimentation in the demonstrators' settings).

1.3 Overview of the PISTIS Evaluation Process

1.3.1 The "Evaluative Thinking" process

An evaluation that reflects evaluative thinking is the systematic process of telling the PISTIS "story" by:

- Identifying assumptions about why we think the project will work and be a success starting from the Description of Action (DoA).
- Determining what change we expect to see during and after we implement what we have set out to do in the DoA.
- Collecting and analysing data to help us understand what happened during the project.
- Communicating, interpreting and reflecting on the results.
- Using these results and lessons learned to help make informed decisions to be able to plan for a successful exploitation after the project finishes and to make any minor adjustments to our work as a result of the interaction with the Theory of Change. (Part of the storytelling will evolve around the creation of the PISTIS "Theory of Change" and "Logic Model".)

A general perception is that evaluation should be designed into a project from the beginning and the DoA provides evidence of this early awareness of this task in hand; it is never too soon to start planning an evaluation. Evaluation should be viewed as a collaborative process that involves all of the stakeholders in various roles, whilst it helps tell the story of the PISTIS project through a continuous cycle of asking, planning, and acting, reflecting and improving.

We should strive to make sure that findings are practical and useful for end users and can inform decision-making and capacity building for further exploitation and sustainability. Indeed, evaluation can be regarded as a means of communication within the project.

In short, "*Evaluation is an objective process of understanding how a project or other intervention was implemented, what effects it had, for whom, how and why*"[1]

We will return to evaluative thinking in more detail in section 2.3.2. and how it is engaged with in PISTIS, in the following chapter.

1.3.2 What is an evaluation framework?

The PISTIS evaluation framework can be described as having six interdependent and iterative steps:

1. Engagement of the stakeholders- those persons involved in or affected by the project and primary users of the evaluation.
2. Drawing from the project plan in the DoA, a description of its needs, expected effects, activities, resources, stages, context, logic model, etc.
3. Focussing the evaluation design on relation to purpose, users, uses, questions, methods, agreements.
4. Gathering credible evidence- indicators, sources, quality, quantity, etc.
5. Justifying conclusions - analysis/synthesis, interpretation, judgment, recommendations.
6. Ensure further use and share lessons learned.

It covers design, preparation, feedback, follow-up, dissemination and culminating in a roadmap for further deployment.

In evaluation, there is no "one-size fits all" approach and PISTIS will use a wide range of methods to cover its own requirements. The agile approach to software development, the depth of requirements analysis, the complexity of the situations to be assessed, the wide variety of stakeholders with different ambitions needing to be satisfied within complex eco-systems, all contribute to the need for flexibility in the methods adopted.

Impact Assessment refers to the process of identifying and measuring future consequences of a current or proposed project and its relevance here will be in addressing the differences which may be brought about by the project to the demonstrators, which may not have occurred without the project.

1.4 Relationship to Rest of WP5

To this end, an iterative approach is envisioned, engaging the project's demonstrators in the assessment and feedback loop from the very early development stages. The demonstrator partners and their support technology partners will be constantly engaged with the

[1]HM TREASURY, The Magenta Book, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220542/magenta_book_combined.pdf.

intermediate platform releases to constantly evaluate and test their functionalities, while feedback will be provided to the development teams to update, parameterise and improve the corresponding services.

For this purpose, three different demonstrator hubs have been planned with the aim of validating the PISTIS outcomes in a multi and cross-domain setting and guarantee their applicability for use in different, existing or emerging data spaces. As such, during the validation and demonstration activities, all the different features will be tested and benchmarked, and the corresponding KPIs will be measured to verify the achievement of the objectives set.

Delivery of D5.1 marks a shift from the planning phase to the demonstration phase, when real results will start to appear. Thus, there will be no results available to report in this document. The work marks the commencement of Phase III: Verifying, Validating and Demonstrating PISTIS. For the successful deployment of the PISTIS infrastructure, an all-inclusive framework for verifying, validating and evaluating the outcomes of the previous phases (from their conception to final release and experimentation in pilot settings) will be elaborated. During the validation and demonstration activities, all the different features will be tested and the corresponding KPIs will be measured to verify the achievement of the objectives, both in terms of functional completeness, as well as in terms of users' satisfaction and experience.

The evaluation framework will be studied extensively and defined in complete detail, as it will lead to valuable observations and conclusions about the viability and the sustainability of the PISTIS platform. All partners participating in WP5 will collaborate in the review of test cases that will take place during the execution of the demonstrators. These test cases will be designed based on the business cases, use cases and requirements identified in the previous WPs of the project.

The following "demonstration hub" tasks running from M15 to M40 will deploy the PISTIS bundles in the demonstrator partner sites with the help of technical partners and will execute the demonstrator hub scenarios and deliver the PISTIS added value apps:

- T5.3 -Demonstrator Hub #1 – Mobility and Urban Planning Ecosystem Experimentation
- T5.4 -Demonstrator Hub #2 – Energy Ecosystem Experimentation
- T5.5 -Demonstrator Hub #3 – Automotive Ecosystem Experimentation

A further three PISTIS "data factories", within which the data being processed will be handled complementing all the activities established for each hub. Each will have valuable contributions to make to the overall project in their own right. But they can also be seen as three "support factories" for the three core demonstration hubs above.

These are:

- T5.6 – Cross-Demonstrator Data Spaces Instances Deployment and Experimentation – M15-M40 which focusses on weather data which is clearly of interest to each of these core demonstration hubs. An instance to trade weather data will be developed.
- The PISTIS Living Lab which is described in T6.4 will be domain agnostic, to act as a playground by the Living Lab participants, to be hosted by SPH. It will invite stakeholders of the different data spaces to engage with the Living Lab in order to acquire direct feedback from stakeholders who are external to the consortium parties, and who will formulate the customer audience at the end of the project.
- The third will be for serving selected open data via connecting to the EU Open Data Portal (to be hosted by FGH which implements the EU Data portal as well).

All the work from these previous tasks will culminate in T5.7 – Demonstrators Continuous Evaluation, Impact Assessment and Lessons Learned – M15-M40

Within Task 5.7, the evaluation framework from this deliverable will be utilised once the demonstrators are in operation. Extensive data collection, regarding the experiences of the demonstrator partners with the PISTIS platform, will be conducted. The data collection will meet the guidelines of the predefined evaluation framework in order to ensure the high quality of the feedback gained and the consistence of the evaluation activities. Based on the data collected, an overall assessment and evaluation of PISTIS will be carried out.

Within T5.7, the focus will also be upon the lessons learnt from the project with regard to the implementation, operation and execution of the demonstrators. The lessons generated will contribute to creating methodological adoption guidelines for the further exploitation and utilisation of the PISTIS platform. Moreover, the appropriate guidelines and documentation will be authored to support the partners responsible for the demonstrations in their implementation of solutions with the help of the PISTIS platform, an activity especially important for when it is necessary to deal with “external to the project” stakeholders. This will lead to activities for further population of the platform with data and for bringing on board other entities.

Later deliverables in this work package will essentially report on all the work prescribed in this deliverable and these are:

D5.2 – Demonstrators’ Activities Evaluation Results - First Report due at M28

D5.3 – Demonstrators’ Activities Evaluation Results - Second Report due at M40

Following the launch of the demonstrators at M15, T5.7 – Demonstrators Continuous Evaluation, Impact Assessment and Lessons Learned –will set in operation the verification and validation framework defined in T5.1. Data collection, regarding the experience of the demonstrator partners with the PISTIS platform, will be conducted.

During its course, this task will provide individual, aggregated and comparative assessments of pilot results, considering the performance, efficiency and effectiveness of the PISTIS Data Exchange Market, focusing on interoperability, user acceptance and engagement in data

sharing, cost-efficiency, etc. It will also propose improvement actions, interventions and measures to be applied for successfully paving the exploitation path of the project. Evaluation will also pay special attention on assessing the cost-efficiency and viability of new business models developed by the project in WP7.

Towards the end of the project, an overall impact assessment and evaluation of PISTIS will be carried out involving all stakeholders of the PISTIS Living Lab, to achieve the holistic assessment and collaborative devising of the project results. Benchmarking and impact assessment will be based on the requirements identified in this deliverable, while the strengths and weaknesses of the project will also be seen from this perspective.

1.5 Relation of this Deliverable to rest of project

PISTIS brings forward a reference federated data sharing/trading and monetisation platform for secure, trusted and controlled exchange and usage of proprietary data assets and data-driven intelligence.

PISTIS will build trust among stakeholders and provide solutions to their current concerns. Such stakeholders will formulate a distributed network of existing and new data spaces with built-in governance brought by PISTIS to eliminate silos while accruing the actual data value and multiplying it through derivative assets in a fair and transparent manner. Taking into consideration the data supply and demand perspectives, PISTIS will establish the methodological and technical foundations across different axes.

This deliverable sets out the pathway to demonstrating the technologies which will enable this, whilst liaising with the variety of stakeholders coming together to implement and give their feedback on this work. This will rely on the collaboration with WP6 as set out earlier.

During the initial phases of the project, the needs and requirements of the stakeholders and the overall eco-system were elicited with the findings of WP1 particularly significant for the work to be carried out in WP5. The product development phase involved a series of steps to develop/extend/customise technologies utilising the agile development philosophy to constantly update the platform based on feedback received from the actual users.

For the successful deployment of the PISTIS infrastructure, an all-inclusive framework for verifying, validating and evaluating the outcomes of the previous phases (from their conception to final release and experimentation in demonstration hub settings) has now been elaborated in this deliverable. The reference federated data sharing/trading and monetisation platform and all the relevant service bundles need to be checked to ascertain that they have been built in the right way, without bugs, malfunctions and security issues (technical verification), and to be appropriate for the needs of the targeted stakeholders (business validation).

To this end, an iterative approach, engaging the project's demonstration hubs in the assessment and feedback loop from the very early development stages, has been adopted. And these demonstrators emanating from WP5 will continue to be constantly engaged in the design phases of the project and will be provided with all prototype and intermediate versions

of the platform's Apps, backbone, services, APIs etc. so they would be in a position to provide feedback to the developers in order to update, parameterise and improve the product accordingly.

The final designs and details of the PISTIS business model and plan, will be shaped by the lessons learnt and impact assessment deriving directly from the experience of the project's demonstration hubs, and it will be utilised to increase the reception and market acceptance. The successful implementation of WP5 in terms of effectively testing the PISTIS solution and providing the necessary feedback to evaluate the platform relies on the execution of the demonstrators in a coordinated and unified manner. The project's results (both scientific as well as technical ones) will be validated by external stakeholders, providing further insights on the market readiness of the solution and its exploitable assets.

Figure 2. below, illustrates how this deliverable, is at the heart of the project.

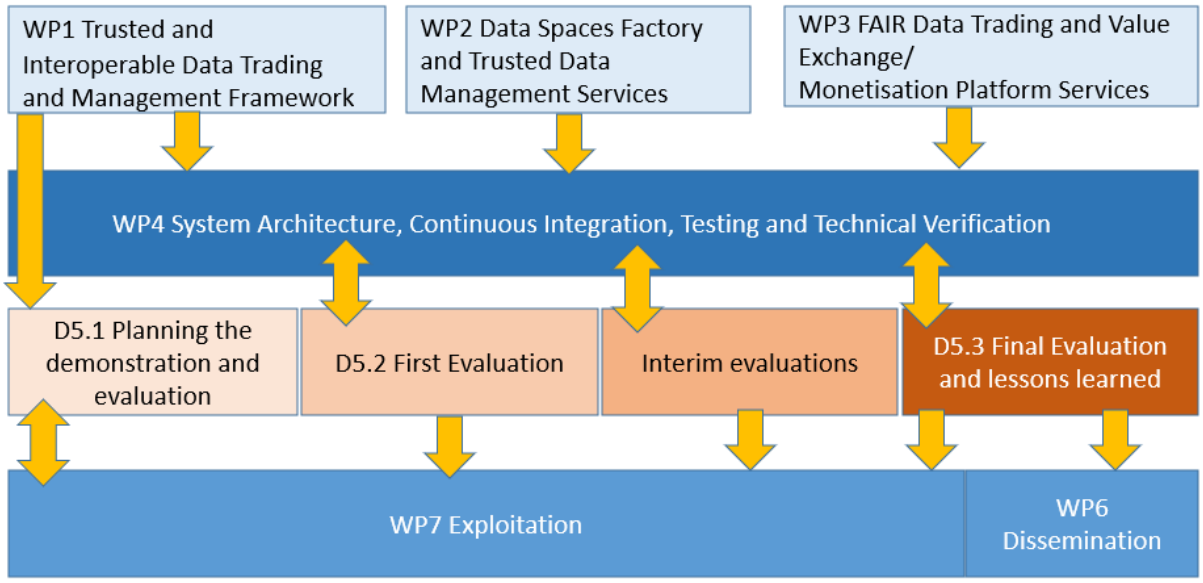

Figure 2: Relationship of D5.1 to the PISTIS Project

The Table 1. below, indicates some of the foundations for Task 5.1.

WP/Task	**Link to this deliverable**
D1.1 has determined the user-requirements from the full range of stakeholders in the project.	This document establishes the mechanism for ensuring that all these identified requirements are met, and that the outcome of the project is as planned from the outset.
Task 1.5 Evolution of the MVP. PISTIS has adopted the approach of Minimum Viable Product development that in its core is oriented at validating the envisioned solution, instead of identifying problems. In essence, the	The process towards developing the PISTIS MVP depends heavily on having a clear definition of the scope and purpose of the project, by fleshing out the actual value of the proposed solution for the end users.

PISTIS MVP represents the overall mind-set and process adopted for product development to consider user expectations, deliver actual value and validate the methodological ideas and hypothesis.	This will contribute to forming the "story" of PISTIS as set out in the "Theory of Change" for the project and in raising further questions to be answered.
Task 1.1 is devoted to systematically aggregate and analyse the user and business requirements of all stakeholders involved in the PISTIS value chain, so as to conclude on the requirements that should be met by the PISTIS platform.	Provides the framework for the technical validation.
The Task 1.2 market need elicitation will derive the user stories in the PISTIS product backlog and the MVP of the project's platform and pilot cases. That, in turn, will attract representative (candidate) customers of the end-product. The objective of this phase is to develop a truly innovative product that meets the requirements of the users in a cost-effective and time-efficient manner, which we will be verifying.	"A requirement is a statement of a customer need or objective, or of a condition or capability that a product must possess to satisfy such a need or objective. A property that a product must have to provide value to a stakeholder".[2] This deliverable will provide a mechanism to help provide the answers to whether the requirements have been satisfied at the end of the project.
WP2. Security Aspects, Privacy Considerations, Value Generation.	Generated questions to be answered in the evaluation.
WP6 Dissemination strategy	This helps to shape the discussions of what constitutes success in realising the business values and developing an exploitable product, along with direct input from its Living Lab in supporting the demonstrations whilst engaging with stakeholders.

Table 1: Foundations for D5.1

[2] K. E. Weigars, Software requirements 2, Washington: Microsoft press, 2003.

1.6 DOCUMENT STRUCTURE

Out of necessity, this is a lengthy document, as it is a cornerstone of the project.

The evolution of the project will be determined by the plans set out in this document, both for how we proceed with the demonstrations and subsequently how we evaluate them, whilst taking a holistic approach to PISTIS.

D5.1 is split into four sections.

The first four chapters following the introduction cover the planning and framework for the evaluation process whilst the second section, from Chapter 5 on, covers the preparatory work for how we will conduct the demonstration activity, which will be the focus for our subsequent evaluation and impact measurement.

The general guidelines will be used to monitor, coordinate and align the phases for the demonstration of the PISTIS platform. Section 3 introduces the Evaluation and Demonstration Plan itself, focussing on what will be done, by who and when.

Finally, the fourth section focusses on how the evaluation process will be carried out, based on the planning framework set out in section 1.

This reflects the fact that the document is covering the work carried out in two tasks:

T5.1 – Verification and Validation Framework Definition and Baseline Impact Assessment
T5.2 - Demonstrators Use Cases Detailing and Execution Planning

The document structure embraces the following chapters:

- Chapter 1 introduces the scope and objectives of the document.

SECTION 1 THE EVALUATION FRAMEWORK

- Chapter 2 provides the PISTIS Evaluation Methodology outlining the potential tools which could be used.
- Chapter 3 covers the evaluative thinking underpinning PISTIS and provides the PISTIS Theory of Change and Logic Model, which tells the “story” of PISTIS which is to be evaluated.
- Chapter 4 covers the Evaluation Criteria and Measurement framework for the questions, which are to be identified and answered.

SECTION 2 DEMONSTRATOR PREPARATION ACTIVITIES

- Chapter 5 is the creation of the PISTIS Evaluation Plan which will subsequently be referred back to, for the duration of the project.
- Chapter 6 Stakeholders Engagement Strategy for interacting with those stakeholders linked to the demonstration activities or to the project as a whole.

SECTION 3. THE DEMONSTRATION PLAN

- Chapter 7 is the Demonstration Preparation Activities Plan
- Chapters 8, 9 and 10 cover the three Demonstration Hubs
- Chapter 11 takes a holistic approach for the Cross-cutting and Supporting activities.
- Chapter 12 is the Demonstrator's technical requirements.
- Chapter 13 covers the legal and ethical considerations.
- Chapter 14 looks at the valuation and monetisation mechanisms.
- Chapter 15 looks at the contracting processes.
- Chapter 16 looks at the Stakeholder Engagement planning.

SECTION 4. CARRYING OUT THE EVALUATION

- Chapter 17 covers the evaluation process.
- Chapter 18 is the evaluation of the demonstrators' activities.
- Chapter 19 looks at the technical aspects.
- Chapter 20 looks at the satisfaction of the Business Requirements.
- Chapter 21 covers Meeting Common Criteria across all the Demonstration Hubs.
- Chapter 22 examines the progress of the PISTIS Product.
- Chapter 23 provides the overall Conclusions.

Appendix 1 is "Scoping the Evaluation Questions".
Appendix 2 is the basis for the evolving "Demonstration and Evaluation Plan".

SECTION 1: The EVALUATION Process

2 EVALUATION METHODOLOGY

2.1 INTRODUCTION

The introduction began to set out the ethos underpinning the PISTIS evaluation methodology, which we will now provide in more detail in this section. That ethos, founded on the decision to utilise an agile software development path, embraced an iterative approach which is strongly dependent upon good interaction and communication between all the project team, the demonstration sites and the third parties which we are involved with.

Just as the requirements evolved in WP1 and continue to evolve through a collaborative and iterative interaction between self-organising and cross-functional teams, a similar approach to the evaluation of the project will be taken, having the demonstration sites as partners and the extended reach of the third-party stakeholders as customers and potential collaborators.

The approach advocates adaptive planning, evolutionary development, early delivery, and continual improvement and it encourages rapid and flexible response to change.

This section outlines all the different options and different approaches which were available to the evaluation team. The following section will go into more detail surrounding the different approaches which we have selected to take forward in establishing the Evaluation Framework and which are most suited to the PISTIS project.

2.2 EVALUATION DEFINED

The literature on this topic is wide and varied as mentioned above, but a definition used by the EU is that evaluation is the:

"*Systematic and objective assessment of on-going or completed interventions (actions/policies), their design, implementation and results according to the following criteria: relevance, effectiveness, efficiency, sustainability, impact, coherence and EU added-value. It assesses how well a specific measure has worked (or is working) and whether it is still justified or should be changed.*"[3]

The European Evaluation Society cites the OECD definition of Evaluation as "*The systematic and objective assessment of an on-going or completed project, programme or policy, its*

[3] EC, [Online]. Available: https://ec.europa.eu/neighbourhood-enlargement/tenders/monitoring-and-evaluation_en. [Accessed 5 Nov 2020].

design, implementation and results. The aim is to determine the relevance and fulfilment of objectives, development efficiency, effectiveness, impact and sustainability. An evaluation should provide information that is credible and useful, enabling the incorporation of lessons learned into the decision– making process of stakeholders. Evaluation also refers to the process of determining the worth or significance of an activity, policy or program. An assessment, as systematic and objective as possible, of an initiative".[4]

A definition used by the Magenta Book issued by the UK Government describes it as: "*Evaluation is an objective process of understanding how a policy or other intervention was implemented, what effects it had, for whom, how and why.*" [5]

2.2.1 The purpose for Evaluation

A common acronym is ROAMEF which stands for:

- Rationale – setting out the rationale for action in any particular area.
- Objectives – defining the objectives a policy or project aims to achieve.
- Appraisal – assessing the best ways of delivering it and estimating the costs and benefits.
- Monitoring – continuously checking progress in delivering the stated objectives.
- Evaluation – assessing the effectiveness and impact of the policy to see whether the anticipated benefits have occurred.
- Feedback – ensuring learning from the initiative is fed back into its implementation.

A well-designed evaluation should provide PISTIS with all the information we need and is able to match the scope and acknowledged complexity of the project.

In the work carried out in WP5, we can broadly break it down into three rough phases in an evaluation, although later chapters of this deliverable will break this down to numerous discrete elements.
These phases are:

- Evaluation assessment or framework (the planning phase).
- Evaluation study; and
- Decision-making based on findings and recommendations.

2.2.2 Different approaches to carrying out an evaluation.

There are a variety of accepted types of evaluation. In the PISTIS case we will be combining aspects of value from several, wherever they may shed light on the project's progress.

2.2.2.1 Process evaluations.

These look at how a project was delivered. They typically include a mixture of quantitative and qualitative methods used to understand:

- The programme's financing and resourcing.
- Perceptions of quality and effectiveness.

[4] OECD, [Online]. Available: https://www.oecd.org/dac/evaluation/seco_guidelines.pdf. [Accessed 20 June 2021].
[5] HM TREASURY, The Magenta Book, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220542/magenta_book_combined.pdf.

- And facts and figures on the carrying out of the project.

2.2.2.2 Impact evaluations

Impact evaluations look at the difference a project has made:

- What were the observed outcomes, such as technological development, or business opportunity?
- How much of any observed change in outcomes can be attributed to the project?
- How did changes affect the different stakeholders?
- Were there any unintended outcomes?
- Did the project achieve its objectives?

2.2.2.3 Economic evaluations

Economic evaluations, which are less suited to PISTIS needs, look at whether the benefit of a project justifies its costs. They come in two forms:

- A cost-effectiveness analysis estimates the total cost per unit of outcome achieved.
- A cost-benefit analysis places a monetary value on the outcomes.

2.2.2.4 Outcome evaluation

An outcome or summative evaluation is concerned with:

- Investigating whether the project achieved the desired outcomes and what made it effective or ineffective.
- Making mid-course adjustments to the planned effort.
- Assessing if the effort is sustainable and replicable.

2.2.2.5 Resources

What is missing for PISTIS from a standard approach to evaluation is the determination of what resources will be required to conduct a particular evaluation and the coverage of the allocation of resources. What it will cost. This is because this is clearly established in the DoA- both the amount of time available and the allocation between partners. In fact, WP8 will monitor this aspect closely. But a judgement had to be taken into how the specific elements of the project should be evaluated and which were the most suitable approaches. This was fine for the tangible results- the software development, the successful operation of the demonstrators etc.

But for the high-level goals this is more complex and difficult to progress. The issue lies around how a project can evaluate how a contribution was made to a particular wider goal such as growing the data economy or encouraging greater use of shared data, given the wider environment PISTIS is working within.

Resources could have been spent on trying to assess this in more scientific ways, attempting to separate the contribution made by PISTIS to the process. But it was determined to be of more value to ignore this *"ante"* position of setting base lines etc. and to concentrate on demonstrating effect on other wider initiatives working to the same purpose.

In conclusion, PISTIS will essentially adopt a combination from all of the above, picking and choosing which provides more benefit and value to the project's overall evaluation and impact assessment.

2.2.3 Impact Assessment

The description of Task5.1 includes:

- Creating an accurate baseline to be used as a reference for the verification of the *impact*.
- Assessing the project *impact*
- And issuing lessons learned as part of the overall *impact.*

And so, it is worthwhile to set out how the meaning of "impact assessment" is interpreted in PISTIS. We can divide the results from PISTIS into those higher-level goals, such as the contribution to EU Policy or to standards or to supporting the emerging EU DataSpaces and those more specific goals which are linked to the running of the demonstration sites and satisfaction of individual location-based goals. It is for this aspect of the evaluation of PISTIS at the local level that impact assessment is valuable.

Impact Assessment refers to the process of identifying and measuring the future consequences of the project. **Impact** can be seen as the difference, which is brought about by the **project**, which may not be there without the **project**.

Its initial use was in ascertaining impact on the environment of activities being undertaken, but now it has a much wider meaning, and it is this which we will adopt. Impact assessment in the PISTIS setting seeks to answer the simpler question of "Did our project have the desired impact?"

2.2.4 Phases in the process

1. PISTIS evaluation assessment phase identifies the main issues and questions to be addressed in the study and develops appropriate methods for gathering evidence on these.
2. Once specific terms of reference are developed, the evaluation study can begin. Data are collected and analysed to produce findings about the evaluation issues.
3. Measuring performance is an essential link in this cycle as there is a need to produce timely, relevant credible and objective findings and conclusions on the PISTIS performance, based upon valid and reliable data collection and analysis.
4. These findings and subsequent recommendations form the basis on which decisions are made about the future of the project.
5. Ideally evaluations should present these findings and conclusions in a clear and balanced manner that indicates the reliability of the findings.[6]

2.3 PISTIS EVALUATION: TOOLS AND TECHNIQUES

PISTIS is a complex project with many partners (28) and a wide range of external stakeholders. The evaluation process will adopt a string of techniques and tools to extract the information we require to make sensible judgements both during the iterations of the project platform and at the end of the project. We will return to these techniques and tools in the following

[6] Canadian Government., [Online]. Available: pem-mep-eng CANADA evaluation overview pdf.

section covering them in more detail for their contributions and chosen role in the PISTIS Evaluation Framework. Below is essentially a list of the set or system of methods and procedures we will be utilising, in order to derive the questions which we wish to answer.

Needless to say, the DoA establishes many of the building blocks and the basic conditions we will start from.

2.3.1 Overview of Approach

As pointed out above, we will return to the topics covered below in greater detail. For the sake of completing the description of the methodology which we have adopted, we will mention some aspects in advance of this more thorough and contextual description later in this document, so that we can outline the steps covering the following stages:

- We will have defined a high-level logic model for the project, based on setting out the objectives and intended outcomes. This manifested itself in the PISTIS "Theory of Change", with "evaluative thinking" permeating the project at all levels and stages.
- We will have correlated the requirements we processed with the DoA and remain open to amend the project to embrace any elements we discover to require adjusting. (For example, whether the piloting covers all the identified Third Party requirements.)
- We will have defined the "audience" of stakeholders.
- We will have identified the objectives of the evaluation and the research questions to be answered and defined the scope of the evaluation.
- We will have identified the appropriate evaluation approaches.
- We will have defined the monitoring framework and considered what data is required to answer the evaluation's research questions, whilst identifying data sources.
- We will have defined the governance around the evaluation in tandem with the design of the demonstration hubs operation.

2.3.2 Evaluative Thinking

As introduced in section 1.4.1 above, Evaluative Thinking is essentially the process reflecting how we approach the evaluation. In the PISTIS case, at the preparation stage for conducting an evaluation, we were able to rely heavily upon the DoA, as well as from the experiences gained through the first year of the project. A well-rounded impression was formed of what we were trying to achieve, and a "voice" adopted for describing and communicating this. Workshops to elicit the demonstration hubs requirements within WP1 being valuable for example.

We carried out extensive desk research regarding options available to the project team in tandem with the DoA as the foundation, in order to establish the PISTIS "Theory of Change" (TOC). This is covered in detail in section 3.2, but a definition is that a **Theory of Change** explains the links between activities and outcomes and how and why the desired change is expected to come about, usually based on past research or experiences and in this instance, the thinking behind the evolution of the PISTIS project, brought together in the DoA.

The project's TOC at this design stage was prepared, but with a view to making amendments if required as the evaluation itself progresses. This process of checking that the initial Theory

of Change still holds true will continue throughout the project, with potential amendments to be made prior to the final evaluation process, based on feedback received.

Figure 3 illustrates the phasing of a typical evaluation process that reflects evaluative thinking.

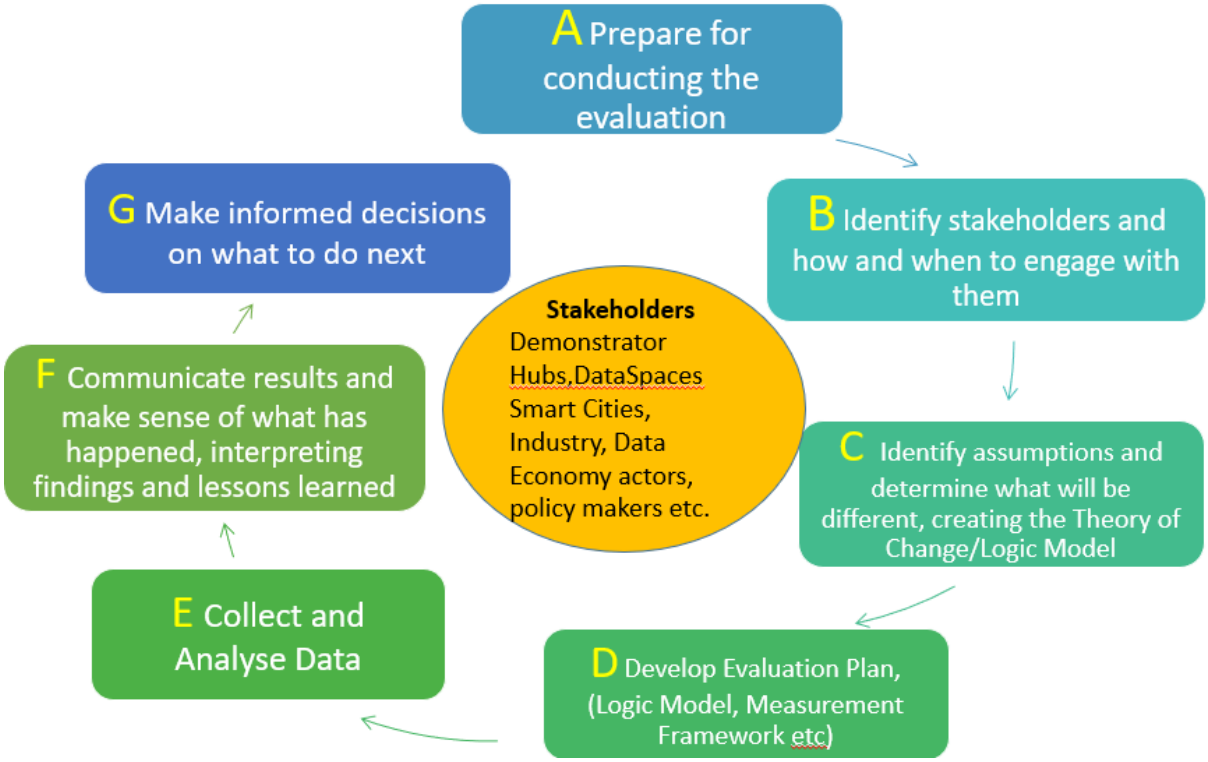

Figure 3: Phases of evaluation process that reflects evaluative thinking.

2.3.3 Summarising the Assumptions made

Several assumptions, some referred to earlier, were made from the outset in starting to draw up:

i) The PISTIS Project and Pilots Evaluation and Impact Measurement Plan.
ii) The evaluation framework and validation methodology.
iii) In defining the various practices for recording feedback from the demonstration activities.
iv) In the design of a set of test-cases to be executed by the demonstrator partners.

These assumptions included:

- That the principles of evaluation adopted would go hand in glove with the software approach- a community approach which is iterative. This iteration had been set out formally in the stages of evaluation described in the DoA, covering the alpha and beta stages, as well as the final results.
- That the evaluation process should form a solid basis for dialogue and for it to be used as a communication tool, providing a framework for interactions between stakeholders, all based on a shared understanding and vision.
- That there will be flexibility of approach, not being reliant on any single one of the numerous models portrayed in the literature, as there is no “one size fits all” approach or a “correct” way to do it.

- That the evaluation process should also be flexible and adaptable as projects don't exist in a vacuum and events can affect their implementation and outcomes. Therefore, evaluators and implementers must be flexible and work together to adapt to such events and respond to the needs of stakeholders.
- Taking different perspectives and utilising "mixed methods", which intentionally use two or more kinds of data gathering and analysis tools — typically a combination of qualitative (e.g., focus groups and interviews) and quantitative (e.g., multiple choice surveys and assessments) — in the same evaluation, helps to capture the reality and outcomes experienced by stakeholders.
- Acknowledging the necessity to have made an early start, given that planning for evaluation should begin the moment any project was conceptualised.
- Demonstrators will need to go beyond their immediate goals and identified requirements and heed the wider project goals, as will the three "support hubs" outlined.
- The Evaluation should be designed to address real issues and to provide project team members and stakeholders with reliable information to address problems and to build on strengths and opportunities.
- The Evaluation should invite multiple perspectives and involve a representation of people who care about and benefit from the project.
- We are not trying to compare or rank the demonstrator hubs, but to extract as much information as possible from each of them to best answer some of the higher-level questions we are interested in.

2.4 Monitoring and Evaluation Framework

Typically, a monitoring and evaluation framework looks at:

- **Inputs**: Which are the resources required to achieve the project objectives, which in the case of PISTIS, are pre-determined within the DoA.
- **Activities**: Again, these are clearly set out in the DoA.
- **Outputs**: This is the direct result of the activity, observable by the end of the activity. Generally technological progress, or increased knowledge would be looked at.
- **Outcomes**: These are the changes or benefits that result to the project stakeholders.
- **Impacts**: These are the final, wider changes that result from the project to the overall programme set out in the Call and contributions to higher level goals for the EU.

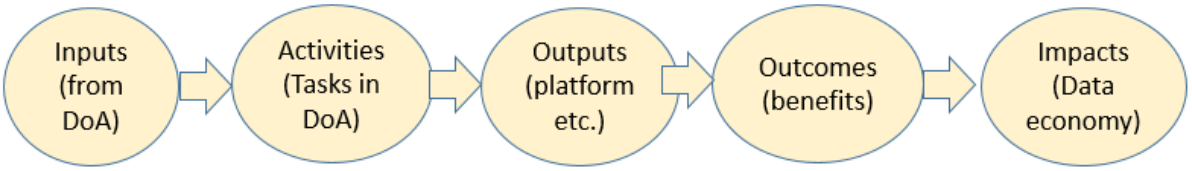

Figure 4: Typical Monitoring and Evaluation Framework

2.5 Identification of Stakeholders and Their Engagement Strategy

For the PISTIS evaluation process to be a collaborative, useful learning process, all stakeholders had to be identified and engaged accordingly to provide multiple perspectives about the main issues that could affect the evaluation, and about what they want to know from the evaluation.

This categorisation was equally valid and required for all aspects of the project, cutting across WPs. Embracing all views reduces the potential for missing important questions and issues of stakeholders, who were not included in the design and planning process.

Steps taken included the following:

- Identification of stakeholder roles in evaluation planning, implementation, interpretation of results and decision-making about next steps.
- Reviewing the list of stakeholders which the project as a whole produced, to ensure all appropriate stakeholders were included.[7]
- Creating a plan for stakeholder involvement.
- Identification of areas for stakeholder input.
- Bringing the stakeholders together as needed and creating the opportunities and structures for this to occur.
- Targeting key stakeholders for regular structured participation in the process.
- Involving stakeholders in the creation of the evaluation questions

Points for consideration included the following:

- Who needed to be involved in the development of the PISTIS Logic Model and Theory of Change?
- How do we engage with people getting them to become and then remain involved?
- What information is required or already held to make a start?
- How will we capture and share learning as the project progresses?
- How do we articulate and test the underlying assumptions of the project?
- How will we communicate with and capture feedback from the demonstration site communities?
- What are the specific requirements of the EU as a stakeholder?

2.5.1 Governance of the evaluation

In any evaluation framework, it is necessary to establish the governance structure. This is set out in “Section 5.3 PISTIS Evaluation Team.” The governance of the evaluation process was created around several building blocks. The corresponding task of planning and operating the demonstration sites was paramount and had to match the planning of the evaluation. The governance structure was built around this inter-relationship, alongside the structuring of the interaction with the identified stakeholders.

2.6 Process of Creating the Theory of Change and Logic Model

This underlying intent of this stage of the methodology, in creating the PISTIS Theory of Change and Logic Model, was to identify the assumptions and to set about determining what

[7] PISTIS - Community Building - All Documents (sharepoint.com)

will be different at the end of the project. The concepts of the PISTIS Logic Models and Theory of Change are covered in detail in Chapter 3 but are touched on below in terms of their place in the overall evaluation methodology.

2.6.1 Logic model and Theory of Change

A logic model is a graphic that sets out a programme's expected path. It is a graphic representation of the theory of change that illustrates the linkages among resources, activities, outputs, stakeholders and short, intermediate and long-term outcomes for the project. It shows the relationships between each step and a framework for understanding how best to monitor and evaluate a programme.

A logic model is a living document for the duration of the project, with a particular emphasis on the actual process of logic modelling, contributing to the shared understanding required for PISTIS. Section 3.6 deals with a more refined version which is that of Benefits Logic.

Figure 5 in section 3.3 depicts a typical simple logic model, demonstrating what data needs to be captured through monitoring and evaluation and instead of just focusing on the final results and objectives it shows the expected shorter-term outputs and outcomes.

2.7 Evaluation Questions

The logic model also helps to generate the evaluation questions by enabling different aspects to be covered at different stages of the project. The logic model acts like a hypothesis: It allows the project team to see which stage of development we are in, with regard to the iterations within the project and therefore what types of questions to ask. It also helps craft specific questions.

For instance, without a logic model, you could simply ask the question, *"Did the project achieve the intended outcomes?"* With a logic model, we can see that only certain outcomes should be expected after a certain month of implementation. Thus, the questions can be more precise and easier to answer.

The formulation of the evaluation questions was shaped by asking:

- Who does the PISTIS project benefit?
- What is the effort intended to do?
- When do the activities occur?
- Why the effort is important?
- How will the effort bring about the desired change?

2.8 Measurement Framework

"*Measurement is the first step that leads to control and eventually to improvement. If you can't measure something, you can't understand it. If you can't understand it, you can't control it. If you can't control it, you can't improve it.*"[8]

[8] H. James Harrington. [Online]. Available: https://memoori.com/cant-measure-cant-improve-path-better-buildings. [Accessed 13 May 2021].

A measurement framework was generated from the logic model. A measurement framework helped to determine how to assess the progress toward achieving outcomes. The measurement framework includes seven main components: outputs; outcomes; indicators; measures of change; data collection methods; data sources; and data collection frequency.

The mixed approach of utilising a wide range of quantitative and qualitative evaluation methods for measuring the impact of the project was adopted as a single method will rarely be sufficient to capture the full impact of a project, so by bringing together multiple methods provides a more complete picture of impact. The use of qualitative methods alongside quantitative analysis helps demonstrate why observed impacts are happening; they tell the story behind what is happening through the logic model.

2.9 Development of the evaluation Plan

2.9.1 Bringing together the results from the tools adopted

In summary, we utilised the information from the logic model, evaluation questions and the measurement framework, alongside the explanation of how we intend to collect and analyse data within that framework, to create the evaluation plan.

This was complemented by feedback from stakeholders and the determination of success criteria, alongside the explanation of how we intend to collect and analyse data within that framework, to complete the development of the evaluation plan.

2.9.2 Stakeholder input into evaluation plan

The following questions were asked of the stakeholders in order to shape the plan:

- What results do you expect from PISTIS?
- What does success look like and how do you know when you have achieved it?
- What factors might help or hinder achieving that success?
- Who or what are the best data sources?

Chapter 6 covers this aspect of the evaluation process.

2.9.3 Communication

It was important that we included in the plan, a strategy to use and communicate the findings. This is also covered in Chapter 6. As apparent throughout the project, good communications within the project and with external audiences and stakeholders is vital. The project wide Dissemination Strategy and Exploitation Strategy are key elements for the necessary communications within the evaluation strategy.

2.10 Collection and Analysis of Data

The evaluation framework of D5.1 will be set in operation once the operation of the demonstrators starts at M19. Extensive data collection, regarding the experience of the demonstrator partners with the PISTIS platform, will be conducted. The data collection will meet the guidelines of the predefined evaluation framework in order to ensure the high

quality of the feedback gained and the consistence of the evaluation activities. Chapter 7 covers this aspect of the methodology.

Similarly, there is input from WP9 covering the Ethics Requirements available to take into consideration. This input includes risk assessment guidelines and tools such as the PISTIS Data and AI Risk Assessment Framework for each of the demonstration hubs, in relation to data processing.

In addition to this evaluation process in WP5, WP8 covering the overall project coordination will gather feedback, in order to monitor the running of the overall project and its allocation and use of resources.

"*Monitoring seeks to check progress against planned targets and can be defined as the formal reporting and evidencing that spend and outputs are successfully delivered, and milestones met.*"[9]

2.11 ITERATIONS AND THE THEORY OF CHANGE

Section 1.3 above, sets out the iterative nature of the project.

In the earlier stage of the project, the Theory of Change was to be used primarily as a design tool, but as the project matures, it will morph into a more dynamic tool as part of the evaluation process, responding to this iterative nature of the project.

During the early stages of the evaluation process the TOC at the "project evaluation design" stage was discussed with key actors involved in the implementation and execution of the project. Subsequently, the Theory of Change can be seen as something running in the background. But these discussions will continue as the project evolves. Revisions and updates to the TOC are made to reflect any changes in the project's intended results or intervention logic and to take into account any changes in external context of the project that may influence the causal pathways and the changing needs and priorities of stakeholders.

For example, in the course of a project's implementation, some project outputs or components might have been amended, cancelled or added, in order to respond to external changes (or misjudgements at design) regarding, among other things, stakeholder needs and priorities, resource availability, partner capacity and risk factors.

As the iterations take place, the TOC at this stage of evaluation should reflect these changes, to the extent that these have been formally captured and agreed in project revision documents, minutes etc.

For example, the TOC may need to respond to a variety of potential changes in circumstances:

- The causal linkages between results and the other results statements in the TOC can be made explicit and, where necessary, adjusted.

[9] HM TREASURY, The Magenta Book, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220542/magenta_book_combined.pdf.

- Intermediate results can be added where necessary.
- Any new drivers and assumptions might be added and their role in the change processes explained.
- New stakeholders or eco-systems of interest to PISTIS may have been identified or existing ones may be affected by changes.

The interim evaluation findings indicate whether the theory of change, is true. Returning to the TOC at this stage allows a check to see if what was expected to happen, actually did. If not, an assessment can be made of where the effort did not unfold as expected and what improvements are needed, and subsequently, what adjustments might be necessary for the measurement framework and evaluation plan.

Having set out the overall value of utilising this approach, the next chapter will look at the PISTIS Project's Theory of Change in detail.

2.11.1 Evaluation Reports

The deliverables referred to in section 1.3 above, in relationship to the iterative nature of the demonstration phase, provide the main opportunities to communicate results and discuss and emphasise what has actually happened in the project and provide the basis for interpreting findings and facilitating learning. The data collected will contribute to an overall assessment of PISTIS.

The benchmarking and impact assessment which will be provided based on the requirements and elaboration of the strengths and weaknesses of the services will need to be shared widely and rely on a good communication strategy. The methodology and communication strategy will need to be refined as the project progresses and results become available.

This reporting is to enable us to make informed decisions with regard to the improvement of our actions and in shaping the next steps, both at each iterative stage and for the eventual sustainability for PISTIS. The reporting will be crucial for defining the next steps in the project.

2.11.2 Lessons Learned

The methodology also needed to take into account how we approach gathering the "lessons learned" in the next stages of the project. The reporting process will be crucial for the interpretation of findings and for deriving the lessons learned. And lessons learned from PISTIS may be augmented by lessons we have learned through PISTIS having interactions with other stakeholders and initiatives acting as a catalyst for new observations.

We will finalise this aspect of the methodology as the project progresses. But due consideration will be given to how we ensure that they are gathered and valued.

2.11.3 The overall Importance of Evaluative Thinking in the Methodology

As set out in the methodology, we made an early start on the evaluation process.

Whilst WP5 spans the demonstration activities and monitors them, the ongoing work in WP1 can be seen as a direct contributor to the evaluation process, determining the requirements, which in turn will be the focus for evaluation. Similarly, the activity being carried out in WP6

and WP7 will be part of a continuous flow of work, which all together contributes towards designing and preparing the activities which will prove:

i) Whether what was envisaged at the project design stage in the DoA works,
ii) What was set out to be accomplished in it was right.
iii) That the next stages of the project are designed to enable us to show we did it correctly and successfully.

Underlying evaluation is a way of thinking about what results are expected, how results can be achieved and what data or evidence are needed to inform future actions so that results can be improved. It helps tell the story of the project through a continuous cycle of asking, planning, and acting, reflecting and improving. At its core are dialogue, reflection, learning and iteration to improvement. It is necessary to consider evaluation not just as an inquiry that leads to a judgment (was the project carried out as expected) but also as evaluative thinking, which will make the process more comfortable for all stakeholders participating.

It is about understanding- using a systematic process of collecting and analysing data instead of a set of disorganised, random opinions- and telling the story about the project. It is based on the belief that a systematic process is valuable and necessary. This is clearly apparent in such a complex project as PISTIS. This involves identifying assumptions about what we think works and what doesn't work and why. Posing thoughtful questions about what we expect to see differently during and after the implementation of the planned effort, pursuing deeper understanding through reflection and dialogue, communicating what was learned without underestimation or exaggeration, and making informed decisions in preparation for action and gathering the lessons we will have learned.

The evolution of the user-stories and requirements of stakeholders created and gathered in WP1 is indicative of this approach. They formed a solid basis for discussion and evaluative thinking as they matured into technical decisions. WP1 set out to deliver the overall PISTIS Methodology, defining high level usage scenarios making the overall concept more visible and understandable to all and becoming the driver for the technical discussions to follow.

Thus, in summary, as emphasised in the previous sections, the evaluative thinking should directly lead to having an evaluation process emphasising utility, where our findings will be practical and useful for all end-users and subsequently inform decision-making and capacity building strategies for all stakeholders. Evaluative thinking will focus on designing and using our logic models to illustrate how the PISTIS project will create change with a design that is driven by the questions we have thought through. Significantly, the adoption of evaluative thinking will impact the demonstrations. What could be a narrow perception of achieving a successful piloting of locally valuable applications will be widened to embrace the knock-on effect of these actions on the wider goals of the project and in particularly upon prospective third-party data users.

Evaluative thinking will contribute to having richer demonstrations, which will be constantly iterative, supporting new scenarios and willing to extend and adapt the existing starting premises which have evolved. Having the additional three "support hubs" in particular will

benefit from such flexibility, given the DoA does not specify in too much detail their overall roles in the project.

3 PISTIS THEORY OF CHANGE AND LOGIC MODELS

In the previous chapter, we set out the tools and methods available for the evaluation of the project. The following chapters will highlight some of those selected within the PISTIS context.

3.1 INTRODUCTION

This section describes in detail and sets out the advantages of including in the PISTIS evaluation framework, the combination of a Theory of Change and a Logic Model referred to earlier, as key tools for enabling the evaluation to be as comprehensive and successful as possible. Their use is pivotal to the whole process. Although the two will be intertwined, for simplicity we shall initially cover the advantages of them separately.

Theory based evaluation is an approach to evaluation and not a specific method or technique. It is a conceptual analytical model used to structure and undertake analysis in an evaluation. The Theory of Change explains how an intervention is expected to produce its results.

We will proceed to set out the mechanism by which they will help to guide us through the evaluation process, outlining the steps needed to be taken to utilise these methods for planning and undertaking the evaluation. They will help shape the demonstrations.

3.2 THEORY OF CHANGE: THE CONCEPT

As set out in covering the evaluation tools available for us to utilise, a **Theory of Change** explains the links between activities and outcomes and how and why the desired change is expected to come about, usually based on past research or experiences and in this instance, the thinking behind the evolution of the PISTIS project, brought together in the DoA.

A catalyst for bringing together these past experiences and past research lies with the projects we have identified with, both in terms of those already referred to in the DoA and in the Exploitation Strategy set out in D7.1 PISTIS Exploitation, Business Model and Market Entry Plan - Report 1 whilst the ongoing work to produce the iteration of this at M22 will be followed.

Those initiatives which we have subsequently engaged with are set out in the project's dissemination tracking, maintained by WP6.[10]

Our concern here is not with the evaluation of the dissemination effort itself, as this is carried out by the WP internally with its accompanying KPIs and by WP8. We are concerned with the contribution it makes to enable the demonstrations to collaborate cohesively with wider stakeholders on one hand, and in supporting the demonstrations to contribute to the overall goals for the PISTIS project.

[10] PISTIS_Community.xlsx (sharepoint.com)

A definition is that a Theory of Change evaluation "*involves the specification of an explicit theory of 'how' and 'why' an initiative might cause an effect which is used to guide the evaluation. It does this by investigating the causal relationships between context-input-output- outcomes-impact in order to understand the combination of factors that has led to the intended or unintended outcomes and impacts.*"[11] In the literature, Theories of Change are referred to by a variety of names including "programme theories", "impacts pathways" and "pathways of change".

As already described, a Theory of Change is a method and an approach that in the PISTIS case has been used for designing and monitoring the project interventions and as a framework for use in the evaluation. We started out with a sequence of events and results (outputs, immediate outcomes, intermediate outcomes and ultimate outcomes) that are expected to occur owing to the efforts of the project. It describes the processes of change by outlining the causal pathways from outputs (goods and services delivered by the project) through direct outcomes (changes resulting from the use of outputs by our key stakeholders) through other 'intermediate states' towards the eventual impact.

This process of change is explained by showing these causal linkages in an intervention, its outputs, direct outcomes, 'intermediate states', and longer-term outcomes and this is commonly referred to as the "programme logic" or "logic model." This is the basis for our PISTIS Project Logic Model. The identified changes are mapped as a set of interrelated pathways with each pathway showing the required outcomes in logical relationship with respect to the others, as well as chronological flow.

The Theory of Change had to clearly identify the main stakeholders involved in the change processes and what role they play in, and/or how they are affected by the changes. This is a key element. It needed to be discussed and agreed by key actors so that it represents a shared understanding that describes the intervention. It essentially reflects a negotiated understanding or interpretation of the project intervention logic – it is both contextual and temporal. It is also regarded as dynamic - subject to changes/modifications as contexts change over time. The earlier process of requirements capture in WP1 reflected a similar process of reaching consensus with the stakeholders.

However, for evaluation purposes, the original stated targets and intended results of an intervention should remain apparent in the Theory of Change, with the results that stakeholders are accountable for remaining explicit.

For presentation purposes, it is a combination of a narrative alongside a diagram which can be used to show an overview of the causal pathways, the cause-to-effect relationship between different results / changes, and the drivers and assumptions that apply along the causal pathways. The narrative, however, will explain how or why one result is expected to lead to another, and should also present the roles of the main stakeholders in the change

[11] I. Vogel, "Review of the use of 'Theory of Change' in international development Review Report," [Online]. https://assets.publishing.service.gov.uk/media/57a08a5ded915d3cfd00071a/DFID_ToC_Review_VogelV7.pdf. [Accessed 13 May 2021].

processes and how they can be affected by the changes resulting from the project intervention. The theory-based approach argues that the "logic of the logic" is the important feature of logic models; it focuses on the connections (which can be thought of as the "short-cycle" logic) between the boxes in a visual logic model rather than the "long-cycle" logic of the results chain.

Simply put, theories of change explain how the project is expected to bring about the desired results rather than just describing the results. Theory-based evaluation has evolved over a period of time and is now considered mature. But, there is wide variety in the terminology and the concepts. But there is also agreement in the main messages and on the value of theory-based approaches. When dealing with high levels of complexity and uncertainty, theory-based evaluation offers a robust approach to measuring impact. The logic model is a key tool to support this approach.

In summary, Theories of Change link outcomes and activities to explain HOW and WHY the desired change is expected to come about. In contrast, the complementary logic models, which we will turn to next, graphically illustrate program components such as inputs, activities and outcomes.

3.3 LOGIC MODELS: THE CONCEPT

A **logic model** is a graphic representation of the Theory of Change that illustrates the linkages among resources, activities, outputs, audiences and short-, intermediate- and long-term outcomes. Essentially, a logic model helps with evaluation by setting out the relationships and assumptions, between what a project will do, and what changes it expects to deliver.[12]
Logic models are typically used in theory-based evaluation, which is designed to explicitly articulate the underlying theory of change which shapes a project. Essentially, it shows how the project will achieve its outcomes and impacts through a series of activities. Teasing out the logic pivotal to the project. From an evaluation perspective, using a logic model enables engagement in the process from the outset of the project, building on the vision and aims of the project and will be beneficial to the iterative approach of PISTIS as well as for the final evaluation stage.

Generally, they can help the project focus on the most critical outcomes, bring out key metrics during the design process and help determine what data should be collected and to provide insights into how the project is evolving and what might need to change. [13] [14]
A logic model is often expressed in a tabular format, such as represented in Figure 5 below:

[12] "Using Logic Models in Evaluation, Strategy Unit, NHS," [Online]. Available: https://www.strategyunitwm.nhs.uk/sites/default/files/2017-09/Using%20Logic%20Models%20in%20Evaluation-%20Jul16.pdf.

[13] L. Rodrigueez-Campos and P. Gugui, "Semi-structured interview protocol for constructing logic models. Evaluation and Programme Planning," 2007, pp. 30, 339-350.

[14] M. Jordan. [Online]. Available: https://www.canr.msu.edu/spdc/uploads/files/Programs/URP/Urban_Collab/LogicModelDocument.pdf. [Accessed 13 May 2021].

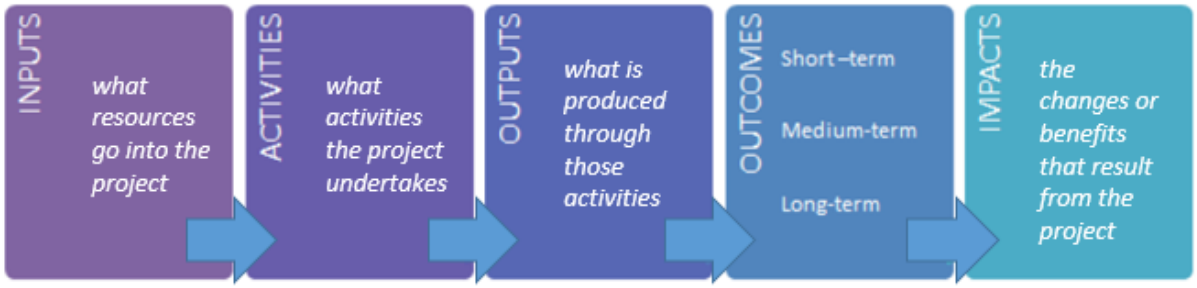

Figure 5: Example of a Logic Model

In PISTIS, interaction with the stakeholders is extremely important (see Chapter 6) and using a logic model will help to reduce potential misunderstandings whilst ensuring that activities are focused on the outcomes to be achieved. "The process can also help to bring together stakeholders who will inevitably have different perspectives and possibly conflicting agendas or imposed targets" [15] [16]

The literature reflects a wide variety of differing approaches, with there being no wrong or right way. But we will use a flexible approach tailored to meet the demands of the project, cherry-picking what is of most use to the project. We will embrace a variety of aspects which will enable us to capture the perceived benefits of using a logic model, which are essentially that it is able to help:

- Tell the project's story and vision within a structured framework.
- Enable the development of a shared understanding amongst all the stakeholders.
- Provide another focal point to help the overall communication process.
- Act as a check list to identify gaps and inconsistencies.
- Identify the key metrics and data requirements and focus on the most significant outcomes and activities.
- To support an iterative approach and further understanding of progress or lack of it
- The capture of key lessons learned.

Logic models are not evaluation tools; they are learning and management tools that should be used throughout the life of a project. A logic modelling process should facilitate effective planning, implementation, evaluation and improvement of efforts made. As McLaughlin and Jordan note,[17] creating a logic model enables you to set out the programme's "story", detailing:

- What are trying to achieve and why is it important?
- How will you measure effectiveness?

[15] J. J. Herranz, "The Logic Model as a tool for developing a network performance measurement system," in *Public Performance & Management Review Vol. 34, No. 1 (September 2010)*, Taylor & Francis, Ltd., 2010, pp. 56-80.

[16] HM TREASURY, The Magenta Book, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220542/magenta_book_combined.pdf.

[17] M. Jordan. [Online]. Available: https://www.canr.msu.edu/spdc/uploads/files/Programs/URP/Urban_Collab/LogicModelDocument.pdf. [Accessed 13 May 2021].

- How are you actually doing?

As indicated earlier, this dovetails well with the approach dictated by the adoption of agile software development and user stories in determining the PISTIS' requirements.

3.4 THE PISTIS THEORY OF CHANGE MODEL

We have covered the general theory underpinning a Theory of Change above and it is now necessary to outline what this translates to in the case of PISTIS and the approach taken to create the PISTIS Theory of Change model.

Figure 5 above sets out the general process for developing Logic Models and this will be a basis for progressing the development of the PISTIS Theory of Change. At this stage we are identifying the assumptions and determining what changes we anticipate seeing and what will be different at the end of the project, essentially creating the theory of change and logic model for the project.

In general, and at the highest level, we can say that our Theory of Change model is based on the logic of the DoA. Our work will have three outcomes:

- We will provide mechanisms for stakeholders to have greater control of their data.
- We will provide tools and technical support to improve the data industry.
- We will provide a catalyst effect on the data eco-system.

These will combine to create a data-sharing culture, enhancing the EU Data Eco-system and supporting the evolving DataSpaces. In turn, this will all contribute to achieving the following goals:

- Growing the Data Market
- Growing the Data Economy
- Improving the Data Industry
- Contributing to a growing eco-system
- Creating new data eco-systems
- And in the process, contributing to EU Policy and Strategy and sharing knowledge generated.

3.4.1 Preparing the Theory of Change at the Design stage.

At this stage, we are looking at the creation of the Theory of Change. Things will change at the later stage when the project's interaction and relationship with it will evolve as the project matures and the Theory of Change will be brought into use for help in scrutinising the progress of the project. The following stages can be identified:

1. A first stage in the process is the scrutiny of the narrative description of the PISTIS project and to extract from this all the relevant material to make a start.
2. An examination of the anticipated results and their causal logic from the project DoA and the drivers and assumptions from the narrative sections from the DoA and in particular covering the critical success factors and risks identified.
3. Creation of the comprehensive list of stakeholders- from the DoA to start off with.

4. Capturing the intended causality of the intervention at the time of its formal approval. It should describe a logical sequence of direct outcomes, intermediate states and impacts and the identification of appropriate, assumptions, drivers and indicators along each causal pathway, making sure that that all the main causal pathways have been identified alongside the project goals and objectives, anticipated project outcomes, project outputs etc.
5. It is important that these results statements feature or are clearly referenced in the Theory of Change. This is to ensure that the results for which the project are held formally accountable are clearly presented and form a part of the evaluative framework.
6. We should clearly articulate the expected impact from the project derived from the project purpose or goal / objective statement, it should be comprehensive, with all the main causal pathways being represented and the causal linkages between results made explicit.
7. The Theory of Change narrative should explain how one result is contributing or leading to the next with rationale statements why one outcome is a pre-requisite for another.
8. It should be plausible.
9. Intermediate results should be added where the 'leap' from one result to another misses out important intermediary steps. Most frequently, these will be 'intermediate states' between direct outcomes and impact.
10. It should be complete; any missing drivers and assumptions are added and their role in the change processes explained.
11. Any missing stakeholders involved in the change processes are identified as well as how they affect or are affected by the changes.
12. Interdependencies between causal pathways are identified.
13. Finally, it should be measurable. The Theory of Change should present (or clearly reference) indicators for the direct outcomes (as a minimum) and, ideally, for the intermediate states and impact in the main causal pathways.

Returning to the basic concept, questions raised in this respect should include:

- "How do we grow the data spaces?" followed up with "Did what we say would work, actually work?"
- "How do we grow the wider data economy eco-system?" and again followed up with the question "Did what we say would work, actually work?"
- How do we make the demonstrations become catalysts for new waves of adoption? Etc.

Appendix 1 sets out an exhaustive list of questions to act as an overall checklist of the project's process to gauge a feeling of progress required and keeping in sight the overall context for what we are trying to achieve, as opposed to a being key markers.
All the above become components of a narrative for the project and this narrative can be seen in Figure 6. The PISTIS Theory of Change, below. Accompanying this is Figure 7 which provides the key for some of the boxes indicated in Figure 6.
The Metrics and the Measurement framework will be covered in Chapter 4.

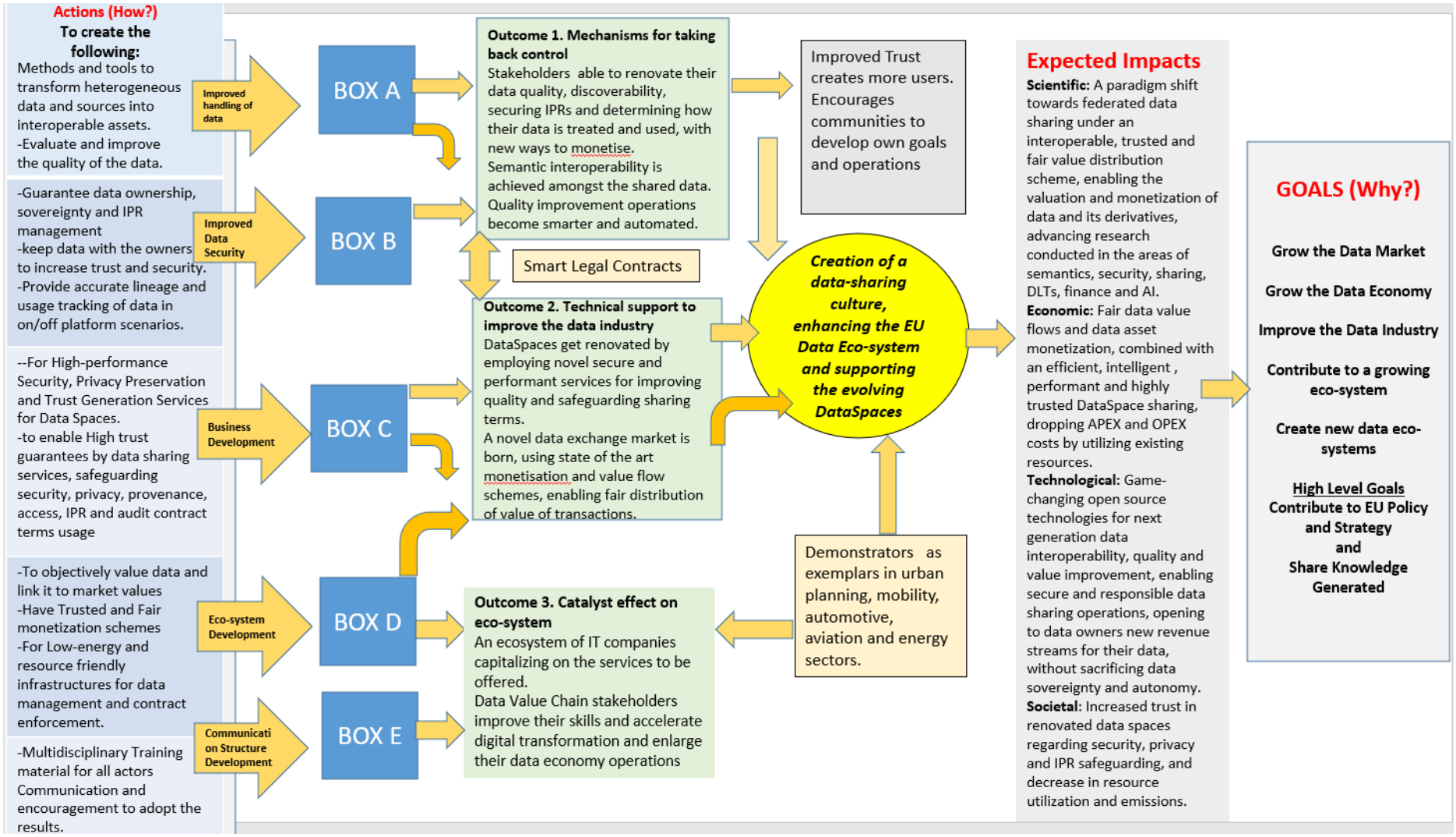

Figure 6: The PISTIS Theory of Change.

BOX A	BOX B	BOX C	BOX D	BOX E
• Sectorial Data Models • Pistis Metadata Repository • Methods for data Ingestion • Methods for data transformation • Methods for data enrichment • ML-based Data Quality Assessment methods	• Federated Data Sharing through peer-to-peer data exchange • Lineage tracking IPR safekeeping and contract enforcement modules, all provided as the background knowledge for the bundles to be part of the PISTIS Data Space Factory environment. • Exchange Log based on Blockchain • Data Monetisation Options (NFT + Data Investment schemes) • Data Contract Monitoring and Management • Data Usage Monitoring and Management • Interconnection with DataSpaces	• Data Security and Trust bundle • Distributed ledger technologies (DLT) • Access Policies • Identity Provider • Searchable Encryption Scheme	• A set of methods to drive the multi-dimensional valuation of data, the fair dynamic pricing of it, the definition of the market dynamics and the core features and the creation of novel data investments schemes (such as the Stablecoin, NFTs and Data Investment), to deliver the necessary data-sharing features that will be provided by the bundles of the PISTIS Data Trading and Value Exchange/Monetisation platform. • Data Market Insights service • Low Energy Blockchain infrastructure	• Demonstrations in five settings (3 demonstrator hubs with 12 partners + 3 more deployments with cross-domain data (weather data/open data)) and be used by the Living Lab as well. • Publications in scientific journals and international conferences. • 1 Business model targeting market entry and adoption of PISTIS by the Data Spaces. • 4 Business Models and Monetisation strategies (3 demo hubs + weather demonstrator). • MOOC and Training Material • Engagement of DIHs in the demonstrator dissemination activities

Figure 7: Key to the "Boxes" in previous figure.

3.5 CREATING THE PROJECT'S LOGIC MODEL

This section sets out some general principles which the project team will need to take into consideration when creating the PISTIS Project Logic Model. We need to incorporate the underlying assumptions, or theory underpinning the project, which articulates how undertaking the various tasks in the Description of Work (interventions and mechanisms) will resolve the problems and achieve the goals which PISTIS is targeting.[18] [19]

The Theory of Change shows the big picture with all the possible pathways and is messy and complex. The Logical Framework on the other hand shows the neat and tidy pathway which the project deals with. They are both based on the same set of assumptions made by the project and so can share many aspects of the approach taken.

Typical stages in developing a logic model which PISTIS had to consider included the following:

	Stage	What this entails
1	Collection of information needed to develop the model.	This involved working with multiple sources, including the PISTIS DoA, Deliverables, other documents, intense interaction with stakeholders, identified projects and published literature. It includes the basic EU programme and policies and the contextual information - social, political, ethical, legal.
2	Description of the problem(s) which PISTIS aims to address and the context in which we are working, and in particular, the factors which contribute to the problem.	This entails implementing the stakeholder engagement plan covered in Chapter 6 below in order to gauge the problems. Examples of methods which were available included the semi-structured interview protocol (SSIP) approach, designed to assist evaluation teams to collect perspectives from project teams and stakeholders, to inform the logic model which was developed by Gugui and Campos.[20]
3	Definition of the individual elements of the logic model.	Following on, it was possible to introduce the plausible theory of change in the previous section, which essentially links together the outcomes, activities, outputs and inputs. "At this stage, it may be helpful to ask constructively challenging "how" and "why" questions to articulate what you are doing and why". [21]
4	Construction of the model.	From the definition to the generation of the elements and to the construction of the logic model became and continues to be an iterative process. All the elements gathered, were translated into outcomes, activities, outputs at individual, organisational, system and community levels and the inputs.
5	Verification of the model,	Again, working closely with stakeholders, which sets the tone for continuous review, we looked at whether the PISTIS Theory

[18] Kellogg Foundation, "wk-kellogg-foundation-logic-model-development-guide," [Online]. Available: https://www.wkkf.org/resource-directory/resource/2006/02/wk-kellogg-foundation-logic-model-development-guide . [Accessed 26 June 2023].

[19] University of Wisconsin, "evallogicmodel," [Online]. Available: http://www.uwex.edu/ces/pdande/evaluation/evallogicmodel.html . [Accessed 18 January 2023].

[20] L. Rodrigueez-Campos and P. Gugui, "Semi-structured interview protocol for constructing logic models. Evaluation and Programme Planning," 2007, pp. 30, 339-350.

[21] S. A. Kaplan and K. E. Garrett, "Use of Logic Models by Community based initiatives," in *Evaluation and Programme Planning 28 (2)*, 2005, pp. 167-172.

		of Change, setting out why our activities will lead to desired outcomes, is feasible and also, which activities are most critical for achieving outcomes?
6	Iterative adaption of the model	The stages for doing this included: • Identifying and removing those elements which were unclear, unrealistic or meaningless. • Prioritising our intended outcomes, to identify the most critical outcomes and therefore where to focus evaluation. • Presenting the graphical and tabular logic models to organise the information collected in this process.

Table 2: Typical Stages in developing a logic model.

3.6 BENEFITS LOGIC MODEL

Since their introduction, various adaptations to the basic premise have emerged to overcome perceived weaknesses in the initial approach. An approach pioneered by the Canadian Government widened the scope from a simple query as to whether a project had been delivered on time, within budgets and achieving the set targets to one which further scrutinised whether the perceived business benefits were also realised. It is this approach which is of greater value to PISTIS and which we will adopt.

A Benefits Realisation approach embraces a set of activities, methods, processes, and tools for understanding, planning, tracking, managing and realising desired outcomes from IT initiatives or projects. It sets out the factors in the realisation of intended outcomes or benefits including business functions beyond the narrow IT project. The logic of the process to realise such benefits is represented by a 'Results Chain'. This further contributes to the management of stakeholder expectations[22]

Taking this a stage further, we can illustrate how benefits are linked to the demonstrator's success criteria and performance indicators as shown in Figure 8 below.

[22] R. Arthur, "presentation to Canadian Evaluation Society, Arthur Rabinovitch," 19 June 2007. [Online]. Available: https://evaluationcanada.ca/distribution/20070619_rabinovitch_arthur.pdf. [Accessed 18 January 2021].

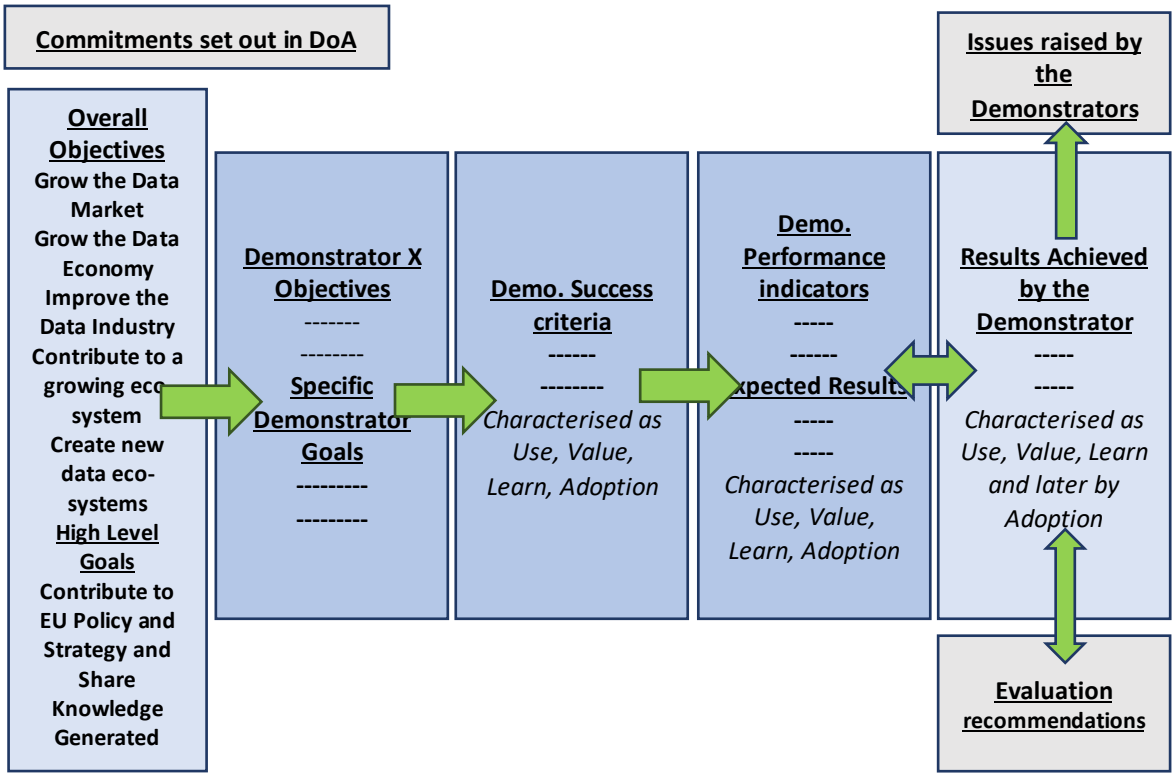

Figure 8: PISTIS Benefit Logic Model

The Evaluation Plan will reflect this Benefit Logic Model approach.

USE	Measurable results related to the use of the services demonstrated (number of users, uptime of the services etc.)
VALUE	Results linked to the technical or business value added as a consequence of using PISTIS enabled services (service provider estimations, user's satisfaction etc.)
LEARN	Lessons learned from the technical and business perspective and effect on future policy.

Table 3: Definitions of USE, VALUE and LEARN

And in the subsequent evaluation processes, these categories of "Use, Value and Learn" will be returned to in the reporting.

4 Evaluation Criteria and Measurement Framework

4.1 Use of the Theory of Change to inform evaluation criteria

There is a difference in the use of the PISTIS Theory of Change from the time it is being developed as a tool for shaping the evaluation process, to when the evaluation process has started. At the design stage, it helps formulate the questions to focus upon. But at the evaluation stage, its focus shifts and one aspect of this can be seen in its use to inform the evaluation criteria. Questions can be raised which help address the following topics:

- Strategic Relevance.

To what extent does the project meet the needs of the EU and what lessons learned may be of value to it. How do we meet the high-level policy goals promised in the DoA? Are we contributing to such concepts as the European Data Strategy objectives and especially European Common Data Spaces as the project call is built around these concepts? For example, some of the key features of a common European Data Space set in the second Commission Staff Working Document on Common European Data Spaces[23] can be considered within the PISTIS Theory of Change and PISTIS evaluation plan.

- Quality of Project Design.

How well were stakeholders involved during the project design processes? At the evaluation stage we will need to assess the quality of the stakeholder analysis in the project documentation, by verifying whether key stakeholders have been properly identified and assess whether sufficient analysis is provided on how different stakeholders can affect or be affected by project results.

This includes the nature of relationships that exist among stakeholders and how they were incorporated into the project design in their various roles. On the basis of the assessment of the project focus and the stakeholder analysis, it will then be possible to pose questions to assess how well the most relevant stakeholders were involved during project design.

- Effectiveness: Achievement of outputs

While the assessment of achievement of outputs should cover all the PISTIS project's outputs, as set out in the DoA, and those outputs added to by possible project revisions, it will be impossible to assess all project outputs with the same level of detail. The Theory of Change at the evaluation stage can be used to determine which project outputs are most essential for achieving the project's direct outcomes, and also may provide insights to assess the minimum characteristics and quality requirements for the project outputs so that they are fit to provide their expected contribution to the overall project outcomes.

The assessment of the achievement of outputs can then focus on the most critical outputs and verify whether these meet the requisite characteristics and quality. D1.2 PISTIS Technical

[23] https://digital-strategy.ec.europa.eu/en/library/second-staff-working-document-data-spaces

Requirements and MVP along with its iteration as D1.3 provides further guidance in this respect in the structuring of the Maximum Value Product.

- Achievement of direct outcomes

Direct outcomes are defined here as changes resulting from the use of project outputs by key stakeholders. The direct outcomes of the project are expected to result directly from the outputs, so the accountability of the PISTIS project team for their achievement is high. Outcomes are often changes in capacity and behaviour at the individual, industrial and institutional levels and this will hold true for PISTIS.[24]

- Internal logic of the project and its Impact

The PISTIS Theory of Change at the evaluation stage can be used to assess the internal logic of the project. The evaluation will also verify whether the project outputs are logically connected (from cause-to-effect) to the intended direct outcomes. It is also used when assessing the extent to which direct outcomes have been achieved and whether all necessary drivers and critical assumptions have been adequately considered. It can also be used to assess whether the direct outcomes are logically connected along the various causal pathways to the intended impact.

The PISTIS Theory of Change assists the evaluation team to make an informed judgment on how likely it is that the project will contribute to intended impacts. If the internal logic of the project is strong, outcomes have been achieved, all drivers and assumptions are in place, and progress towards intermediate states and possibly impact at a smaller scale have been demonstrated, it is highly likely that the intervention will contribute to the impact.

On the other hand, if there are flaws in the internal logic of the project, some key outcomes have not been achieved, certain drivers or assumptions are not in place, or there is very little evidence of any progress towards intermediate states and impact, the likelihood that the intervention will contribute to impacts such as increasing confidence in the data market or accelerating the data economy will be much lower.

- Catalytic role, replication and scaling-up

For assessing the replication potential and the roadmap to take-up of the project, using the PISTIS Theory of Change, the evaluation will focus on those direct outcomes, drivers and assumptions that are most necessary for replication and take-up of project results. Thus, it can be checked to see whether replication and up-scaling have been built into the causal pathways and whether the necessary drivers and assumptions promoting replication and take-up have been adequately considered in the project's intervention logic. It is expected that those most valuable in this process towards sustainability will be present and playing their role in further take-up of the projects results. The reliability of this assessment can be enhanced by looking for early evidence of replication or up-scaling during the project lifetime. Evidence of this will start to be reported in D5.2 and D5.3.

[24] United Nations Environment Agency, "evaluation-criteria-and-ratings," [Online]. Available: https://www.unenvironment.org/about-un-environment/evaluation-office/our-evaluation-approach/evaluation-criteria-and-ratings. [Accessed 21 JAN 2021].

- Formulation of recommendations to enhance replication.

The Theory of Change may also be used in offering a 'prediction' of how the project might be adjusted to maximize results in a different implementation settings. This is where demonstrations morph into the basis for a spreading eco-system and raises questions of how we can engage with wider evolving eco-systems, which the demonstrators are on the fringe of. With PISTIS, the DoA already provides a solid basis for this pathway to be followed.

- Sustainability

The assessment of sustainability is concerned with verifying whether the necessary conditions are in place for the continuation of the project benefits after PISTIS has ended. The Theory of Change during the evaluation process can be used to inform an assessment of whether sustainability has been built into the causal pathways and whether the necessary drivers and assumptions affecting sustainability have been adequately considered in the creation of the project's intervention logic and subsequently translated into action during the implementation phase.

- Ethics self-evaluation

The PISTIS Theory of Change at evaluation can have the demonstrators utilise the PISTIS Data and AI Risk Assessment Framework defined in D9.1 – OEI Requirements No.1, in their risk assessment in relation to the ethical and legal issues associated with the use of the specific features of PISTIS platform in the context of Business to Business data sharing and monetisation in each demonstration hub, and eventually to enable the demonstrators and technical partners to develop and implement necessary technical and organisational measures to enhance the project's compliance with the legal requirements and the ethical principles identified in D1.1 - PISTIS Operation Principles and Context Detailing which will complement the project legal and ethics monitoring activities carried out as part of Task T8.4 - Project Legal and Ethics Requirements Management

- Stakeholder participation and cooperation

The PISTIS Theory of Change at the evaluation stage can verify whether it includes a satisfactory approach for sharing information and encouraging cooperation with partners, national/local project stakeholders and other EU projects and programmes once the demonstrations have started. In using the Theory of Change at the evaluation stage, stakeholder analysis should assist in the identification of the key stakeholders along with their respective roles, capabilities and motivations in each step of the causal pathways from activities to achievement of outputs, direct outcomes and intermediate states towards impact. Will we have engaged with the eco systems we are aligned with and mirroring the current and evolving strategic activity from the Commission, for example?

4.2 VERIFICATION AND VALIDATION

The title of Task 5.1 is "Verification and Validation Framework Definition and Baseline Impact Assessment". Whilst "Verification and Validation" are referred to in relation to the Technical, Business and Science and Innovation Objectives and elsewhere in the DoA, for clarification it is worthwhile defining them here:

- **Verification** is the evaluation of whether or not the PISTIS service/platform complies with the determined requirements, specifications, conditions and ethical principles set out in the DoA, and referred to above.
- **Validation** is the assurance that a product, service, or system meets the needs of the customer and other identified stakeholders. It also involves acceptance and suitability with external customers and potential customers.

Verification is done by the project team to ensure that they are on the right track and working as per the agreed specification and process whereas Validation is the assurance that the deliverable meets the customer's need.

Whilst Verification is an internal process, Validation is more an external process done by the potential end-users and identified stakeholders.

The main differences between these two terms are:	**Verification**	**Validation**
To Ensure that:	Specifications are Met	Needs are Met
To Build	Solution correctly	Correct Solution
Carried out by	Project and Solution Team	Stakeholders and Business
Uses	Peer Review and Inspection	Continual confirmation and Requirement walk through

Table 4: Differences between verification and validation

4.3 Development of Evaluation Questions

We are moving on from the logic model and evaluation criteria to the evaluation questions to be raised and then on to the measurement framework required for these questions to be answered.

4.3.1 Questions raised via the Logic Model

The next stage of the process is to utilise the logic model to help formulate the questions which we will need to answer in order to carry out the evaluation. The method was to take the logic model and go through it asking five basic questions to start the formulation of the evaluation questions themselves.

Who?	Who was the project designed to benefit?
What?	What was the effort intended to do? What was the context within which the effort took place and how could it have affected its implementation and outcomes?
When?	When did activities take place? When did the desired changes start to occur?

Why?	Why is the effort important to the stakeholders involved? Why might it be important to people outside the project?
How?	How is the effort intended to affect the desired changes or bring about the desired outcomes?

Table 5: Types of questions suggested by logic model.

4.3.2 General categories of evaluation questions

In relation to the activities undertaken during the project, a further set of guidelines for assisting in the formulation of the PISTIS evaluation questions can be seen in Table 6 below:

Aspect of Effort	Example of Evaluation Question
Theory of Change and Logic Model	Was the theory of change and logic model correct? What aspects of the theory and logic model did not happen in practice? If it did not happen - why didn't it?
Implementation	Was the effort implemented as intended?
Results and Outcomes	To what extent did the effort lead to the anticipated results? What was the change and to what extent did the effort contribute to the change? What difference did the effort make to the stakeholders and wider community?
Context	What other factors could have influenced the project's implementation and outcomes?
Learnings	What worked and what did not? What were unintended consequences or benefits?
What Next?	Can the effort be scaled up? Can the effort be replicated elsewhere? Is the change self-sustaining or does it require continued intervention? Are we able to satisfy any business-related queries?

Table 6: Examples of categories of Evaluation Questions

4.3.3 Identification of Questions arising from the Project's Existing Documentation

An exhaustive exercise was undertaken of trawling through all of the project's existing documentation and the result of this was that attention was drawn to all the potential questions capable of being asked. The results of this exercise, essentially designed so as to make sure nothing was overlooked and as guidance as to what questions had already been raised to follow up on, can be found in "Appendix 1 Scoping the Evaluation Questions." Responsibility for providing answers to the questions, grouped under various headings, will be allocated to the appropriate partners/WP and Task leaders. Clearly, given the indicative nature of this exercise, should something not have been achieved, observations as to why not will

contribute to lessons learned for the project team, but should not be judged in isolation or be generally treated as being too significant.

No question was ignored for the sake of this exercise, which provided a checklist to return to at the end of the question selection process. Whilst some deliverables touched on detailed requirements which will need proof of satisfaction, the more technical deliverables were the root for steering the technical validation and specifically WP4 System Architecture, Continuous Integration, Testing and Technical Verification.

The DoA along with WP6 and WP7 added further questions to the above, but in addition, provided the guidance as to the higher policy and programme goals and questions to be raised in relation to their satisfaction.

4.3.4 Use of quantitative methods

At the most basic level, quantitative methods are concerned with "what? -who? -and when?" Therefore, we need to consider quantitative methods as our evaluation questions will include inquiries about who participated and benefited from the project, what lessons were available to learn from, what changes were brought about by our project; and when the changes occurred or are anticipated.

4.3.5 Use of Qualitative Methods

At the most basic level, qualitative methods are concerned with "why and how?" and are useful for in-depth study of a particular issue rather than a broad study.

4.3.6 Use of Mixed Methods

Over the past three decades, a trend in evaluation has been to shift toward mixing quantitative and qualitative methods into a single evaluation called "mixed method evaluation." This approach seeks to combine the strengths and dilute the weaknesses of the two methods, combining them can lead to a stronger, more complete evaluation than a conventional evaluation that uses only one method.

A mixed method evaluation systematically integrates two or more evaluation methods, usually drawing on both quantitative and qualitative data, such as using surveys and focus groups in one evaluation study.

4.3.7 PISTIS Questions

The eventual questions were determined along with the allocated responsibility for answering them and the wider set can be found in the Appendix 1 whilst a more focussed set will appear in the Evaluation Plan itself.

It needs to be stressed that this will become a living document and it will be regularly updated.

As the project evolves, the iterative nature of it will be reflected in the nature of the questions posed, with some being added as the likelihood of a response increases with each iteration and in accordance with the increasing maturity of the project.

4.4 MEASUREMENT FRAMEWORK

4.4.1 Introduction

We have developed our Logic model and our Theory of Change which underpins the evaluation process, and this led us to the range of questions requiring an answer. This section now turns to a description of another tool in the preparation of an evaluation, the PISTIS Measurement Framework. Developing such a framework allows us to determine **how** to assess progress toward achieving outcomes and answer the evaluation questions. It helps to give a clearer picture of how to conduct the evaluation, whilst providing a further opportunity for stakeholders to further define outcomes. With it, consideration can be given as to what the outcomes mean in more concrete terms.

What is important to know, is when there is progress toward the desired outcomes and how that progress will be measured, be it in descriptive terms, in a numerical format as totals or as percentages, etc.

4.4.2 Key Components of the Measurement Framework

A measurement framework generally consists of seven basic components.

- **Outputs** are direct products of activities and may include types, levels and targets of services to be delivered by the project. Generally speaking, outputs are the goods, products and services that are delivered.
- **Outcomes** are the immediate, intermediate and long-term changes or benefits to be documented and these are gleaned from the logic model.
- **Indicators** are markers of progress toward the change which PISTIS should make.
- **Measures of change** are values - quantitative and qualitative - that can be used to assess progress made.
- **Data collection methods** are the strategies for collecting data. This could include quantitative methods, such as conducting surveys or analysing existing data, or qualitative methods, such as conducting interviews or a document analysis and is covered later in this document.
- **Data sources** are the locations from which or people from whom we will obtain data.
- **Data collection frequency** is how often we plan to collect this data.

4.4.3 The Measurement Framework

Having identified the outputs and immediate, intermediate and long-term outcomes, the Table 7. below can be populated.

Output/ Outcome *(Specific outputs or changes derived from the Logic Model)*	**Indicator** *(Markers toward Progress)*	**Measures of Change** *(Value for assessing progress)*	**Data Collection Methods** *(How data will be Collected)*	**Data Sources** (*Where data will be obtained from)*	**Frequency of Data Collection** *(How often data will be collected)*

Output (each output and outcome are listed in the first column) Having listed them, a clear plan can be made for assessing progress toward that particular output or outcome by completing the other columns.

Table 7: The Measurement Framework

A variety of factors need to be taken into account when progressing with this task. These include the following:

- Contextual factors need to be acknowledged, both positive and negative.
- Realistic indicators and measures of change should be identified.
- As continually stressed, key stakeholders should be involved enhancing opportunities for feedback.

The measurement framework becomes a living document. It is a tool for planning, but should be regularly modified, based on changes in the project's progress and activities, or based on information gained from the data collected.

The logic model and evaluation questions are designed to be adjusted and these changes should be subsequently reflected in the evaluation plan.

Section 2: The Demonstration and Evaluation Preparation.

5 CREATING THE EVALUATION PLAN

5.1 INTRODUCTION

An evaluation plan sets out the proposed details of an evaluation - what will be evaluated, how and when.

This evaluation plan includes information about what the evaluation is trying to do, (previous sections have reflected on what is to be evaluated, the purposes and criteria of the evaluation and key evaluation questions) and how it will be done (what data will be collected, how and when, how data will be analysed, synthesized and how and when results will be reported).

We have already set out the factors which will determine how the evaluation process is carried out and in determining the Evaluation Plan. These include the overall purpose for evaluation, the PISTIS Evaluation Methodology, Logic Model and Theory of Change, the general approach to measurement and the identification of key questions which require an answer, utilising both quantitative and qualitative methods. The logic model puts into effect the project's theory of change. During the evaluation, we will collect data to test the theory.

This section sets out how to provide an evaluation plan which is a written document that describes how an evaluation will be managed. It clarifies the steps needed to assess the outcomes and processes of the project. The evaluation team and the stakeholders have agreed on the contents of the evaluation plan.

"An effective evaluation plan is a dynamic tool, or a 'living document', that should be updated on an ongoing basis to reflect changes and priorities over time."[25]

The PISTIS Evaluation Plan itself is a living document and its first iteration can be found in Appendix 2 and subsequently on the PISTIS site.

[25] UK Government, "Planning an evaluation," [Online]. Available: https://www.gov.uk/government/publications/evaluation-in-health-and-well-being-overview/planning-an-evaluation. [Accessed 10 December 2020].

The creation of the Evaluation Plan is intrinsically linked to the planning of the demonstration activities, the planning of which is the focus of Task 5.2 which sets out a basic set of actions to be covered in the PISTIS Evaluation Plan and to *T5.7 – Demonstrators Continuous Evaluation, Impact Assessment and Lessons Learned*.

The timetable will be determined by the requirements for the demonstrations identified in this task, alongside elements set out In the DoA. Given the requirements of the demonstrators on one hand, with the need to be organised when dealing with a wide range of stakeholders, and the more flexible approach taken by the technical teams, with their agile approach, a balance will need to be struck.

Similarly, some of the results and benefits from the evaluation will be linked to T5.7 which includes the "Demonstrators Continuous Evaluation and Lessons Learned".

Here, many of the "lessons learned" from the project, regarding the implementation, operation and execution of the demonstrators, will be generated and will be incorporated into "What comes next". They will be formulated as methodological adoption guidelines for the further exploitation and utilisation of the PISTIS platform. This will further contribute to the exploitation of the project by suggesting follow-up activities for further population of the platform with data and for bringing on board other entities. Essentially, we will be considering how the experiences of the demonstrators can best help to scale-up activities and establish a replication roadmap.

The evaluation itself will focus on two specific time periods:

- One running from the delivery of this document at M14 through to Evaluation of the Alpha Platform version with its deliverable D5.2 at M28.
- And the period up to the final evaluation and impact assessment from M28 to the delivery at M40 of D5.3 Demonstrators' Activities Evaluation Results.

Whilst the official reporting has two set times, there will be an ongoing continuous evaluation process with phases of taking stock of the situation at appropriate times related to the technical developments and indicated in the Evaluation and Demonstration Plan.[26]

5.2 Planning the Evaluation

Many of the steps which are recommended when planning an evaluation have already been carried out above.

What is required to complete the Evaluation Plan itself is to cover the following remaining steps:

1. Determine who will be involved. This is shaped by the discussion on the role of the stakeholders which is covered in detail in the Chapter 6.
2. Preparation and maintenance of the plan.
3. Set milestones and manage time in relation to the DoA.
4. Allocate the use of the available resources set out in the DoA.

[26] Demonstration and Evaluation Plan.xlsx (sharepoint.com)

5. Consider how the evaluation findings will be disseminated and used.

5.3 THE PISTIS EVALUATION TEAM

All partners will be involved in the evaluation process either directly as main actors in the demonstration planning and demonstration activities, or having a direct involvement in assuring that the full potential for the exploitation process is realised.

The demonstrations are structured in such a way that each demonstration site has a nominated technical partner who will provide an important role in ensuring there is close collaboration between the technical and demonstration teams. A key role for these technical "envoys" will be to ensure that the technical work is also driven by the needs of the demonstrators, rather than just by the needs of the technical teams and secondly, given the flexibility of the agile software development approach, to ensure a degree of discipline is provided, in the sense that strict markers should be put down to ensure that the demonstrators will know when they can prepare trials etc and so demonstration activities are not subject to continual set-backs, hindering the preparation process and the recruitment of participants process. Good will is a necessary ingredient in the demonstration process and it is easily lost.

Given the overlap with the roll-out of the demonstration process and the requirement for the demonstration sites to be capable of providing answers to all the evaluation questions identified, it is vital for a close relationship between the two tasks to be created and hence the PISTIS steering group will cover this overlap.

A third element is in ensuring that those stakeholders which are outside the project, actors in the data economy, smart cities etc. are engaged in the evaluation process, and this holds true for the stakeholders linked to the demonstration hubs. Hence the WP leaders of WP6, ensuring good communication and interactions and WP7, keeping exploitation to the fore, will also contribute alongside the WP5 Leader.

The demonstration sites themselves will join as required, but also have the option of joining in wherever they wish to participate. Figure 9 below reflects this envisaged structure.

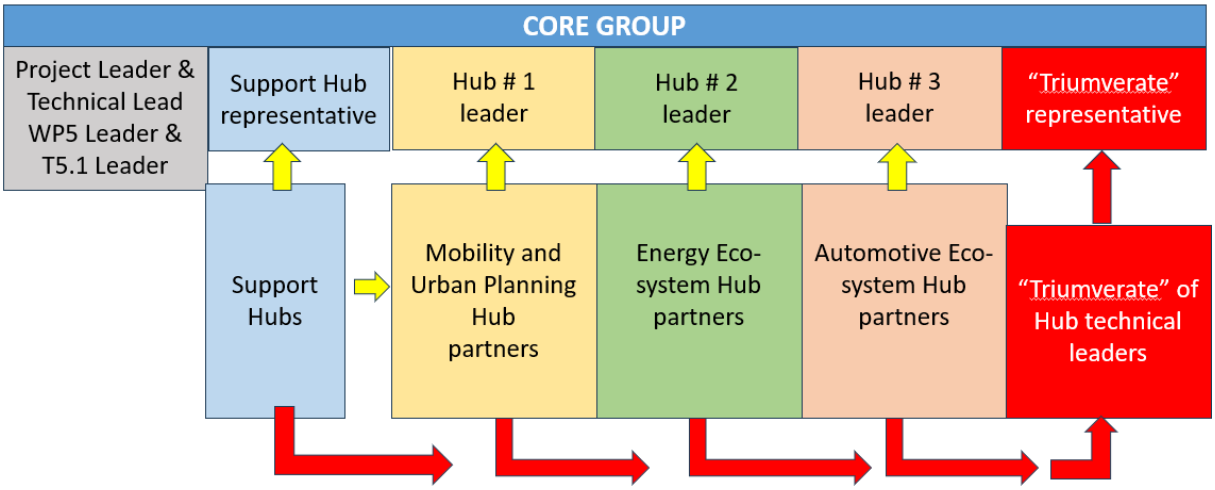

Figure 9: WP5 Organisational structure.

5.4 CONTRIBUTIONS BROKEN DOWN TO INDIVIDUAL PARTNERS

Major Partner contributions to the Demonstration and Evaluation Process.		
Partner	***Specific Role within WP5***	***Contribution to WP***
5.Assentian	WP5 Leader. T5.2 Task leader "Demonstrators Use Cases Detailing and Execution Planning". T5.7 Task leader for "Demonstrators Continuous Evaluation, Impact Assessment and Lessons Learned". Core Group Steering Committee.	Lead Role in WP taking a general coordination role. Major role in aligning demonstration planning and implementation with evaluation process. Ensuring that the demonstrations cover all identified aspects needing to be evaluated, whilst taking into account that exploitation pathways are also being covered. Leading role in evaluation from the perspective of achieving higher level goals. Retain a uniform evaluation of the project results across demonstrators. Responsible for D5.2 Demonstrators' Activities Evaluation Results - First Report and D 5.3 Demonstrators' Activities Evaluation Results - Second Report.
14.Polimi	T5.1 Task Leader for "Verification and Validation Framework Definition and Baseline Impact Assessment". Core Group Steering Committee.	Major role in aligning demonstration planning and implementation with evaluation process. Retain a uniform evaluation of the project results. Responsible for D5.1 – Demonstrators Evaluation Plan and Preparation Activities Report.
6.Suite 5	Technical Lead Core Group Steering Committee.	Measure the project's technical maturity and the results achieved at the demonstrators. Technical implementation planning and evaluation overlapping with T4.5 - Platform Software Validation and Verification. Lead for Technical chapters of deliverables.
1.FHG	Core Group Steering Committee.	T5.6 Instance 1 for serving selected open data via connecting to the EU Open Data Portal to be hosted by FGH. Stakeholder input and feedback from T6.3 - Liaison Activities and Strategic Partnerships, and Standardisation.
8 EURECAT	Contributions to planning and evaluation tasks.	Contributor to the business aspects of the evaluation. Main focus is on the monetisation planning and evaluation strategy.
9 DBL	Stakeholder liaison strategy, implementation and evaluation.	Stakeholder input and feedback from WP6 Living Lab and ongoing dissemination requirements.

10 DSME	Main focus is on the cross-cutting demonstration.	T5.6 Instance 1 for utilising Living Lab. Stakeholder input and feedback from T6.4 - PISTIS Living Lab Setup and DIH/SMEs Engagement
11 UBITECH	UBITECH, as a technical partner, will bring this viewpoint to T5.2-the planning of the demonstrations and to T5.7, their evaluation.	UBITECH will deliver the security bundles, the blockchain network, and the integrated version of the PISTIS Exchange Market environment and in this capacity, will support the demonstrators in its deployment. It will perform analysis on pilot sites for integration purposes.
12 ALEGAL	T5.1 and T5.7-Planning the evaluation framework in relation to legal and ethical issues and carrying out the evaluation.	Ensuring the correct legal and ethical position is taken throughout the preparation and conducting of the demonstration activities and reporting this in the deliverables.
13 SPH	Technical partner.	Task 5.6. Instance 3 Hosting the domain agnostic instance, to act as a playground by the Living Lab participants.
15 ICCS	Technical support partner for Demonstrator Hub#1, providing its expertise in intelligent transport systems.	Assistance wherever is needed in data collection and the definition of available data assets, in the context of demo hub #1. Contribution on defining relevant interfaces to be integrated into PISTIS platform. Assistance in the creation of an accurate baseline to be used as a reference for the verification of the impact. More to be added depending on the progress of the project and the needs of demo hub #1 partners.
16 UBIMET AT	Task leader for T5.6 – Cross-Demonstrator Data Spaces Instances Deployment and Experimentation	Lead for Creation of specific validation scenarios, associating them to sub-groups of Key Performance Indicators (KPIs) to properly address specificities of each pilot case, Demonstration activities. Instance 1 to trade weather data.
16.1 UBIMET DE	Major role in T5.6 Cross-demonstrator Data Spaces.	T5.2. Planning the demonstration, T5.6 cross-cutting work and T5.7 -the evaluation process.
17 AIA	Task Leader forT5.3 - Demonstrator Hub #1 – Mobility and Urban Planning Ecosystem Experimentation. Core Group Steering Committee.	Lead for Creation of specific validation scenarios, associating them to sub-groups of Key Performance Indicators (KPIs) to properly address specificities of each pilot case, Demonstration activities.
18 GOLDAIR	Use-case contributor	T5.3 - Demonstrator Hub #1 – Mobility and Urban Planning Ecosystem Experimentation.

19 DAEM	Use-case contributor	T5.3 - Demonstrator Hub #1 – Mobility and Urban Planning Ecosystem Experimentation.
20 OASA	Use-case contributor	T5.3 - Demonstrator Hub #1 – Mobility and Urban Planning Ecosystem Experimentation.
21 CUERVA	Task Leader for T5.4 – Demonstrator Hub #2 – Energy Ecosystem Experimentation. Core Group Steering Committee.	Lead for Creation of specific validation scenarios, associating them to sub-groups of Key Performance Indicators (KPIs) to properly address specificities of each pilot case, Demonstration activities
22 BAMBOO	Use-case contributor	T5.4 – Demonstrator Hub #2 – Energy Ecosystem Experimentation.
23 OMIE	Use-case contributor	T5.4 – Demonstrator Hub #2 – Energy Ecosystem Experimentation.
24 CARTIF	Technical partner for Demonstrator Hub #2 – Energy Ecosystem Experimentation. Participation in T5.2, T5.4 and T5.7	Development of algorithms and techniques for forecasting electricity demand. Use of these techniques for predicting events of congestion in lines and overvoltage in nodes. Calculation of the power that we need to rearrange using flexibility to avoid these events.
25 VIF	Task Leader for T5.5 – Demonstrator Hub #3 – Automotive Ecosystem Experimentation Core Group Steering Committee.	Lead for Creation of specific validation scenarios, associating them to sub-groups of Key Performance Indicators (KPIs) to properly address specificities of each pilot case, Demonstration activities. Technical representative for Hub.
26 CARUSO	Use-case contributor	T5.5 – Demonstrator Hub #3 – Automotive Ecosystem Experimentation.
27 TRAF	Use-case contributor	T5.5 – Demonstrator Hub #3 – Automotive Ecosystem Experimentation.
29 OAG	Use-case contributor	T5.3 – Demonstrator Hub #1 – Mobility and Urban Planning Ecosystem Experimentation.

Table 8: Partners' contribution to the Evaluation Planning.

The skill set required to implement the Evaluation Plan is present within the consortium, with members having carried out similar tasks on numerous occasions.

In addition to the core group steering committee structure set out in Figure 9 above, regular hub-focussed meetings will take place as well as smaller meetings of the technical representatives of the hubs.

	1 – FHG	5.ASSENT	6 SUITE5	7.UMALTA	8.EURECAT	9 - DBL	10– DSME	11.UBITEC	12 LEGAL	13 - SPH	14 POLIMI	15 - ICCS	16UBIMET	16UBI.DE	17 - AIA	18.GOLDAIR	19.DAEM	20.OASA	21. ERVA	22.BAMBOO	23. OMIE	24 CARTIF	25. VIF	26.CARUSO	27.TRAF	29. OAG
T5.1Validat Framework		2	2	2	1	2	1	1	1	1	7	1	1		2	1	2	1	1	1	3	1	1	1	1	
T5.2 Demo Planning	1	8	4		2	4	2	4		5	4	2	4	1	8	4	4	4	4	4	2	6	4	4	4	2
T5.3 Mobil/ Urban Plan			6			2				8	2	6	2		28	15	12	16								10
T5.4 Energy						2					2		1						28	10	14	18				
T5.5 Auto - motive	6					2					2		2										25	10	14	
T5.6 Cross-Demo.						1	3				1		10	4												
T5.7 Evaluation	1	12	2	4	1	2	1	4	4	4	6	2	2	2	8	4	4	4	6	2	2	2	4	4	4	
Total 482	8	22	14	6	4	15	7	9	5	19	24	11	22	7	46	24	22	25	39	17	21	27	34	19	23	12

Figure 10: Allocation of effort in WP5.

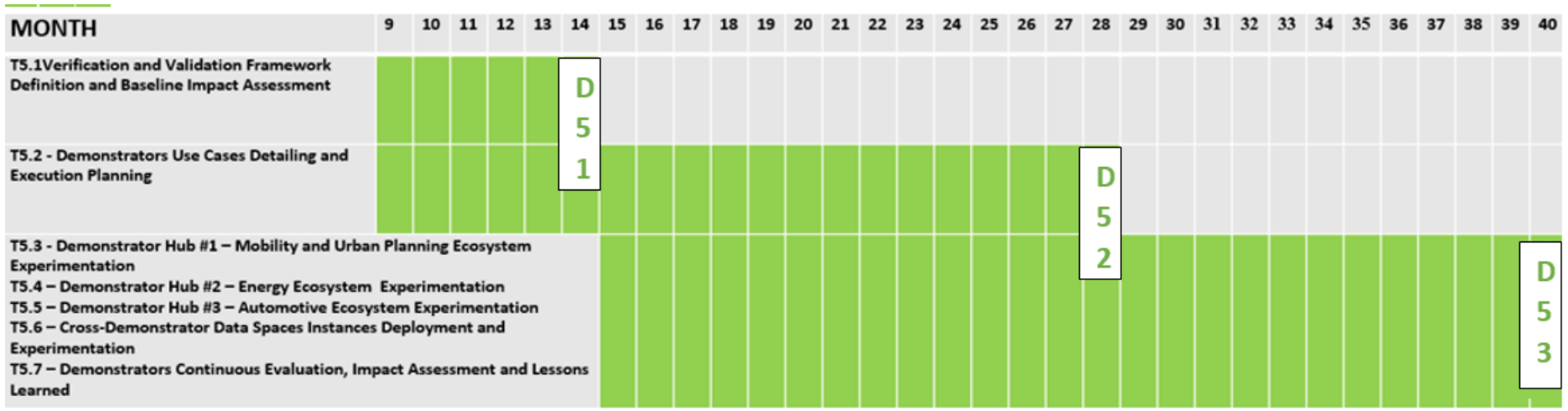

Figure 11: Gantt chart for WP5.

5.5 INVOLVEMENT OF STAKEHOLDERS

Here we can briefly reflect on the general role of stakeholders before returning to the specific details of stakeholders in Chapter 6.

Stakeholders here are all those affected by the results of an evaluation, whatever their interest and involvement in the project is. They need to be engaged with from the outset, but may be involved at any stage and could include those providing funding, developing or implementing the intervention, supporting the evaluation, or using the evaluation findings. Stakeholders clarify what will work in practice and where barriers may lie.

The following questions may help identify relevant stakeholders.

- Who is involved in the intervention including staff, service users and funders?
- Who needs to be involved to carry out the evaluation?
- Who needs to be involved for any change to take place as a result of the evaluation?
- Who will be affected by any change stemming from an evaluation?

A range of stakeholders were required to be involved in the initial evaluation discussions to ensure a broad outlook, rather than ending with an evaluation process which may only address the narrower requirements of a few of the stakeholders.

Having identified stakeholders at the beginning of the project (and earlier in the writing of the proposal) we needed to consider at what stage and at what level is the involvement of different stakeholders required. The question was raised as to whether there needed to be a structure to ensure representation such as on a steering group, representation at the demonstration sites, Data Industry input, etc. and how the engagement with the evaluation teams was to occur. This will await further consideration as the project proceeds.

Similarly, patterns and mechanisms for engagement were discussed, in regard to levels of participation, whether they will attend stakeholder consultations or take part in interviews or focus groups as part of the evaluation. It was also noted the importance of involving stakeholders in the dissemination stages of the evaluation. Discussion regarding most suitable online tools is important. Additionally, it was noted that there is a need to have involvement of those who will use the findings of the evaluation for whatever purpose.

5.6 ANSWERING THE EVALUATION QUESTIONS AND MEETING THE EVALUATION OBJECTIVES

An evaluation usually addresses questions about whether and how the aims and objectives of an intervention were achieved. The evaluation questions are critical because they shape what data is needed and how they will be analysed. Chapter 4 established an exhaustive process for determining which of the wide array of questions which we initially identified, should have resources dedicated to their being answered. Having defined the evaluation questions within a context of specific objectives for the project, the work plan and outputs could then be agreed based on the resources available, which in the case of PISTIS, were already determined by the DoA.

The work to be planned is very much shaped by the questions selected as this directly influences the methods adopted to answer them and which data needs to be gathered.

Different methods are needed to address different questions and so this also involves specifying activities needed to answer the evaluation questions, in relation to the recruitment of participants, and for the collection of particular data and scheduling these etc.

Whilst there will evolve a set of significant questions to be considered, there will remain a much wider range of questions essentially designed to check that the project is on course and fulfilling the general objectives established for the project, produced in Annex 1.

T5.2 in the early stages of the project, will create, on top of the initial work for the landscaping that will be delivered by T1.2, the following:	**Partners responsible.**
A detailed list of the available data assets at each demonstrator for the realisation of the project's pilot activities.	Tasks 5.3-to 5.6 leaders
Refining the landscaping of the data assets involved in the project's demonstrators and their characteristics	All partners
Reviewing relevant IPR policies at each data-ecosystem.	ALEGAL/Task Leaders
Designing Demonstrator-specific use cases based on the end-to-end usage scenarios and data trading lifecycle design identified in T1.2.	All Task Leaders
A detailed execution plan will be provided with the demonstration activities, including processes, needed inputs and expected outputs.	All Task Leaders
Perform a gap analysis at the project's demonstrators to define additional activities.	All partners, WP5 leader
Define Consent Collection procedures where required.	ALEGAL
Define deployment of internal infrastructure.	Tasks 5.3-to 5.6 leaders
Define connections and sensors.	Tasks 5.3-to 5.6 leaders
Cover compatibility with specific APIs.	Tasks 5.3-to 5.6 leaders
Resolve any network communication issues.	Tasks 5.3-to 5.6 leaders

Table 9: Preparatory work for the demonstrators.

Following the progressive delivery of the platform, this task will coordinate their deployment in the demonstrators and their integration with existing data spaces.

What is crucial is the approach taken to:

- Determine the most suitable metrics to be adopted in the evaluation process,
- Determine the methods for Data Collection and its subsequent analysis.
- Set out the legal and ethical parameters which the demonstration hubs are working within, initially established in D1.1 and subsequently, ensuring that the recommendations made have been heeded in practice.

These topics are covered in later Chapters.

5.7 ESTABLISH MANAGEMENT STRATEGIES

Like any project, it is important to keep the roll-out and evaluation on track and ensuring emerging issues are dealt with in a timely manner. It is recognised that communicating well and early, within the team and with any external collaborators is crucial.

Not all challenges can be anticipated in the evaluation process. So, it may need to be revisited and revised. Priorities can also change once the evaluation is in progress, especially if it is conducted over a long time period. In these cases, it is important to document what was changed and why and note any implications of these changes for evaluation objectives and usefulness.

Again, these changes will be captured in the living document which is "*The PISTIS Demonstration and Evaluation Plan*".[27]

5.8 TIMETABLE

A typical timetable for evaluation might include the following three phases:

- *Ex-ante*: Do the plans of the demonstrators focus on the right overall targets of the project?
- Midterm: Did the execution of the demonstrations take place according to the defined plans?
- *Ex-post*: Did the results of the pilots match the promised results?

In the case of the PISTIS project there is a slightly different approach to the three phases at which evaluation takes place. This is due to the agile software development method being used for the development of the platform.

The timetable, with a regular schedule of meetings, is laid out within the Evaluation Plan. The first version of this can be found in APPENDIX 2.THE DEMONSTRATION AND EVALUATION PLAN and reflects the iterative nature of the project set out in section 1.3.

6 STAKEHOLDERS ENGAGEMENT STRATEGY

The key stakeholders to involve during the demonstration process, to achieve some of the higher-level objectives for PISTIS and their roles, are reported below:

- **Data Space Operators:** These stakeholders are pivotal in managing and overseeing the data spaces. Their role includes ensuring data integrity, security, and accessibility, which are crucial for the successful functioning of the data ecosystem.
- **Researchers and Scientists:** They provide the necessary academic and scientific rigor to the project. Their involvement ensures that the latest scientific methodologies and research findings are integrated into the project, enhancing its validity and effectiveness.

[27] Demonstration and Evaluation Plan.xlsx (sharepoint.com)

- **ICT SMEs, Software Vendors, and Developers:** This group plays a critical role in the technological development of the project. They contribute to the design, development, and maintenance of software solutions, ensuring that the project's technological needs are met with cutting-edge solutions.
- **Public Sector Organisations:** These stakeholders represent the governmental and administrative perspective. Their involvement is essential for aligning the project with public policies, regulations, and societal needs. Additionally, they can facilitate the implementation of project outcomes in public services and infrastructures.
- **Standardisation Bodies:** These organisations are responsible for establishing and maintaining industry standards. Their participation ensures that the project adheres to international standards, promoting interoperability and consistency across different data spaces and systems.

The demonstration activities of the PISTIS project hinge on the involvement of data owners, providers, and subjects (data-supply side), as well as data consumers and users (data-demand side). This dynamic ensures a comprehensive approach to data handling, from generation to utilisation.

Expanding upon the additional key stakeholders of the PISTIS project reveals a diverse and multifaceted group. The following list includes stakeholders and initiatives that will potentially be reached to bring their unique perspectives and expertise to the table:

- **Policy Makers:** They play a crucial role in shaping the regulatory framework within which the project operates. Their insights help ensure that the project's outcomes are not only innovative but also compliant with existing and forthcoming policies and regulations.
- **The European Commission:** Their involvement is crucial for funding, guidance, and alignment with broader European Union objectives and initiatives.
- **Reviewers post-review:** These are experts who evaluate the project after key milestones. Their feedback is invaluable for continuous improvement and ensuring that the project meets its intended objectives.
- **Collaboration with Sister Projects:** Recognising the power of synergy, the PISTIS project aims to collaborate with other similar initiatives to pool resources, share knowledge, and drive innovation.
- **Data Spaces Enhancement:** A significant aspect of the project is to identify and enhance existing and proposed Data Spaces, ensuring they are optimally utilised and contribute to the broader data ecosystem.
- **Engagement with Major Initiatives**: The project proactively engages with significant initiatives like GAIA-X, EOSC, IDSA, BDVA, etc., to align its goals with broader industry trends and leverage collective expertise.
- **Ecosystem Interaction:** The project interacts with ecosystems that align with the PISTIS demonstration hubs, ensuring a harmonised approach to data management and utilisation.

- **Living Lab Activities:** Involving stakeholders through Living Lab activities is crucial for real-world testing and implementation of project outcomes.
- **Strengthening T5.6 Impacts:** Stakeholders play a critical role in enhancing the impact of the T5.6 – Cross-Demonstrator Data Spaces Instances, a pivotal component of the project.
- **Involvement of EU Institutions:** EU institutions, particularly those involved in policy goals like the European Green Deal Strategy, are key to integrating the project's outcomes into broader policy frameworks, especially in sectors like Energy, Mobility, and Urban Planning, which are the focus for the demonstration activity.

Given the multifaceted nature of the stakeholders and their wide and heterogeneous expertise, the stakeholder engagement strategy also required a multifaceted, wide, and heterogeneous approach. Such strategy begins with an in-depth evaluation of the PISTIS project, assessing its capabilities to extend to external fields beyond the initially investigated Hubs and use cases. This stage is pivotal in understanding the project's alignment with specific use case needs. Prior efforts have focused on identifying the needs of individual demonstrators, creating relevant data landscapes, and determining functional requirements for the platform components. However, a critical gap remains in understanding how the platform aligns with the needs of the users and demonstrators, and whether all components effectively address potential shortcomings.

The following Figure 12 encapsulates this strategy.

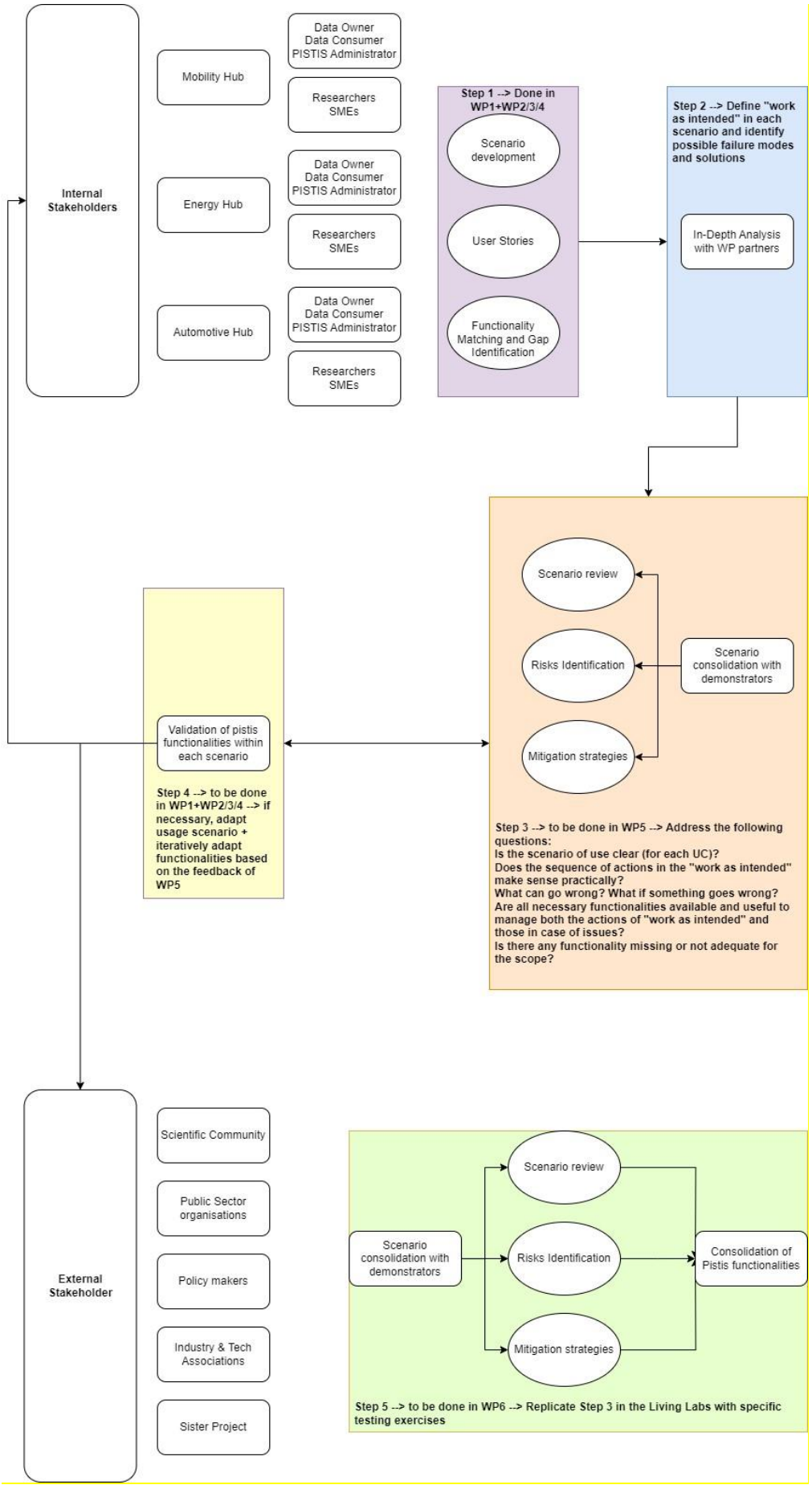

Figure 12: Stakeholders Engagement Strategy

To bridge this gap, the strategy will encompass the following steps set out in Figure 12:

- Scenario Development (Steps 1): Starting from the knowledge acquired within WP1-WP4, the previous user stories and landscapes will set the ground for the definition of the scenario within each use cases. Such scenarios will then be mapped against the PISTIS components and functionalities, to assess the existence of any gaps in fulfilling the users' needs and requirements. These narratives are essential in outlining how the project's tools and methodologies will be applied in real-world situations. The primary objective of this step is to ensure that the developed scenarios align closely with the needs and expectations of the users and demonstrators.

- In-Depth Analysis with WP Partners (Step 2): A collaborative review with WP partners will be set to consolidate the outcomes of the scenarios development. At this stage, scenarios will be reviewed with specific focus on the gaps identified, in order to define whether such gaps can be addressed in any way by the PISTIS platform. For each scenario, the team defines what successful outcomes would look like. This involves detailing the desired results and the processes needed to achieve them, providing a clear roadmap for implementation. A critical part of scenario development is identifying potential failure modes – the ways in which a scenario might not unfold as planned. Alongside identifying potential problems, this step involves brainstorming and proposing solutions or preventative strategies to mitigate these risks.

- Scenario Consolidation with Demonstrators (Step 3): The first crucial aspect of this step is reviewing each use case to ensure its scenario is clear and understandable. This involves verifying that the objectives, processes, and expected outcomes of each use case are well-defined and comprehensible. This step will be performed in collaboration with the demonstrators, with whom the scenarios are scrutinised to ascertain whether the sequence of actions designed under "work as intended" is practical and feasible in real-world applications. A key part of this stage involves anticipating what could go wrong in each scenario. This proactive approach to risk management involves identifying potential failure points in the sequence of actions. In addition to identifying what could go wrong, it's essential to have plans for such eventualities. This includes establishing what actions should be taken if something does not go as planned, ensuring there are robust contingency measures in place. An in-depth analysis is conducted to determine whether all necessary functionalities are available and useful in managing both the actions of "work as intended" and those in case of issues. This step also involves assessing if there are any missing or inadequate functionalities for the scope of the use cases. It's about ensuring that the platform or system has all the tools and features needed to handle both normal operations and unexpected challenges. The primary outcome of this step is a set of refined scenarios that are not only clear and practical but also resilient to potential problems.

- Validation and Iterative Development (Step 4): After the demonstrators have consolidated their scenarios, an internal assessment is conducted to identify any discrepancies. This includes pinpointing any risks or gaps that might not have been previously considered or adequately addressed in the scenario planning. The assessment also scrutinises the proposed mitigation solutions to determine their feasibility. It's essential to confirm that these solutions can be practically implemented and will effectively address the identified risks and gaps. The feedback obtained from the internal assessment is used to refine the scenarios further. This involves adjusting the scenarios based on real-world insights from the demonstrators and the internal risk assessment. The iterative development process ensures continuous improvement of the scenarios. As new information or challenges emerge, the scenarios are adapted accordingly, maintaining their relevance and effectiveness. The validation also assesses whether all necessary functionalities are available and sufficient to manage both the intended actions and any unforeseen issues.
- External Stakeholder Engagement (Step 5): A range of stakeholders outside the project consortium, including the scientific community, public sector organisations, policy makers, industry & tech associations, and sister projects, are involved in this step. External stakeholders will be engaged to review and consolidate the project scenarios. The objective is to ensure the scenarios are robust, realistic, and informed by the knowledge and needs of these stakeholders. Risks are identified collaboratively with external stakeholders. This process benefits from their external viewpoints and knowledge, which might highlight risks that internal team members might not foresee. Once risks are identified, appropriate mitigation strategies are developed. These strategies are informed by the insights of external stakeholders, which can lead to more comprehensive and effective solutions. The process includes ensuring that the functionalities of PISTIS are in alignment with the project's goals and stakeholder expectations. This involves confirming that all necessary functionalities are available and that they address both intended actions and potential issues. Step 5 is to be carried out in WP6, implying that the engagement and consolidation process will be replicated in a Living Lab environment. This suggests a hands-on approach where specific testing exercises are employed to validate the scenarios and mitigation strategies in a controlled yet realistic setting that mimics real-world conditions.

Throughout this multifaceted process, the commitment is to maintain a transparent and detailed communication channel, regularly updating stakeholders on the progress and adaptations made in relation to the use cases. We aim to ensure that our strategic approach (detailed in D6.1 - Dissemination, Communication, Liaison, Training and Living Lab Plan), in its entirety, is rigorously evaluated, refined, and aligned with the dynamic requirements of each use case, thus fulfilling the project's objectives and ensuring practical applicability in real-world settings.

Section 3
The PISTIS Demonstration and Evaluation Plan

7 DEMONSTRATION PREPARATION ACTIVITIES PLAN

7.1 INTRODUCTION

The successful implementation of WP5 in terms of effectively testing the Pistis solution and providing the necessary feedback to evaluate the platform relies on the execution of the demonstrators in a coordinated and unified manner, forming a representative sample audience of users to evaluate each version released, and from a variety of perspectives from stakeholders.

The first part of this section sets out to consider all the aspects of PISTIS which will shape the plan for carrying out the demonstrations. It will focus more on **planning the execution of the demonstrations** of the eleven use-cases. The following chapters in this section will then concentrate upon the **actual evaluation process**, which the overall plan must take into account.

Appendix 2 to this document will be the actual plan as to how we will run the demonstration activity between M15 and M40, incorporating the actions required to carry out the evaluation process.

The inter-related tasks of T5.1 – Verification and Validation Framework Definition and Baseline Impact Assessment and T5.2 - Demonstrators Use Cases Detailing and Execution Planning combined to provide the content for the overall deliverable. They formed the basis for the evaluation framework and the implementation overview for WP5 Demonstration, Benchmarking, Business Validation and Impact Assessment.

Task 5.2, in the early stages of the project, created on top of the initial work for the landscaping that was delivered by T1.2, a detailed list of the available data assets at each demonstrator for the realisation of the project's pilot activities.

Work was also focused on refining the landscaping of the data assets involved in the project's demonstrators and their characteristics (including relevant IPR policies), to get a

good understanding of the information sources that will be handled and managed during the experimentation at each data ecosystem.

This section provides the approach to and design of the demonstrator-specific use cases. These are being designed based on the end-to-end usage scenarios and data trading lifecycle design identified in T1.2 and a detailed execution plan will continue to evolve alongside the unfolding demonstration activities, including processes, needed inputs and expected outputs.

Task 5.2 will also perform a gap analysis at the project's demonstrators to define additional activities (e.g. consent collection, deployment of internal infrastructure, connections sensors, compatibility with specific APIs, and resolution of network communication issues) which are necessary in order to facilitate the realisation of the project's demonstrators.

Following the progressive delivery of the platform, this task will coordinate the deployment of the demonstrators and their integration with existing data spaces and this planning will be captured in periodic iterations of Appendix 2 which is designed to be a living document to be placed in the Pistis repository for the duration of the project and to be regularly updated at each stage of the project, setting out the plan for how the demonstration hub activity should be implemented in a uniform way.

7.2 DEMONSTRATION DEPLOYMENT PLANNING

7.2.1 Context to Timetables to running the demonstrations.

All scenarios are operating within the same timings as dictated by the overall project timetable.

From the development and integration Work Packages, WP2, WP3 and WP4, we expect several full releases, namely Alpha on M21, Beta on M33, an interim version-v0.5 between that version and v1.0. This is expected to become the final product at M42, at the end of the project. There will of course be later improvements in what we will refer to as the "exploitation phase" after the project itself is completed.

At each release, a different set of features/functionalities will be made available.

The Alpha version will offer basic functionalities (as described in the final MVP set out in D1.4 and in deliverables D3.1 and D4.1.) This will include Data Sources Connection and Closed Group Data Collection. From the demonstrator's perspective, their role in the early months is simply to monitor activity to make sure they will be able to meet any technical requirements which they might need to deploy at their sites. Closer to completion of this development stage, they will be called upon to give feedback on the user interfaces emerging to also ensure that they meet their requirements.

The Beta version will offer full functionality, with non-critical features being at an early experimental level of maturity. In this phase there will be an Extension of Data Owners base and operational readiness testing and covers the early operation.

Version 0.5 will fix all major defects identified after the evaluation of Alpha and Beta versions and shall offer full functionality plus mature, experimental-to-functional level of non-critical features.

At the same time, the audience who will evaluate each version of the Pistis platform shall also evolve. The Alpha version shall be evaluated mainly by a small, closed group of users, usually employees of the demonstrator who have also taken part in setting up the Pistis platform at the premises of the demonstrator, i.e. with good knowledge of the goals of the project and both the technical details (e.g. connection of the data sources) and the business details (e.g. the goals that each demonstrator aspires to achieve via the adoption of the Pistis platform).

The Beta version shall be evaluated by a larger scale closed group, or a limited open group, depending on the nature of each demonstrator. At this stage, the users should have limited to no knowledge of the technical and business details behind the demonstrator's adoption of the Pistis platform. Finally, v0.5 shall be evaluated by a fully open group of users, who could range from invitees of the demonstrator to groups of clients of the demonstrator or wider. All this activity will result in the availability of the final version at M42.

The Final Phases will include the Branding and Operational Deployment of the Marketplace and this phase covers the full-fledged pilot operation.

The test scenarios devised for all three demonstrator hubs in Chapters 8, 9 and 10 are split into three phases, which are designed in order to gradually evolve at full scale, following the Alpha, Beta and v0.5 releases of the Pistis platform. In addition, the audience expected to evaluate each version of the Pistis platform will be described in more detail in the demonstration evolution plans, according to the particularities of each demonstrator.

It is stressed that the evaluation of the system and of the scenarios will be done within WP5 whilst the technical testing will be carried out in WP4 which will:

- Construct the reference architecture and produce detailed specifications of the integrated PISTIS platform,
- Describe thoroughly the interfaces and design the APIs of all the different components/ bundles/ services that will be integrated.
- Document an integration plan which will guide the integration and DevOps efforts (code maintenance, continuous integration, software evaluation) and will integrate the various components of the main service bundles of the reference architecture, at the PISTIS platform level and at the on-premises PISTIS factory instances.
- Assess and validate the correct functioning of the PISTIS platform implementation as a whole and make sure corrective actions are taken upon any defects encountered.

The testing effort in WP5 has started with pilot planning and preparation activities, well before the Alpha version is available, and shall be ongoing throughout the project as this "Demonstration Scenarios and Implementation Plan" evolves. The development of the connectors and necessary customisations at each demonstrator follows this phase, so that every demonstrator can get ready to connect to the Alpha version of the platform around M21.

Prior to the availability of the alpha version, the main technical interaction between the development team and the demonstrators will be ensuring that their viewpoint remains in focus and so that the demonstrators can plan what technical developments and interfaces, software etc will be required for them to be able to integrate with the PISTIS platform. Prior to the emergence of the alpha version, the main contribution the demonstrators can make will be in giving their feedback on the user interfaces as they emerge to ensure they meet their requirements. As a consequence of the timing of the alpha release, much detail will need to be reported in D5.2 with evaluation of the outcomes being reported fully in D5.3.

Whilst the software development has adopted a fluid and flexible approach, that of "agile software development" as being the most fit for the purpose, we also need to take into consideration the less flexible needs of the demonstrators. In order to prepare the demonstrations and attract and maintain the desired end-users to test the evolving platform, there needs to be a greater degree of certainty with regard to the timing of trials, which in turn will give them the confidence that their efforts are worthwhile. A degree of certainty is also required to enable good planning for the demonstrators, and more significantly, that these plans do not need to be amended too much as the project progresses.

An analogy might be that whilst the software development might be travelling by road and have flexibility of which route to take and when to stop, the demonstration activities could be seen as travelling by rail and having to halt at prescribed stations and to a strict timetable to adhere to, particularly for the benefit of the passengers. (In this analogy, the passengers are those assisting in the demonstrations.)

It is important that these two "modes" do come together at "stations" to ensure smooth coordinated demonstration of the software. A degree of certainty at specific times is required by the demonstration partners.

7.2.2 Wider role for demonstrators

In addition to the pivotal demonstration work arising from WP5 activities, the Demonstration Plan in Appendix 2 and its online iterations also need to take into account other actions expected of the demonstrators, which other WPs have established. Naturally, the overall planning is built upon the timing of the technical work coming out of WP4, but the demonstrators also need to contribute to achieving the goals set out in WP6 and WP7 in helping to disseminate and prepare the exploitation for the project. A joined-up plan covering all the activities expected of the demonstrators will help in the coordination of all these different demands of the demonstrators. Figure 13 is a high-level representation of the amalgamation of all these different requirements being made of the demonstrators.

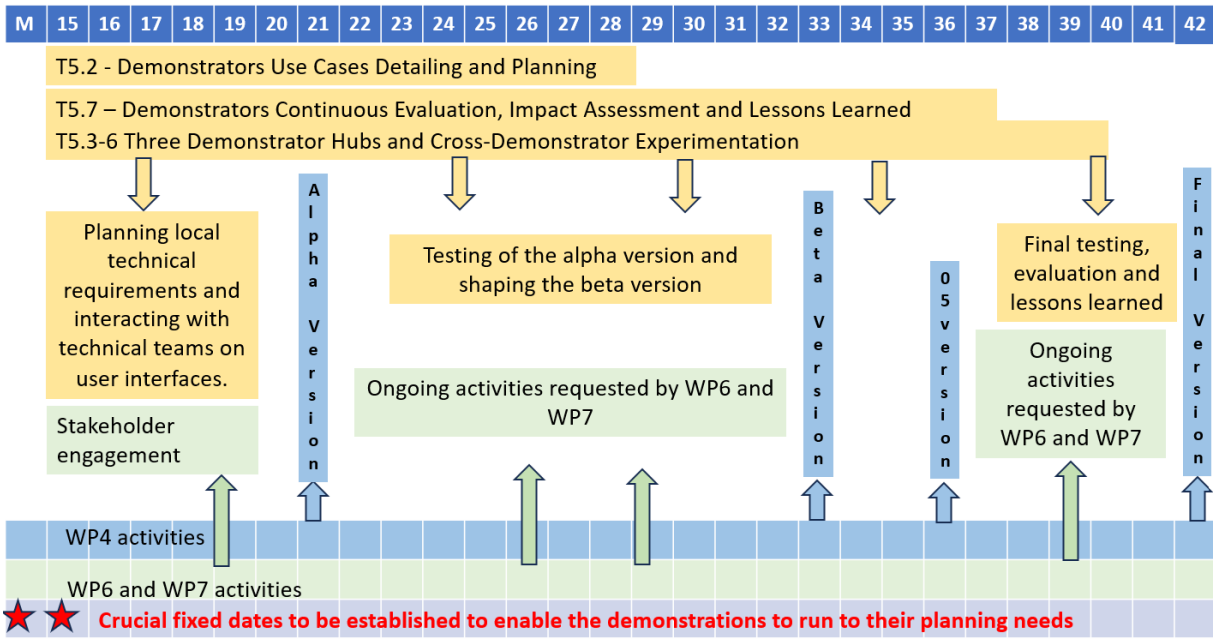

Figure 13: Demonstration High Level Execution Plan with needs from other WPs.

7.3 PISTIS ARCHITECTURE: WHAT WE WILL BE IMPLEMENTING AND EVALUATING

The architecture of PISTIS follows a federated infrastructure approach, divided into two core blocks: the PISTIS Data Space Factory Environment and the PISTIS Data Trading & Value Exchange/Monetisation platform.

The **Data Space Factory Environment** is a crucial component of the PISTIS platform. It is deployed on the premises or on private infrastructure owned by supply-side stakeholders. It is responsible for data transformation, enrichment, and execution of data sharing transactions by communicating directly with other transaction parties.

The Data Space Factory Environment is divided into four bundles:

1. Data Ingestion and Transformation bundle
2. Data Security and Trust bundle
3. Data Exchange Preparation bundle
4. Data Peer-to-Peer Transfer Gateway bundle

Overall, the Data Space Factory Environment forms the core of sensitive data operations within the PISTIS ecosystem. It empowers stakeholders to improve data quality, ensure security and privacy, prepare data for exchange, and facilitate peer-to-peer transactions while maintaining the flexibility to integrate with existing services.

The **Data Market Exchange environment** is a cloud-based system that governs and orchestrates operations related to data monetization and data market exchange that need to be propagated to the Data Space Factory environments. It acts as a central intelligence hub and access point for the demand side, storing metadata rather than actual data to ensure secure and trusted data sharing.

The environment consists of the following components:

- PISTIS Data Explorer
- Monetisation Explainable Artificial Intelligence (XAI) Engine
- Data Value Contract Composer
- PISTIS Data Exchange Market
- Data Exchange Governance
- PISTIS Identity Manager
- Data Models and Platform Services Configurator

Overall, the Data Market Exchange environment serves as the central point of intelligence for the data market exchange and monetisation services. It stores metadata about the data assets, handles data discovery, and provides monetisation insights and recommendations within the PISTIS platform.

7.4 STAGES

The Pistis Demonstration and Evaluation Plan needs to take into account the following stages which the demonstration sites need to be suitably prepared for to ensure a successful demonstration and evaluation process.

These include in relation to **planning the roll-out of the demonstrators**:

- Performing an analysis in the pilot sites for defining available data assets and relevant interfaces for integration.
- Creating an accurate baseline to be used as a reference for the verification of the impact.
- Utilising the PISTIS verification & validation framework set out earlier in D5.1 and applying it in the context of the different demonstrators.
- Coordinating and realising the demonstration/ validation of the PISTIS platform in the project's demonstrators.
- Assessing the project impact, user acceptance and engagement in data sharing, cost-efficiency and viability of new business models.
- Issuing the lessons learned as part of the overall impact assessment.

With regard to the simultaneous **planning for the evaluation procedures** and for the subsequent reporting of these activities, the core questions which we will be raising will fall into the following categories, which are also reflected in the Appendix 1 to D5.1- "Scoping the Evaluation Questions".

These categories are:

- In relation to the legal and ethical issues facing PISTIS
- In relation to the Business Model.
- In relation to the creation of the "product"
- In relation to the overall communication with stakeholders
- In relation to the technical trials
- In relation to the demonstration activity

- Those at a higher strategic level
- And finally, those linked to the non-functional requirements

7.5 DATA LANDSCAPE

The beating heart of the project is the data being utilised in WP5. The following chapters covering all the eleven use cases focus on the data requirements. For each use-case this information has been captured in tables derived from the work in WP1 – from D1.1 and D1.2. To make progress, it is essential to know what types of data required, who is the Data provider supplying the data and who is the Data Consumer using the data and in what format it is-and indeed, whether the required data is available or not. It is essential to know this in order to plan the demonstration activity and hence to establish measures for evaluating this process.

All these data requirements are set out in tables for each use-case in the following chapters.

7.6 BUSINESS ANALYSIS & USE CASES FOR DEMONSTRATION HUBS

The three demonstration hubs will demonstrate the practicality of the PISTIS solution, both vertically within the individual hubs as well as in cross-domain and cross sector scenarios, enhanced by collaboration with the three "support hubs" covering Open Data, Weather Data and that created by a Living Lab.

To assess the degree to which the proposed framework can be successfully introduced to the different data spaces, PISTIS will undergo real-life testing and validation in these demonstration hubs, with their combined total of eleven use-cases.

As well as analysing the detailed activity required for a successful demonstration for each of the three hubs with their range of specific use-cases, it is worthwhile taking an overview of some aspects which are common to all the eleven use cases.

These include technical aspects, legal and ethical issues, the monetisation and the valuation processes etc.

8 HUB#1 - MOBILITY AND URBAN PLANNING ECOSYSTEM

Demonstrator Hub #1 focuses on facilitating data trading and sharing amongst stakeholders in aviation, public transport, and public administration, who are key actors in a value chain that can be built around mobility and urban planning data, augmented with data from the "support hubs" and elsewhere.

In this demonstrator, such actors (most of them operating in the same geographic region – i.e. Athens, Greece) are already collaborating, however not in the frame of an integrated value chain whose exploitation can lead to significant benefits for all, and generate new revenue streams, both within the value chain, **but also with external actors that can consume insights.**

More specifically, the demonstrator includes AIA (Athens International Airport), GOLDAIR (Ground Handling Service Provider), OASA (Athens Public Transportation System, including bus and metro lines) and DAEM (City of Athens IT company), that act as data consumers and/or providers depending on the use case.

Data coming from OAG **(aviation data marketplace**), as well as **weather data** from UBIMET, that act as data brokers, **will be also leveraged.**

Demonstrator Hub #1 has five use cases which are set out below.

8.1 USE CASE #1.1. BAGGAGE HANDLING MANAGEMENT.

Ground handlers receive baggage-related timestamps from the airport that enable proper baggage management and make it possible for the early identification of irregularities in the baggage delivery process to the passengers. Post-operation analysis of such data is very important to investigate further incidents or non-optimal performance of the baggage delivery process.

The airport would benefit from information regarding the baggage loading and unloading process from the handler, the status, the number, and the availability of the ground support equipment (GSE), the scheduling and availability of the required personnel for baggage management processes.

Information from the handler's staffing and rostering system, the daily flight schedule on a time horizon of six months, and weather predictions can be combined to produce the probability that the flights will be serviced with no delays. Also, the data can be combined with flight updates/changes in real time and signify the latest and most updated status and the probability of achieving the designated aircraft turnaround and flight departure times.

8.1.1 **Ambition of use-case**

To **improve operational performance** of baggage handling, reduce irregularities in the process and predict the probability of flights delays due to baggage handling. Efficient baggage handling reduces the risk of delays and coordination between the airport and ground handling would help mitigate operational anomalies.

8.1.2 Challenges Faced

The **problem** being faced is the lack of exchange of operational information across airport stakeholders which slows down the baggage management process, with potential delays as a cascading effect.

PISTIS will provide a method for standardised communication and effortless exchange of data between stakeholders, in particular the Airport and the Ground Handler who are the main actors, but with additional data coming from other providers of information, within agreed key performance indicators (KPI) and Service Level Agreements (SLA).

In summary, the current constraining factors include isolated data spaces; non interoperable data; low trust in data sharing; no monetisation schemes; and traditional data sharing using proprietary methods and low visibility of data to all the stakeholders in the value chain.

8.1.3 Target Audience Descriptions

The actors in UC1.1 are the Greek cluster partners of PISTIS, namely AIA, Goldair that collaborate for the preparation and implementation of Hub 1 demonstrator. The actors can be identified as data owners (AIA) and seekers (Goldair), and they are divided as internal (the PISTIS partners) and external - from other stakeholders, bodies and organizations such as other Ground Handling Companies operating in Athens Airport or state authorities.

8.1.3.1 Data Owners

Internal

The main data owner is AIA since it will provide and exchange data sets to the PISTIS platform for the UC1.1 implementation. Other data owners may be OAG, UBIMET, OASA.

External

No additional external data owners are foreseen for this UC.

8.1.3.2 Data Seekers[28]

Internal

The Internal data seeker is Goldair since they will be the main PISTIS partner consuming the data. With the data acquisition they will enhance their operational effectiveness in the Airport premises. Data will be used by Goldair to proactively solve operational issues, to efficiently plan equipment and staff allocation, to better understand seasonal trends and to analyse historical performance.

External

External data seekers may be other Ground Handling companies operating in Athens Airport or any state authorities that may have an interest in baggage data.

[28] Definitions of a Data Seeker etc. which need to be more precise when considered in a legal context or in designing software, can be much more colloquially used in these early descriptions of the demonstrators. This enables us also to divide some of these “fixed” categories into useful sub-divisions, for our initial understanding of what will be required. Here we regard “internal” as being part of the demonstration partnership.

Such data seekers may be: Swissport Handling, Skyserv Handling, the Customs service, the Police and the Hellenic Civil Aviation Authority (HCAA).

8.1.3.3 Means to reach external Data Seekers.

The aforementioned stakeholders are foreseen to be contacted initially through an invitation for an initial online meeting in order to be introduced to PISTIS, its tools and objectives. Then the aim of this UC and the benefits for each stakeholder will be communicated to them in order to highlight the added value. Thus, as soon as the technical developments of the PISTIS tools will be at a version that has been tested and used by the internal PISTIS network and can be disseminated and used by external data seekers of Athens, the above action points will be followed.

8.1.4 Analytics capacity

Data collected from UC1.1 will be used and analysed:

- To improve day to day operations: By sharing real time baggage data to ground handlers, will help to speed up all the processes related to baggage handling, aircraft loading and resource allocation. Data will provide all necessary counters, baggage positions and relative time stamps needed by several units like Ramp handling, Station Control, Lost & Found and others.
- For historical analysis: Historical analysis of the data will help ground handling to utilise resource allocation, manpower staffing, provide baggage trends and support several KPI's.

8.1.5 Actions of Buyers of Data

- Data Exploration
- Data Navigation/Querying
- Data Matchmaking Services
- Data Contract Preparation
- Contract Drafting
- Contract Notification
- Data Acquisition
- Data Transfer
- Data Decryption

8.1.6 Actions of the Data Spaces owners-the sellers of data

- Data Ingestion, Transformation and Treatment.
- Data Check-In: the collection of data from the PISTIS system through various options (e.g., APIs, Pub/Sub, etc.).
- Data Enrichment: the cleaning of data from errors and/or inconsistencies and the matching of ingested data to a common model for interoperability purposes.
- Analytics/Insights Engine: the application of some ready-made analytics on the data, to extract some information.
- Data Lineage Tracking: the application of tracking tags on the data for allowing tracking of the subsequent actions.

- GDPR Checker: the evaluation of whether the data contains GDPR relevant information and the suggestion to strip (if wanted) such information from the dataset (or to change it if needed) prior to exchanging it with other stakeholders.
- Data Anonymisation: Application of anonymization techniques.
- Data Quality Assessment: The assessment of the data for extracting indexes that can describe the quality in different dimensions.
- Data Storage: The storage already treated data back to the original data storage facilities, keeping “pointers” at the PISTIS facility.
- Data Publication Preparation.
- Access Policies Definition: Mechanisms for the application of policies for the access level on stored data of PISTIS system.
- Data and Metadata Publication: The publishing of metadata of the treated datasets in the federated PISTIS repositories for the allowing their querying and the publication of a small set of Data online to be displayed to interested stakeholders.

8.1.7 Other actions of Data Spaces owners

- Transactions Monitoring (in case transactions are available).
- Auditing of Transactions: An interface where a user can have a log of his transactions.
- Auditing of On/Off Platform Usage: An interface where the user can witness how the data he has traded is used.

8.1.8 Data Landscape for Baggage Handling management

Data Type	Data Provider	Internal/ External	Data Consumer	Data Availability	Data Format	Plan for accessing Data if not available	Risk level/ Amelioration strategy
Historic Traffic Data	OAG	External	AIA, GOLDAIR	Available (on a route-by-route level, not flight level)	CSV file	not/applicable	not/applicable
Arriving/Transfer/Departing timestamps	AIA, GOLDAIR[29]	Internal	AIA, GOLDAIR	Available	.txt/.csv	n/a	n/a
Minimum Connecting Times for Transfer Bags	GOLDAIR	Internal	AIA	Available	.xlsx	n/a	n/a
Flight Schedule and day of operation updates (Delays, Scheduled/ Estimated/ Actual Flight Timings)	AIA, GOLDAIR	Internal	AIA, GOLDAIR	Available	.xml	n/a	n/a
Force majeure and operational irregularities	AIA	Internal	AIA, GOLDAIR	Available	.txt	n/a	n/a
Weather data (adverse weather conditions)	UBIMET	Internal	AIA, GOLDAIR	Available	.csv, GeoTIFF	n/a	n/a
Public Transport Scheduling data (staff arrival issues)	OASA	Internal	AIA	Available	GTFS data, .txt, .csv	n/a	n/a

Table 10: Data Landscape: Baggage Handling Management

[29] On the same type of data, different partners may produce different quality of this data, therefore these partners can be both providers and consumers (e.g., AIA and GOLDAIR regarding the Arriving/Transfer/Departing timestamps data)

8.1.9 Summary of actions within use-case #1.1

Before interacting with the PISTIS platform:

- All actors within this use case are involved in the definition of relevant data contracts, details, terms of use, pricing policies etc and need to agree on conditions for data sharing.
- AIA & OAG examine relevant registry available data sources and identify the data that will be needed to support Goldstar, whilst defining licensing and policies to use the data.
- The data providers will engage in Data Quality assessment, transformation & analytics activities.

The first stage of interaction with the PISTIS platform following the decision to share data (entire dataset or preliminarily a sample, as deemed necessary) through PISTIS will be to provide the following data:

- Arrival/Transfer/Departing Bag timestamps (AIA BHS system) data.
- Minimum connecting times data. (AIA & Goldair).
- Flight schedule and day of operations updates data. (AIA).
- Force majeure and operational irregularities data. (AIA).
- Public Transport Scheduling Data. (OASA).
- Transmission of weather data through PISTIS. (UBIMET).

The second stage relates to the output retrieved from PISTIS with the checking of example data for data format, data characteristics, compliance with requirements and standards, match with user needs, etc. by Goldair and AIA and their subsequent retrieval of data.

The next step is for Goldair and AIA to retrieve the output from PISTIS, checking example data for data format, data characteristics, compliance with requirements and standards, its match with user needs, etc. and subsequently to receive the data.

The fourth stage is the Data quality assessment and generation of new analytics (through PISTIS or offline), and this includes:

- Data quality assessment, data decryption and - if necessary – preprocessing.
- Analysis and combination of traffic data to derive predictive analytics and optimise baggage transfers.
- Analysis and combination of traffic and weather data to compute predictive analytics of potential delays.
- Data providers monitoring that data is correctly transferred and that it is used as agreed in the licences.
- And the new analytics are made available through PISTIS if requested.

And finally, after the interaction with PISTIS:

- Fine tuning the data usage, evaluating the business value of the data received, and identifying additional data to increase this business value.
- Developing algorithms and business logic that will use the input to provide useful and exploitable results, feeding internal systems with data.

- Improving internal processes and exploring data sharing with third parties.

8.2 USE CASE #1.2: TRANSFER PASSENGER MANAGEMENT.

The impact of delayed transfer passengers who transit at the Athens International Airport (AIA) will be investigated. Information on the number of passengers' transfers at AIA and on the delay of arriving flights is useful for departing flights which are waiting for transfer passengers, to calculate the impact of such delay on their schedules.

Sharing information on scheduled and actual transfer passengers between airlines, ground handlers and the airport could also help the optimal allocation of aircraft stands to specific flights to minimise passengers' connection times between arriving and departing aircrafts.

8.2.1 Ambition of use-case

The goal for this use case is to optimise allocation of aircraft stands for specific flights and minimise passengers' connection times.

8.2.2 Challenges Faced

The problem faced is that the delayed transfer passengers have an impact on the overall airport operations and on the respective stakeholders (airline, ground handler) performance.

Assistance from PISTIS takes the form of providing real-time data to enable better staff allocation and process improvement and to improve passenger experience.

8.2.3 Target Audience Descriptions

The actors in UC1.2 are the Greek cluster partners of PISTIS, namely AIA and Goldair that collaborate for the preparation and implementation of Hub 1 demonstrators. The actors can be identified as data owners (AIA) and data seekers (Goldair), and they are divided as internal (the PISTIS partners) and external from other stakeholders, bodies and organisations such as other Ground Handling Companies operating in Athens Airport or the state authorities

8.2.3.1 Data Owners

Internal

The main internal data owner is AIA since will provide and exchange data sets to the PISTIS platform for the UC1.2 implementation. Other data owners may be OAG and UBIMET.

External

No other external data owners are foreseen for this UC.

8.2.3.2 Data Seekers

Internal

The internal data seeker is Goldair since they will be the main PISTIS partner consuming the data. With the data acquisition they will enhance their operational effectiveness in the Airport premises.

External

External data seekers may be other Ground Handling companies or airline operators operating in Athens Airport or any state authorities that may have an interest on transfer passenger data.

Such data seekers may be: Swissport Handling, Skyserv Handling, Customs, the Police and HCAA.

8.2.4 Analytics capacity

The data collected for UC#2.2 will be used and analysed for two main reasons.

Firstly, current and future (hours ahead) information of stand allocation will allow the ground handler to have a constantly updated and up-to-date picture of the operational circumstances. This will allow for better decision making in terms of resource allocation. Secondly, historical analysis of the data will allow the discovery of trends and the creation of future forecasts. This will allow us to anticipate and prepare possible problems and proactively amend them. Furthermore, the analysis of passenger volumes transferring to and from Athens International Airport should be explored. The passenger volumes could be used to promote better stand allocation, in order to improve passenger experience. Lastly, transfer passenger data might be used by other consortium members like DAEM, to recognise tourism trends with arriving and departing passengers to Athen's airport.

8.2.5 Actions of Buyers of Data and of the Data Spaces owners

For this hub, all five use-cases need to carry out similar actions to each other and these are set out in sections 8.1.5 to 8.1.7 and are relevant to all use cases.

8.2.6 Data Landscape: Transfer Passengers Management

Data Type	Data Provider	Internal/ External	Data Consumer	Data Availability	Data Format	Plan for accessing Data if not available	Risk level/ Amelioration strategy
Flight status	OAG	Internal	AIA	Available	API	not/applicable	not/applicable
Handler processes data stamps	GOLDAIR	Internal	AIA, GOLDAIR	Available	.xml	n/a	n/a
Arrival/Transfer/Departing Bag Number	AIA	Internal	AIA, GOLDAIR	Available	.txt/.csv	n/a	n/a
Transfer passenger numbers and destinations	GOLDAIR	Internal	AIA, GOLDAIR	Available	.xml	n/a	n/a
PTM Messages	GOLDAIR	Internal	AIA	Available	.txt/.ftp	n/a	n/a
Transfer Baggage information	GOLDAIR, AIA	Internal	AIA	Available		n/a	n/a
Type of connections	AIA	Internal	AIA, GOLDAIR	Available	txt/.csv	n/a	n/a
PRM Passengers	AIA	Internal	AIA, GOLDAIR	Available	.xml	n/a	n/a
Minimum Connecting Times	AIA	Internal	AIA, GOLDAIR	Available	.xlsx	n/a	n/a

Flight Schedule and day of operation updates	GOLDAIR, AIA	Internal	AIA	Available	.xml	n/a	n/a
Force majeure and operational irregularities	AIA	Internal	AIA, GOLDAIR	Available	.txt	n/a	n/a
Weather data	UBIMET	Internal	AIA	Available	.csv, GeoTIFF	n/a	n/a

Table 11: Data Landscape: Transfer Passengers Management

8.2.7 Summary of actions within use-case #1.2

Before interacting with the PISTIS platform:

- Define relevant data contracts, details, terms of use, pricing policies.
- Examining relevant registry available data sources and identifying the data that will be needed.
- Agreement on conditions for data sharing.
- Data quality assessment, transformation & analytics.
- Define licensing and policies to use the data.

Step 1 - Input provided to PISTIS:

- Decision to share data (entire dataset or preliminarily a sample, as deemed necessary) through PISTIS.
- Flight status data, handler data-stamps, arrival/departure/transfer Bag number.
- Transfer passenger number and destination, Passenger Transfer Message (PTM), type of connection.
- Passengers with disabilities and reduced mobility (PRM), Immigration – Customs Clearance numbers and waiting times.
- Minimum connecting times data.
- Flight schedule and day of operations updates data.
- Weather data.

Step 2 - Output retrieved from PISTIS:

- Check example data for data format, data characteristics, compliance with requirements and standards, match with user needs, etc.
- Retrieve data.

Step 3 - Data quality assessment and generation of new analytics (through PISTIS or offline):

- Data quality assessment, data decryption and - if necessary – preprocessing.
- Analysis and combination of traffic data, minimum transfer data, Customs Clearance processing times, etc. to derive predictive analytics and optimise passenger transfers.
- Analysis and combination of traffic data, minimum transfer data, Customs Clearance processing times, and weather data to compute predictive analytics of potential delays.
- Data providers monitor that data is correctly transferred and that it is used as agreed in the licences.
- The new analytics are made available through PISTIS if requested.

Step 4 - After the interaction with PISTIS:

- Fine tuning data usage, evaluate the businesses value of the data received, identify additional data to increase business value.
- Develop algorithms and business logic that will use the input to provide useful and exploitable results, feeding internal systems with data.
- Improving internal processes, Exploring data sharing with third parties.

8.3 USE CASE #1.3: AIRCRAFT TURNAROUND PROCESS.

Information about the Target Off Block Time (TOBT) and the turnaround times for the aircraft's servicing and the underlying processes, such as catering, fuelling, cleaning etc. is very important for it to be exchanged between the involved stakeholders. Additionally, information on the aircraft turnaround process enables us to estimate whether the daily schedule will be performed as planned. It is very important for the airport to know as soon as possible any issues regarding the turnaround of the aircraft and to exchange real-time information with the handlers and airlines regarding issues or incidents in a secure manner. The sooner the airport or handler become aware of any irregularities, the shorter the reaction time for mitigation measures will be, thus minimising impact.

8.3.1 Ambition of use-case

The **ambition** for this use-case is to Optimise processes to achieve an increasingly efficient turnaround process and avoid delays compared to target off-block time.

8.3.2 Challenges Faced

The **problem** faced is that currently there is limited shared information between the airport and ground-handling stakeholders, including that about weather. This might result in an inefficient process for aircraft servicing, with potential delays compared to TOBT and thus consequences for the regularity of the flight.

The **PISTIS role** is to provide a platform for the exchange of real-time data that enables better coordination during the aircraft turnaround process.

8.3.3 Target Audience Descriptions

The actors in UC1.3 are the Greek cluster partners of PISTIS, namely AIA and Goldair that collaborate for the preparation and implementation of the Hub #1 demonstrator. The actors can be identified as data owners (AIA) and seekers (Goldair), and they are divided as internal (the PISTIS partners) and external- those from other stakeholders, bodies and organisations such as other Ground Handling Companies operating in Athens Airport or State authorities.

8.3.3.1 Data Owners

The internal main data owner is AIA since it will provide and exchange data sets to the PISTIS platform for the UC1.3 implementation. Other data owners may be OAG and UBIMET.

External

No other external data owners are foreseen for this UC.

8.3.3.2 Data Seekers

Internal

The internal data seeker is Goldair since they will be the main PISTIS partner consuming the data. With the data acquisition they will enhance their operational effectiveness in the Airport premises.

External

External data seekers may be other Ground Handling companies or Aircraft Operators operating in Athens Airport or any state authorities that may have an interest for the turnaround process of the flight.

Such data seekers may be: Swissport Handling, Skyserv Handling, ATC, Aircraft Operators Network Operations.

8.3.4 Analytics capacity

Turnaround data include mostly timestamps and numeric values. They represent the airline, aircraft type, scheduled/estimated/actual times for arriving and departing sectors, stands, delay codes that might have been used and more. The main goal of analytics on this dataset is to understand and predict aircraft delays. To achieve this, a thorough analysis of the provided dataset must be performed.

As with the UC1.2, also with UC1.3, the turnaround data will be used and analysed for two main reasons. Firstly, current information will allow the ground handler to have a constantly updated, up-to-date picture of the operational circumstances. This will allow for better decision making in terms of resource allocation. Secondly, historical analysis of the data will allow us to discover trends and create future forecasts. This will allow us to anticipate and prepare for possible problems and to proactively amend them.

8.3.5 Actions of Buyers of Data and of the Data Spaces owners

For this hub, all five use-cases need to carry out similar actions to each other and these are set out in sections 8.1.5 to 8.1.7 and are relevant to all use cases.

8.3.6 Data Landscape: Aircraft turnaround process

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Data Type	Data Provider	Internal/ External	Data Consumer	Data Availability	Data Format	Plan for accessing Data if not available	Risk level/ Amelioration strategy
Flight schedules	GOLDAIR	Internal	AIA, GOLDAIR	Available	.xml	not/applicable	not/applicable
Flight Delay data	GOLDAIR	Internal	AIA, GOLDAIR	Available	.xml	n/a	n/a
Aircraft Stand allocation data	GOLDAIR	Internal	AIA, GOLDAIR	Available	.xml	n/a	n/a
Aircraft Stand usage	AIA	Internal	AIA, GOLDAIR	Available	.xml	n/a	n/a
Load factor data	GOLDAIR	Internal	AIA, GOLDAIR	Available	.xml	n/a	n/a
Type of Aircraft	OAG	Internal	AIA	Available	API	n/a	n/a
Ground times (major EU hubs)	OAG	Internal	AIA, GOLDAIR	Available?	API	n/a	n/a
Weather	UBIMET	Internal	AIA, GOLDAIR	Available	.csv, GeoTIFF	n/a	n/a
Passengers' numbers	GOLDAIR	Internal	AIA, GOLDAIR	Available	.XML	n/a	n/a
Force majeure and operational irregularities	AIA	Internal	AIA, GOLDAIR	Available	.txt	n/a	n/a

Table 12 :Data Landscape: Aircraft turnaround process

8.3.7 Summary of actions for Use-Case #1.3: Aircraft Turnaround Process.

Before interacting with the PISTIS platform:

- Define relevant data contracts, details, terms of use, pricing policies.
- Examining relevant registry available data sources and identifying the data that will be needed.
- Agreement on conditions for data sharing.
- Data quality assessment, transformation & analytics.
- Define licensing and policies to use the data.

Step 1 - Input provided to PISTIS:

The first stage of interaction with the PISTIS platform following the decision to share data (an entire dataset or preliminarily a sample, as deemed necessary) through PISTIS will be to provide the following data.

- Flight status data, handler data-stamps, arrival/departure/transfer Bag number.
- Transfer passenger number and destination, PTM Message, type of connection.
- Passengers with disabilities and reduced mobility (PRM), Immigration – Customs Clearance numbers and waiting times.
- Minimum connecting times data.
- Flight schedule and day of operations updates data.
- Weather data.

Step 2 - Output retrieved from PISTIS:

- Check example data for data format, data characteristics, compliance with requirements and standards, match with user needs, etc.
- Retrieve data.

Step 3 - Data quality assessment and generation of new analytics (through PISTIS or offline):

- Data quality assessment, data decryption and - if necessary – preprocessing.
- Analysis and combination of traffic data, minimum transfer data, Customs Clearance processing times, etc. to derive predictive analytics and optimise passenger transfers.
- Data providers monitor that the data is correctly transferred and that it is used as agreed in the licences.
- The new analytics are made available through PISTIS if requested.

Step 4 - After the interaction with PISTIS:

- Fine tuning data usage, evaluate the business value of the data received, identify additional data to increase business value.
- Develop algorithms and business logic that will use the input to provide useful and exploitable results, feeding internal systems with data.
- Improving internal processes, Exploring data sharing with third parties.

8.4 USE CASE #1.4: PUBLIC TRANSPORTATION PLANNING SUPPORT.

Data exchange between the airport and the municipality can help improve the overall planning of public transport, allowing the development of services that are able to predict the accuracy of the load within the day to improve route scheduling, deployment of vehicles and efficient the utilisation of its fleet, thus offering to commuters better services and lowering operational costs.

The outputs of the analysis might also be traded back to parties such as the airport and the city, for the latter to be able to improve their own offer and services towards the commuters, or to relevant third parties (e.g., duty-free shops, local city businesses, etc.). This can be achieved by combining data for incoming passenger traffic to the airport from public transport (e.g., bus occupancy), data from the airport service handler (e.g., expected queuing, check-in counters availability, security checkpoint staffing), and information such as airport routing, flight, and weather information, etc.

8.4.1 Ambition of use-case

The **aim** of this use case is to design a better service for passengers from and to the airport and the optimisation of the public transport service for the airport.

The scope of the use case includes the combined analysis of the number of inbound/ outbound passengers of Athens International Airport (AIA) with ticketing data (i.e. card and ticket validations) from the public transport system for specific time periods within the day and within the year. The objective is to explore the actual usage of the different public transport modes servicing the airport (metro and buses) in connection with air passengers arriving at/ leaving from AIA and provide insights that will enable the Athens Urban Transport Organisation (OASA) to proceed to make improvements to the public transport schedules in the services offered, if and when necessary.

On top of that, the use case will try to set up a process to enable the live data sharing on road traffic conditions (kerbside), between AIA and OASA. This is to facilitate the OASA driver to make an informed decision on the route to follow so as not to get stuck in traffic and be delayed. The existing data coming from the access control system at the kerbside needs to be further processed so as to provide a meaningful piece of information that is worth sharing.

8.4.2 Challenges Faced

The **problem** faced is that there is a need for better scheduling of public transport routes, the deployment of vehicles and the optimisation of fleet utilisation, to meet the need for improved commuter services, especially during peak season, and the reduction of operational costs.

Furthermore, the timely sharing of live information results in tangible benefits at both ends (minimising delays in the service provided, avoidance of further congestion at the kerbside etc.) and paves the way for a number of new applications aiming to raise customer service.

The **role for PISTIS** is to facilitate data trading and sharing between various sources such as the Athens International Airport (AIA) and the City of Athens (DAEM) to improve the overall planning of the transportation of OASA, allowing the development of services that are able to

predict the accuracy of the load during the day, in order to better schedule routes, deploy vehicles and maximise the utilisation of its fleet, offering to commuters better services and lowering operational costs.

8.4.3 Target Audience Descriptions

Athens Urban Transport Organisation (OASA), Athens International Airport (AIA) and the City of Athens (DAEM) are the core actors involved in Use Case 1.4. In the public transportation planning support process, OASA acts both as a data seeker and a data owner. As data seeker, OASA will utilise the input data provided by the other actors with the aim of refining its services, whereas as data owner, the organisation will trade back data to the rest of the actors in order for the latter to improve their own services and offerings. The same applies to AIA who acts as a data owner, mainly feeding the PISTIS platform with the relevant data to be utilised by OASA and as a data seeker receiving data from the Public Transport Authority. DAEM in Use Case 1.4 mainly acts as a data seeker, whereas UBIMET acts as a data owner.

8.4.3.1 Data Owners

Internal

OASA can provide access to data containing the public transport scheduled service for bus and metro, capacity of buses servicing routes to/from the airport, card and ticket validations, transport modal split and bus geolocation information on bus arrivals/ departures for all bus routes.

AIA can provide access to data containing historic information on flight schedules, airport modal share, inbound/outbound passengers per hour, transport modal split, passenger numbers and provisional loads.

UBIMET can provide access to current weather data as well as to historical weather data.

External

For achieving the main purposes of Use Case 1.4, the immediate need for external data owners was not identified.

8.4.3.2 Data Seekers

Internal

OASA is the core data seeker in this particular use case since the input from data owners, mainly the datasets provided by AIA, will support the improvement of its service. AIA and DAEM also act as data seekers receiving data from OASA that might enable them to improve their own services and offerings to third parties.

External

An entity that might be interested in getting access to the data exchanged in Use Case 1.4 is Hellenic Trains, a private company, which runs the Suburban Railway Line in greater Athens Area connecting Athens International Airport with the port of Piraeus.

8.4.4 Analytics capacity etc

Both organisations (OASA, AIA) possess the ability to effectively leverage data analytics methods to derive meaningful insights and implement those in the decision-making process in order to drive business value. If needed ICCS will assist in data analysis and data modelling, given its expertise in intelligent transport systems

8.4.5 Actions of Buyers of Data

Buyers' actions can include:

- Data exploration by browsing the PISTIS platform in order to recognise types of data that meet the buyer's needs.
- Data evaluation by listing data specifications, review of quality indicators and accompanying metadata.
- Purchase decision on whether the dataset aligns with buyer's requirements or not.
- Monetary value transaction.
- Contract drafting.
- Integration into the buyer's system for further analysis and use.

8.4.6 Actions of the Data Spaces owners-the sellers of data

Sellers actions can include:

- Listing and describing their datasets, providing details such as data source, format and source information.
- Setting pricing strategy involving either setting a fixed price or a subscription price.
- Contract drafting.
- Responding to potential inquiries.

8.4.7 Other actions of Data Spaces owners

For the time being no other actions have been identified. Nevertheless, after the PISTIS alpha version release this list can be populated.

8.4.8 Data Landscape: Public Transportation Planning

Data Type	Data Provider	Internal/ External	Data Consumer	Data Availability	Data Format	Plan for accessing Data if not available	Risk level/ Amelioration strategy
Public transport schedules (Bus/ Metro)	OASA	Internal	AIA, DAEM	Available	GTFS data	not/applicable	0
Card and ticket validation data	OASA	Internal	AIA, DAEM	Available	.txt data files	n/a	0
Transport Demand (Origin-Destination matrices	OASA	Internal	AIA, DAEM	Available	.xls, .csv	n/a	0
Geolocation dataset on all bus routes and bus arrivals/ departures (currently available for the previous day)	OASA	Internal	AIA, DAEM	Available	.txt data files	n/a	0
Historic data (e.g. flight schedules, gate/terminal usage)	AIA	Internal	OASA	Available	IATA standards, excel, text, API	n/a	0
Airport modal share	AIA	Internal	OASA, DAEM	Available	IATA standards, excel, text, API	n/a	0

Weather	UBIMET	Internal	OASA, AIA, DAEM	Available	.csv, GeoTIFF	n/a	0
Inbound/outbound passengers per hour	AIA	Internal	OASA, DAEM	Available	Open file format	n/a	0
Transport modal split	OASA, AIA	Internal	AIA, OASA, DAEM	Available	.xls data files	n/a	0
No. of Buses dedicated to the Airport routes	OASA	Internal	AIA, DAEM	Available	.xls data files	n/a	0
Capacity of Buses servicing routes to/ from the Airport	OASA	Internal	AIA, DAEM	Available	.xls data files	n/a	0
Bus Occupancy data for routes servicing the airport	OASA	Internal	AIA, DAEM	Available	.xls data files	n/a	0

Table 13: Data Landscape: Public Transportation Planning

8.4.9 Summary of actions for Use-Case #1.4: Public Transportation Planning Support.

Before interacting with the PISTIS platform:

- Define relevant data contracts, details, terms of use, pricing policies.
- Examining relevant registry available data sources and identifying the data that will be needed.
- Ensure that PISTIS use has interoperability with airport internal systems.
- Data anonymisation and removal of business sensitive information.
- Semantic enrichment of the data to make it searchable, also using keywords.
- Agreement on conditions for data sharing.
- Data quality assessment, transformation & analytics, licensing, and policies to use the data.

Step 1 - Input provided to PISTIS:

- Decision to share data (entire dataset or preliminarily a sample, as deemed necessary) through PISTIS.
- Public transport timetables (buses and metro) data.
- Public transport vehicle data and occupancy (static) data
- Metro station incoming / outgoing passengers' data and bus geolocation data (currently available for previous day).
- Historic data (e.g., flight schedules, gate/terminal usage), inbound/outbound passenger per hour.
- Timestamps, Aircraft load factors.
- Transport modal split.
- Weather.

Step 2 - Output retrieved from PISTIS:

- Check example data for data format, data characteristics, compliance with requirements and standards, match with user needs, etc.
- Retrieve data on public transport movements and occupancy.
- Receive data on expected visitors flows based on destination locality.

Step 3 - Data quality assessment and generation of new analytics (through PISTIS or offline):

- Data quality assessment, data decryption and - if necessary – preprocessing.
- Compute predictive analytics to optimise vehicle availability from/to the airport.
- Data providers monitor that data is correctly transferred and that it is used as agreed in the licences.
- Set up algorithms to receive specific data sets automatically on regular intervals (e.g., daily update of the datasets/operation plan).
- The new analytics / services are made available through PISTIS if requested.

Step 4 - After the interaction with PISTIS:

- Improve planning and decision making of public transport.

8.5 USE CASE #1.5: INSIGHTS FOR CITY COMMERCIAL BUSINESSES.

Added value services will be offered across specific areas of interest in the city of Athens based on the analysis and prediction of the load expected within the city, informing local businesses on how people are expected to move within the commercial zones of the city. The intention is to improve local entrepreneurship and boost businesses turnover, and to deliver services that can improve the mobility experience of the citizens and visitors of the city, which will lead to an optimisation of mobility services in specific areas (e.g. dynamic PT timetables, less queuing on touristic sites) and could help the Public Transport Operator to adapt in the longer term its routes and timetables with respect to touristic/heavy load destinations.

Data shall be traded with the stakeholders involved in the demonstrator, such as the airport and the transportation system data, combined with weather and other event data coming from within the municipality and other open sources (such as local events data, etc.)

8.5.1 Ambition of use-case

The **intention** is to enable data exchange between the airport, the public transport agencies and city to offer better services to citizens, to improve local entrepreneurship in Athens according to expected loads in specific areas and to leverage the mobility/touristic experience of the city according to foreseen mobility flows.

8.5.2 Challenges Faced

The **issue faced** is that the lack of exchange of (open) data between stakeholders affected by mobility at the airport and in different parts of the city prevents the development of added value services across specific areas of interest in the city and improvements to local entrepreneurship, mobility experience and mobility services.

The **role for PISTIS** is to facilitate access to data from the partners of the Greek cluster and other external data sources, e.g., potentially touristic sources, GIS data and businesses data.

8.5.3 Target Audience Descriptions

The actors in UC1.5 are the Greek cluster partners of PISTIS, namely AIA, OAG, OASA and DAEM that collaborate for the preparation and implementation of the Hub 1 Demonstrator. The actors can be identified as data owners and seekers, and they are divided as internal (the PISTIS partners) and external from other stakeholders, bodies and organisations.

8.5.3.1 Data Owners

Internal

Internal data owners are AIA, OASA, OAG and DAEM since they will provide and exchange data sets to the PISTIS platform for the UC implementation. The main partner however for this UC is DAEM.

External

Other external data owners that could enhance this UC are part of a large ecosystem. Below are mentioned some indicative organisations that are foreseen:

- The Municipality of Athens,

- Weather and environmental bodies that provide data on the weather conditions forecasts to leverage the UC apart from UBIMET, e.g. Meteo, the Hellenic National Meteorological Service etc.
- Other transport organisations operating in Athens apart from OASA, for example Ellinico Metro that operates the metro and tram lines, the Hellenic Railways Organisation that operates the trains etc.
- Private companies of taxis and taxis associations.
- Other public organisations with interest in the use-case e.g. the Region of Attica, the Ministry of Tourism, the Ministry of Infrastructure and Transport.
- Municipalities neighbouring to Athens or in the wider area of Attica with business and touristic interest e.g. the municipalities of Elefsina, Tavros-Moschato, Piraeus, Glyfada etc.
- Touristic, cultural and archaeological bodies such as museums, the National Garden of Athens, Athens Culture Net, the Acropolis Museum etc.
- Local business associations and unions of shops and professionals operating in the Athens area.

Means to reach external Data owners.

The aforementioned group of stakeholders can be reached through the network of contacts of the Hub partners. For example, DAEM is a company of the municipality of Athens and maintains contacts with bodies such as the National Garden, other municipalities etc. Also, portals of open data will be explored such as the data.gov.gr and gis.gov.gr etc. Finally, open calls for submission of open data sets can be published to interested parties.

8.5.3.2 Data Seekers

Internal

Internal data seekers are AIA, OASA, OAG and DAEM since all PISTIS partners will consume the data that will be produced and shared in this use-case to increase their services and exploit them according to the partner's profile and activities. However, DAEM will be the main actor in this use-case.

External

External data seekers are mainly organisations mentioned in the previous section of external data owners such as other municipalities, but additional organisations are envisioned in this group, mainly unions and associations that can consume the data from the PISTIS platform for their best interest. The latter can include informing their members, to design a service based on the data of Hub 1 etc.

Indicative data seekers are mentioned: HATTA (Hellenic Association of Tourist and Travel Agencies), HHF (Hellenic Hoteliers Federation), POESE (Hellenic Union of Restaurants and similar food businesses), SATA (Syndicate of taxi drivers of Attica), the Athens Museums and Cultural Institutions Network, associations of kiosk and market owners, other local entrepreneurs etc.

Means to reach external Data seekers.

The aforementioned stakeholders are foreseen to be contacted initially through an invitation for an initial online meeting in order to be introduced to PISTIS, its tools and objectives. Then the aim of this UC and the benefits for each stakeholder will be communicated in order to highlight the added value for the members of each association/union for them being part of the PISTIS ecosystem. Thus, as soon as the technical developments of the PISTIS tools will be at a version that has been tested and used by the internal PISTIS network and can be disseminated and used by external data seekers of Athens, the above action points will be followed.

8.5.4 Analytics capacity etc

The data collected for this use-case will be correlated whilst also exploiting any related results from the other UCs of the Hub. Then it will be analysed to extract the volume of visitors expected in specific area and commercial zones of Athens, combining also the type of businesses located there and the weather conditions. Additional analysis will include the expected load of luggage in specific areas and the availability of storage services as well as the expected visits to cultural and historical sites.

At a later stage the external data seeker, as mentioned above, will consume this data for other services in order to maximize the commercial profit for their members and enhance the customers' experience for both Athens visitors and the locals.

Data provided by DAEM, hence the City of Athens, are useful for the other Greek partners of the Hub to design and test more services as well as for other external bodies.

8.5.5 Actions of Buyers of Data and of the Data Spaces owners

For this hub, all five use-cases need to carry out similar actions to each other and these are set out in sections 8.1.5 to 8.1.7 and are relevant to all use cases.

8.5.6 Data Landscape: Insights for City Commercial Businesses

Data Type	Data Provider	Internal/ External	Data Consumer	Data Availability	Data Format	Plan for accessing Data if not available	Risk level/ Amelioration strategy
Timestamps, arriving to ATH and departing from ATH Passenger Data.	OAG	Internal	DAEM	Available	API	Not applicable	n/a
Mobility/touristic/business registry.	AIA, OASA	Internal	DAEM	Available	O-D matrices in .xls format for OASA Mobility data.	n/a	n/a
Number of expected visitors.	AIA	Internal	DAEM	Available	xls/csv	n/a	n/a
Destination of visitors.	AIA	Internal	DAEM	Available	xls/csv	n/a	n/a
Business registry GIS info on location, district, address, floor, postal codes, areas codes.	DAEM	Internal	DAEM	Available	xls/csv	n/a	n/a
Business registry - Type of business and admin changes.	DAEM	Internal	DAEM	Available	xls/csv	n/a	n/a
Municipality of Athens GIS data – districts, areas, postal codes.	Municipality of Athens	Internal	DAEM	Available	xls/csv	n/a	n/a

Departure and arrival bag data.	AIA	Internal	DAEM	Available	xls/csv	n/a	n/a
Public transport data on buses- timetables, passengers, routes.	OASA	Internal	DAEM	Available	xls/csv	n/a	n/a
Weather and environmental data and forecasts.	UBIMET	Internal	DAEM	Available	zip	n/a	n/a
Public transport data for metro, tram, railways.	Ellinico Metro, Hellenic Railways Organisation	External	DAEM	This information is not available yet.	This information is not available yet.	Contact the organisations and explore their interest in engaging and providing data.	3
Data for taxi fleets, load of passenger, destination/departure points.	Taxi associations & companies	External	DAEM	This is information is not available yet	This information is not available yet	As above.	3
Data on touristic flows, points of interest, locations for accommodation.	Region of Attica, Ministry of Tourism, neighbouring municipalities	External	DAEM	This information is not available yet	This information is not available yet	As above.	3
Number of visitors, analytics on visits (seasonal, hours of peak visits, demographics of visitors etc) from touristic, cultural and archaeological bodies.	Museums, National Garden of Athens, Athens Culture Net, Acropolis Museum	External	DAEM	This information is not available yet	This information is not available yet	As above.	3

Types of businesses, analytics on business activities within Athens.	Local business associations and unions	External	DAEM	This is information is not available yet	This information is not available yet.	As above.	3

Table 14: Data Landscape: Insights for City Commercial Businesses

8.5.7 Summary of actions for Use Case #1.5: Insights for city commercial businesses.

Before interacting with the PISTIS platform:

- Define relevant data contracts, details, terms of use, pricing policies.
- Data anonymisation and removal of business sensitive information.
- Semantic enrichment of the data to make it searchable, also using keywords.
- Anonymisation of the city businesses registry and provide it for export.
- Agreement on conditions for data sharing.
- Data quality assessment, transformation & analytics, licensing, and policies to use the data.

Step 1 - Input provided to PISTIS:

- Decision to share data (entire dataset or preliminarily a sample, as deemed necessary) through PISTIS.
- Timestamps.
- Mobility/touristic/business registry.
- Number of expected visitors.
- Destination of visitors.
- GIS info on location, district, address, floor.

Step 2 - Output retrieved from PISTIS:

- Check example data for data format, data characteristics, compliance with requirements and standards, match with user needs, etc.
- Receive data on expected visitors flows based on destination locality.

Step 3 - Data quality assessment and generation of new analytics (through PISTIS or offline):

- Data quality assessment, data decryption and - if necessary – preprocessing.
- Compute analytics to predict expected visitors flows based on destination locality.
- Data providers monitor that data is correctly transferred and that it is used as agreed in the licences.
- The new analytics / services are made available through PISTIS if requested.

Step 4 - After the interaction with PISTIS:

- Notify local businesses.
- Create an open public call for local businesses to participate, to provide feedback.

8.6 IMPACTS EXPECTED FOR THIS DEMONSTRATOR HUB

The impacts expected for this demonstrator hub based on the scenarios set out above include:

- A reduction in baggage delivery SLA violations.
- A reduction of flight delays.
- Improved accuracy of load predictions.

- Improved capacity handling for public transport.
- Greater satisfaction with bus services provided to the airport.
- Improvements to local businesses.

The measurement of the actual impacts will be provided in deliverable D5.3 and the process for evaluating this progress is set out in Chapter 18 of this document.

8.6.1 Impact for the Organisation

The Demonstrator Hub 1, as part of the PISTIS project, involves a collaboration between various Greek partners, including Athens International Airport (AIA), Goldair, OASA, DAEM, OAG, and UBIMET. The impact of the Demonstrator Hub 1 on these organisations can be expected to be multifaceted

8.6.2 Impact for the Data Owners

Athens International Airport (AIA)

- Data Management and Sharing: AIA could see improvements in its data management and sharing capabilities through integration with the PISTIS platform, which would enhance its operational efficiency.
- Operational Efficiency: Enhanced decision-making from better data utilisation could lead to more efficient airport operations, including baggage handling, transfer passenger management, and aircraft turnaround.
- Passenger Experience: Insights gained from the shared data could improve the passenger experience through smoother operations and reduced waiting times.

OASA (Athens Public Transportation System)

- Transportation Planning: OASA could benefit from better planning and optimisation of bus and metro services, better informed by airport data.
- Schedule Alignment: There could be improved alignment of public transport schedules with flight operations, enhancing the overall travel experience for passengers.
- Resource Allocation: Data-driven decision-making could lead to more efficient resource allocation and service improvements.

DAEM (City of Athens IT Company)

- Smart City Initiatives: DAEM could leverage the data and analytics capabilities of the PISTIS platform for smart city initiatives, enhancing municipal service delivery.
- Urban Planning: Integration with airport and transport data could contribute to better urban planning and infrastructure development.
- IT Infrastructure Advancement: The project could contribute to advancing the IT infrastructure for the City of Athens.

OAG (Aviation Data Marketplace)

- Data Value Enhancement: Participation in the PISTIS project could enhance the value and applicability of OAG's aviation data, leading to new business opportunities.
- Industry Insights: Sharing data within a trusted platform could provide new insights for stakeholders within the aviation industry.

UBIMET (Weather Data Provider)

- Decision-Making Processes: UBIMET could enhance decision-making related to airport operations and public transportation planning by sharing its weather data.
- Operational Disruptions: More efficient responses to weather-related disruptions could improve safety and reduce operational delays.

8.6.3 Impact for Collaborators (Data Seekers)

GOLDAIR (Ground Handling Service Provider)

- Ground Handling Operations: GOLDAIR may experience increased efficiency in its ground handling operations due to improved data acquisition from AIA and other partners.
- Service Delivery: The ability to provide better service to airline customers and passengers could be enhanced, leading to a competitive advantage.
- Cost Reduction: Access to real-time and comprehensive data could potentially reduce operational costs and delays.

8.6.4 Impact from cross-cutting hubs and Living Labs activities

Thanks to the environment created by PISTIS, we can gather information about the expected use of the platform by other Hubs. In this way, we can identify requirements and possibilities that were not initially considered. Furthermore, this can provide additional information when valuing the data.

Furthermore, this collaboration and application in the living labs optimize the development of various platform components, making visible those requirements that can be applied in different areas.

8.6.5 Impact towards wider exploitation goals

- **Data Sharing Culture**: The collaboration could foster a culture of data sharing and interoperability, contributing to a more integrated ecosystem for airport and urban operations.
- **Sustainable Operations**: There could be a move towards more sustainable operations due to the enhanced efficiency and resource utilization.
- **New Business Models**: The shared data and insights could lead to the development of new business models and opportunities.

9 DEMONSTRATION HUB #2 - ENERGY

The Energy Demonstrator hub will focus on ensuring the resilient operation of the distribution grid through the utilisation of the flexible capacity that can be offered by local prosumers and triggered by the aggregator (as the main actor involved in flexibility transactions and representing aggregated clusters of prosumers in energy markets), thus providing a real environment for validating the operational benefits of data sharing. Four Use Cases are foreseen.

9.1 USE CASE #2.1: INCREASE THE HOSTING CAPACITY OF THE GRID.

The demo case focuses on the effective resolution of distribution grid congestions, through innovative flexibility-based grid management mechanisms. Smart metering data provided by local prosumers, together with distributed generation data (photo-voltaic, PV) and SCADA (Supervisory control and data acquisition) information from the Distribution Service Operator (DSO) will be jointly analysed to extract accurate demand and generation forecasts (in the short and mid-term). Also to estimate anticipated events in the distribution grid thanks to the digital twins. The required flexibility to effectively address them will be procured by the Aggregator.

The increase in the Distributed energy resources (DERs) can cause problems to the grid because installations below 15kW can be connected without any licence and hence measures to ensure grid balance (also at infrastructural level) cannot be easily planned. Thanks to the data coordination, the DSO, working closely with the Market Operator (MO) and the aggregators, can anticipate and manage these problems, coming up with solutions related to the participation in global markets and the introduction of the DERs and aggregators in the short-term flexibility market, whilst empowering the DSO to limit some of the DERs to protect the grid. Hence, there is a need for data interchange between DSO, MO, DERs and Aggregator, resulting from the negotiation of these short new term flexibility products, and one of the biggest advantages is that this can be automated.

The data regarding anticipated events and flexibility requirements will be exchanged between the DSO (Distribution System Operator) and the Market Operator (MO), who will then formalise them. The aggregator will access this information to engage prosumers in the flexibility market.

The aggregator will, subsequently, get involved in data transactions with local prosumers to acquire their smart metering, smart devices, distributed generation, and local storage information and proceed to the analysis of the flexibility, the segmentation and classification of the different types of flexibility and to the optimal clustering of local flexibility sources and the formulation of dynamic Virtual Power Plants (VPPs) in order to address evolving distribution grid needs and requirements.

These will be shared with the MO in order to create the baseline against flexibility dispatch and activation will be validated and remunerated (with the use of prosumer data acquired and utilised by the MO, for settling all flexibility activation events). Once a flexibility dispatch event is launched, the aggregator will generate the appropriate control signals towards local

prosumers and assets to enable the provision of the available flexibility. With the ultimate target to deliver services to the DSO for the increase of network resilience and operational efficiency with the accompanying maximisation of RES integration, minimisation of power losses and resolution of local congestions.

9.1.1 Ambition of use-case

The **aim** of this case study is to Increase the hosting capacity of the grid by accommodating DERs smoothly, whilst also negotiating new short-term flexibility products.

Thanks to the short-term flexibility market, one-off events due to grid overload can be avoided by making the flexible elements work, so that during the rest of the time it is possible to accommodate more distributed generation in the grid, thanks to controllability.

9.1.2 Challenges Faced

The **problem** faced is that the distributed grid with multiple DER "prosumers" creates challenges for the energy offered to meet the demand. Coordination is necessary between DSO, aggregators, and MO, to enable technical and market mechanisms that prevent grid congestions and protect the grid.

It is **intended** that PISTIS will provide an environment where data, services, and analytics are exchanged between the DSO, the MO, the aggregators, and service providers about the static topological properties of the network and the dynamic use of energy (demand and offer), so that optimised technical and short-term flexible market mechanisms can be identified, in order to guarantee an efficient use and distribution of the resources across the network.

9.1.3 Target Audience Descriptions

In this Use Case, the participating actors include all those from the Energy Hub, where Omie is the market operator and provides a local flexibility market platform, Cuerva as the DSO, and Bamboo as the aggregator. In the case of Cartif, it will act as the developer providing the technology that in a real-world setting would be part of the DSO. Additionally, Cartif will also serve as an independent flexibility service provider, a role to which the aggregator turns to create the flexibility offering.

UBIMET will provide meteorological data to Cartif for the generation of consumption, generation, and network event prediction data.

9.1.3.1 Data Owners

Internal

Cuerva: Owner of the grid and metering data. In real conditions Cuerva are the owners of the data that define the event on the grid. In this project Cartif as tech provider will calculate this data, then send it to Cuerva, Therefore, Cuerva will post this data in the platform.

BAMBOO: Owner of the flexibility data from the aggregation process.

UBIMET: Owner of the climatological data.

External

No external data owners are detected for this Use Case.

9.1.3.2 Data Seekers

Internal

OMIE: Need the data of the requirements from the DSO and the energy bids sent by the aggregator.

BAMBOO: Need the result of the matchmaking to apply the process to deliver final flexibility.

External

CARTIF: Need the matchmaking between the requirement and the solution for the validation process.

9.1.4 Analytics capacity etc

In the case of the grid data, Cuerva will provide CARTIF with all the information needed in order to define the grid and all the historical consumption and generation data, with this CARTIF will create the forecasting of consumption and generation to detect the events on the grid. For this, combining with other data sources may be necessary (climate data).

9.1.5 Actions of Buyers of Data

- Data Exploration
- Data Navigation/Querying
- Data Matchmaking Services
- Data Contract Preparation
- Contract Drafting
- Contract Notification
- Data Acquisition
- Data Transfer

9.1.6 Actions of the Data Spaces owners-the sellers of data

- Data Ingestion, Transformation and Treatment
- Data Check-In: the collection of data from the PISTIS system through various options (e.g., APIs, Pub/Sub, etc.)
- Data Enrichment: the cleaning of data from errors and/or inconsistencies and the matching of ingested data to a common model for interoperability purposes.
- Analytics/Insights Engine: the application of some ready-made analytics on the data, to extract some information.
- Data Lineage Tracking: the application of tracking tags on the data for allowing tracking of the subsequent actions.
- GDPR Checker: the evaluation of whether the data contains GDPR relevant information and the suggestion to strip (if wanted) such information from the dataset (or to change it if needed) prior to exchanging it with other stakeholders.
- Data Anonymisation: Application of anonymisation techniques.
- Data Quality Assessment: The assessment of the data for extracting indexes that can describe the quality in different dimensions.
- Data Storage: The storage already treated data back to the original data storage facilities, keeping “pointers” at the PISTIS facility.
- Data Publication Preparation.

- Access Policies Definition: Mechanisms for the application of policies for the access level on stored data of PISTIS system.
- Data and Metadata Publication: The publishing of metadata of the treated datasets in the federated PISTIS repositories for the allowing their querying and the publication of a small set of Data online to be displayed to interested stakeholders.

9.1.7 Other actions of Data Spaces owners

Transactions Monitoring (in case transactions are available).
Auditing of Transactions: An interface where a user can have a log of his transactions.
Auditing of On/Off Platform Usage: An interface where the user can witness how the data he has traded is used.

9.1.8 Data Landscape: Increasing the hosting capacity of the grid.

Data Type	Data Provider	Internal/ External	Data Consumer	Data Availability	Data Format	Plan for accessing Data if not available	Risk level/ Amelioration strategy
Grid Topology	CUERVA	Internal	CARTIF	Available	Files	Not Applicable	n/a
DERs Location	CUERVA	Internal	CARTIF, OMIE	Available	Files, form	n/a	n/a
DERs Generation	CUERVA	Internal	BAMBOO	It's possible that the distributor's data may not be sufficient for the accurate characterization of the profiles.	Files	In-depth study of consumption data.	If necessary, algorithmic methods will be used to generate synthetic data that approximates reality.
Grid Events (historical)	CUERVA	Internal	CARTIF	Available	Files	n/a	n/a
User Consumption (historical)	CUERVA	Internal	CARTIF	Available	Files	n/a	n/a
Flexibility Aggregated Data	BAMBOO	Internal	OMIE, CARTIF	Not Available now	Files	Data will be available once the calculation is done.	Not needed at this point
Bids	BAMBOO	Internal	OMIE, CARTIF	Not Available now	Files	Data will be available once the	Not needed at this point

						calculation is done.	
Hosting Capacity Analytical Results	CARTIF	Internal	CUERVA	Not Available	Files	Data will be available once the calculation is done.	Not needed at this point
Topology of the network, measurement of energy use by customers, future actions on the network and the economic value that this entails.	CUERVA	Internal	BAMBOO, CARTIF	Available	Files	n/a	n/a
Unit power, unit location, unit schedule, unit bids (hour contract, quantity and price)	BAMBOO, CUERVA	Internal	OMIE	Not Available	Files	Data will be available once the list of product attributes is defined	Not needed at this point
Requirement (quantity, limit price, hour contract)	CUERVA	Internal	OMIE	Not Available	Files	Data will be available once the list of product attributes is defined	Not needed at this point
Data generated by the grid (voltage, current, power, switches position, etc.), Data generated by the users (energy consumption)	CUERVA	Internal	BAMBOO, CARTIF	Available	Files	n/a	n/a
Weather data, energy forecasting data for PV-, wind- and hydropower	UBIMET	Internal	BAMBOO, CUERVA	Available	API	n/a	n/a

applications, as well as feed in management solutions.							
Electrical consumption and generation.	CUERVA	Internal	BAMBOO, CARTIF	Available	File	n/a	n/a

Table 15: Data Landscape: Increasing the hosting capacity of the grid.

9.1.9 Summary of actions within use-case #2.1 Hosting Capacity of the Grid.

Before interacting with the PISTIS platform:

- Agree on a Common Information Model (CIM), data format and protocols.
- Prepare data on grid topology, DERs location, DERs generation, historical data on grid events and user consumption, and pre-processing to produce forecasts.
- Semantic enrichment of the data to make it searchable.
- Data quality assessment, transformation & analytics.
- Price signals (before the flexibility market operation).
- Define licensing and policies to use the data.
- Implement APIs/mechanisms to automatically transmit data, also in real time if necessary.
- Implement APIs/mechanisms to automatically retrieve data, also in real time if necessary.
- Check and eliminate unnecessary GDPR-relevant information in data.
- Anonymise study-relevant personal data (e.g., energy consumption, DER production and location).
- Data publication preparation.
- Data value estimation and monetisation scheme definition.
- Identify flexible assets in the grid.

Step 1 - Input provided to PISTIS:

- Decision to share data (entire dataset or preliminarily a sample, as deemed necessary) through PISTIS.
- Transmit grid data through PISTIS.
- Transmit weather data through PISTIS.
- Provide flexibility market results (after the flexibility market operation).
- Transmit data from field sensors and IoT.
- Geographical definition of the portion of grid susceptible of being potentially congested (and therefore derive on a requirement of flexibility).
- Location of DERs with aim of providing their flexibility.

Step 2 - Output retrieved from PISTIS:

- Check example data for data format, data characteristics, compliance with requirements and standards, appropriate match with user needs, etc.
- Retrieve grid data (including both network topology, prosumers data, energy consumption, etc).
- Retrieve weather data.

Step 3 - Data quality assessment and generation of new analytics (through PISTIS or offline):

- Data quality assessment, data decryption and - if necessary – preprocessing.

- BAMBOO uses grid and weather data and uses it to compute analytics and predictions on flexibility.
- CARTIF uses grid data to analyse hosting capacity.
- CUERVA uses weather data to improve predictions of energy generation.
- Data providers monitor that data is correctly transferred and that it is used as agreed in the licences.
- The new analytics are made available through PISTIS.

Step 4 Output **retrieved from PISTIS and generation of new analytics**

- Data quality assessment, data decryption and - if necessary – preprocessing.
- CARTIF combines and analyses grid data, prosumers data, flexibility validation data to generate new insights and predictions of network hosting capacity.
- Data providers monitor that data is correctly transferred and that it is used as agreed in the licences.
- The new analytics are made available through PISTIS.

Step 5 - After the interaction with PISTIS:

- CUERVA uses the analytics and predictions generated by BAMBOO, CARTIF to create action plans for upgrading the network, leveraging flexibility to reduce network events in the context of increased DERs connections.
- OMIE shares the results of the flexibility markets with all the participants (CUERVA as the requester and providers who have resulted in being assigned in the auction), so that CUERVA could use them to optimise the use of the grid.

9.2 USE CASE #2.2: INVESTMENT DEFERRAL.

This UC focuses on investment reduction thanks to the available data and the flexibility of the system. The most benefited actor is the DSO that can plan the grid operation, including the use of flexibility agents, and create a long-term local flexibility market. In this case, the market is planned to create commitments with the DSO for the following months or years, thus effectively enabling a new management tool for the DSO. These data are interchanged over time thanks to the platform, being thus registered, and if it is necessary, apply tradability or penalties in the validation process.

9.2.1.1 Ambition of use-case

The **goal** for this use-case is to focus on studying the impact of utilising data and flexibility in grid development, as an alternative to traditional approaches that address issues like overvoltage and congestions. There is the need to facilitate the exchange of valuable information and resources, leading to more efficient grid management and cost savings in the energy sector.

9.2.2 Challenges Faced

Challenges emerged on the data format compatibility among parties, on communication protocols, on interoperability issues and a lack of a standardised Common Information Model

(CIM). Ensuring data availability from the Distribution System Operator (DSO) is also a problem to be analysed.

The **role** of the PISTIS platform is to provide support to the DSO in the process of planning grid operations, and thus allowing the creation of a long-term local flexibility market and making commitments with flexibility agents.

9.2.3 Target Audience Descriptions

The interaction with the platform and all the processes in the flexibility market are the same as stated above in the use-case #2.1 Hosting Capacity of the Grid, section 9.1.3. Similarly, the data to be shared are the same and the only difference is the period of the events, and the flexibility offers.

9.2.4 Data Landscape: Investment deferral

Data Type	Data Provider	Internal/ External	Data Consumer	Data Availability	Data Format	Plan for accessing Data if not available	Risk level/ Amelioration strategy
Grid Topology	CUERVA	Internal	CARTIF	Available	Files	Not applicable	n/a
Grid Investment	CUERVA	Internal	CARTIF	Available	Files	n/a	n/a
Grid Events (historical)	CUERVA	Internal	CARTIF	Available	Files	n/a	n/a
User Consumption (historical)	CUERVA	Internal	CARTIF	Available	Files	n/a	n/a
DERs Generation	CUERVA	Internal	BAMBOO	Available	Files	In-depth study of consumption data.	If necessary, algorithmic methods will be used to generate synthetic data that approximates reality.
Flexibility Aggregated Data	BAMBOO	Internal	OMIE, CARTIF	Not Available	File	Data will be available once the calculation is done.	Not needed at this point

Result of problem solved thanks to flexibility	CARTIF	Internal	CUERVA	Not Available	Files	Data will be available once the process is done.	Not needed at this point
Topology of the network, measurement of energy use by customers, future actions on the network and the economic value that this entails.	CUERVA	Internal	BAMBOO, CARTIF	Available	Files	n/a	n/a
Unit power, unit location, unit schedule, unit bids (hour contract, quantity and price)	BAMBOO, CUERVA	Internal	OMIE	Not Available	Files	Data will be available once the list of product attributes is defined.	Not needed at this point
Requirement (quantity, limit price, hour contract)	CUERVA	Internal	OMIE	Not Available	Files	Data will be available once the list of product attributes is defined	Not needed at this point
Data generated by the grid (voltage, current, power, switches position, etc.), Data generated by the users (energy consumption)	CUERVA	Internal	BAMBOO, CARTIF	Available	File	n/a	n/a
Weather data, energy forecasting data for PV-, wind- and hydropower	UBIMET	Internal		Available	API	n/a	n/a

applications, as well as feed in management solutions							
Electrical consumption, electrical generation.	CUERVA	Internal	BAMBOO, CARTIF	Available	Files	n/a	n/a

Table 16: Data Landscape: Investment deferral

9.2.5 Summary of actions within use-case #2.2

Before interacting with the PISTIS platform:

- To find agreement on the type of information, e.g. data format, that will be exchanged, communication protocols and other technical requirements.
- Data Enrichment.
- Data Anonymisation.
- Data Quality Assessment.

Step 1 - Input provided to PISTIS:

- Transmit grid topology data.
- Transmit grid investment data.
- Transmit grid events (historical) data.
- Transmit user consumption (historical) data.
- Transmit DERs generation data.
- Provide historical data (results, prices) of previous auctions carried out on these congested zones (before the flexibility market occurs).
- Provide flexibility market results (after the flexibility market has been carried out).
- Transmit flexibility aggregated data.
- Data Ingestion (tool + several connectors to important data sources/ data spaces).
- Geographical definition of the portion of grid susceptible of being potentially congested (and therefore derive on a requirement of flexibility).
- Location of DERs with aim of providing their flexibility.

Step 2 - Output retrieved from PISTIS:

- Data Ingestion (tool + several connectors to important data sources/ data spaces).

Step 3 - Data quality assessment and generation of new analytics (through PISTIS or offline):

- Analytics/Insights Engine (the tool and scripts for data quality analysis).
- Use Case specific data Analytic for investment economic data.

Step 4 - Output retrieved from PISTIS and generation of new analytics.

- Data and Metadata Publication.
- Data Trading and acquisition from/to another PISTIS user.

Step 5 - After the interaction with PISTIS:

- Digital Twin creation
- Flexibility market results
- Report system for the results.
- Long-term Flexibility forecasting
- Use Case specific data Analytic for investment economic data.
- Data scaling
- App / interface for the DSO

9.3 USE CASE #2.3: P2P TRADING BETWEEN USERS OR ENERGY COMMUNITIES.

Currently, in view of the promotion of self-consumption, shared self- consumption and the growing number of new energy communities, users are increasingly wishing to be aware of the origin of the energy purchased from the grid and the destination of the energy fed into the grid. At present this information is unknown, beyond the guarantees of origin offered by some traders. Peer-to-Peer (P2P) trading is proposed to allow the user to choose which grid user to sell to or buy from, thus enabling the creation of these peer-to-peer exchanges and, therefore, empowering the users to know exactly what they are consuming and where it comes from.

This could be enabled by new platforms operated by the MO, where different resources trade energy in local level. In this case, the DSO is not seeking to solve a problem with the supply quality, but it cannot allow events to occur due to exchanges between users that could lead to unexpected situations. Therefore, the distributor's role is to act as a controller of these exchanges for prior validation before technical dispatch.

9.3.1 Ambition of use-case

The **aim** is to create peer-to-peer exchanges with a new platform operated by the MO, to facilitate free negotiation among energy resources and assets (that is -without any DSO call).

It is also interesting for the DSO to study how P2P affects not only the grid, but also short and long-term flexibility markets, and the need to intervene in P2P to ensure the quality of supply.

9.3.2 Challenges Faced

Challenges emerged on the data format compatibility among parties, communication protocols, interoperability issues and the lack of a standardised Common Information Model (CIM). Ensuring data availability and communication among parties would empower the user and increase P2P exchange frequency.

The **PISTIS platform** will provide support to the partners in the enhancement and facilitation of data trading and communication among users.

9.3.3 Target Audience Descriptions

In this use case, the primary roles are covered by the MO (Market Operator) and the Aggregator, using the short-term market platform as a free market platform. In this scenario, end-users could place energy demand and supply on the platform outside of the time periods when the DSO requires flexibility for specific moments. However, it is essential to consider how these P2P exchanges affect the grid and whether they generate new flexibility requirements.

9.3.3.1 Data Owners

Internal

Bamboo: owner of the flexibility provider data and the requirements of the buyers of energy.

Cuerva: Information on the state of the grid during the time intervals when flexibility is required.

External
None detected.

9.3.3.2 Data Seekers

Internal
Cartif: Dispatch data for conducting grid state simulation.

OMIE: bids placed on the market platform from energy buyers and sellers.

External
Not detected in this UC

9.3.4 Analytics capacity etc

In this UC Cuerva and Cartif will provide the necessary data to Bamboo in order to create the appropriate signals, so that it can create those signals needed for use in the P2P market. Likewise, Cartif will use the results of the matchmaking to determine its impact on the grid.

9.3.5 Actions of Buyers of Data

- Data Exploration.
- Data Navigation/Querying.
- Data Matchmaking Services.
- Data Contract Preparation.
- Contract Drafting.
- Contract Notification.
- Data Acquisition.
- Data Transfer.

9.3.6 Actions of the Data Spaces owners-the sellers of data

- Data Ingestion, Transformation and Treatment
- Data Check-In: The collection of data from the PISTIS system through various options (e.g., APIs, Pub/Sub, etc.)
- Data Enrichment: The cleaning of data from errors and/or inconsistencies and the matching of ingested data to a common model for interoperability purposes.
- Analytics/Insights Engine: The application of some ready-made analytics on the data, to extract some information.
- Data Lineage Tracking: The application of tracking tags on the data for allowing tracking of the subsequent actions.
- GDPR Checker: The evaluation of whether the data contains GDPR relevant information and the suggestion to strip (if required) such information from the dataset, (or to change it if needed) prior to exchanging it with other stakeholders.
- Data Anonymisation: Application of anonymisation techniques.
- Data Quality Assessment: The assessment of the data for extracting indexes that can describe the quality in different dimensions.

- Data Storage: The storage of already treated data back to the original data storage facilities, keeping “pointers” at the PISTIS facility.
- Data Publication Preparation.
- Access Policies Definition: Mechanisms for the application of policies for the access level on stored data of the PISTIS system.
- Data and Metadata Publication: The publishing of metadata of the treated datasets in the federated PISTIS repositories for allowing their querying and the publication of a small set of Data online to be displayed to interested stakeholders.

9.3.7 Other actions of Data Spaces owners

- Transactions Monitoring (in case transactions are available).
- Auditing of Transactions: An interface where a user can have a log of his transactions.
- Auditing of On/Off Platform Usage: An interface where the user can witness how the data he has traded is used.

9.3.8 Data Landscape: P2P Trading Users or Energy Communities

Data Type	Data Provider	Internal/ External	Data Consumer	Data Availability	Data Format	Plan for accessing Data if not available	Risk level/ Amelioration strategy
Any kind of data collected by or from stakeholders.	CUERVA	Internal	EURECAT	Available	File	Not/Applicable	n/a
Grid Topology	CUERVA	Internal	CARTIF	Available	Files	n/a	n/a
User Consumption (historical)	CUERVA	Internal	CARTIF	Available	Files	n/a	n/a
DERs Generation	CUERVA	Internal	BAMBOO	Available	Files	n/a	n/a
Flexibility Aggregated Data	BAMBOO	Internal	OMIE, CARTIF	Not available	Files	Data will be available once the process is done.	Not needed at this point.
Topology of the network.	CUERVA	Internal	BAMBOO, CARTIF	Available	Files	n/a	n/a
Measurement of energy use by customers.	CUERVA	Internal	BAMBOO, CARTIF	Available	File	n/a	n/a
Unit power, unit location, unit schedule, unit bids (hour contract, quantity and price).	BAMBOO, CUERVA	Internal	OMIE	Available	File	If it is not possible to obtain some of the data, an	Some of the personal data may be difficult

						estimate will be made based on the trend of the rest of the users.	for the distributor to access.
Data generated by the users (energy consumption).	CUERVA	Internal	BAMBOO, CARTIF	Available	File	n/a	n/a
Weather data, energy forecasting data for PV-, wind- and hydropower applications, as well as feed in management solutions.	UBIMET	External	CARTIF	Available	API	n/a	n/a
Electrical consumption, electrical generation.	CUERVA	Internal	BAMBOO, CARTIF	Available	File	n/a	n/a

Table 17: Data Landscape: P2P Trading between Users or Energy Communities

9.3.9 Summary of actions within use-case #2.3

Before interacting with the PISTIS platform:

- To find agreement on the type of information, e.g. the data format that will be exchanged, communication protocols and other technical requirements.
- Data Enrichment
- Data Anonymisation
- Data Quality Assessment

Step 1 - Input provided to PISTIS:

- Transmit grid topology data.
- Transmit user consumption data.
- Transmit DERs generation data.
- Peer to peer trading results.
- Data Ingestion (tool + several connectors to important data sources/ data spaces).

Step 2 - Output retrieved from PISTIS:

- Data Ingestion (tool + several connectors to important data sources/ data spaces).

Step 3 - Data quality assessment and generation of new analytics (through PISTIS or offline):

- Analytics/Insights Engine (the tool and scripts for data quality analysis).
- UC specific data Analytic for investment economic data.

Step 4 - Output retrieved from PISTIS and generation of new analytics:

- Data and Metadata Publication.
- Transmit flexibility aggregated data.
- Data Trading and acquisition from/to another PISTIS user.

Step 5 - After the interaction with PISTIS:

- Digital Twin creation.
- Report system for the validation of the transaction.
- Power flow calculation.
- Smart contract creation between users.
- Use data to feed algorithms that will help the grid distributor to improve the management of the grid. To use data generated by the grid to solve problems not directly related to electricity.
- Storage of the contracts and validation result.

9.4 USE CASE #2.4: MONETISATION OF ENERGY EXCHANGE DATA

This UC will explore the possibility to monetise the data, which is owned by the different actors participating in the energy exchange over the grid, to third parties for different uses, such as energy as a service (EaaS). The potential consumers are aggregators, installers, energy service

companies, retailers, consultancy or advisory companies, private research groups and universities, EV charging companies and software companies. They would be able to optimise their existing services and develop new ones thanks to the additional information obtained through use of the data.

9.4.1 Ambition of use-case

The **Goal** for this case study is to define the process of data valorisation to target potential consumers of energy assets, who may use them for Energy as a Service (EaaS) including aggregators, installers, energy service companies, retailers, consultancy firms, research groups, universities, EV charging companies, and software companies.

9.4.2 Challenges Faced

The **problem** faced is that the challenge lies in acquiring adequate information to accurately assess the economic value of data, as it involves a complex analysis of not only data acquisition but also estimating future savings, to create a complete and adequate model.

The **PISTIS platform** will provide support to the partners in the enhancing and facilitation of data trading and communication among users to inform the economic value of data.

9.4.3 Target Audience Descriptions

In this scenario, every member of the Energy Hub acts as both a data proprietor and purchaser, collaboratively exploring potential external entities that might be interested in acquiring the data produced.

9.4.3.1 Data Owners

Internal

Throughout the development of this project, the role of each participant will be closely observed, as well as the expected value that will result from their actions in the buying and selling processes. Therefore, all participants are susceptible to being data owners as well as data seekers.

9.4.3.2 Data Seekers

Internal

Mentioned in the previous point.

9.4.4 Analytics capacity etc

This use case will utilise a specific Data Analytic for economic investment data and the Analytics/Insights Engine (the tool and scripts for data quality analysis).

9.4.5 Actions of Buyers of Data

Data Exploration
Data Matchmaking Services
Data Contract Preparation
Contract Drafting
Contract Notification

9.4.6 Actions of the Data Spaces owners-the sellers of data

Data Quality Assessment: The assessment of the data for extracting indexes that can describe the quality in different dimensions.

9.4.7 Other actions of Data Spaces owners

Transactions Monitoring (in case transactions are available).

9.4.8 Data Landscape: Monetisation of Data owned by the different Actors to Third Parties

Data Type	Data Provider	Internal/ External	Data Consumer	Data Availability	Data Format	Plan for accessing Data if not available	Risk level/ Amelioration strategy
Digitalisation Costs.	CUERVA	Internal	CUERVA, BAMBOO, CARTIF	Available	Files	These are private company data that may not be shareable, and the study of their value should be carried out solely by CUERVA	
Grid O&M operation.	CUERVA	Internal	CUERVA, BAMBOO, CARTIF	Available	Files	As above.	
Data Infrastructure Costs.	CUERVA	Internal	CUERVA, BAMBOO, CARTIF	Available	Files	As above.	
Future actions on the network and the economic value that this entails.	CUERVA	Internal	CUERVA, BAMBOO, CARTIF	Available	Files	As above.	
Data generated by the grid (voltage, current, power, switches position, etc.), Data generated by the users (energy consumption).	CUERVA	Internal	CUERVA, BAMBOO, CARTIF	Available	Files	n/a	n/a
Weather data, energy forecasting data for PV-, wind- and hydropower applications, as well as feed in management solutions.	UBIMET	Internal	CUERVA, BAMBOO, CARTIF	Available	API	n/a	n/a

Electrical consumption, electrical generation.	CUERVA	Internal	CUERVA, BAMBOO, CARTIF	Available	Files	n/a	n/a

Table 18: Data Landscape: Monetisation of Data owned by the different Actors to Third Parties

9.4.9 Summary of actions for Use-Case 2.4: Monetisation of data.

Before interacting with the PISTIS platform:

- To find agreement on the type of information, e.g. data format, that will be exchanged, communication protocols and other technical requirements.
- Data Enrichment
- Data Anonymisation
- Data Quality Assessment

Step 1 - Input provided to PISTIS:

- Transmit digitalisation cost data.
- Transmit grid O&M operation data.
- Transmit data infrastructure cost data.
- Data Ingestion (tool, plus several connectors to important data sources/ data spaces).

Step 2 - Output retrieved from PISTIS:

- Data Ingestion (tool, plus several connectors to important data sources/ data spaces).

Step 3 - Data quality assessment and generation of new analytics (through PISTIS or offline):

- Analytics/Insights Engine (the tool and scripts for data quality analysis).
- UC specific data Analytic for investment economic data.

Step 4 - Output retrieved from PISTIS and generation of new analytics.

- Data and Metadata Publication
- Data Trading and acquisition from/to another PISTIS user

Step 5 - After the interaction with PISTIS:

- Establishing the value of data that will be monetised or traded in any of the use cases.
- Definition of processes for the valorisation of data
- Studies dedicated to data valorisation.
- Smart contract creation between users
- Use data to feed algorithms that will help the grid distributor to improve the management of the grid. To use data generated by the grid to solve problems not directly related to electricity.
- Storage of the contracts and validation result

9.5 IMPACTS EXPECTED FOR THIS DEMONSTRATOR HUB

The impacts expected for this demonstrator hub based on the scenarios set out above include:

- Increase in hosting capacity of grid.
- Increased participation from DER in the LFM.
- Improve the investment deferral.

The measurement of the actual impacts will be provided in deliverable D5.3 and the process for evaluating this progress is set out in Chapter 18 of this document.

9.5.1 Impact for the Organisation

The Energy Hub case is based on simulation by the partners of a flexibility market for Use Cases 2.1 and 2.2. These markets are not yet integrated into the Spanish energy system. Therefore, knowing the technical requirements to which we must adapt in the not-so-distant future is of great importance to DSOs, aggregators, and market operators alike.

In the process of developing these two use cases, the various participants in the demonstration will integrate communication requirements between the actors in the flexibility market, allowing us to adapt to future requirements to a large extent from a good starting position. The impact of this lies in the swift adaptation for when these markets are regulated and operational.

In the specific case of each partner, the impact is different. For the DSO, it will not only allow them to understand the market requirements to demand flexibility but also to understand the impact of flexibility on the grid. This can be used to increase hosting capacity and promote the deployment of distributed and decentralised generation. It can also be used to conduct in-depth studies of grid needs and, as a result, postpone investments in technology and equipment to support the growing electrical demand. This favours investment deferral and creates a more sustainable electrical system.

For the aggregator, it is important to understand the possibilities offered by flexibility providers and to bring their technology into the real world by creating flexibility offers that meet market needs. Additionally, by working alongside a market operator and a DSO, the aggregator can adapt to the needs of both entities, potentially offering a highly valuable and indispensable product in the future, for all potential flexibility providers wishing to participate.

In the case of the Market Operator, the PISTIS project allows them to work closely with the two main elements of the market they will serve: the DSO and the aggregator. This helps them understand their requirements and adapt the service for the best possible performance, also setting the guidelines for participation.

The impact for the technology developer is significant because, through collaboration, they can learn about the requirements of those involved in flexibility markets with regard to the development of technology adapted to their requirements and to those of the companies involved. This can facilitate future deployment of the technology in other contexts.

The Use Case 2.3 (P2P trading) represents a step further. For the Market Operator, it means leveraging existing platforms to adapt them to a free market among network users. For the aggregator, it opens up new business models, expanding their possibilities and reach. The technology developer can also explore new services thanks to P2P and its implications beyond the platform offered by PISTIS.

Lastly, data valuation is a crucial point of knowledge for all partners. It will allow us to explore all the possibilities surrounding the data which is naturally generated in the systems, identifying stakeholders and the value that data represents for them.

9.5.2 Impact for the Data Owners

Within the Energy Hub, Cuerva, as a DSO, is the largest data owner because the flexibility market relies on the ability to detect events on the grid and validate actions on it. In a real-world environment, the technology that enables this detection would be within the company, although all the data processing proposed by PISTIS is still necessary for many of them. Thanks to the technology proposed in the project, it is possible to make use of this data, maintain proper control over it, and assess its value.

This technology is of great value to third-party companies in the sector, which in many cases, due to lack of knowledge or a data processing system, are not able to extract value from the data and use it beyond the boundaries of their own company. Thanks to this, it will be possible for them to adapt to market and electrical system requirements much more efficiently.

9.5.3 Impact for Collaborators (Data Seekers)

The availability of accurate and valuable information can be crucial for the operations and business strategies of the partners and third companies. The ability to access and effectively utilise data can provide competitive advantages, inform decision-making, and facilitate the creation of new business models. This is well reflected in the Energy Hub, promoting the deployment of the flexibility market, but beyond this demonstration, it will also provide a secure and reliable environment to obtain data. Collaboration in the PISTIS project not only benefits data seekers within the Energy Hub but also sets a precedent for the development of solutions that harness available information in other contexts, offering additional opportunities for growth and innovation across various industries.

9.5.4 Impact from cross-cutting hubs and Living Labs activities.

Thanks to the environment created by PISTIS, we can gather information about the expected use of the platform by other Hubs. In this way, we can identify requirements and possibilities that were not initially considered. Furthermore, this can provide additional information when valuing the data.

Furthermore, this collaboration and application in the living labs, optimises the development of various platform components, making visible those requirements that can be applied in different areas.

9.5.5 Impact towards wider exploitation goals

As of today, there are no solutions in the market that integrate as many sources as possible of data, not only energy-related but also from other fields, to support their transaction along with a variety of tools for their processing. Therefore, it represents the ideal synergy between the technology that can drive flexibility markets and the exchange of energy data and the visibility of the platform, as it technologically supports significant changes in the electricity markets.

10 DEMONSTRATION HUB #3 - AUTOMOTIVE

The Demonstrator Hub #3 focuses on facilitating data sharing amongst stakeholders in the mobility and transport system.

The automotive demonstrator hub will support environmentally friendly, safe, and efficient mobility and transport. Specifically, the mobility hub will use various data sources, e.g. connected vehicle data from car manufacturers (via CARUSO, data provider operating a data marketplace), vehicle trip data (via VIF, Europe's largest RTO for virtual vehicle technology), weather data (via UBIMET), map data (OpenStreetMap), and air quality data (open government data) to focus on traffic quality assessment in urban areas and driving style and driving risk assessment.

The two use cases in this Hub will use the data and provide concrete data-driven services to individual drivers (driver warning and coaching), businesses (corporate mobility management for green driving), and public administrations (urban emission modelling, risk hotspot analysis).

Given that the Use Case #1 Traffic Quality Assessment builds upon Use Case #2 Driving Style and Risk Assessment, it is logical in this document to present that use case first.

10.1 USE CASE 3.2: DRIVING STYLE & RISK ASSESSMENT.

The assessment of driving style and driving risk by using multiple data sources is a major topic for safe driving research and applications. This is a comprehensive safety technology designed to analyse various factors related to driving behaviour, environmental conditions, and potential hazards on the road. The ultimate goal is to provide timely warnings to drivers, helping them proactively navigate potential risks and enhance overall road safety.

A driving risk can be computed by analysing data from connected vehicles (such as location, speed, or driving direction), data about past accident hotspots, data indicating individual driving behaviour (such as harsh braking, acceleration, speed or driver distraction), and data indicating weather conditions and changes, to name a few examples. Thereby, driving-risk relevant events extracted from various data sources form the input for a driving risk assessment pipeline. Drivers may undergo categorisation based on their distinctive driving behaviours, encompassing safety-related events like speeding, braking, use of assistance systems, or reckless driving, all derived from the vehicle's sensor data. To enhance the precision of the driving risk evaluation, the severity of driving events is carefully weighed by incorporating contextual data. Factors such as weather conditions, road topography, locations of harsh driving, or accident hotspot data are integrated to provide a more nuanced understanding.

In the subsequent phase, this rich dataset may become a cornerstone for personalised driver coaching. Leveraging gamification strategies, drivers are incentivised through point systems or rankings, fostering a sense of competition. This encourages the adoption of environmentally friendly and safe driving practices. By employing these engaging techniques, the driving experience transforms into a dynamic platform for continuous improvement, benefitting both individual drivers and the broader community.

In a nutshell this use case revolves around analysing shared data to identify safety-related events. Tailored to individual driving contexts, the system issues driver warnings, promoting safer driving practices. For transportation managers, a comprehensive overview of the entire data landscape is presented through an interactive dashboard, providing a holistic perspective on driver-risk relevant events.

10.1.1 Ambition of use-case

The **goals** are to create a data-driven driving risk prediction and warning system for (1) vehicle drivers that enhances driver awareness, reduces risky behaviours, and improves overall driving and road safety, integrating different data sources from different data providers. The knowledge of risky locations in the road network may also be of interest to (2) transportation managers who may want to establish risk mitigation mechanisms and are therefore provided with an interactive dashboard.

Therefore, the use case aims to

- Establish data trading partnerships or agreements with data providers (e.g., for vehicle and weather data) to ensure a continuous supply of current and historical data.
- Obtain data from relevant sources to develop algorithms and models for a more accurate and useful inference of driving risk and the development of respective driver warning and assistance systems.
- And to have access to large-scale car data alongside current and historic weather data, for a more scalable solution adaptable to a broader application context.

10.1.2 Challenges Faced

Besides creating the business logic for the data-driven application to be developed, the use case faces several data-related challenges:

The **difficulty** faced is in ensuring effective data access and management for a scalable and reliable service/product. This is because there is insufficient relevant data availability and well-defined data integration process, as well as insufficient data processing, data quality and frequency, and time synchronisation. Finally, difficulty in setting up the relevance of alerts for drivers to consider in the driving risk prediction model.

The **PISTIS role** is to provide support for efficient data management to ensure scalability and reliability. Also, to facilitate the data integration process and simplify the process of acquiring and integrating data from different providers and to support the implementation of mechanisms to assess and ensure data quality. Furthermore, PISTIS will help design accurate risk prediction and warning mechanisms enabled by the data shared, based on both historical and current data.

10.1.3 Target Audience Descriptions

10.1.3.1 Data Owners

Internal

VIF can provide access to data containing the location of past acceleration, braking and curve driving events including metadata such as location, time, driving speed and speed change, derived from data containing past road trips.

CARUSO can provide access to vehicle data (personalized data) if the driver/owner of the vehicle has agreed to the use of this data for a specific service. CARUSO also has access to anonymous/synthetic vehicle data.

UBIMET can provide access to current weather data as well as to historical weather data.

10.1.3.2 Data Seekers

Internal

VIF is seeking access to vehicle data (provided by CARUSO) as well as to current and historical weather data (provided by UBIMET).

10.1.4 Data Landscape: Driving Style and Risk Assessment.

Data Type	Data Provider	Internal/ External	Data Consumer	Data Availability	Data Format	Plan for accessing Data if not available	Risk level/ Amelioration strategy
Past trip data (anonymised trips).	VIF	Internal	CARUSO, VIF	Available	CSV	not/applicable	not/applicable
Data about location of brake events.	VIF	Internal	CARUSO, VIF	Available	CSV	n/a	n/a
Data about location of acceleration events.	VIF	Internal	CARUSO, VIF	Available	CSV	n/a	n/a
Data about the location of curve events.	VIF	Internal	CARUSO, VIF	Available	CSV	n/a	n/a
Data about the location of driver warnings.	VIF	Internal	CARUSO, VIF	Available	CSV	n/a	n/a
Vehicle trip data.	CARUSO	Internal	CARUSO, VIF	Available	CSV	n/a	n/a
Driving style data.	VIF	Internal	VIF, TRAFFICON	Available	API	n/a	n/a
Weather Data (historical).	UBIMET	Internal	VIF	Available	API	n/a	n/a
Weather Data (live).	UBIMET	Internal	VIF	Available	API	n/a	n/a
Anonymised Connected Car Data.	CARUSO	Internal	VIF	Available	API	n/a	n/a

Personalized Connected Car Data.	CARUSO	Internal	VIF	Available	API	n/a	n/a

Table 19: Data Landscape: Driving Style and Risk Assessment.

10.1.5 Summary of Actions for Use Case #3.2: Driving Style & Risk Assessment

Before interacting with the PISTIS platform:

- Prototypical implementation of a system that can warn drivers based on a risk computed from historical data sources termed “D-TRAS - Digital Platform for Traffic Safety Risk Prediction” consisting of:
    - A set of preliminary, internal data sources (dockerized data services) for testing purposes containing locations/clusters of brake, acceleration and curve events gained from past trip data).
    - A server-based implementation (connects several data services and combines the output to compute driver warning events).
    - And a client implementation (mobile app for smartphones that connects to the server and displays computed risk-relevant events based on the driving context that are ahead of the driver’s driving route and finally warns drivers).
- Pre-processing (in each data-service) to fit the data into the data model of the software products, e.g. uniform time series with the aim to compute driving-risk relevant events from raw data (e.g. time series data on past trips > location of brake events with meta information > brake event clusters).
- Visual analytics of historical data on single trips and extracted driver-risk events (trip data visualiser).
- Agreement on conditions for data sharing with CARUSO and UBIMET.
- Define relevant data contracts, details, terms of use, pricing policies.
- Development of semantic enrichment for the shared data sets using a common ontology (ORM - data service ontology).

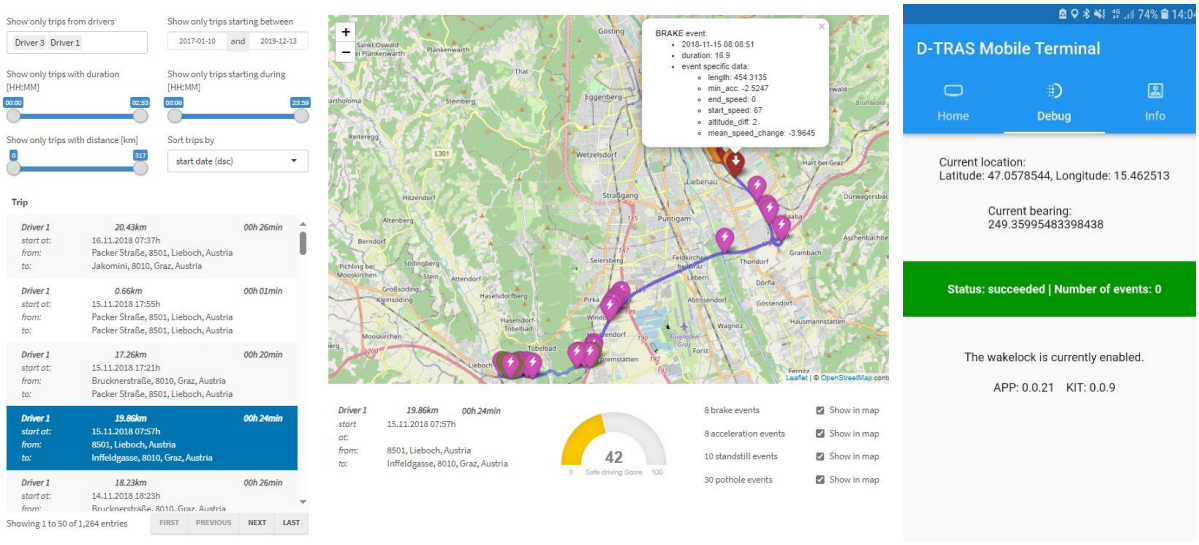

Figure 14: Trip Data Visualiser, Smartphone Driver Warning App

Step 1 - Input provided to PISTIS:

- Decision to share data (entire dataset or preliminarily a sample, as deemed necessary) through PISTIS.
- Automation of event detection, driving style analysis and risk computation.

- Mobile app including a kit that is connecting to the service platform to query the relevant information.
- Provision of driving style & risk data.
- Implementation of APIs/mechanisms to automatically transmit weather data, also in real time if necessary.
- Real-time information, raw weather data via continuous data stream.
- Integration of weather data via VIF app/dashboard.
- The provision of weather parameters and associated risks such as road icing conditions and low visibility.
- Access use of smart contracts and crypto currencies.
- Street graph data.
- Accident hotspot data.
- Live Weather Data.
- Historical Weather Data for Styria.
- Anonymised Connected Car Data.
- Personalised Connected Car Data (using synthetic data).

Step 2 - Output retrieved from PISTIS:

- Access to new and relevant data sources (including a data catalogue to search for information).
- Improved and simplified mechanisms for and gaining access to new data sources to improve the driving risk prediction and driver warning solution.
- Integration of further data sources into the solution: Street graph data, accident hotspot data, live Weather Data, historical Weather Data for Styria, anonymised Connected Car Data, and personalised Connected Car Data (using synthetic data).
- Improved Server Platform integrating further data-services and establishing a risk-model that takes advantage of the data stemming from this new data-services.
- Improved Client-based systems (and user experience – UI/UX) targeted at end users-
    - Vehicle drivers: Improved mobile warning app and risk model.
    - Transportation managers: Dashboard allowing them to interact with driver-risk relevant information on a map.
    - Developers: Dashboard to simulate drives (virtual drivers) and illustrate the computation of driving risk and generation of warnings based on the available data (allowing to select different risk models) allowing to experiment with different parameters.
- Improved mechanisms for and allowing to share data generated in the use case with other partners (where applicable to sell data to further stakeholders).
- Data providers monitor that data is correctly transferred and that it is used (in the solution) as agreed in the licences.

Step 3 - Data quality assessment and generation of new analytics (through PISTIS or offline):

- Data quality assessment, data decryption and - if necessary – preprocessing.
- Visual exploration of driving risk data to develop automated data quality analysis and improvement.
- Calculation of events (relevant to the calculation of driving risk) from raw data (e.g., trip data or anonymised trip data) to feed into risk prediction models and quality assessment of event data.
- Queries events with a geo-spatial key computed on the driver's app and assessment of the quality of geo-spatial data.
- Computation of a cone for risk calculation depending on the driving speed and other input parameters and assessment of the quality of the cone computation.
- Novel means of event filtering and risk calculation taking advantage of the additional data fed into the system and assessing the quality of the computed risks.
- Improved means of driver warnings computation and visualisation and assessment of the quality of driver warnings.
- The new analytics are made available through PISTIS.

Step 4 - After the interaction with PISTIS:

- Improved driving style and driver risk assessment solution that can more realistically infer a driver's risk (to be evaluated with real drivers in a small-scale study).
- Calculation of events (relevant to the calculation of driving risk) from raw data (e.g., trip data or anonymised trip data) to feed into risk prediction models.
- Compute: risk score for drivers considering their driving style, geo-location and time and driving style out of vehicle movements.
- Sell service: Alert drivers using a mobile app based on the risk events in their driving corridor and show risk-events to risk managers on a map (event dashboard) and let them explore.

The measurement of the actual impacts will be provided in deliverable D5.3 and the process for evaluating this progress is set out in Chapter 18 of this document.

10.2 USE CASE 3.1: TRAFFIC QUALITY ASSESSMENT.

Driving patterns of vehicles will be analysed in their temporal, spatial and situational context using vehicle sensor data (connected car data via CARUSO). From this data, specific information is calculated, e.g. acceleration, speed, and fuel consumption patterns along a specific route at certain times and their correlation with weather and air quality. These insights are used as input parameters for urban analytics applications facilitating planning processes, such as emission models or the hot-spot detection of stop-and-go patterns. This generated information is also used for incentivising green driving styles and mobility decisions (such as reducing the share of motorised individual transport in the modal split of a commute) and optimising potentials for greener transport in the context of mobility management. Novel urban analytics components will be prototyped, including input parameters for emission models and traffic quality parameters, as well as mobility management services and mechanisms for companies to promote more sustainable driving styles.

10.2.1 Ambition of Use-case

The **goal** of this use-case is the development of two demonstrators: urban analytics and corporate mobility management. This will entail the exploration of new datasets, including previously unknown sources, and establish mechanisms for selecting only the right sources that are truly relevant and available on a stable basis.

a) Urban analytics

This will involve urban car traffic quality assessment with combination of geospatial time series data to generate an emission model. The combination of floating car data and detector data to estimate traffic volume, with acceleration patterns and locations of individual vehicles provided by CARUSO, allows the generation of an in-depth model of estimated air pollution levels for various road segments.

Subsequently, road segments with significant pollution levels are identified and clustered based on both temporal and spatial factors. This clustering not only enables a clear visual representation of pollution hotspots but also allows for detailed statistical analysis, offering deeper insights into the dynamics of traffic congestion and its environmental impact.

This results in an improved model of the environmental impact of road traffic on the surrounding environment, facilitating the implementation of targeted traffic planning measures in order to strategically minimise the burdens to the cities and communities.

b) Corporate mobility management

This will entail a dashboard integrating real-time data on weather conditions and emission levels across selectable locations. It actively encourages eco-friendly and healthy commuting by recommending sustainable transport options like bicycles or public transport. The recommendations consider user-specific factors such as the starting point and destination of journeys, but also generalisable factors such as current environmental conditions like temperature (provided by UBIMET), precipitation (provided by UBIMET), risk-zones (provided by VIF) and air quality (using the data generated in the urban analytics use case). Recommendations are based on textual hints, called nudges, that encourage the user to make an environmentally conscious choice of transport.

10.2.2 Challenges Faced

The **problem** faced is that there is insufficient real time driving data (acceleration, speed, fuel consumption patterns) and that their interrelation with weather poses challenges for urban traffic planning to be able to incentivise green driving styles and optimise greener transport options within corporate mobility management, by using real time weather data.

PISTIS will provide support to the integration and combination of diverse data sources, enabling informed decision and real-time analysis and prediction a well as support to the integration of driving data, driving style and risk assessment, street graph data, and live weather data.

10.2.3 Target Audience Descriptions

10.2.3.1 Data Owners

External

TRAFFION has access to vehicle data, floating car data and public transport data. These data sources are already in use and available.

Additional road networks based on OpenStreetMap data are used as reference point to combine the data and use as a standardised reference.

Internal

CARUSO can provide access to vehicle data used to characterise emissions based on vehicle type, speed engine RPM and other factors.

UBIMET can provide access to current weather data.

VIF can provide risk events for further use by Trafficon.

10.2.3.2 Data Seekers

Internal

Trafficon seeks data from UBIMET, VIF and CARUSO via the Pistis Platform. In addition, external data described above is imported in other means.

10.2.4 Data Landscape: Traffic Quality Assessment

Data Type	Data Provider	Internal/ External	Data Consumer	Data Availability	Data Format	Plan for accessing Data if not available	Risk level/ Amelioration strategy
Vehicle sensor data	CARUSO	Internal	TRAF	Available	API	Not/applicable	n/a
Vehicle data	CARUSO	Internal	TRAF	Available	API	n/a	n/a
Fuel/Emission data	CARUSO	Internal	TRAF	Available	API	n/a	n/a
Weather Data (live)	UBIMET	Internal	TRAF	Available	API	n/a	n/a
Vehicle Detector	TRAF	External	TRAF	Available	DATEX2	n/a	n/a
Public Transport Data	TRAF	External	TRAF	Available	OSM-CSV	n/a	n/a
Floating Car Data (FCD)	TRAF	External	TRAF	Available	JSON	n/a	n/a
Road Graph Integration OSM	TRAF	External	TRAF	Available	OSM-CSV	n/a	n/a
Risk Events	VIF	Internal	TRAF	Depending on Use Case 3.2	CSV & API	n/a	n/a
Emission Model	TRAF	Internal	TRAF	Depending on Use Case 3.1 (a)	CSV	n/a	n/a

Table 20: Data Landscape: Traffic Quality Assessment

10.2.5 Summary of actions for Use Case #3.1: Traffic quality assessment

Before interacting with the PISTIS platform:

- Pre-processing to fit the data into the data model of the software products, e.g., uniform time series.
- Agreement on conditions for data sharing.
- Define licensing and policies to use the data.
- Data quality assessment, transformation & analytics.
- Integrating a road graph (e.g., OSM).
- Data harmonisation.

Step 1 - Input provided to PISTIS:

- Decision to share data (entire dataset or preliminarily a sample, as deemed necessary) through PISTIS.
- Processed data made available for querying through API.
- The Integration of floating car data (if available).
- Provision of driving/car and accidents data.
- Provision of safety data.
- Provision of driving data.
- Provision of live weather data.
- Transmit vehicle sensor data/connected Car Data (fuel consumption, risk, driving styles).
- Transmit street graph data.
- Transmit public transport data.
- Data visualisation dashboard for urban analytics and (Corporate) mobility management.

Step 2 - Output retrieved from PISTIS:

- Retrieve the data (sample or entire data set).

Step 3 - Data quality assessment and generation of new analytics (through PISTIS or offline):

- Implementation of data resolution, calculation of hotspots and calculation of correlations/recommendations.
- Data quality assessment, data decryption and - if necessary - preprocessing
- Combine spatial data and live traffic data.
- Interact through the database through a web-app (frontend).
- Interact through a Service oriented Architecture (e.g., APIs).
- Monitoring system checking that data is correctly transferred and that it is used as agreed in the licences.
- The new analytics are made available through PISTIS.
- Data will be combined (e.g., weather data and traffic flows) and analysed, including statistical and geospatial analysis.

Step 4 - After the interaction with PISTIS:

- Data will be modelled for user interaction through GUI.

- The results will be made available for platform users.
- Consider options on how to display risks or make risks visible to drivers.

10.3 IMPACTS EXPECTED FOR THIS DEMONSTRATOR HUB

The impacts expected for this demonstrator hub based on the scenarios set out above include:

- Improved driving risk inference (based on additional data sources available through PISTIS).
- Improved driving style detection.
- Greater availability of datasets to improve AI model training (for risk prediction and driving style detection).
- Reduction of data being transferred from vehicle to data centre.
- Greater objectivity in driving behaviour and driver risk assessment.

The measurement of the actual impacts will be provided in deliverable D5.3 and the process for evaluating this progress is set out in Chapter 18 of this document.

10.3.1 Impact for the Organisation

The Use Case Leader, VIF, can refine a research prototype accordingly and assess its usefulness with two target groups, drivers, and transportation managers interesting in risk mitigation.

10.3.2 Impact for the Data Owners

When the solution is released to the market (as a future project exploitation activity), data owners can receive financial compensation for their contribution, opening new opportunities to monetise their data. PISTIS will enable sharing and monetising data (including the valuation of data assets and price estimation).

10.3.3 Impact for Collaborators (Data Seekers)

As a data seeker, VIF will be able to increase the value of its driving risk prediction solution based on the availability of additional data sources provided by PISTIS.

10.3.4 Impact from cross-cutting hubs and Living Labs activities.

Collaboration with the other hubs may result in a cross-use of developed artifacts from the use cases (e.g., a traffic risk manager operating in the city of Athens may use parts of the automotive hub solution).

10.3.5 Impact towards wider exploitation goals

There is no event-based driver risk assessment available on the market that integrates a variety of historic and current data sources. The availability of such a system (as will be developed in this use case) will make a significant contribution to the EU Road Safety: Towards Vision Zero program.

11 HOLISTIC APPROACH: CROSS-CUTTING AND SUPPORTING ACTIVITIES

T5.6 will deal with the deployment of the three PISTIS instances which are considered horizontal to the above-mentioned core demonstrators:

- The instance to trade weather data which will be developed by UBIMET.
- One domain agnostic, to act as a playground by the Living Lab participants (to be hosted by SPH).
- One for serving selected open data via connecting to the EU Open Data Portal, which will be hosted by FGH which implemented the EU Data portal.

Whilst the activities and contribution which the Weather Hub can make, as a cross-cutting demonstrator, were clearly envisaged in the DoA, this is not the case for the Open Data Hub, whilst the specific contributions expected from the Living Lab hub remain to be determined in any detail.

It is too early in the project to fully appreciate the value which all three of these activities will bring to the individual demonstrators and to the overall exploitation effort for the project as a whole.

We will touch on some of the issues to be scrutinised as the project develops and make some comments on how this work may progress and how we look to evaluate its impact where it has an effect on WP5 activities. But we will look more closely at this topic in the coming months and report on our deliberations and expectations and how these will be met and evaluated in D5.2 and D5.3.

11.1 WEATHER HUB

This is an example of PISTIS instances which are considered horizontal. An instance to trade weather data will be developed.

Weather data are valuable in all demonstration hubs, however, with a different focus. For example, this includes static data (historical reanalysis data sets, e.g. Use Case 3.1. (Automotive Hub) to real-time data exchange via e.g. API (UC1.1 and UC1.3 mobility hub) through to derived data (energy forecasts for renewables, UC2.3 energy data space). For all these scenarios a bidirectional communication is necessary, i.e. the end-user/stakeholder needs to be able to select specific parameter sets and geographical areas.

Connecting the weather data space to the mobility, urban planning, energy, and automotive data spaces can unlock a wealth of benefits and enable a wide range of innovative applications.

Direct data integration

The weather data space will be integrated with the other data spaces through standardised data formats, protocols, and governance rules. This allows for seamless data exchange between the data spaces, enabling organisations to access and analyse weather data in conjunction with their own domain-specific data. For instance, the stakeholders in the automotive data space can leverage meteorological reanalysis and real time information to

assess weather-related driving risks, while energy providers and distributors can forecast energy production and grid capacity based on weather patterns.

Data federation

The data federation approach via the PISTIS framework involves establishing a central platform that connects the weather data space with the other instances/demonstration hubs. This architecture acts as an intermediary, managing data exchange and ensuring compliance with data privacy regulations and governance policies. Data federation facilitates more complex analyses that involve combining data from multiple sources, such as analysing weather patterns and traffic data to predict disruptions or optimising energy consumption based on weather forecasts and occupancy patterns.

API integration

The weather data space exposes APIs and other data sharing interfaces that enable other data spaces to access and integrate weather data into their own applications and systems. This approach provides flexibility and allows for integrating weather data into existing workflows without significant changes to underlying data structures or processes. For example, urban planning organisations could leverage weather data APIs to dynamically adjust building energy management systems or update traffic signal timing.

Connecting data spaces across different sectors and domains has the potential to transform the way organisations operate, make decisions, and innovate. As data becomes more ubiquitous and interconnected, the value of connected data ecosystems will only grow.

Enhanced decision making: By combining data from multiple sources, organisations can gain a more comprehensive and insightful view of their operations and the broader environment. This information can be used to make better informed decisions about resource allocation, risk mitigation, and strategic planning.

Improved optimisation: Data-driven optimisation can be achieved in various areas, such as traffic flow management, energy consumption, and urban planning. By analysing weather data in conjunction with other domain-specific data, organisations can optimise their operations and reduce costs.

Accelerated innovation: Connected data spaces foster a collaborative environment where new data-driven products and services can be developed and deployed more rapidly. Cross-disciplinary teams can leverage combined data assets to create innovative solutions that address complex challenges.

Enhanced data governance: Federated governance models ensure that data remains under the control of its owners while facilitating authorised access for collaboration. This approach balances data privacy with the need for data sharing and innovation.

11.1.1 Potential contribution to core hubs

11.1.1.1 Mobility and Urban Planning Hub

Contribution to optimising aircraft turnaround time (Use-Case #1.3)

The first use case revolves around the optimisation of aircraft turnaround time, employing weather data and UBIMETs innovative lightning detection systems as a strategic tool in various aspects of aviation operations. Firstly, weather data proves invaluable in predicting potential flight delays and disruptions. Armed with this predictive capability, airlines and ground handlers can proactively adjust schedules and resource allocation to minimise turnaround time, enhancing operational efficiency. Additionally, weather data plays a critical role in informing crucial activities such as de-icing and snow removal operations, ensuring that aircraft are prepared for take-off promptly in adverse weather conditions. Furthermore, the integration of weather information into aircraft routing and flight planning enables the optimisation of routes, minimising detours and enhancing fuel efficiency. This not only reduces operational costs for airlines but also contributes to a decrease in overall fuel consumption and emissions, aligning with the industry's sustainability goals. In essence, the strategic utilisation of weather data proves integral to streamlining aircraft turnaround processes and improving overall performance in the aviation sector.

Improving passenger experience

Several of the use cases within the Mobility Hub are designed to enhance the passenger experience, reducing risks in delays and missed flights, better baggage handling processes etc. This use case centres around enhancing the passenger experience within the aviation industry, leveraging weather data to address various aspects of travel.

Firstly, weather data proves instrumental in keeping passengers informed by providing real-time updates on flight delays and cancellations. This proactive communication helps manage expectations and enables passengers to make informed decisions about their travel plans. Additionally, the strategic integration of weather information contributes to optimising passenger flow within airports, mitigating congestion and streamlining the overall airport experience.

Moreover, weather data plays a crucial role in improving the comfort and safety of passengers. By utilising this data, airports can make informed decisions regarding adjustments to temperature and lighting in terminals, creating a more pleasant and secure environment for travellers. In essence, the thoughtful application of weather data not only facilitates better operational management but also significantly contributes to an enhanced and more enjoyable journey for air passengers.

Enhance airport safety and resilience.

Here, the focus is on elevating airport safety and resilience through the strategic application of weather data. Primarily, weather data proves indispensable in predicting and mitigating the impact of severe weather events on airport operations. By leveraging advanced forecasting, airports can proactively implement measures to minimise disruptions caused by adverse weather conditions, ensuring the safety and well-being of passengers and staff.

Additionally, weather data plays a crucial role in identifying and addressing potential safety hazards, such as assessing conditions for slippery runways and icy taxiways. This information enables timely interventions to maintain optimal safety standards. Furthermore, the integration of weather data is instrumental in the development and implementation of comprehensive emergency response plans. These plans are designed to address various scenarios, ranging from extreme weather events to other unforeseen circumstances, contributing to the overall resilience of airport operations. In essence, the strategic use of weather data emerges as a cornerstone in fortifying airport safety measures and bolstering the ability to respond effectively to challenges, ensuring the continuity of operations even in adverse conditions.

11.1.1.2 Energy Hub

Contribution to increasing the hosting capacity of the grid (Use Case #2.1)

The first use case revolves around augmenting the hosting capacity of the grid through the strategic utilisation of weather data. By employing weather forecasts, grid operators gain the ability to foresee fluctuations in electricity demand and renewable energy generation. This foresight proves invaluable in optimising power dispatch, ensuring a stable and efficient grid operation. Furthermore, the integration of historical reanalysis data offers insights into past weather patterns, facilitating the identification of potential bottlenecks within the grid infrastructure. Armed with this information, grid operators can make informed decisions regarding investments and upgrades, effectively addressing vulnerabilities and enhancing the overall resilience and capacity of the grid. Thus, the judicious application of weather data emerges as a key enabler in the continuous improvement and sustainability of the energy grid.

Contribution to Investment deferral (Use Case #2.2)

The second use case centres on the strategic deferral of investments through the judicious application of weather data. Weather forecasts serve as a crucial tool in predicting electricity demand and renewable energy generation, enabling grid operators to make informed decisions about delaying investments in new power generation and transmission capacity. By leveraging this predictive capability, grid operators can effectively manage resources and optimise existing infrastructure. Additionally, historical reanalysis data comes into play, offering a retrospective analysis of past weather patterns. This analysis aids in pinpointing areas of the grid most susceptible to disruptions. Armed with this knowledge, grid operators can strategically channel investments to enhance the resilience of the grid in targeted areas, minimising the need for extensive and premature infrastructure expansion. Thus, the integration of weather data emerges as a key factor in facilitating cost-effective and strategic investment deferral while maintaining the robustness of the energy grid.

Optimisation of renewable energy production

The third use case focuses on the optimisation of renewable energy production through the strategic application of weather data and energy forecasts. These forecasts play a pivotal role in this context, providing real-time insights that enable the fine-tuning of the operation of renewable energy generation assets, including solar panels and wind turbines. By leveraging these forecasts, operators can align the energy production process with prevailing weather conditions, maximizing efficiency and output. Moreover, historical reanalysis data emerges as

a valuable tool for long-term planning. It aids in identifying optimal locations for new renewable energy projects, taking into account historical weather patterns. Furthermore, this data assists in assessing the sustained performance potential of these projects over the long term, allowing for informed decision-making in the development and placement of renewable energy infrastructure. Thus, the integration of weather data proves instrumental in not only enhancing the current operational efficiency of renewable energy assets but also in shaping future investments for sustainable energy production.

11.1.1.3 Automotive Hub

Weather data plays a pivotal role in the automotive hub use cases, influencing various aspects of driving decisions.

Route Planning

Firstly, it proves instrumental in route planning by enabling the avoidance of hazardous weather conditions and facilitating the selection of the most efficient route to a destination. Moreover, weather data is harnessed to fine-tune vehicle performance parameters like engine power and traction control, thereby optimizing overall performance and enhancing safety across diverse weather scenarios.

Driver assistance systems

Additionally, the integration of weather data is crucial for empowering driver assistance systems, including features like adaptive cruise control and automatic emergency braking. By leveraging this information, these systems contribute to improved safety on the road and alleviate the workload on drivers, exemplifying the multifaceted impact of weather data within the automotive context.

11.1.2 Technical elements in relation to core hubs

Functional requirements

Data request submissions – data users should be able to submit requests for weather data through a data space. These requests should include the following information:

- Locations: Latitude and longitude (coordinates) of the requested location or region.
- Meteorological parameters: The specific meteorological parameters required, such as temperature, precipitation, wind, cloud cover, irradiation and more. The full set of available parameters will be published in the data catalogue/repository.
- Forecasting horizon: The desired forecasting horizon, for example 1-day, 3-days or 7-day ahead forecasts.
- Update frequency: The desired update frequency for weather data, e.g., real-time, hourly, daily.
- Energy forecasts: Additionally, for energy forecasts, site specific parameters need to be shared to be able to provide accurate forecasts. This includes master data such as location and orientation of the PV panel(s), maximum nominal production, and, if available, time series of production.

Data description – The globally accessible data catalogue needs to provide detailed description of the available weather data, including:

- Data types: The specific data types offered, such as historical reanalysis, real-time data, meteorological forecasts, energy forecasts, and lightning data.
- Geographic coverage: The geographical regions covered by the individual data.
- Temporal coverage: The temporal range and availability of the various data sets.
- Data formats and interfaces: The supported data formats for delivery, such as GeoTiff, CSV, JSON, and XML. Additionally, the delivery or data sharing methods, such as APIs, FTP/SFTP, Kafka servers, or other suitable methods.
- Data quality information: Information on the quality and origin of the provided weather data.
- Search and discovery: The data catalogue should enable efficient search and discovery of relevant weather data based on various criteria, such as location, weather parameters, forecasting horizon, update frequency, and data formats.

Moreover, data access policies should be available and editable for different data users, specifying which data is accessible for which user and under what conditions.

11.2 FURTHER SUPPORT FOR THE CORE HUBS

The previous section covered the potential impacts which the cross-cutting Weather Hub may have on the three core hubs. This was designed within the project as a key element.

We need to continue to build on and enhance these activities being carried out by the core hubs. But it is not expected that we should have the answers to all the issues surrounding the support which can be provided to the three core hubs by the Weather Hub, the Living Labs and by the Open Data Factory. This aspect was less explicit in the DoA compared with the identification of how progress should be made with the core demonstrations. Indeed, it is a matter of “walking before we can run”.

The basic demonstration hubs need to be well-organised and functioning before the extent of support needed and support available can be considered fully. Hence the following sections are touching on the issues which we will only be able to fully document in the following deliverable, D5.2.

11.3 LIVING LAB

The Living Lab has a wider variety of functions in addition to lending support to the core demonstrators, and as such, its activities will be planned and evaluated within WP6, which will have its own KPIs etc. The deliverable D6.1 establishes the core functions and activities for the Living Lab, which also sets out means to measure the results of the activities and to track progress towards the planned goals. Here we are only concerned with the Living Labs from the perspective of how the actions to be carried out by the core hubs within WP5 can be enhanced and consequently, how these should be planned. Any evaluation aspects will be restricted simply to the achievement of any goals identified by the demonstrators regarding how the Living Labs may be of benefit to the demonstration activities. The concern is with potential enhancements and increased value which they may contribute to the effectiveness of the demonstrations as a whole.

As stated above, we will return with greater detail in later WP5 deliverables and cover this within the evolving online "Demonstration and Evaluation Plan". Below we are signposting just how these Living Lab activities can enhance the detailed demonstration activity through its deliberations, insights and outcomes.

The PISTIS "User-Driven Innovation Approach" will be realised through the establishment of the project's Living Lab which provides a mechanism for the sharing of experiences, knowledge exchange and integration through user and business-driven open innovation. The PISTIS Living Lab fulfils a wide-ranging set of functions which are covered in D6.1.[30] The specific area which we are concerned with here, is in obtaining feedback from major stakeholders, end-users and targeted beneficiaries throughout the project duration, in order to optimise all the project developments by properly addressing their critical needs. The Living Lab will invite stakeholders of the different data spaces to engage in order to acquire direct feedback from external to the consortium parties, through to the evaluation and full deployment stages of the project.

The PISTIS Living Lab will establish the mechanisms for reaching out to external stakeholders and involving them in the continuous co-creation and co-validation of the project results. Through the Living Lab external stakeholders will obtain free access to the PISTIS Solutions, experiment with it and provide feedback for its further improvement. Moreover, data collected, and derivative data generated by the project will offer "indirect" open access to the project partners' assets and will allow data value chain stakeholders to work with them, extract insights and realise new value either by optimising their operations or by introducing novel services. It is this interaction with the core demonstrator hubs which WP5 is most interested in within this deliverable.

T6.4 activities will define various interaction and collaboration mechanisms so that the Living Lab will be properly organised and planned in close collaboration with T6.3 and with the WP5 demonstration hub tasks. A set of targeted Living Lab engagement workshops will be conducted, coordinated by the task leader and organised by the demonstration partners. Whilst several functions are envisaged within WP6 for the Living Labs, the aspects we are concerned with in WP5 are principally the involvement of end users in the requirements definition activities of the project and the involvement of all stakeholders in the evaluation of PISTIS results.

The overall process will aim at establishing an open innovation 2.0 and value co-creation framework, involving all end-users and stakeholders, either directly participating in or affected by the project and ranging from the project consortium partners to relevant end-users and stakeholders, along with scientific, technological and business communities. The consortium will also engage with Digital Innovation Hubs (DIHs) and Small Medium Enterprises (SMEs) actively involving them in the requirements elicitation process and utilising their feedback on testing and verifying T5.6 outcomes.

It is anticipated that this will provide potential contributions to the enrichment of the core demonstration activities, of benefit to all involved. Through the Living Labs, we have mentioned how the data value chain stakeholders might extract insights and realise new

[30] PISTIS D6.1 Dissemination, Communication, Liaison, Training and Living Lab Plan v1.0.docx (sharepoint.com)

value. But this should be a two-way process with the demonstrator hubs benefitting from these interactions. Such open access will be applicable during the implementation of the project. For the post-project period, open access will be provided for Open-Source software components under an easy licensing scheme (e.g. Apache License 2.0).

The PISTIS Living Lab objectives of significance to the demonstration activities include:

- Facilitation of the co-creation process, whereby the potential end-users are involved through interactive workshops, collaborative input provision / discussion / interviews (or other means to provide feedback).
- Engagement of the actual end-users in the project's requirement collection phase.
- 'End-users' inputs for the customisation of technology and validation against real market and users' needs, once the beta version of the platform is developed.
- Facilitation of PISTIS Platform adoption by the end-users and support to the definition of the end-product.
- End-user involvement to the PISTIS impact assessment and evaluation.
- Improving business processes or developed products/services with a support of PISTIS solution.
- Contributing to the novel approaches or ideas in stimulating the data-driven business models and practices.
- Networking, learning and creating new partnerships thanks to a positive exposure *vis-à-vis* the project's industry and academia partners and other participants of the Living Labs.

The PISTIS Living Lab focuses on engaging stakeholders to co-create innovations. As such, stakeholders become central for the Living Lab and in considering the stakeholders to approach, we should also include the criteria of how this participation will be of benefit to the demonstrators themselves. Furthermore, besides the external stakeholders (directly targeted end-users), the Living Lab will also contain PISTIS project partners as some of the key participants.

11.3.1 Potential contribution to hubs

The Living Lab model is strategically crafted to engage a diverse range of stakeholders, ensuring targeted benefits for end-users, project partners, and the broader ecosystem and serving as a catalyst for innovation.

Within the PISTIS Living Lab framework, SMEs find a valuable platform for co-creating innovations, addressing their resource constraints while contributing significantly to the European workforce and data market. Additionally, the Living Lab supports DIHs by providing access to technical expertise and testing opportunities.

Clusters and business associations, acting as multiplier organizations, play a crucial role in disseminating knowledge about the PISTIS solution among SMEs, contributing to broader awareness and understanding.

While PISTIS Project Partners are not direct target audiences, their multifaceted roles as research practitioners, technology providers, end-users, and innovation accelerators significantly enrich the Living Lab with diverse perspectives.

In the broader context of project advancements, the Living Lab activities involve project partners as knowledge and technology providers. In this regard, for Demonstrator Hubs, engagement with Living Labs becomes pivotal. By actively involving potential end-users of the PISTIS solution, these hubs can obtain valuable feedback and insights, fostering a dynamic environment for iterative development and improvement. Furthermore, PISTIS Living Labs play a crucial role in allowing partners involved in the three Demonstrator Hubs to leverage the process to validate their tools, which are meant to address real-world business problems, enhancing the overall impact and applicability of the PISTIS project.

Consequently, the Demonstration Plan will embrace a programme of Living Labs. More detail will be elaborated in D5.2 on how the demonstrators will be enhanced by these activities. when there will be greater familiarity both with the platform and how the demonstrators and Living Labs have interacted. An example of the contribution this process can make towards the deployments within the Mobility and Urban Planning Hub is that some key targets can be involved in the demonstration process at an early stage. These would include for example, the Airport Council International (ACI) and the International Air Transport Association (IATA) and the identification of new requirements from their perspectives can only lead to a greater depth and impact for the core demonstration activity.

11.4 Open Data Hub

11.4.1 Issues preventing greater use of Open Data

Whilst activities within the Open Data Hub, to be based at Fraunhofer, are still to commence, one objective for this hub is to pave the way for the core demonstration hubs to enhance their activities through access to “better” open data. From a data quality perspective, the different data providers often make their data available without continuously ensuring its requisite quality and reliability, which inevitably raises insufficient (or no) interest for use by other stakeholders. For example, open data repositories are used at far lower rates than was expected, which is attributed to uncertainties about data quality) and leads to the misjudged belief that data exposure is a cost centre only. In addition, the preparation of data for sharing and re-use is often an underrated procedure as the data need to be accessible, searchable and unambiguously understandable by external stakeholders.[31]

One role of the Open Data Hub will be to help reduce these barriers and encourage interoperable exchange of open data within PISTIS. A core resource available is the EU Open Data Portal, which was developed by Fraunhofer.

11.4.2 Value of the Living Labs in introducing Open Data

The work of the Living Labs will complement this activity and can act as an intermediary between the Open Data Hub and the three core demonstration hubs. The Living Labs will be bringing together the individual hubs with the stakeholders which have been identified. In any analysis of PISTIS and its utilisation of the core data in hand, a simple exercise can be carried out with regard to what other “open data” might be available to enhance the overall value of

[31] https://data.europa.eu/en

the demonstration activities and make the business propositions more attractive in the exploitation phase. Here the co-creation aspect of a Living Lab will come into play.

And the reverse process holds true, scrutinising relevant open data and questioning how that may be enhanced with output from PISTIS.

11.4.3 Potential contribution to hubs

At this stage of the project, there is a focus on getting the basic first steps in place, before we consider these open data aspects in detail. But we will address this in greater detail in D5.2 whilst further reporting on our endeavours in D5.3. But some flavour of how the demonstrations can benefit from access to Open Data can be seen from the examples below.

11.4.3.1 Mobility and Urban Planning Hub

Given the participation of the public sector in this hub, there is already a solid understanding of the role open data can play. Through DAEM, there is already a stated intention to explore and utilise portals of open data will be explored such as the data.gov.gr and gis.gov.gr etc. They will build further by organising open calls for submission of open data sets which can be published to interested parties. And open data identified by one hub may have added value to other hubs, such as the mapping. Map data (OpenStreetMap), and air quality data (open government data) can be utilised to focus on traffic quality assessment in urban areas, as well as addressing environmental concerns.

11.4.3.2 Energy Hub

In the case of the Energy Hub, the aim is to demonstrate the use of flexibility markets, which involves a relatively closed exchange of data among participants. The distribution company holds data on the grid to study its status, while the aggregator will close data exchange contracts with private clients, and market clearing is public.

This doesn't mean that the use of open data isn't relevant. For the distribution company, leveraging weather data to enhance predictions is crucial. In this scenario, there are various options, such as national weather systems from different meteorological stations where data can be obtained.

On the other hand, the data enriching the datasets of the partners are not limited solely to direct application in the flexibility market. For studying the evolution of the power grid, demographic data to correlate demand evolution in certain areas, or trends in DER (Distributed Energy Resources) deployment data, are highly relevant for enriching the existing datasets.

In the case of PISTIS, where data valuation will be studied, any data from open sources that can add value to the data from each of the partners is necessary to increase the economic value of the datasets.

11.4.3.3 Automotive Hub

The automotive hub makes general use of open data with respect to geographic maps and street graph data from the open street map project. Furthermore, we regularly screen the

data shared within the Austrian mobility data space[32] and the Austrian open data dataspace[33] and assess its usefulness for our use cases.

Collaboration with the other hubs may also result in a cross-use of developed artifacts from the use cases (e.g. a traffic risk manager operating in the city of Athens may use parts of the automotive hub solution). Open data in use in Athens may enhance the product further.

11.5 CONCLUSIONS

Thus, from the above, the three cross-cutting supporting initiatives can be seen as having the potential to create considerable additional value to the three core demonstration hubs. There are clear examples above, of how the more mature Weather Hub can contribute, whereas the contributions which the Living Lab and the Open Data Factory can make will emerge in due course. The overall philosophy of the PISTIS project, underpinned by the process of "agile software development" is well suited to the creativity which will be needed in scrutinising the wider data landscape and in bringing more data and more insights into the demonstration process. This in turn will enhance the final product and increase the potential for exploitation.

Task 5.6 states that "It will also propose improvement actions, interventions and measures to be applied for successfully paving the exploitation path of the project. Evaluation will also pay special attention on assessing the cost-efficiency and viability of new business models developed by the project in WP7." This supporting hub work can make a valuable contribution.

12 DEMONSTRATOR'S TECHNICAL REQUIREMENTS

The technical requirements for the PISTIS platform have been developed and defined within WP1. The main testing will occur within WP4 but there will be aspects of the evaluation process to be carried out within WP5, where these requirements relate to the technical adaptations which may be needed at the demonstration sites. They have been identified by the demonstrators according to their own specific internal circumstances, with the purpose of establishing compatibility with the technical developments foreseen for the PISTIS platform.

Further, the process for eliciting all the remaining necessary requirements will be made explicit in the initial Demonstration Plan set out in Appendix 2 to this document and which will evolve.

The Alpha version will offer basic functionalities (as described in the final MVP set out in D1.4 and in deliverables D3.1 and D4.1.) This will include Data Sources Connection and Closed Group Data Collection. From the demonstrator's perspective, their role in the early months is simply to monitor activity to make sure they will be able to meet any technical requirements which they might need to deploy at their sites. Closer to completion of this development

[32] https://mobilitydata.gv.at/
[33] https://data.gv.at

stage, they will be called upon to give feedback on the user interfaces emerging to also ensure that they meet their requirements.

So, prior to the availability of the alpha version, the main technical interaction between the development team and the demonstrators will be ensuring that their viewpoint remains in focus and so that the demonstrators can plan what technical developments and interfaces, software etc will be required for them to be able to integrate with the PISTIS platform.

In the period in which the alpha version is under development, this scrutiny by the demonstrators with regard to the ongoing technical work will focus on topics such as:

- Addressing the system from a position of being able to recognise whether it is appropriate to their needs as it is evolving.
- The extent to which a product or system can be used by the specified users in order to achieve the specified goals of learning to be able to use the system with effectiveness, efficiency, freedom from risk and satisfaction in using it.

Specifically, what will come to the fore will be ensuring that the user-interfaces are suitable covering such aspects as:

- The degree to which a product or system has attributes that make it easy to operate and control.
- The degree to which a system protects users against making errors.
- The degree to which a user interface enables pleasing and satisfying interaction for the user.
- The degree to which a product or system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.

Lessons Learned at this stage by the demonstrators should be documented, whilst maintaining a watch for material which might be of value to the training programmes being created.
But, given that we are a long way from having an alpha version to interact with at each demonstration site, we do not expect to have a clear and detailed set of requirements until the alpha version is close to appearing at M21. Technical work to be carried out by the demonstrators, whilst identifying which software, APIs etc they will need to deploy locally to meet their own demonstrators use-case requirements, will focus on interacting with the technical teams to ensure that their own preparation work will cover all that is going to be necessary to implement locally.

Key roles will be played by the technical representatives of the three core hubs to ensure that the needs of both the technical teams and those of the demonstration hubs are compatible. Interaction and useful feedback will be the key activity in these early months, until more focussed work can be carried out as the alpha version matures.

As a consequence of the timing of the alpha release, much detail will need to be reported in D5.2 with evaluation of the outcomes being reported fully in D5.3.

An ongoing process has started with questionnaires and tables designed to capture these emerging local requirements. Each use case will need to consider during this process, what they need also to deploy in order to have an application/service from their side that will

consume the data retrieved from PISTIS (or provide data to PISTIS). At some point, these demonstrator-specific requirements will tally with what the technical teams developing the main platform will expect, with compatibility being the clear objective. Minor omissions of basic software packages being not available at a demonstration site can cause unnecessary delays.

Discussion points being captured initially at the outset of the WP5 activities included:

- How Datasets are to be retrieved from the local infrastructure.
- Transformation needs.
- Data Enrichment needs.
- Will datasets go through a quality assessment before placing them on the market?
- Is anonymisation to be used?
- Will datasets be checked against GDPR?
- Will you use Searchable Encryption?
- How would you sell datasets -to individual purchasers or to many parties?
- Would you sell the NFT to the dataset (and transfer ownership)?
- Would you use the Dataset Investment option (selling part of the dataset ownership)
- Would you like to monitor if your sold datasets are used according to agreements?
- Will you exchange datasets encrypted or not?

Outcomes of such dialogues for example, taking the last point, might indicate to the need to utilise legiSPOFtion to store the data encrypted in the PISTIS factory if the answer were to be "encrypted".

Questionnaires have captured some basic needs, but having the agile software development accompanied by the demonstrators having technical representation within the development teams will enable the necessary liaison activities to be carried out to ensure that all technical requirements are identified in time to deploy and subsequently test the alpha version. Templates for easily reporting bugs will be created.

There will be a rolling review, to the scheduled timetable for the demonstration plan, of all the demonstrators' technical requirements, so that they are fully equipped to deploy the alpha version when it becomes available.

13 Legal and Ethical Considerations for Demonstrator Hubs

This chapter sets forth the legal and ethical considerations for demonstration hubs with the aim to guide the technical partner responsible for the operation of the PISTIS platform, as well as the demonstrators, in implementing the project use cases in compliance with the legal requirements and ethical principles that have been identified in the previous project deliverables of D1.1 — PISTIS Operation Principles and Context Detailing[34] and D9.1 - OEI - Requirement No. 1.[35]

[34] PISTIS D1.1 PISTIS Operation Principles and Context Detailing v1.0.docx (sharepoint.com)
[35] PISTIS D9.1 OEI - Requirement No. 1 v1.0.docx (sharepoint.com)

In PISTIS, legal and ethical compliance has the utmost importance as it has been recognised as the main facilitator and enabler of trust in data spaces. However, creating and maintaining trust requires the operators and the users of data space to take into account various ethical and legal considerations to ensure responsible and lawful use of data and to create a level of comfort and trust among data space users. In that regard, PISTIS follows the guidance of the EU lawmakers considering that the significance of trust in data sharing has been consistently and repeatedly noted in the recitals of Data Act, Data Governance Act and Digital Services Act. Furthermore, PISTIS considers also that integrating artificial intelligent technology into data space introduces additional challenges to creating trust among the users due to the complexities of AI systems.

The identification of the legal and ethical considerations has started with the initial plotting of the legal requirements in EU legislation that are likely to be applicable to the PISTIS platform and technologies in D1.1 — PISTIS Operation Principles and Context Detailing and the preliminary ethical assessment of PISTIS in D9.1 — Other Ethics Issues (OEI) – Requirement No.1. Considering that PISTIS aims to enable data sharing among a multitude of sectoral sub-data spaces within its urban planning and mobility, energy, and automotive hubs, the legal and ethical considerations focuses on EU cross-sectoral or horizontally applicable EU digital legislation such as the Data Act, GDPR, Data Governance Act, Digital Services Act, NIS 2 Directive etc that lays out principles and guidelines that apply to all sectors. This approach will enable PISTIS not only to create a baseline for the validation of project outcomes but also to produce and test best practice for cross-sectoral data spaces and consequently contribute to the development of common European data spaces.

It is recommended for the demonstrators to take into account these legal and ethical considerations, which are set out in the table below, during the demonstration hubs planning, and process and take the necessary actions in collaboration with their internal compliance teams, particularly in the thematic areas which are covered within these considerations. This approach will support development of PISTIS solutions in compliance with EU laws. Furthermore, it will help the consortium to verify and validate it in the forthcoming deliverables of WP5.

Ethical Considerations for PISTIS Demonstration Hubs		
1.	**Use Case Definition**	It is essential to have clear descriptions of use cases including any technologies, datasets, data processing activities they may involve in and their purpose(s). This will give the partners a better understanding of the nature, scope, context and purpose of the activities and help them determine any potential regulatory requirements, challenges or boundaries. Further explanations and guidance can be found in Chapter 3.4 of D9.1 – OEI - Requirement No.1.
2.	**Privacy and Data Protection**	The rights to privacy and protection of personal data are the fundamental rights and therefore they need to be safeguarded by the users and orchestrator of PISTIS digital ecosystem. Therefore, prior to making a dataset available in PISTIS platform, it is important for the data holder to check whether such dataset contain personal data. In such case,

		the personal data needs to be appropriately processed by all the relevant parties, including the data holder, data recipients and other third parties such as provider of data sharing platform and ancillary services in compliance with law.
3.	**Risk Assessment and Security**	Risk assessment is a critical ethical consideration when managing a data sharing ecosystem as it involves identifying, analysing, and mitigating potential risks associated with data handling. This process is essential for ensuring responsible and ethical data and AI practices. Identifying and assessing risks enables the users and providers of PISTIS services to implement appropriate security measures to prevent protect PISTIS data sharing ecosystem from unauthorised access, breaches and cyberattacks. Regular risk assessment is important to update security measures to address evolving cybersecurity threats.
4.	**Transparency**	It is important to be transparent about how data is processed and how AI-based services functions. Information on data processing activities and AI-supported operations should be made available and communicated in a clear and plain language by the operators of data spaces to the users and other relevant stakeholders.
5.	**User Control and Traceability**	Data space should preserve data holder's control over the data they generate and share within its legal boundaries. The availability of traceability mechanisms could be a measure consolidating such control.
6.	**Accountability**	Accountability in the context of PISTIS means the state of being responsible or answerable for data transactions and the provision of ancillary services in PISTIS platform and for their potential impacts. This acknowledgement of responsibility for actions, decisions, and assets is the fundamental step for creation of trust. Identity and access management in a data space may play an important role for ensuring accountability.
7.	**Fairness and Openness**	It is essential to create and ensure competitive, fair and equal playing field in the context of exchanging commercially sensitive data. This requires fair treatment of the users of PISTIS and avoid discrimination toward certain groups in data sharing and in the governance of PISTIS ecosystem. In addition, participation to the PISTIS ecosystem remains open to all organisations to ensure openness.
8.	**Data Accuracy**	The accuracy of the data made available in PISTIS is essential to prevent misinformation and potential harm. To maintain the accuracy, PISTIS project aims to develop and implement certain mechanisms that can correct inaccuracies and update outdated datasets.

Table 21: Ethical Considerations for PISTIS Demonstration Hubs

Legal Considerations for PISTIS Demonstration Hubs		
1.	**Compliance with EU Digital Legislation**	The EU Digital Legislation, particularly, the Data Governance Act, Digital Services Act, Data Act, AI Act, NIS 2 Directive regulate the digital infrastructures and data intermediation services that will be provided by PISTIS and thus the orchestrators, service providers and the users are required to comply with a number of conditions and requirements set therein, including adopting procedures to prevent fraudulent or abusive practices, unauthorised access, etc.
2.	**Compliance with Data Protection and Privacy Laws**	Any processing operations on datasets containing personal data should be carried out in compliance with relevant data protection and e-privacy regulations such as GDPR, e-Privacy Directive or other national data protection and e-privacy laws. Particularly, such processing operations should have at least one applicable legal ground stipulated in the relevant legislation. Furthermore, before using the PISTIS solution for processing personal data, it is always recommended for the users and the operators to carry out a Data Protection Impact Assessment to assess potential risks and to adopt necessary technical and organisational measures including data processing agreements, privacy policies etc.
3.	**Data Sharing Agreements**	Data sharing agreements to be used in PISTIS should have fair, proportionate, and non-discriminatory terms and conditions, outlining the permissible ways in which data can be used, shared, and processed by the recipient and provide legal certainty to the users.
4.	**Terms and Conditions**	The providers of PISTIS platform and of the relevant services should define and inform the users about the rules of a data space as well as the terms and conditions of the offered services. It is essential to notify the users, impose in a clear, plain, intelligible, user-friendly and unambiguous language, of their responsibilities and liabilities in relation to data transaction which they become party of, and of any conditions, restrictions, and/or limitations that the operator may impose.
5.	**Protection of Intellectual Property Rights**	Having necessary measures in place to protect intellectual property rights related to data including copyrights and *sui generis* rights is crucial to create trust in data sharing ecosystems
6.	**Access Control and Authentication**	Access control measures to restrict access to a data space and authenticate users to prevent unauthorized access need to be implemented.

Table 22: Legal Considerations for PISTIS demonstration hubs.

Building on these legal and ethical considerations, the evaluation of PISTIS solutions will be carried out with the aim to promote the operationalisation of the ethics-by-design-and-by-default approach, supporting the project compliance with the ethical principles constituting the core of the EU digital legislation and policies, and elaborating lessons learnt for the PISTIS

operations in real-life environments. For the evaluation of legal and ethical conformity which will take place in the forthcoming deliverables D5.2 and D5.3, the responsible partners will be invited to provide input to the checklist presented in Table 39 of this deliverable.

The partners' input will be taken into account as part of the project verification and validation framework for the assessment of legal and ethical aspects of the project results as indicated in Table 38.

14 DATA VALUE AND COMPENSATION/MONETISATION ASPECTS CONSIDERED

14.1.1 Data Valuation process

Data Monetisation is preceded by Data Valuation – a process that quantifies the value of data across several dimensions – some with their own sub-dimensions (data context, data quality, data utility, GDPR compliance, privacy and anonymisation etc.), before aggregating them under one composite data value score.

Before evaluating the monetisation process, we need to focus on the evaluation of the data valuation process. The literature on data valuation focuses on describing data valuation tools and processes, with their evaluation still receiving only limited attention and mostly focusing on reporting use cases about their application to selected data sets. A review of the literature allows us to identify the main steps leading to an evaluation protocol for data valuation:

1. Establish a definition of data value. In the context of PISTIS, data value is a complex, multi-dimensional process, consisting of quantifiable data value dimensions, which can be aggregated in a composite data value score. Additionally, it aims to provide mappings between technical data-centred outcomes and business outcomes.
2. Develop a tool for assessing the value of data. In the context of PISTIS, this would be the FAIR Data Valuation Component.
3. Select a group of potential users. The literature suggests that this should cover a variety of business roles (e.g., CEOs, CDOs, CTOs, head data analysts) from different business sectors (traditionally energy, insurance, banking). Through its demonstrator hubs, PISTIS has the advantage of bringing together a variety of business roles from the energy sector, as well as industries that have never engaged into data valuation processes (aviation, automotive).
4. Have the users at step 3 use the tool. The challenge is to have them engage with the tool for a significant amount of time in order to collect relevant output. Examples in the literature range from one-time uses to long term uses (8 months).
5. Organise debrief sessions. These may take the form of interviews, workshops, documented uses or surveys. We suggest an iterative process, coupled with technical development of the Data Valuation Component, and thus leading to its incremental improvement.
6. What are we measuring? Existing literature suggests a two-fold focus, on: (i) the efficiency of the data valuation tool with respect to predefined objectives and (ii) its usability. In PISTIS, we propose to quantitatively evaluate the **relevance** of each data

value dimension in the context of each demonstrator hub. Such information could provide insights into the challenging topic of valuation context formalisation. Next, such relevance-based measurements could be used to measure the **efficiency** of the data valuation tool; however, efficiency criteria will be defined together with the demonstrator hubs in the next period and will be included in deliverable D5.2. Finally, measures of **usability** should assess each of the following three aspects: the data valuation process, the scoring and aggregation system, and the complementary explanations.

In the upcoming months, we will be engaging with the partners in the demonstrator hubs, to refine each of the steps in the process above to the requirements imposed by each of their data use cases. What we expect from these sessions are clarifications on the following:

1. The confirmation or the possible extension of the definition of the value of data.
2. Getting feedback on the progress of developing the FAIR Data Valuation Component.
3. Define the user roles, which will be involved in or can be impacted by the data valuation process. These roles are those that will engage in the evaluation process.
4. Define minimum engagement requirements with the tool, for each user role.
5. Choose the type of debrief sessions and define their structure.
6. Define metrics for evaluating data value dimensions relevance, tool efficiency and tool usability.

15 THE CONTRACTING PROCESS

The PISTIS FAIR Data Trading & Value Exchange Monetisation Platform coordinates the Interaction between the Data Space Factories and oversees all data trading transactions and contracts. PISTIS provides Federated, Secure Data Sharing which includes:

- Secure peer-to-peer (encrypted/unencrypted) data transfer.
- Data usage monitoring/tracking
- Multi-party contracts
- Contract Compliance/Enforcement
- Data Value Contract Composer
- Data Contract Preparation
- Contract Drafting
- Contract Notification

Within the demonstration activities, actors within use cases are involved in the definition of relevant data contracts, details, terms of use, pricing policies etc and need to agree on conditions for data sharing. Smart contracts are to be created between users and these need to be stored.

A Scientific and Technical objective for the project is the provision of Smart Contract Execution, Enforcement and Governance Techniques & Services. In this case, we need to provide at least five different Data Contracts Templates for enriched and derivative data assets.

Whilst the demonstrators will be involved in checking that the technical requirements on their side are available and suitable, the only real input in the early stages of the demonstration phase will be to iteratively assist in designing and checking the user experiences associated with the contracting processes, at all its stages.

Feedback will be valuable to the development teams with regard to the effective management and on-chain storage of (multi-party) data contracts "in an inherently human-understandable manner." Similarly with the provision of the secure peer-to-peer data transfer and usage monitoring mechanisms for appropriately retrieving, provisioning, self-serving on-demand and tracking the appropriate data 'slices' according to the relevant contract provisions. Input will be required in improving automatic enforcement of conditions as agreed within data sharing contracts and the process of monitoring of the actual data usage in compliance with geography-based data use regulations.

More detail will only be available to be reported in D5.2 and evaluation results provided in D5.3.

15.1.1 Contracting and the PISTIS Business model

To ensure that the PISTIS business model is progressing in the right direction, we need to ensure that the platform:

- Supports the definition of relevant data contracts, details, terms of use, and pricing policies. This ensures clarity and agreement among all parties involved in data sharing. This requirement is fulfilled when the respective processes of data contract preparation and contract signing are executed.
- Enables the creation of smart contracts between users, automating and ensuring the execution of agreed-upon terms and conditions.
- Provides a secure storage mechanism for storing smart contracts and validation results, ensuring transparency and traceability of peer-to-peer transactions.

15.1.2 Contracting from the legal perspective

The Legal teams within the project will be well aware of the need for their expertise with regard to:

- The legally binding nature of the formalised smart data contracts.
- The need to monitor and lead the activities that relate to the GDPR, ethical, legal compliance of the project and the design of the legal clauses of the smart contracts.
- The need for the contract templates to adhere to the provisions of the Data Governance Act and the Data Act, focusing on regulating Data Spaces and Data Sharing and GDPR provisions.
- The need for the methods and tools to guarantee data ownership, sovereignty and IPR management, to keep data with the owners, increasing trust and security whilst providing accurate lineage and usage tracking of data in on/off platform scenarios.
- The Data Contract Monitoring and Management along with the Data Usage Monitoring and Management.

15.1.3 Contracting from the technical perspective

This section summarises the actions performed from the construction to the invoking of a contract in the context of PISTIS. Thus, in the context of the contracting process for data trading operations the main anchor is to convert the qualified legally binding contract templates into digital smart contracts. This conversion comprises the parameters that has been fleshed out during the compilation of the legal contract. Such parameters include the price and the usage control policies to be aligned with the privacy regulations so that the data provision process is GDPR compliant (e.g., the purpose of using the data, the allowed time of using the data, the ability to re-trade the data, etc.).

To deploy and instantiate such a digital smart contract is necessary to manage the consents of the involved parties (e.g., data provider and data consumer). Consent management is the action or process to manage user consent (in our case data provider and data consumer) for processing data[36]. Consent is usually protected using a variety of cryptographic mechanisms and collected using blockchain and smart contracts etc. For instance, consent management is handled by a blockchain-based platform where smart contracts are used for consent collection and access control. In addition, cryptography and asymmetric key pairs are used to assist the consent management process (e.g., digital signature on the smart contract).

In the context of PISTIS, the acceptance of the usage control policies included in the smart contract is an implicit equivalent to the data provider's consent, which is further validated with the data provider's digital signature, that is also been stored for provenance as part of the smart contract. Once this phase is finalised, the smart contract is instantiated and deployed and any data consumer, if allowed depending on the agreed usage control policies, can request to trade this specific data. Upon a data purchase, the data consumer signs the smart contract and consents on the contract terms (e.g., usage control terms).

In this context and considering the architecture and the design choice of PISTIS framework with the adoption of two different ledger infrastructures one focused on data identifiable objects and another one focused on monetisation related data, synchronisation is of paramount importance. One permissioned ledger is deployed as part of each Data Factory keeping more granular information about the user and the data and another one on the PISTIS cloud which is a permissionless ledger that keeps information for the transactions but without keeping any identifiable information. Such a design choice mandates a strong synchronization and mirroring between events that take place on the same piece of data. For instance, if a piece of data is traded by a consumer x, this needs to be stored on the data ledgers including the identifiable information and this event to mirrored without the identifiable information on the public ledger.

The initial step or contracting process is the actual deployment of the contract to the PISTIS Data Ledger. To do so, the Smart Contract Template Composer component creates the smart contract templates that include all the necessary parameters (in line with the legal aspects) and provides these templates to the Smart Contract Execution Engine component upon

[36] P. V. Kakarlapudi and Q. H. Mahmoud, "A systematic review of blockchain for consent management," in Healthcare, 2021, vol. 9, no. 2, p. 137

request. Then the Smart Contract Execution Engine finally deploys the smart contract to the PISTIS Data Ledger.

In addition, two types of actions are considered, one focused on the data provider to make his data available and another one focused on the data consumer who is willing to buy an existing dataset. In the first case, a data provider wishes to sell his/her dataset. During the data check-in phase, the PISTIS Data Ledger is capable to record metadata information auxiliary to what is kept by the Lineage Tracker (e.g., hash of data stored in Lineage Tracker and the associated UIID). Further, the PISTIS Data Ledger records actions performed on the data such as anonymisation actions, GDPR compliance report and applied encryption and keywords for auditability purposes. This flow starts from the optional Anonymisation of the dataset, continuing with mandatory GDPR check and finally with the optional Searchable Encryption functionality. Following all these steps the Data Provider initiates the process to make the data available for purchase.

In the second case, a data consumer requests the available dataset of interest and if such a dataset exists, he/she then can request to purchase it. The performed request for purchase is recorded to both PISTIS distributed ledgers. More specifically, the PISTIS Monetary Ledger stores the public information of the monetary transaction, and the PISTIS Data Ledger stores the private information of the data transaction

Table 23 below summarises the core operations that rely on the correct deployment of the contracts for the whole lifecycle of the data i.e. from the data check-in and storage on the factory side to the data query and trading. On top of that, a common aspect of these operations is the provenance and the auditability functionalities.

Functionalities	Description
Data Check-in Process for Data Providers Wishing to Sell Their Dataset	
Metadata Storage	The data provider records all the essential metadata to PISTIS Data Ledger, such as the dataset storage location (e.g., pointer), a unique dataset identifier, public keys, and signatures. This information is auxiliary to what is store to the Lineage Tracker.
Dataset Privacy Transformation	Prior to making the dataset available, the data provider may choose to apply certain transformations to enhance privacy of the data provider also in alignment with the regulations and standards. Thus, the PISTIS can offer (a) anonymization control through the PISTIS UI by using the Anonymization component and/or ensuring (b) GDPR compliance to automatically check the dataset and used mechanisms whether they abide with the GDPR according to a specified rule set using the GDPR Checker component. These two steps could run more than one times according to the data provider preferences. Subsequent to these parallel actions, the same contract is updated to reflect the transformations applied to the dataset.

Dataset Security Transformation	On top of the previous step, the data provider may choose to enhance the security of the dataset. Thus, security mechanisms such as searchable encryption for querying purposes and encryption with data provider's identity key for storage are also offered. Again, the same contract is updated to reflect these actions.
Making the Dataset Available	Once the dataset is ready, the data provider updates the contract to specify the terms under which the dataset can be accessed. This could range from conditions for sharing and reselling to permissions for editing the dataset, thereby making it available for potential buyers.
Data Availability for Data Consumers Wishing to Purchase a Dataset	
Dataset Discovery	Data consumers can search for available datasets through the Distributed Query Engine component, which either directly queries the Data Factory Storage for cleartext datasets or invokes the Searchable Encryption component using specific keywords that match their interests or needs. These query actions are stored separately on the public channel of the PISTIS Data Ledger for auditability purposes and to avoid attacks by fake data consumers with malicious behaviours.
Initiating Purchase	Upon finding a dataset of interest, the data consumer reviews the dataset, considering various factors such as GDPR compliance, the logic outlined in the contract and available balance. Then the data consumer can request to purchase it by invoking the relevant contract. This action triggers a series of actions for digitally signing as part of the consent process, to transferring money from the data consumer to the data provider and stored on both the PISTIS Monetary Ledger and the PISTIS Data Ledger. Regarding the PISTIS Data Ledger, data are stored on the private channel of PISTIS Organisation Boundaries (e.g., full information) and the public channel of the PISTIS Cloud Platform (e.g., information without identifiable information for privacy preservation).
Data Available to the Consumer	Finally, the dataset is transferred securely to the data consumer.

Table 23: Functionalities that relied on the correct deployment of the contract

16 STAKEHOLDER ENGAGEMENT PLAN

16.1 TIMELINE OF ACTION

The timeline of actions for the stakeholders, across Hubs, will be structured as follows:

Step 1: Scenario Development (Months 14-15)

- Focus: Leverage knowledge from WP1-WP4 to define scenarios for each use case, based on prior user stories and landscapes.
- Actions: Map scenarios against PISTIS components to identify gaps in meeting user needs. Align project tools and methodologies with real-world applications to match the expectations of users and demonstrators.
- Methodology: review and merging of information from previous deliverables. Should further information be required from partners, questionnaires will be administered to respond to such lack of knowledge.

Step 2: In-Depth Analysis with WP Partners (Months 16-17)

- Focus: Collaborative review of developed scenarios by WP partners, concentrating on identified gaps.
- Actions: Assess if PISTIS can address these gaps. Define success criteria for each scenario, anticipate potential failure modes, and devise mitigation strategies.
- Methodology: Internal meetings will be scheduled for the review of the scenario, along with internal documentations (e.g., spreadsheet) to track the changes within each scenario.

Step 3: Scenario Consolidation with Demonstrators (Months 18-19)

- Focus: Review each use case scenario for clarity and feasibility in collaboration with the demonstrators.
- Actions: Verify objectives, processes, and expected outcomes. Anticipate potential issues and establish contingency plans. Conduct an in-depth analysis to ensure necessary functionalities for managing both planned actions and unforeseen challenges.
- Methodology: The review and consolidation of the scenario will be addressed with Demonstrators through co-design workshops.

Step 4: Validation and Iterative Development (Months 20-32)

- Focus: Conduct an internal assessment to identify discrepancies, risks, or gaps in the scenarios.
- Actions: Evaluate the practicality and effectiveness of proposed solutions. Use feedback for further refinement, adjusting scenarios based on demonstrator insights and risk assessments. Ensure continuous improvement and adaptability of the scenarios.
- Methodology: As in step 2, internal meetings along with continuous update of internal documentation will be used to track changes within each scenario. If, during the

validation phase (Step 4), new discrepancies, risks, or gaps are identified in the scenarios, it indicates a need for further refinement. The process then loops back to Step 3 (Scenario Consolidation with Demonstrators). Here, scenarios are re-examined and adjusted in collaboration with the demonstrators. This reiteration ensures that all newly identified issues are adequately addressed and that the scenarios remain practical, clear, and resilient.

Step 5 (Round 1 and 2): External Stakeholder Engagement (Months 20-25 and 32-42)

- Focus: Engage external stakeholders to review and consolidate project scenarios, ensuring they are robust, realistic, and meet stakeholder needs.
- Actions: Identify risks collaboratively with external stakeholders, leading to comprehensive risk mitigation strategies. Verify that PISTIS functionalities align with project goals and expectations. Utilise Living Labs in WP6 for hands-on testing and validation in realistic settings.
- Methodology: External stakeholders will be engaged in a series of workshops for the consolidation of the scenarios. Following the first round of external stakeholder consultations (Step 5, Round 1), any proposed changes or additional insights necessitate adjustments to the scenarios. The strategy circles back to Step 4 (Validation and Iterative Development). During this phase, the scenarios undergo further internal assessment and refinement, integrating feedback from the first round of external consultations. After revising the scenarios in Step 4, the process advances to the second round of Step 5 (External Stakeholder Engagement, round 2). This round serves to validate the revised scenarios with a broader range of stakeholders, further solidifying the robustness and practicality of the project scenarios.

16.2 Summary

This is summarised in Figure 15 below.

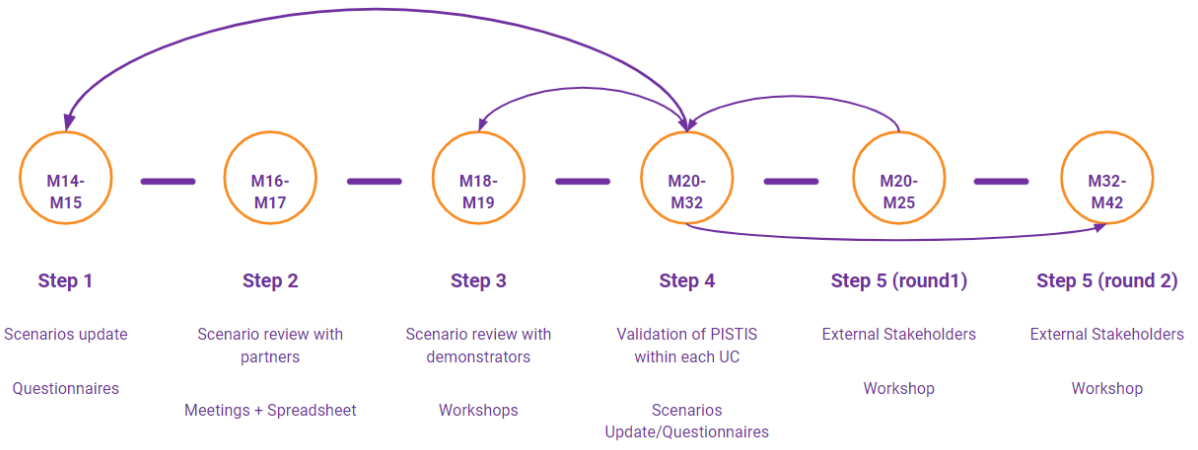

Figure 15 Timeline of action for stakeholder interaction.

Section 4
Carrying out the Evaluation

17 THE EVALUATION PROCESS

17.1 INTRODUCTION

Section 1 of this deliverable set out the Framework for evaluating the individual demonstration hubs and a holistic approach to evaluating the impact of PISTIS. It scrutinised the most suitable available tools for carrying out a successful evaluation and drew together a set of techniques which could prove valuable to PISTIS.

The second section specified which of the collection of tools and techniques discussed in Section 1 will be of most value and will be eventually utilised in PISTIS. We considered issues such as how we would carry out measurements and what would be the metrics to adopt? What would be the evaluation criteria for different aspects of the project? And how we should engage with stakeholders? Section 3 covered how we were to set about implementing the demonstration activities.

This final part of the document now covers how we will prepare for and subsequently evaluate the progress being made by the project. Data collected in carrying out the plan described in Appendix 2 will be at the core of the evaluations to be carried out and which will be presented in D5.2 and D5.3.

Deliberations within WP5 have ascertained the optimum data collection mechanisms to ensure we have enough detail to provide solid, and hopefully positive responses, to all the questions which we have set ourselves to answer.

In the early work of WP5 we have:

- Defined a high-level logic model for the project.
- Defined the “audience” of stakeholders and started to interact with them.
- Identified the objectives of the evaluation and the research questions to be answered.
- Defined the monitoring framework and considered what data is required to answer the evaluation’s research questions, whilst identifying data sources.
- Defined the design of the demonstration hubs operation.

We have defined the key components of the measurement framework: the outputs, the outcomes, indicators, measures of change, data sources and the frequency and methods for collection.

The topics which we tackle, covering the various aspects of the evaluation process, will be maintained and provide the framework for the subsequent deliverables which will be reporting on the progress made. They will include:

- The overall legal and ethical requirements established and followed during the project.
- Technical aspects of the demonstrations
- Running of the demonstrations and progress captured
- Satisfaction of the business requirements established.
- Holistic progress to creating a PISTIS product.
- Meeting the non-functional requirements for PISTIS
- Taking into account stakeholder needs
- Monitoring the overall strategic impact through the Theory of Change

These topics are reflected in the Tables 24 to 31 set out below, to help gather and present evidence. They include:

- Tables providing the checklists regarding availability of the identified required data for each of the eleven use-cases.
- The Quality in Use Model which assesses software quality from a user's point of view.
- KPIs
- Non-Functional requirements, including business requirements.
- Legal and ethical conformity of the PISTIS solutions at the demonstration hubs.
- Communication and interaction with Stakeholders.

This Framework will evolve as the project progresses and is not set in stone.

18 THE DEMONSTRATIONS

18.1 FULFILLING THE DATA REQUIREMENTS FOR EACH USE-CASE

The basis for evaluating progress in gathering the required data in order to achieve all the goals for PISTIS in running the demonstrations and for implementing the use-cases can be found in Tables 10 to 21 above.

These initial tables set out the data requirements for each use-case, whilst the later WP5 deliverables will monitor the satisfactory access to the identified data requirements set out in chapters 8, 9 and 10, covering the core hubs.

Data Type	Data Provider	Data Consumer	Data Availability	Data Format	Risk/Amelioration	Status

Table 24: Evaluating the progress made within the data landscape.

18.2 Coverage of Pistis core functionality across use cases

The table below sets out the usage of the core PISTIS functionalities, to ensure that there is a wide spread of their usage by the individual use-cases, so as to provide enough activity for these functionalities to be evaluated.

Core Pistis Functionality	**Mobility & Urban Planning**					**Energy Hub**				**Auto-motive**	
Use case	**1.**	**2.**	**3.**	**4.**	**5.**	**1.**	**2.**	**3.**	**4.**	**1.**	**2.**
Data Ingestion tools and connectors	x	x	x		x	x	x	x		x	x
Data Enrichment	x	x	x		x	x	x	x			x
Data Transformation	x	x	x		x	x	x	x		x	x
Analytics /Insight engine for data quality analysis	x	x	x		x	x	x	x	x	x	x
Data Lineage tracking	x	x	x		x			x			x
GDPR Checker	x	x	x		x	x	x	x		x	x
Data Anonymisation	x	x	x		x	x	x	x		x	x
Data Quality Assessment	x	x	x		x	x	x	x	x	x	x
Data Storage	x	x	x		x	x	x	x		x	x
Data Trading Contract Drafting									x	x	x
Contract Notification						x	x		x	x	x
Contract Execution						x	x				x
Data Transaction Monitoring	x	x	x		x	x	x	x	x		x
Data Navigation/ Querying						x	x				x
Data matchmaking services									x		x
Internal to Pistis Data Acquisitions						x	x			x	

Table 25 Use Case deployment of core PISTIS functionalities

18.3 Individual Demonstration Hub KPIs

18.3.1 Demonstration Hub #1 Impact

Use-case	KPI	Calculation Method	AS-IS Value	TO-BE Value	Verification Means
	5% reduction of Baggage Delivery SLA violations.	Reduction of arrival Baggage Delivery MSDS Violations= (Previous Period MSDS Violations –Current Period MSDS Violations)×100%	To be determined at a date within this period	-	Implement a tracking system to continuously monitor arrival baggage delivery times against MSDS requirements. Regular audits and comparisons with historical data can help verify improvements. Additionally, benchmarking against industry standards provides an external validation of performance.
	7% reduction of delays (average delay time) per flight caused by Transfer Passengers or baggage.	Average Delay Time per Flight, Number of Flights Affected, Total Delay Time.	To be determined within this period	-	Use flight and baggage handling data analytics to track and analyse the specific causes and durations of delays. Regular reporting and trend analysis can help verify reductions in delays. Peer comparisons with similar airports can also serve as a verification tool.
	10% improvement on accuracy and time horizon of predictions of TOBT vs AOBT.	5% improvement on turnaround predictability	Comparison of actual turnaround time vs scheduled/estimated one	To be determined within this period	Tracking the deviation between predicted and actual times and observing the trend of these deviations. Peer review and comparison with industry-leading practices can further validate the improvements.
	10% improved prediction of load public means commuters to/from the Airport.	% calculation between two periods	To be determined within this period	-	Compare the predicted commuter loads with actual observed data to assess the accuracy of predictions. Regularly updating and refining prediction models based on historical accuracy can serve as an internal verification process. Engaging with

Use-case	KPI	Calculation Method	AS-IS Value	TO-BE Value	Verification Means
					public transportation authorities for external validation can also be beneficial
	15% reduction in bus trips with very low load.	% calculation between two periods	To be determined within this period	-	Monitor and analyse bus load data to identify trends and improvements in load optimization. Comparing current data with historical benchmarks can verify the effectiveness of measures taken to optimise low-load trips. Feedback from transportation partners can also provide external verification.
	20% increase of perceived QoS in routes to/from the airport.	Survey data analysis	To be determined within this period	-	Conduct regular passenger surveys to gauge the perceived quality of service on airport routes. Analysing trends in survey results over time can verify improvements in QoS. Comparing these results with industry benchmarks or surveys from other airports can also serve as a means of verification.
	2% increase of turnover of local businesses due to insights on anticipated load.	Regression Analysis	To be determined within this period	-	Collaborate with local businesses to track changes in turnover and correlate these with the implementation of predictive insights on passenger loads. Periodic reviews and impact assessments can help verify the effectiveness of these insights. Benchmarking against similar initiatives in other regions can provide additional validation.

Table 26: Impact KPIs for Demonstration Hub #1

18.3.2 Demonstration Hub #2 Impact

KPI	Calculation Method	AS-IS Value	TO-BE Value	Verification Means
40% Increase in the Hosting Capacity of the LV Grid;	We use as a baseline the peak generation capacity (the time of year with the highest generation and lowest consumption). It is expected that, thanks to the flexibility market, asset management can be carried out, reducing the injection of energy into the grid and increasing peak capacity.	0 ("0" means that no more distributed generation can be installed on the grid.) For example, 50 kWp	To achieve a value of 0 again but with a 40% increase in installed capacity (e.g., 70 kWp).	To perform the calculations with the new 'flexible capacity' to verify the feasibility of installing more distributed generation before overloading the grid.
Participation of 40 DER in the LFM (from 0 participating today)	Define a time period (1 year) And conduct the necessary simulations to verify the participation of flexibility providers	0	40	Participation of flexibility providers.
45% reduction in investment deferral in new grid reinforcements.	Study of long-term operating costs, network expansion, and reinforcement, without flexibility and with it.	AV (Actual value)	0.55*AV	Study of long-term flexibility market results and include them in the network study, hoping to see that the need to reinforce the network is reduced.

Table 27: Impact Target KPIs for Demonstrator Hub #2

18.3.3 Demonstration Hub #3 Impact

KPI	Calculation Method	AS-IS Value	TO-BE Value	Verification Means
Use Case #3.2 Driving Style and Risk Management				
Number of events in the solution that are used to compute a driver warning.	Counting dataset size	~2500	> 10x	The integration of additional data sources gained via PISTIS enable us to generate more events, thereby enabling more effective warnings for the driver.
Accuracy of risk models for driver warning	Improved risk models	-	Positive expert feedback	Considering the supplementary data sources within PISTIS, we craft (improved) risk models adept at incorporating shared data in a meaningful manner. To ensure the efficacy of our risk models, we actively seek qualitative feedback from both traffic risk experts and service users.
Access to further relevant data sources via PISTIS	Counting	2	7	The data shared through PISTIS empowers us to compute additional events spanning various topics, such as weather and hazards, which significantly impact driver risk computation. These insights are seamlessly integrated into our solution to enhance its overall effectiveness.
Interchangeability of data sources per domain Access	Data assessment	No	Yes	Our solution is designed to be data-source agnostic, allowing for seamless integration of diverse data providers. While PISTIS currently relies on UBIMET as the weather data provider, the flexibility of our system ensures compatibility with various weather providers. This adaptability ensures that our solution remains robust and can effectively incorporate data from different sources, accommodating the preferences or requirements of our users and stakeholders.

KPI	Calculation Method	AS-IS Value	TO-BE Value	Verification Means
Usefulness of driver warning solution	Evaluation (empirical study)	-	> 75%	Within PISTIS, we execute a small-scale empirical driving study, involving a minimum of 10 users who actively engage with the driving service for a specified duration, typically lasting at least one month. Subsequently, we gather valuable insights by surveying these participants to gauge their satisfaction levels with the quality of the service provided. This user-centric approach allows us to assess and enhance the overall experience based on real-world usage and user feedback.
Use Case# 3.1 Traffic Quality Assessment for Urban Analytics and Corporate Mobility				
Emission values per road segments	Emission Model	-	Working Verified Emission Model	Comparison of generated emission values with reference sensor data, to verify emission values generated for road segments near sensor locations.
Access to further relevant data sources via PISTIS	Counting	3	5	The additional PISTIS data enables us to calculate geospatial layers concerning emission values which can then be seamlessly integrated into the DynaminTrafficMonitor solution.
Improve Analytic Capabilities	User-Evaluation	-	Positive User Feedback	Evaluation study using questionnaire and interviews with traffic operators and traffic analysts using the extended analytic tool.
Access to further relevant data sources via PISTIS	Counting	4	7	By incorporating data on weather conditions, emission levels, and public transport systems, we aim to generate more context aware mobility recommendations.
X 20 times larger datasets at disposal for AI model training (timeseries data)	Measurement of dataset sizes.	3GB	60GB	Increase in data due to the datasets gained from CARUSO (simulated data) and UBIMET.

Table 28: Impact Target KPIs for Demonstrator Hub #3

18.4 PISTIS IMPACT KPIS

Impact KPI	Scale	Target	Verification
Increasing Data Interoperability	Concerning all the incoming data to be used over PISTIS	100% as all data can be passed through the PISTIS Factory environment and of relevant tools to be renovated, with 70% less manual effort	Demonstrators (AS-IS vs Demo-Result)
Improved Data Autonomy	All the target groups in the domain of data operations	100% autonomy as all assets to be shared will be residing locally at the owner/provider	Demonstrators (AS-IS vs Demo-Result)
Improved Data Discoverability & Acquisition	Concerning all data shared within PISTIS	+100% as all data to be shared over PISTIS will be part of the distributed data catalogue and to be found 10x faster; 80% less time required to reach a data sharing/trading agreement	Measuring No. of discoverable assets before and after PISTIS deployment
Improved Data Quality	Concerning the data to be treated by the PISTIS tools.	+50% taking as a baseline at least 3 quality dimensions (such as completeness, consistency, timeliness, etc.) are continuously. observed and treated with 80% less manual effort	Based on PISTIS Data Quality service evaluation
Increased Lineage Tracking of Data	Concerning all the data to be treated over PISTIS	+25% assuming at least ¼ of operations/ transactions performed are not tracked today	Lineage service evaluation
Improved Data Valuation	All the target groups in the domain of data operations	+50% fair and realistic market value estimation	Demonstrators (AS-IS vs Demo-Result)
Added Value Generation from Data	All the target groups in the domain of data operations	+25% additional data trading revenue (from monetisation of own assets); +10% operational efficiency improvements (based on new insights from acquired data)	Demonstrators (AS-IS vs Demo-Result)
Improved Trust Security and Privacy Guarantees of Data Sharing	Concerning all data operation services treated in PISTIS	>95% improvement based on the trust generation to users and overall user acceptance.	Through the demo based on users' perception/ questionnaires

Table 29: Overall Impact KPIs

18.4.1 Communication with stakeholders

In addition to having its own KPIs reported in WP8 deliverables, we have shown the importance of having good interaction with stakeholders, in the Evaluation Framework.

We need to monitor that their involvement meets what is required for a satisfactory evaluation process, with the following questions raised.

Questions raised	Response	Comment
Have we identified the stakeholder's roles in evaluation planning, implementation, interpretation of results and decision-making about the next steps?	YES/NO	
Has the list of stakeholders been reviewed to ensure all appropriate stakeholders are included?	YES/NO	
Have we created a plan for stakeholder involvement and a communication strategy?	YES/NO	
Have areas been identified for stakeholder input?	YES/NO	
Have stakeholders been brought together as needed?	YES/NO	
Have key stakeholders been targeted for regular participation.	YES/NO	
Have we involved stakeholders in the evaluation process?	YES/NO	

Table 30: Communication with stakeholders

18. 4. 2 Impact of communication activities KPIs

Impact KPI	Scale	Overall Targets-not demonstration specific	Verification	Demonstrators' contributions
Cultivation of New Skills.	All the workers to be engaged in the PISTIS ecosystem.	1 Certification Degree of PISTIS courses attendance for being knowledgeable (rate: >8/10) in the domains of interest of PISTIS.	Based on MOOC Trainee Evaluation.	
Lowering access barrier for SMEs to the usage of advanced data management operations.	All companies where the establishment of data spaces is a critical part of their business.	20% easier access to data technologies and infrastructures, due to less investments for having such services in house.	Demonstrators (AS-IS vs Demo-Result).	
Contribution to standardisation groups dealing with, data operations, sharing and cybersecurity.	Standards relevant data management operations, sharing and cybersecurity.	3 contributions in standardisation bodies, based on the project's research in Data Quality Assessment, Lineage, IPR protection, Interoperability, Security, Valuation, Monetisation, AI and DLTs.	Submissions to be provided to standardisation bodies.	
Contribution to opensource	Open-Source software	2 contributions in an existing community based on the project's outputs,	Project's results integrated	

Initiatives by demonstrators.	utilised for developing PISTIS services.	focusing on the data management opensource methods and DLT tools.	into open-source initiatives.	

Table 31:Impact of communication activities KPIs

19 TECHNICAL ASPECTS

19.1 DETERMINATION OF THE TECHNICAL REQUIREMENTS

The principal scope of D1.2[37] was to define the minimum set of technical requirements for PISTIS that would meet the business needs and expectations of the end-users.

A methodology, derived from agile product development, was adopted following the stakeholder's identification and the provision of detailed descriptions of their interactions and functionalities required of the PISTIS framework from their individual perspectives, using the tool of user stories. Using common understanding between end-users and developers, a list of technical requirements was identified based on the analysis of these user stories. These requirements have been evaluated and prioritised based on the end-users needs and on the feasibility of their technical implementation. This resulted in the definition of the PISTIS MVP.

The first step of the methodology identified five roles for the PISTIS Users: the data owners, the data consumers, the organisation's administrator, the PISTIS administrator and the auditor.

- The **Data Owner** is a part of a specific organisation and can manage the datasets (data and metadata) registered in the PISTIS platform, particular in the organisation's PISTIS Data Factory. Users acting with this role can also manage organisations asset on PISTIS marketplace including their monetisation and publication.
- The **Data Consumer** is also a user belonging to an organisation acting as a potential buyer in the PISTIS ecosystem. Data Consumers can search for data assets to buy and complete financial deals with the Data Owners that will conclude to the acquisition of the data.
- The **Organisation Administrator** is managing the resources (users and datasets) of an organisation's PISTIS Data Factory.
- The **PISTIS Administrator** is responsible for managing the functionalities and resources of the PISTIS Central Platform, such as the management of the connected PISTIS Data Factories.
- The **Auditor** is an external or internal entity (maybe an administrator) who is responsible for auditing the behaviour of the systems or sub-systems of PISTIS framework.

From the perspective of the actors-systems, the PISTIS platform was defined as the main system that will be interacting with the users. Further, the actors-systems includes some of the functional modules of the PISTIS Platform that are widely known to the users or are

[37] PISTIS - D1.2 - All Documents (sharepoint.com)

providing crucial operations, such as the Data Factory, Identity Access Management and Marketplace.

A list of fourteen user stories was selected to be elaborated on, based on the business requirements identified in D1.1. For the depiction of each user story, a combination of natural language and formal definition were used. The work was conducted with the close collaboration of both end-users and technology providers. Each user story includes:

a) The description of "Who, What, and Why" user stories template, defining the actors, the description and the benefits,

b) The formalism of the story using the Business Process Model Notation (BPMN) defining the interactions between users and systems, and

c) The list of technical and operational challenges and issues that must be taken into consideration in the design and implementation phase.

This thorough definition of user stories allowed the identification of seventy-six technical requirements for the PISTIS framework. These technical requirements are specific for expressing the added value and benefits provided by PISTIS and do not include classical information systems technical requirements, such as accessibility and standard security measures.

Finally, both end-users and technology providers have prioritised the technical requirements using the MoSCoW method. A prioritisation based on weighted voting which gave more importance on the votes of the end-users group, determined the final list of requirements that must or should be met to determine the PISTIS Maximum Value Product.

19.2 The Technical Testing

This technical testing work will be carried out within WP4. As part of Task 4.5 - the Technical Verification and Integration Testing, execution of both automated and manual tests will be performed on a regular basis, synchronized with release schedules and the progress of this testing procedure will be monitored here. All the software development activities will be followed, and a software verification and testing framework will be employed to be used on all outputs.

The components of the platform will be covered by functional and integrated tests. To keep the quality of the User Interface component, manual test scenarios will be created based on the input received from the previous WP2 and WP3 and possibly become automated. Execution of both automated and manual tests will be performed on a regular basis synchronised with release schedules. Essentially Task 4.5 - Platform Software Validation and Verification will recap all the "Unit tests" of the different components of the PISTIS Platform and verify if these unit tests are correct. This will all be reported in D4.3 and D4.4.

The structure of the WP5 project team includes specific roles with three identified, technical links, acting as the intermediaries between each hub and the technical teams.

19.3 Technical Testing of The Developed Solution

As the core of the technical evaluation of the developed product is happening under WP4, in this section we are going to cover the technical acceptance of the developed solution from the perspective of the demonstrators, based on qualitative, high-level evaluation.

For measuring the quality of the system from a user's perspective (e.g. non-software performance level evaluation) PISTIS makes use of the ISO 25010 Quality in Use Model[38], which describes the perception of the quality of the system from a user's perspective.

The different characteristics and sub-characteristics of this model are derived from testing or observing the results of real or simulated use of the system and in the PISTIS case these are the results of the different demonstration rounds that are executed within WP5.

The Quality in Use Model assesses software quality (from a user point of view) using the following set of characteristics (each of them including other sub-characteristics):

- Effectiveness – Measuring the accuracy and completeness with which users achieve specified goals.
- Efficiency – Evaluating the resources expended in relation to the accuracy and completeness with which users achieve goals.
- Satisfaction- Aiming to capture the degree to which users are satisfied with the experience of using a product in a specified context of use.
- Safety – Providing the degree to which a product or system does not, under specified conditions, lead to a state in which human life, health, property, or the environment is endangered.
- Usability - The extent to which a product can be used to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

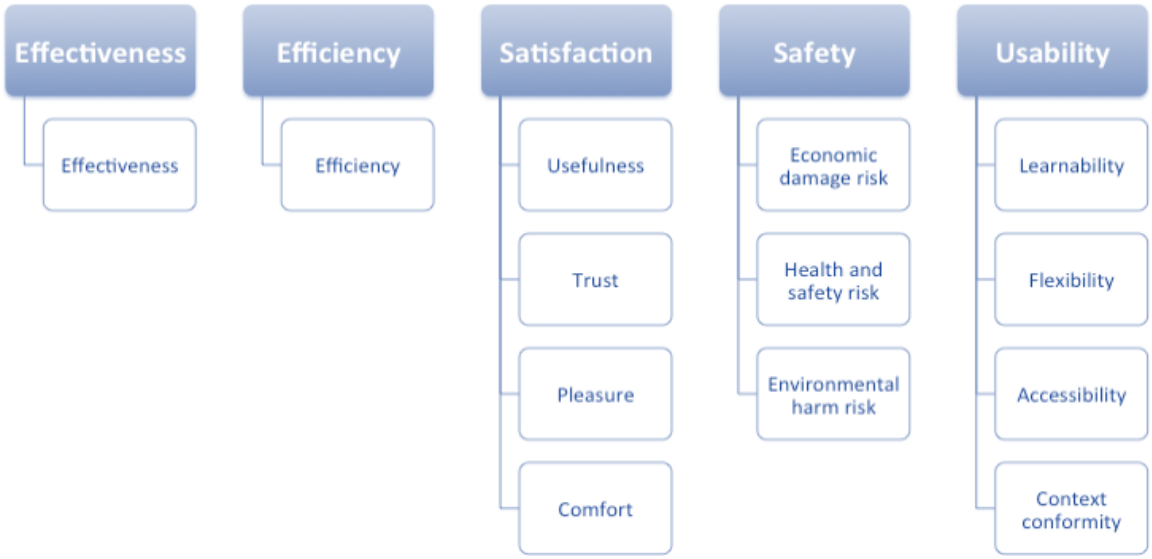

Figure 16: Quality in use model view based on the ISO/IEC 25010:2011 standard.

[38] https://www.iso.org/obp/ui/#iso:std:iso-iec:25010:ed-1:v1:en

The next table presents the qualitative evaluation metrics which correspond to the quality in use model for evaluating the PISTIS platform from an end-user (demonstrator's perspective), always based on the promised results of each release round.

It is noted that not all parts of the model are evaluated, as some are not relevant to the PISTIS case. Furthermore, the evaluation process will only concern the features and the experience provided by the current available release of the platform, and the same exercise will be performed at the end of each demonstration phase, aiming to identify problems in each release and correct them in the upcoming releases.

Sub-characteristics	KPIs	Assessment Question	Urban Planning	Energy Hub	Automotive
Functional completeness	Level of Completeness	Do the features offered by PISTIS cover all tasks/objectives promised for this release? YES/NO			
Functional correctness	Level of Correctness	Does the platform provide accurate results when it comes to its operations? YES/NO			
Functional appropriateness	Level of Appropriateness	Do the functions of PISTIS accomplish the promised tasks foreseen in this release? YES/NO			
Ease of Use	Level of Ease of Use	Does PISTIS have attributes that facilitate usability? YES/NO/Partially			
User interface aesthetics	Aesthetics Level	Do the aesthetics of the PISTIS platform satisfy the needs of the user?			
Effectiveness	Level of Effectiveness	Can you accurately achieve your goals with the system? Scale 1-5			
Efficiency	Level of Efficiency	Do you think PISTIS fulfils the intended purpose? Scale 1-5			
Usefulness	Usefulness Index	Do you find PISTIS useful? Scale 1-5			
Trust	Trust Index	Do you trust PISTIS as a platform and the results of its operations? Scale 1-5			
Pleasure	Pleasure Index	Does the PISTIS platform please you when you use it? Scale 1-5			
Comfort	Comfort Index	Do you feel that the PISTIS platform provides a			

		comfortable UI and workflow? Scale 1-5			
Flexibility	Flexibility index	How much do you believe that the PISTIS system can be used for other purposes than the intended use? Scale 1-5 And which are those?			
Accessibility	Accessibility Index	To which extent do you believe PISTIS can be used by disabled users? Scale 1-5			

Table 32: Qualitative Evaluation Results per Demonstrator

19.3.1 Scientific and Technical Objectives Monitoring

Scientific and Technical Objectives (STO)	***Key Results***	***Key Indicators & Quantified Targets***
STO.1: To set and implement the underlying foundations for trusted, fair and reliable data sharing, trading and exchanges in a federated manner over a secure, immutable, sovereignty preserving and IPR respecting multi-party data exchange framework.	End Users and Data Spaces Requirements.	>30 State-of-the-art Approaches Studied and Compared.
	In-depth State-of-the-Art (from technology, market and legal perspectives).	>30 Interviews & >5 Focus Groups.
	Data Sharing/Trading Lifecycle and Models.	>4 Data Sharing/Trading Workflows.
	Smart Contract Execution, Enforcement and Governance Techniques & Services.	5 Data Contracts Templates for enriched and derivative data assets.
	DLT-Powered Data Value Contract Composition.	1 low emission blockchain network.
	Management and Lineage Tracking Services.	Alignment with at least 3 global initiatives.
	Data Monetisation Schemes.	3 different monetisation schemes.
	Data Investments Models.	>3 Data Investment Models.
	Data NFT and StableCoin Framework & Reference Implementations.	>3 NFT approaches studied. 1 low emission blockchain network.
STO.2: To design and deliver appropriate data asset management and governance techniques, addressing ever-present data interoperability, quality assurance and security challenges that are common to both data providers and data consumers.	End Users and Data Spaces Requirements.	>30 State-of-the-art Approaches Studied and Compared. Harmonization of and alignment with >12 widely adopted open standards in the energy, automotive mobility, urban planning sectors.
	Legitimate and Secure Peer-to-Peer Transfer Mechanisms.	3 open specifications-based data spaces connectors compliant with IDSA, GAIA-X specifications.
	In-depth State-of-the-Art Data Management,	PISTIS Metadata Standard based on >3 standards.

	Interoperability and Curation Techniques & Services.	
	Data Security & Trust Services.	1 blockchain service to ensure transactions validity.
	Data Lineage, Observability and Usage Tracking Models & Services.	1 Data Lineage tracking service. 1 Usage Tracking service.
	ML/AI-based Derivative Assets Generation and Tracking.	1 Analytics Engine to deliver analytics as assets. 1 Usage tracking service.
	Distributed Data Asset Discovery;	1 distributed query engine.
	Data Models Network Management.	>4 Sectorial, Interconnected PISTIS Data Models.
STO.3: To develop rigorous and fit-for-purpose data valuation and monetisation methods and tools to allow data providers to accrue the right value for the right data at the right time and reach the actual data potential.	End User & Technical Requirements.	>30 State-of-the-art Approaches Studied and Compared.
	In-depth State-of-the-Art Multi-Facet Data Valuation Assessment Framework.	>10 SotA Approaches studied & compared. ;>5 Data Valuation Perspectives.
	Dynamic Pricing Estimation Models & Services.	>3 Dynamic Pricing Methods for Enriched & Derivative Data.
	AI-based Data Market Insights.	1 AI based market insights engine.
	XAI-based Monetisation Services.	>3 Remuneration Methods.
	Demand-Supply Matchmaking Models.	3 Demand-Supply Matching Methods.
	PISTIS Data Exchange Market, Stablecoin Exchange Desk.	1 facility for monetary value exchange.
STO.4: To integrate and serve the novel PISTIS federated data sharing, value accrual and monetisation platform through easily deployable software, enabling trustful, reliable & interoperable exchanges with a wealth of sources, platforms and data spaces.	End-to-end usage scenarios.	>30 State-of-the-art Approaches Studied and Compared.
	Technical Requirements and MVP.	1 Reference Data Sharing, Value Accrual and Monetization Platform MVP.
	Reference Architecture.	1 Reference Architecture.
	Open APIs.	100% usage of Open APIs.
	Design Blueprints & Plan for Integration.	1 Data Services Blocks with >30 Services/Components. Integration of >7 existing Technologies (Open-source and/or originating from >3 ICT- 13/Data Spaces Projects).
	Distributed Data Spaces Factory Environments.	Achievement of TRL7 for the PISTIS data factory instances.
	Cloud/Centralized Data Trading and Value Exchange /Monetisation Platform.	Achievement of TRL7 for the PISTIS cloud platform.
	Software Verification & Validation.	1 software verification and validation methodology and accompanying results.

Table 33: Scientific and Technical Objectives Monitoring

20 BUSINESS REQUIREMENTS

Business requirements are specific statements or descriptions that outline the needs, objectives, and expectations of a business or organisation. These requirements define what the business aims to achieve, how it should operate, and what outcomes it desires. Business requirements typically focus on the desired results rather than the technical implementation details.

In principle, business requirements are derived from various sources, including customer demands, market analysis, industry standards, regulatory requirements, and internal stakeholders. They serve as a foundation for guiding the development and implementation of solutions, projects, or systems to meet the identified needs of the business.

In essence, business requirements articulate the "what" of a business initiative, describing the desired outcomes, functionalities, capabilities, constraints, and performance criteria that must be fulfilled to address a specific business problem or opportunity. These requirements act as a bridge between business goals and the technical or operational solutions that are designed to fulfil those goals.

In the PISTIS approach, the methodology described in D1.1[39] was followed in order to support the business analysis process and extract the required business requirements. The focus was upon extracting and defining business requirements with respect to the design and implementation of the PISTIS platform to serve the objectives of the use cases.

Each PISTIS business requirement is defined by a unique identifier (id), a title, a description, the actors that are affected and the prerequisites for satisfying each requirement. This information is used to extract the technical functional and non-functional requirements for the PISTIS platform. The interdependencies among the business requirements is a valuable tool that will help to prioritise the implementation of respective components that address the related requirements.

The extracted business requirements are reported in Table 34 below and include the following:

- Standardised Communication ensuring efficient and effortless exchange of data.
- Real–Time Data Exchange
- Automated Data Synchronisation
- Data Source Identification
- Data Quality Assessment
- Licensing and Policies
- Interoperability and Data Format
- Data Monitoring and Usage
- Business Value Evaluation of Data
- Data Anonymisation

[39] D 1.1 - PISTIS Operation Principles and Context Detailing - PISTIS (pistis-project.eu)

- Semantic enrichment of the data
- Data Trading and Acquisition
- Data Scaling
- Peer-to-Peer Trading Results
- Data and Metadata Publication
- Transaction Validation Report System
- Data Exchange Conditions definition
- Data Contracts and Terms
- Smart Contract Creation
- Storage of Contracts and Validation Results Demonstration activity

The Demonstrators contribute to the evaluation process in three distinct ways.

- Primarily they participate in order to showcase the technology and to check it is suitable. Collectively they can contribute to aspects of the project they have in common.
- Secondly, they need to see value in the use of the technology for their own purposes.
- Thirdly, They can add insight and lessons learned to the higher level and strategic goals for the project as a whole.

The various tables in this section of the document form the basis for capturing information from the demonstrations. In addition, questions concerning the legal aspects, concerning the business model etc. are also being tackled at the demonstration level.

Similarly, those sections for each demonstrator in Chapters 8, 9 and 10 above, also describe the impact expected for each of the sites from the perspective of the organisation as a whole, from the perspective of the data owners and from that of the data seekers and local collaborators.

These identified further impacts will also be referred to in the evaluation process.

Objective	Metrics: Description of indicators towards assessing progress	Measures of change: Success criteria	Data Collection Methods and sources	Status at M40	Comments
Hub 1: Mobility and Urban Planning Ecosystem					
Demonstrating the feasibility and effectiveness of PISTIS platform.	Completion of milestones related to Hub 1. System Uptime, Reliability and Error Rates against PISTIS benchmarks.	All MS achieved within timeline. > 99% for system uptime. Steady increase in number of active users.	PISTIS project management tools.		

	Number of active users utilising the platform.				
Providing the PISTIS platform for collaboration between different stakeholders.	Number of joint initiatives between stakeholders. Surveys or feedback mechanisms to gauge stakeholder satisfaction. Data Sharing Volume.	At least 5 joint initiatives by the end of the project. Achieve a satisfaction rate of 80% or higher. Doubling the volume of data exchanged between stakeholders by the project's midpoint.	Development of a Collaborative Project Registry. Surveys, Interviews with Stakeholders.		
Testing and validating new concepts and solutions in a real-world environment.	Mechanisms for collecting and analysing user feedback. Pilot Use Cases Success Rate.	Success in all case studies. 90% of actionable feedback received from users. >75% success rate for use cases.	Case Studies Deliverables Online forms		
Collecting data and feedback to inform further development and scaling of the project.	Data Quality Metrics (i.e., accuracy, completeness, timeliness of data collected. Feedback Implementation Rate.	Achieving data accuracy and completeness rates of 95% or higher. Implementing at least 80% of feedback from users.	Data Quality Management Tools Logs Management System		
<u>Hub 2: Energy Eco-system</u>					
Objective	**Metrics: Description of indicators towards assessing progress**	**Measures of change: Success criteria**	**Data Collection Methods and sources**	**Status at M40**	**Comments**
Standardised Communication for proper	Implement standardised communication	Automatic operation of	Data mostly obtained from Cuerva's		

functioning of the flexibility market.	protocols to ensure effortless data exchange between different entities in the ecosystem.	the flexibility market.	grid, and end costumers		
Data Quality Assessment.	Implement mechanisms to assess and ensure the quality of data shared within the ecosystem.	The data processed by the PISTIS systems does not exhibit gaps or outliers and is enriched.	Data mostly obtained from Cuerva's grid, and end costumers, enriched with open data or 3rd party data		
Facilitation of Collaboration in Energy Efficiency Projects.	Number of energy efficiency projects using shared data for their design and execution.	Growth in the use of shared data to drive collaborative energy efficiency projects.	Data platform analysis, user surveys.		
Hub 3: Automotive HUB – Driver Warning use case					
Objective	**Metrics: Description of indicators towards assessing progress**	**Measures of change: Success criteria**	**Data Collection Methods and sources**	**Status at M40**	**Comments**
Ease of use of PISTIS platform in sharing generated data (providing and consuming data).	Resources spent (1) deploying PISTIS modules in our company network and (2) using the PISTIS platform for transactions.	Reduced efforts in contrast to conventional negotiation approaches.	Interviews with people using the PISTIS solution at VIF.		
Transparency in sharing generated data and data income generation.	Having an overview on all our data transactions and data use scenarios (i.e. who used our shared data for what purpose	Transaction logs.	Qualitative evaluation of PISTIS use and data sharing transactions.		

	and paid how much).				
Ease of identifying relevant data owners and their data offering using PISTIS platform.	Number of relevant data owners identified, and resources spent identifying them (including a data catalogue to get a quick overview on their data).	# data owners # contacts, quality of data catalogue.	Qualitative evaluation of PISTIS platform.		
Automotive HUB – Urban analytics/corporate mobility use case					
Transparent licencing of data provided by the Pistis platform using established licenses.	Ration of data sources using established licences and data sources with no or proprietary licenses.	# data sources using established licenses.	Qualitative evaluation of PISTIS platform.		

Table 34: Satisfaction of Business requirements

21 MEETING COMMON CRITERIA ACROSS ALL THE DEMONSTRATION HUBS

This chapter sets out how we intend to evaluate some of the aspects of PISTIS which are common to all the demonstration hubs.
The following topics are covered from the standpoint of what the demonstrators are expected to contribute:

- The common criteria for the Non-Functional requirements.
- Monitoring the progress made with developing the business model.
- Meeting the business, innovation and exploitation objectives.
- Compliance with legal and ethical aspects.

21.1 COMMON CRITERIA FOR THE NON-FUNCTIONAL REQUIREMENTS

Table 35 below, is indicative of the format which can be utilised for collating the non-functional results from all demonstrator hubs to derive enhanced meaning at the PISTIS project level.

Again, this aspect of the evaluation plan will be in focus at a later stage of the project and will be elaborated further and amended where necessary.

> *"Non-functional requirements are in the form of "system shall be <requirement>", an overall property of the system as a whole or of a particular aspect and not a specific*

function. The system's overall properties commonly mark the difference between whether the development project has succeeded or failed." [40]

The methodology, as set out earlier, is to follow is: MoSCoW: Must, Should, Could or Would where:

- MUST: Metrics that must be included to be considered a success.
- SHOULD: Represents a high-priority metric that should be included if it is possible. This is often a critical requirement but one which can be satisfied in other ways if strictly necessary.
- COULD: Describes a metric which is considered desirable but not necessary. It will be included only if time and resources permit.
- WOULD: Represents a metric that will not be implemented in a given version but may be considered for the future.

However, as shown in Table 35 below, only the M and C symbols are used, as this is more common for non-functional requirements. The table covers the following common criteria which are based on the ISO/IEC 25010 standard.

Functional Suitability: The demonstrations must provide the required functionality. The whole development must fit the functional requirements discussed throughout the project's development. There needs to be functional completeness, correctness and appropriateness.

Security and personal data protection: Availability, integrity and confidentiality of data exchanged through the platform must be guaranteed, alongside non-repudiation, authenticity and accountability. It is extremely important for the success of the demonstrations and project as a whole to ascertain the "feeling" of the user on this aspect and the compliance of national and European regulations.

Performance Efficiency: This includes Time Behaviour, Resource Utilisation and capacity.

Maintainability: This includes Modularity, reusability, analysability, modifiability and testability. The services and the infrastructure required to run them must be maintainable without incurring any "non-reasonable" costs.

Scalability: The addition of new Service Providers and users should be easily dealt with by the system designed.

Flexibility: Desirably, the platform must be designed in a way that allows future development and adaptation with the implementation of new services, integration, etc.

Reliability: The aim of the pilot is to run real-life services. Therefore, the user of the services run within the pilot must perceive them as reliable. This entails maturity, availability, fault tolerance and recoverability.

Portability: The solutions adopted should, as far as possible, be portable to different platforms and environments, being able to demonstrate adaptability, installability and replaceability.

Usability: DataVaults services must offer an acceptable degree of usability and they should comply with commonly accepted standards and be ethically acceptable. It should also be Citizen focussed, as alongside the technicalities of securing personal data, it is also the "feeling" of the user on this aspect, alongside compliance with standards and National and

[40] cscbank.info › doc_d_file=2618 Downloaded 23/08/23

European regulations. The following need to be taken into account: Appropriateness, Recognisability, Learnability, Operability, User Error Protection, User Interface Aesthetics, and Accessibility.

Interoperability: Interoperability among all systems involved in the wider eco-system must be guaranteed, as should **Compatibility** and co-existence.

Business value: The piloted services should add some value to current services, enriching "services" with additional functions.

21.1.1 Common Criteria for Measurement of Non-Functional Requirements across the Hubs.

Common Criteria to be measured	Type	MoSCoW	Description of Metric.	Success criteria for Metric	Method to Gather Results for the Metric
Functional Suitability [41]					
F1 - Functional completeness	Qualitative	M	Degree to which the set of functions covers all the specified tasks and user objectives.	All demonstrator functionalities are delivered.	Requirements Backlog
F2 – Functional Completeness	Qualitative	M	Degree to which a product or system provides the correct results with the needed degree of precision.	Demonstrator app provides results as expected.	Questionnaire
F3 - Functional appropriateness	Qualitative	M	Degree to which the functions facilitate the accomplishment of specified tasks and objectives.	All the demonstrator functionalities have a positive impact to the expected demonstrator result.	Questionnaire
Security and personal data protection					
S1. Confidentiality	Quantitative	M	Degree to which a product or system ensures that data are accessible only to those authorised to have access.	Data can only be viewed by the designated users of the application.	Application tests

[41] The demonstrations must provide the required functionality. The whole development must fit the functional requirements discussed throughout the project's development. There needs to be functional completeness, correctness and appropriateness.

S2. Integrity	Quantitative	M	Degree to which a system, product or component prevents unauthorised access to, or modification of, computer programmes or data.	No changes in backend or data are allowed without proper access.	Application tests
S3. Non-repudiation	Qualitative	M	Degree to which actions or events can be proven to have taken place so that the events or actions cannot be repudiated later.	No actions performed twice by the same event.	Application tests/ log files
S4. Accountability	Qualitative	C	Degree to which the actions of an entity can be traced uniquely to that entity.	All actions performed include the user performing them.	Log Files
S5. Authenticity	Qualitative	C	Degree to which the identity of a subject or resource can be proved to be the one claimed.	Use of an accepted authentication method.	Demonstrators' architecture
Performance efficiency					
P1. Time behaviour	Quantitative	M	Degree to which the response and processing times and throughput rates of a product or system, when performing its functions, meet requirements.	Response of system in less than 10 seconds.	Log Files
P2. Resource utilisation	Quantitative	M	Degree to which the amounts and types of resources used by a product or system, when performing its functions, meet requirements.	Usage of IT resources dedicated to the demonstrator not exceeding 80%.	Log Files

P3. Capacity	Quantitative	C	Degree to which the maximum limits of a product or system parameter meet requirements.	Uninterrupted operation with concurrent 5 users.	Log Files
Reliability/Maturity					
R1. Maturity	Quantitative	M	Degree to which a system, product or component meets needs for reliability under normal operation.	All requests to the system are processed and return information.	Log Files
R2. Availability	Quantitative	M	Degree to which a system, product or component is operational and accessible when required for use.	98% Availability of demonstrator application.	Log Files
R3. Fault tolerance	Quantitative	C	Degree to which a system, product or component operates as intended, despite the presence of hardware or software faults.	Demonstrator Application can operate with maximum of two warning (not crucial) error messages in the backend.	Log Files
R4. Recoverability	Quantitative	C	Degree to which, in the event of an interruption or a failure, a product or system can recover the data directly affected and re-establish the desired state of the system.	Demonstrator Application has the ability to automatically resume operations after an interruption/failure.	Log Files
Portability					
Po1. Adaptability	Quantitative	M	Degree to which a product or system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments.	Demonstrator Application can be used in two different OS platforms.	Demonstrator's Tests

Po2. Installability	Quantitative	C	Degree of effectiveness and efficiency with which a product or system can be successfully installed and/or uninstalled in a specified environment.	Demonstrator Application can be used in two different OS platforms	Demonstrator's Tests
Usability					
U1. Appropriateness /Recognisability	Qualitative	C	Degree to which users can recognise whether a product or system is appropriate for their needs.	Demonstrator Application scores of 75% in this aspect.	Questionnaire
U2. Learnability	Qualitative	C	Degree to which a product or system can be used by specified users in order to achieve specified goals of learning to be able to use the product or system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use.	Demonstrator Application scores 75% in this aspect.	Questionnaire
U3. Operability	Qualitative	M	Degree to which a product or system has attributes that make it easy to operate and control.	Demonstrator Application scores of 75% in this aspect.	Questionnaire
U4. User error protection.	Qualitative	M	Degree to which a system protects users against making errors.	Demonstrator Application scores of 75% in this aspect.	Questionnaire
U5. User interface aesthetics	Qualitative	C	Degree to which a user interface enables pleasing and satisfying interaction for the user.	Demonstrator Application scores of 75% in this aspect.	Questionnaire

U6. Accessibility	Qualitative	C	Degree to which a product or system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.	Demonstrator Application scores of 50% in this aspect.	Questionnaire
Compatibility/Interoperability					
I1. Co-existence	Quantitative	C	Degree to which a product can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product.	Less than 20% performance drop when demonstrator application is co-hosted with other applications that take 50% of system resources.	Log Files
I2. Interoperability	Quantitative	C	Degree to which two or more systems, products or components can exchange information and use the information that has been exchanged.	Ability of demonstrator App to expose information in JSON format.	Requirements Backlog
Maintainability					
M1. Modularity	Qualitative	C	Degree to which a system or computer program is composed of discrete components such that a change to one component has minimal impact on other components.	At least two different components to be used for the development of specific services of the demonstrator.	Demonstrators' architecture
M2. Reusability	Qualitative	C	Degree to which an asset can be used in more than one system, or in building other assets.	Suitability of at least one component of the Demonstrator application to be reusable elsewhere	Questionnaire

M3. Analysability	Quantitative	M	Degree of effectiveness and efficiency with which it is possible to assess the impact on a product or system of an intended change to one or more of its parts, or to diagnose a product for deficiencies or causes of failures, or to identify parts to be modified.	100% of the demonstrator's code documented and including probe points for analysis through log files.	Demonstrators' architecture
M4. Testability	Qualitative	C	Degree of effectiveness and efficiency with which test criteria can be established for a system, product or component and tests can be performed to determine whether those criteria have been met.	Automated test covering 50% of the demonstrator's application code.	Demonstrator's Tests

Table 35: Format for collection of results regarding common criteria

KEY: **C**-Could, **W**-Would.

21.2 CRITERIA FOR MONITORING THE EVOLUTION OF THE PISTIS PRODUCT AS A KEY CONTRIBUTOR TO THE DATA ECONOMY

Objective	Targets set	Measures of change: Success criteria	Data Collection Methods and sources	Frequency of data collection
B.1. Standardised Communication. The PISTIS platform should provide a method for standardised communication between stakeholders, which will ensure efficient and effortless exchange of data.	Open API Calls covering the whole platform communication	All communications done through API calls	Functional Tests of the platform	At the end of each platform release
B.2. Real – Time Data Exchange. The platform should facilitate the exchange of relevant data between stakeholders, adhering to agreed-upon key performance indicators (KPIs) and Service Level Agreements (SLAs).	Support at least 1 real-time data exchange method available	Real-time data exchange between stakeholders tested as part of the platform	Functional Tests of the platform	At the end of each platform release
B.3. Automated Data Synchronisation. PISTIS should support the setup of mechanisms to automatically receive specific data sets at regular intervals. For example, daily updates of datasets and operation plans can be received to ensure the availability of up-to-date information for planning and decision-making.	Support 1 scheduled data updating mechanism Support subscriptions on updating datasets as a monetisation method	Scheduled updating of data ingested over PISTIS tested as part of the platform “Subscription” monetisation options available and schedule data transfers between transaction parties	Functional Tests of the platform	At the end of each platform release

B.4. Data Source Identification. The platform should enable the examination of relevant registry available data sources and identification of the required data.	Support data provenance	Provision of a service to document the provenance and lineage of data	Functional Tests of the platform	At the end of each platform release
B.5. Data Quality Assessment. The PISTIS platform should enable data providers to assess the quality of the shared data and perform necessary transformations. This ensures that the data meets the required standards and can be used effectively by each data consumer. This requirement strongly depends on the definition of the metrics that assess data quality.	Support 1 data quality assessment methodology and a respective service	Provision of a service to measure quality of datasets	Functional Tests of the platform	At the end of each platform release
B.6. Licensing and Policies. The platform should support the definition of licensing and policies for using the shared data.	Support of policies for accessing data Support of adding licensing information in smart contracts	Provision of a service to define access policies on available datasets Provision of Smart Contracts incorporating legal information such as licenses	Functional Tests of the platform	At the end of each platform release
B.7. Interoperability and data format. The platform should support the agreement on a common information model, data format, and protocols. This ensures interoperability and consistency in data exchange	1 common data model per domain (demonstration hub) provided (3 in total) 1 common metadata model	Definition of common data models for the demonstrators and a generic one for the metadata	Functional Tests of the platform	At the end of each platform release

B.8. Data Monitoring and Usage. Data providers should be able to monitor the correct transfer, integrity and usage of data as agreed upon in the licenses. The platform should facilitate this monitoring process and ensure that data is used appropriately.	100% of transactions and data usage monitored	Transactions auditing service returns information for 100% of transactions. Data Usage Tracking service able to provide information for every dataset exchanged	Testing of relevant services	At the end of each demonstration phase
B.9. Business Value Evaluation. After interacting with the PISTIS platform, stakeholders should be able to fine-tune data usage, evaluate the business value of the received data, and identify additional data sources that can increase business value. This evaluation helps optimise internal processes and explore potential data sharing opportunities with third parties.	Increased efficiency of one business process. Design of one new service or product. Increase of the customer satisfaction for one service. Increased profit from the organisation data asset related to the increased revenues from the data sharing. A potential target could be a quarterly increase of 5% of revenues for	The business value can be estimated considering three types of advantages: cost, differentiation, and focus. In terms of costs, the data from PISTIS must contribute to either increasing the efficiency of the operations or reducing the costs of business processes, for example, in terms of decreasing the additional fees for having the required data from external vendors, thus increasing the number of queries at a reduced cost. In terms of differentiation, the data of PISTIS should contribute to new services or products. Thus, for each data set, the number of new offerings of the organization should be assessed. In terms of focus, that leads to the quality of services, or the incremental improvement of services and products allowed by the PISTIS data. This could be measured by looking, e.g., at the increase in customer satisfaction for each service or product connected to a	Depending on the measure of change, that would require quantitative methods (based on analysis of performance, surveys, etc.) or qualitative methods based on interviews, focus groups, etc.	For the performance analysis the data should be monitored weekly or monthly. For the qualitative methods every quarter could be conducted an evaluation.

	the overall data asset.	PISTIS data set. Also, the focus advantage could be evaluated assessing the information capacity and profitability of the company data asset before and after the use of PISTIS.		
B.10.Data anonymisation. The platform should facilitate the anonymisation of data and removal of business-sensitive information to protect data privacy.	Ability to anonymise datasets for removing PIIs	Elimination of PIIs from datasets using the anonymisations services	Functional Tests of the platform	At the end of each platform release
B.11. Semantic enrichment of the data should be supported to make it searchable using keywords, enhancing data accessibility and usability. This enrichment should be performed with the respect to the adopted interoperability standards.	Ability to improve the descriptions of datasets	1 facility to allow different manners to semantically enrich data	Functional Tests of the platform	At the end of each platform release
B.12. Data Trading and Acquisition. The platform should provide mechanisms for users to trade and acquire data from/with other PISTIS users. This promotes collaboration and knowledge sharing among stakeholders.	Ability to support end to end a data transaction	1 data transfer connector, 1 blockchain to record data trading, 1 blockchain to record monetary transactions,	Functional Tests of the platform	At the end of each platform release
B.13. Data Scaling. The platform should support the scaling of data to accommodate large volumes, ensuring efficient processing and analysis.	Ability to scale to accommodate any datasets	1 data store used that is composed of technological elements renowned for supporting scaling	Functional Tests of the platform	At the end of each platform release
B.14. Peer-to-Peer Trading Results. The platform should support the transmission and recording of peer-to-peer trading results, enabling users to track and validate their transactions.	1 facility for allowing data transfers	1 data transfer connector	Functional Tests of the platform	At the end of each platform release

B.15 Data and Metadata Publication. The platform should support the publication of data and associated metadata, making it accessible to relevant stakeholders. This facilitates data sharing and trading among users of the PISTIS platform.	1 marketplace exposing data assets and their metadata	1 catalogue infrastructure deployed to each participant to publish their available data (and the metadata related to them)	Functional Tests of the platform	At the end of each platform release
B.16. Transaction Validation Report System. The platform should include a report system for validating transactions, providing users with a clear overview of their trading activities.	1 transaction auditing service	Transactions auditing service returns information for 100% of transactions.	Testing of relevant services	At the end of each demonstration phase
B.17. Data Exchange Conditions. The platform should enable agreement on conditions for data sharing, ensuring that stakeholders have agreed upon how and when data will be shared, including considerations for data security, privacy, and legal requirements.	Smart Contract terms	1 smart contract agreement including also legal, usage and security terms	Functional Tests of the platform	At the end of each platform release
B.18. Data contracts and terms. The platform should support the definition of relevant data contracts, details, terms of use, and pricing policies. This ensures clarity and agreement among all parties involved in data sharing. This requirement is fulfilled when the respective processes of data contract preparation and contract signing are executed.	Smart Contract terms	1 smart contract agreement including also legal, usage and security terms	Functional Tests of the platform	At the end of each platform release
B.19. Smart Contract Creation. The platform should enable the creation of smart contracts between users, automating	Smart contract creation for all data exchanges	1 smart contract execution engine	Functional Tests of the platform	At the end of each platform release

and ensuring the execution of agreed-upon terms and conditions.				
B.20. Storage of Contracts and Validation Results. The platform should provide a secure storage mechanism for storing smart contracts and validation results, ensuring transparency and traceability of peer-to-peer transactions.	Secure contract information retaining mechanism	1 blockchain to hold all contracts	Functional Tests of the platform	At the end of each platform release

Table 36: Criteria for monitoring the evolution of the PISTIS product as a key contributor to the Data Economy.

21.3 Meeting the Business, Innovation and Exploitation Objectives

Business, Innovation and Exploitation Objectives (BIEO)	***Key Results***	***Key Indicators & Quantified Targets***
BIEO.1: To deploy, operate and validate a reference industrial data sharing, value accrual and monetisation platform within a set of representative demonstrator hubs that implement diverse data and intelligence sharing scenarios and substantiate multi-stakeholder added value in real-world business problem and validate a reference industrial data sharing, value accrual and monetisation platform within a set of representative demonstrator hubs that implement diverse data and intelligence sharing scenarios and substantiate multistakeholder added value in real-world business problems.	Trusted Data and Intelligence Sharing within the "Mobility and Urban Planning", the "Energy" and the "Automotive and Mobility: Demonstrator Hubs; Cross-Demonstrator Data Spaces. Project Verification and Validation Framework. Data Assets Documentation. Detailed Pilot Execution Plans and Impact Assessment. In-depth Data Landscaping.	11 added value scenarios and analytics apps in 4 sectors (mobility, urban planning, energy, automotive) across 3 Demonstrator Hubs. 3 data marketplaces and 1 open data space integrated for interoperable data exchange. >50 Detailed Data Asset Profiles to be shared/traded.
BIEO.2: To diffuse, replicate and scale up the PISTIS offerings, bringing forward novel data	Data Sharing-driven Business Models.	>3 living lab workshops organised per demonstrator hub.

sharing-driven business models and satisfying emerging / explicit needs of a wide range of stakeholders.	Monetisation and Business Innovation Analysis for the Demonstrators. Exploitation and Business Innovation Planning Activities (incl. sustainability plan and financial strategy plan with cost breakdowns and future projections). PISTIS Adoption Guidelines. Scale-up Roadmap. Dissemination & Communication, Liaison & Standardisation Activities. Continuous DIHs, Industry and SMEs Stakeholder Engagement Activities through Living Labs. Collaboration with the Data, AI & Robotics PPP Projects (ICT-13 and Data Spaces Projects).	11 data sharing-driven Business Model Innovations. Exploitation Plan. Data Market Analysis. Replication activities to >3 sectors. 10 public success stories for data sharing per industry/hub. Dissemination & Communication KPIs defined in D6.1.[42]
BIEO.3: To cultivate a data-sharing mentality within the organisation by fostering data sharing-related skills and technology competences, and understanding the "shared" data value concept,	Data Sharing Maturity Assessment Framework. Training Material (Interactive Documentation & Walkthroughs). Platform Online Documentation Mini-Site/Wiki; Open Access MOOC. Open Training Workshops & Webinars. End Users Training Days. End User Performance Assessment.	>12 Data Sharing Maturity Assessment Examples. >7 Lectures with 45' duration in the PISTIS MOOC. >100 End Users completing the PISTIS MOOC. >95% End User/Trainee Skills Improvement. >5 Open Training Workshops & Webinars. Further Education & Training KPIs defined in D6.1.

Table 37: Meeting the Business, Innovation and Exploitation Objectives

[42] D 6.1 - Dissemination, Communication, Liaison, Training and Living Lab Plan - PISTIS (pistis-project.eu)

21.4 LEGAL AND ETHICAL ASPECTS

Regulatory, Legal and Ethical Aspects[43]		
Objective	**Comments**	**Means of Verification**
Regulatory and Legal Aspects		
R.1. Data intermediation services and other additional services are provided in compliance with EU legislation.	D1.1 identifies a list of legal requirements in EU digital legislation, particularly in Open Data Directive, Data Act, Data Governance Act, that are relevant to the PISTIS services including data intermediation services. Given that these services are still in development phase and thus the legal requirements are not yet applicable, it is recommended that these requirements are proactively taken into account for the development of PISTIS digital ecosystem. A checklist (Table 39 below) is intended to be used by the technical partners responsible for development of PISTIS solutions and the demonstrator partners as reference for the identification of and compliance with the relevant legal requirements.	The partners' input to checklist will be used for assessment.
R.2 The governance of the PISTIS platform is designed and carried out in compliance with the principles adopted in Digital Services Act and E-Commerce Directive.	Pursuant to the findings of D1.1, the PISTIS platform is likely to be considered as online platform as defined in Digital Services Act and therefore it is important to comply with the certain principles adopted in Digital Services Act such as transparency, non-discrimination, etc A checklist (Table 39 below) is intended to be used by the technical partners responsible for governance of data space and the demonstrator partners as reference for the identification of the relevant legal requirements and obligations.	The partners' input to checklist will be used for assessment.

[43] Relevant Impact KPI is Improved Trust Security and Privacy Guarantees of Data Sharing

R.3. PISTIS demonstrators are aware of and are compliant with relevant data protection laws.	Although, the end-users of PISTIS will be businesses and not individuals, the datasets which will be made available by the business end-user may still contain personal data and thus exchange, upload, transfer of such dataset will constitute processing of personal data pursuant to GDPR. In that regard, any processing of such dataset in PISTIS should comply with the data protection requirements under GDPR which are explained in D1.1. A checklist (Table 39 below) is intended to be used by the technical partners responsible for governance of data space and the demonstrator partners as reference for the compliance with the relevant legal requirements and conditions set forth in D1.1.	The partners' input to checklist will be used for assessment.
R.4. Conditions of use and practical arrangements of data sharing should be fair, reasonable and non-discriminatory and provide legal certainty to the users of PISTIS.	To create consistency between data access rights and further stimulate business-to-business, PISTIS ensure fair, reasonable, non-discriminatory, and transparent terms and conditions of data sharing. The data sharing agreement to be used by the demonstrators in PISTIS contain fair, reasonable and non-discriminatory terms.	Data Sharing Contract templates to be used by the Demonstrators will be reviewed.
R.5. There are measures in place to ensure that PISTIS activities do not infringe intellectual property rights over the datasets.	The intellectual property rights that could be established on datasets in EU jurisdiction have been identified in D7.1 – PISTIS Exploitation, Business Model and Market Entry Plan – Report 1.	PISTIS terms of services and the Data Sharing Contract templates to be used by the Demonstrators will be reviewed.
R.6. The AI systems in PISTIS have been designed and developed in accordance with the ethical principles for trustworthy AI systems set by the Commission and in compliance with the	The ethical principles are explained as part of AI Ethics in PISTIS in D8.2 – Data Management Plan. PISTIS adheres to these principles in the development of AI systems to be used as part of PISTIS solution.	The descriptions of PISTIS AI systems provided in the technical deliverables will

requirements in the proposed AI Act.	As explained in D1.1, the classification of the AI systems to be utilised in PISTIS needs to be done in order to assess which legal requirements in the proposed AI Act will become applicable to PISITS systems.	be reviewed for the assessment.
Ethical Aspects		
E.1. The guiding ethical principles set in D9.1 have been duly considered when developing and implementing the use cases	In D9.1, five ethical principles are determined as the core of PISTIS Data and AI Risk Assessment Framework, and the demonstrators are expected to consider these ethical principles when designing and developing their use cases.	The partners' input to checklist will be used for assessment.
E.2. PISTIS has utilised effective privacy preserving measures to protect rights to privacy and protection of personal data.	PISTIS utilises components for data security and privacy preservation services in data sharing ecosystem explained in the technical deliverables.	The descriptions of PISTIS Data, Security, Trust and Privacy Preservation services provided in the technical deliverables will be reviewed for the assessment.
E.3. PISTIS has clearly defined legal and ethical framework.	D1.1 Chapter 4 and D9.1 outline the legal and ethical framework for PISTIS.	The partners' input to checklist will be used for assessment.
E.4. PISTIS provide the demonstrators with a Data and AI Risk Assessment Framework?	D9.1 Chapter 3 provides a comprehensive framework to assess potential risk associated with processing of personal data, use of blockchain technology and AI systems in the demonstrations.	The demonstrators are expected to utilise the PISTIS

		risk assessment framework when conducting their risk assessment.

Table 38: Legal and Ethical Aspects

21.4.1 Checklists for legal and ethical conformity

Indicative Checklist for Legal and Ethical Conformity		
Requirement	**Alpha[44]**	**Final**
Platform Governance		
Terms and conditions of PISTIS platform are clear and transparent ensuring fair and non-discriminatory access to its services.		
Terms and conditions of PISTIS platform provide the end-users with clear information on any restrictions that they impose in relation to the use of their service.		
Terms and conditions of PISTIS platform include information on policies and tools used for the purpose of content moderation, including algorithmic decision-making and the rules of procedure of their internal complaint handling system.		
There are measures in place to tackle and prevent illegal activities and unauthorised/misuse of PISTIS services.		
Identity management and access control mechanisms are in place		
Provision of Data Intermediation Services		
Technical standards, formats and specifications used in PISTIS support interoperability across different sectors and with other data spaces.		
There are measures to ensure an appropriate level of security for the storage, processing and transmission of the datasets.		
There are measures in place to ensure a high level of security for the storage and transmission of the datasets containing competitively sensitive information.		
Technical standards and specifications implemented support interoperability across different sectors.		
There are measures in place to inform data holders/owners without delay, in the event of an unauthorised transfer, access or use of their datasets.		
A log record of data transactions is kept.		
There are tools in place for obtaining consent from data subjects or permissions to process or make their data available by data holders.		
The terms of data sharing agreements used between the end-user are fair, reasonable, and non-discriminatory ensuring a level playing field.		
Privacy and Protection of Personal Data		
There are measures in place to support data minimisation.		
There are measures in place to check data accuracy.		
There are measures in place to consolidate data security.		
Information relating to the processing of personal data is easily accessible and easy to understand by the data subjects.		
Data protection by design and by default approach has been duly considered.		
There are tools for the data holders to comply data subject rights		
There are measures in place to govern transfer of personal data to outside of EU.		

[44] Only a few of these will be indicated for the alpha version.

There are organisational and technical measures in place to ensure an appropriate level of security of personal data (including designating a data protection officer, adopting access authentication and authorization policies, encryption, anonymisation, network infrastructure security systems, etc.)		
Risks associated with processing of personal data in PISTIS is thoroughly assessed. (Including conducting a Data Protection Impact Assessment)		
Compliance of AI Systems		
Risk classification of PISTIS AI Systems is made in accordance with the proposed AI Act.		
Information about the automated decision-making processes utilised in PISTIS is provided to the end-users in a clear and plain language.		
Ethics		
Ethics by Design		
Accountability		
Clear allocation of responsibilities and liabilities		
Transparency		
Fairness		
Privacy		
Assessment of risks and Safety		
User friendly user interface		

Table 39: Checklist for Legal and Ethical conformity

22 THE PRODUCT

This aspect of the evaluation plan will not be finalised until later in the project and we will return to it in D5.2.

Task 5.7 is "Demonstrators Continuous Evaluation, Impact Assessment and Lessons Learned". Following the launch of the demonstrators and the setting in operation of the verification and validation framework defined in T5.1. Data collection, regarding the experience of the demonstrator partners with the PISTIS platform, will be conducted.

During its course, this task will provide individual, aggregated and comparative assessments of pilot results, considering the performance, efficiency and effectiveness of the PISTIS Data Exchange Market, focusing on interoperability, user acceptance and engagement in data sharing, cost-efficiency, etc. It will also propose improvement actions, interventions and measures to be applied for successfully paving the exploitation path of the project. Evaluation will also pay special attention on assessing the cost-efficiency and viability of new business models developed by the project in WP7.

Towards the end of the project, an overall impact assessment and evaluation of PISTIS will be carried out involving all stakeholders of the PISTIS Living Lab, to achieve the holistic assessment and collaborative devising of the project results. Benchmarking and impact

assessment will be based on the requirements identified at the beginning of the project, while the strengths and weaknesses of the project will also be seen from this perspective.

The reporting of the results from Tasks 5.3 to 5.6 will form the basis. These tasks will also work towards turning the final solution into a market ready product. For this, we need to check that all documentation and training material will be refined and published in an appropriate, user-friendly format with similarly detailed installation and usage instructions.

The integration of the developed software components will formulate the final solution, which in turn can become a market-ready product. Installation and usage instructions will be also detailed. The integration plan which will be prepared to guide the integration of the developed backbone infrastructure with the various services and components, and this will be reflected in the iterations of the Evaluation Plan.

We set out in Chapter 12 the relationship between WP4 and WP5 with regard to the testing processes and these will also underpin the technical advancements to be made in the later stages of the project. Feedback and the reporting of results from Tasks 5.3 to 5.6 will be of value to refining the technical features of the product.

23 CONCLUSIONS

D5.1 brought together the work from two tasks and covers the planning and framework for the evaluation process whilst also covering the preparatory work for how we will conduct the demonstration activity which will provide the focus for our subsequent evaluation and impact measurement. The general guidelines will be used to monitor, coordinate and align the phases for the demonstration of the PISTIS platform. This reflects the fact that the document is covering the work from the tasks:

- T5.1 – Verification and Validation Framework Definition and Baseline Impact Assessment
- T5.2 - Demonstrators Use Cases Detailing and Execution Planning

In this deliverable, the PISTIS demonstrator partners, assisted by the technical partners that are supporting them, laid down the initial detailed plans for the operation of the demonstrator hubs, which will go hand in hand with the different releases of the platform in order to test the technical innovations of the project.

Plans are embraced for evaluating the platform from various perspectives and most importantly to validate the main concept of PISTIS, by bringing into the picture real Data Owners who would be in a position to provide the anticipated feedback for optimising the platform and its offerings.

At the same time, the scenarios that have been described go beyond the validation of the value and of the user experience of platform by Data Owners, and also test the usefulness of the platform and the business benefits it can provide from the perspective of Data Seekers, as the demonstrator partners take up this role and try, through the operation of PISTIS, to improve their services, procedures and offerings to their main customer audience.

It is noted at this point, that all the technical verification and validation of the whole platform (such as privacy guarantees, system responsiveness, etc.) will be conducted under WP4 and thus does not fall within the scope of the presented scenarios.

As such, the next steps which follow the delivery of D5.1 are to put the plans described in the document at hand in motion; that is to start executing in the different demonstration hubs the first stages of the identified scenarios that have to do with the integration of the demonstrators' systems with the PISTIS platform, the detailed definition and the acquisition of data from different data sources that need to be provided by the Data Owners, and the gathering of an initial set of individuals which will take up the role of Data Owners to run small-scale validation experiments, which are expected to gradually scale as new releases of the platform will surface and more complex editions of the prescribed scenarios will be kickstarted.

All of the above, will be documented in the following two deliverables of WP5, evaluating both the technical and the business benefits that stem from the project. And the outcomes of the evaluation process will be reported, based on this framework described.

Between the delivery of this document and M28 when D5.2 is due, specific attention will be paid to those aspects of the project's evaluation which need a little more time and experience of the project deployment process in order to give informed viewpoints on how best to proceed with the evaluation of aspects such as the monetisation and the contracting progress. Tackling the topics which require a deeper understanding of what they entail at this point in time would not bring about such valuable results as we will be able to provide in D5.2.

Similarly, the Demonstration and Evaluation Plan, initially set out in the Appendix 2 of this document, will be constantly amended and become more detailed and granular as the project progresses and in particular, with the growing familiarity of the demonstration partners with the platform as it is deployed.

APPENDIX 1: EXHAUSTIVE LIST OF POTENTIAL QUESTIONS WITH REGARD TO THE PISTIS THEORY OF CHANGE, THE DOA AND THE PROJECT DELIVERABLES.

This extensive list of questions which can be asked of the PISTIS project from a range of perspectives will be utilised in the final stages of the project to ensure that we have remained on track and to ascertain that we achieved what we set out to do. They will underpin the evaluation process and be addressed in D5.3 with a focus on. They are meant as guidance in the evaluation process. They are grouped under the following categories:

- EU Strategy
- Scientific and Technical Objectives
- Legal and Ethical
- Business, Innovation and Exploitation Objectives
- The Demonstrations
- The PISTIS Theory of Change
- The PISTIS Product
- Social Engagement
- Maximising Impact

EU STRATEGY
Did we contribute to '*Promoting an open strategic autonomy by leading the development of key digital, enabling and emerging technologies, sectors and value chains to accelerate and steer the digital and green transitions through human-centred technologies and innovations.*'?
Did we contribute to '*Making Europe the first digitally led circular, climate-neutral and sustainable economy through the transformation of its mobility, energy, construction and production systems*"?
Did we set out a credible pathway to contributing to the expected impact of Cluster 4 as set out in Horizon Europe Strategic Plan, of becoming a "*Globally attractive, secure and dynamic data-agile economy, by developing and enabling the uptake of the next-generation computing and data technologies and infrastructures, enabling the European single market for data with the corresponding data spaces and a trustworthy artificial intelligence*"?
Did we contribute to standards for data-sharing?
Did we contribute to Energy efficiency?
Did we promote high standards of transparency and openness?
Did we contribute to improving European leadership in the global data economy?
Did we contribute to maximising social and economic benefits from the wider and more effective use of data?
Did we help to reinforced Europe's ability to manage urgent societal challenges?
Did we demonstrate how the PISTIS improvements can have great positive impacts for society, people, economy, or the environment?
Did we advance federated data discovery and sharing?
Did we advance DLTs?

Did we advance data non-fungible tokens (NFTs)?
Did we advance AI driven data quality assessment and monetisation?
Did we build trust among stakeholders and assuage their concerns?
Did we "i*mprove the digital technologies, solutions and interoperable frameworks for data markets and data economy, allowing for data assets to be discoverable, efficiently and fairly priced and shared/traded in a secured, user-friendly, compliant and energy-efficient way"?*
Did we *"promote the development of a European industrial ecosystem of the data economy capable of ensuring digital autonomy"?*
Did we *"develop training material to endow workers in this occupational group with the right skillset in order to deploy the new technologies"?*
Did we contribute to "*Improved European leadership in the global data economy"?*
Did we help to *"Maximise social and economic benefits from the wider and more effective use of data"*
Did we help to *"Reinforce Europe's ability to manage urgent societal challenges."?*

Project Objectives: Scientific and Technical Objectives (STO)
Did we set and implement the underlying foundations for trusted, fair and reliable data sharing, trading and exchanges in a federated manner over a secure, immutable, sovereignty preserving and IPR respecting multi-party data exchange framework? *(STO1)*
Did we meet the End Users and Data Spaces Requirements? *(STO1)*
Did we provide: • Data Sharing/Trading Lifecycle and Models? • Enforcement and Governance Techniques & Services? • DLT-Powered Data Value Contract Composition Management and Lineage Tracking Services? • Data Monetisation Schemes? • Data Investments Models? • Data NFT and StableCoin Framework & Reference Implementations? • A low emission blockchain network? *(STO1)*
Did we design and deliver appropriate data asset management and governance techniques? *(STO2)*
Did they address ever-present data interoperability, quality assurance and security challenges that are common to both data providers and data consumers? *(STO2)*
Did we provide: • Data Management, Interoperability and Curation Techniques & Services? • Data Security & Trust Services? • Data Lineage, Observability and Usage Tracking Models & Services? • ML/AI-based Derivative Assets Generation and Tracking? • Distributed Data Asset Discovery? • Legitimate and Secure Peer-to-Peer Transfer Mechanisms? • Data Models Network Management? *(STO2)*
Did we develop rigorous and fit-for-purpose data valuation and monetisation methods and tools to allow data providers to accrue the right value for the right data at the right time and reach the actual data potential?
Did we provide: • A Multi-facet Data Valuation Assessment Framework?

• Dynamic Pricing Estimation Models & Services? • AI-based Data Market Insights? • XAI-based Monetization Services? • Demand-Supply Matchmaking Models? • PISTIS Data Exchange Market? • Stablecoin Exchange Desk? *(STO3)*
Did we integrate and serve the novel PISTIS federated data sharing, value accrual and monetisation platform through easily deployable software, enabling trustful, reliable & interoperable exchanges with a wealth of sources, platforms and data spaces?
Did we provide: • End-to-end usage scenarios? • Technical Requirements and MVP? • Reference Architecture? • Open APIs? • Design Blueprints & Plan for Integration? • Distributed Data Spaces Factory Environments? • A Cloud/Centralized Data Trading and Value Exchange/Monetisation Platform? • Software Verification & Validation? *(STO4)*

LEGAL and ETHICAL
Did we use legally binding data sharing contracts?
Did we monitor and lead the activities that relate to the GDPR, ethical, legal compliance of the project and the design of the legal clauses of the data sharing contracts?
Did we create the role of PISTIS Ethics Manager?
Did the contract templates adhere to the provisions of the Data Governance Act and the Data Act, focusing on regulating Data Spaces and Data Sharing and GDPR provisions?
Did we utilise legal expertise within the exploitation activities of the project, to facilitate IPR definition and conflict resolution?
Did the legal involvement in PISTIS guarantee the accurate landscaping of regulatory frameworks and barriers in the Data/ AI Domains, while safeguarding the compliance of the project to ethics-relevant regulations and guidelines?
Did we proactively and legitimately address ethical issues and risks involved in the project under a concrete ethics monitoring and assessment framework, as well as, through the PISTIS Data Management Plan?
Did we process personal data in compliance with the principles of the GDPR and the Data Governance Act?
Did we rigorously apply the European ethical standards and guidelines regardless of the country in which we carried out the research?
Did we adopt an ethics-by-design approach?
Did we deliver a Data Management Plan (DMP) which defined in detail the processes and mechanisms to safeguard security and privacy requirements imposed in the project's data processing activities?
Was there transparency on all data management practices performed by the project?
Did we define Ethical and Legal Framework for PISTIS d setting the legal, privacy and ethics background, identifying requirements, potential ethical risks and regulatory and privacy

concerns related to the project activities, and providing a roadmap for handling ethical concerns during the project?
Did we apply a data and ethics management policy enforced by advanced sovereignty and security technologies as well as practices in the project's fields of research and use cases?
Were we in line with the principles of responsible/trustworthy AI?
Did we deliver Data and AI Risk Assessment Framework to identify potential risks and ethical issues according to regulations including the GDPR, the Data Governance Act and the Artificial Intelligence Act, assess them against their severity and probability and provide guidance for technical decisions that can foster compliance?
Did the Ethics Manager maintain an overview of the work throughout the whole course of the project in order to be able to early identify issues that might arise and define how they may be addressed in order to ensure that identified ethical principles of ethical were followed?
Did we contribute towards making comprehensive the methods that will be fuelling PISTIS and to explain to end users in a plain language the IPR, GDPR privacy, Trustworthy AI and FAIR data principles?

Business, Innovation and Exploitation Objectives (BIEO)
Did we deploy, operate and validate a reference industrial data sharing, value accrual and monetization platform within a set of representative demonstrator hubs? *(BIEO.1)*
Did these hubs implement diverse data and intelligence sharing scenarios and substantiate multistakeholder added value in real-world business problem? *(BIEO.1)*
Did we validate a reference industrial data sharing, value accrual and monetisation platform within a set of representative demonstrator hubs? *(BIEO.1)*
Did we provide: • Trusted Data and Intelligence Sharing within the "Mobility and Urban Planning", the "Energy" and the "Automotive and Mobility" hubs? • Cross-Demonstrator Data Spaces? • Data Assets Documentation? • Detailed Pilot Execution Plans and Impact Assessment? In-depth Data Landscaping? *(BIEO.1)*
Did we diffuse, replicate and scale up the PISTIS offerings, bringing forward novel data sharing-driven business models and satisfying emerging / explicit needs of a wide range of stakeholders? *(BIEO.2)*
Did we provide: • Data Sharing-driven Business Models? • Monetisation and Business Innovation Analysis for the Demonstrators? • Exploitation and Business Innovation Planning Activities (incl. sustainability plan and financial strategy plan with cost breakdowns and future projections)? • The PISTIS Adoption Guidelines; Scale-up Roadmap? • Dissemination & Communication, Liaison & Standardisation Activities? • Continuous DIHs, Industry and SMEs Stakeholder Engagement Activities through Living Labs? Collaboration with the Data, AI & Robotics PPP Projects (ICT-13 and Data Spaces Projects)? *(BIEO.2)*

Did we help to cultivate a data sharing mentality within the organisations by fostering data sharing-related skills and technology competences, and understanding the "shared" data value concept? *(BIEO.3)*
Did we achieve TRL 4-5 by the end of the project?

The DEMONSTRATORS
Did the demonstrators successfully run for the required length of time?
Demonstration Hub #1
Did we improve baggage handling management?
Did we Improve Transfer Passenger Management?
Did we improve the Aircraft Turnaround process?
Did we provide valuable support to the Public Transportation Planning System?
Did we provide valuable insights for city commercial businesses?
Demonstration Hub #2
Did we Increase the hosting capacity of the grid?
Did we offer opportunities for Investment Deferral?
Did we provide P2P trading between users or Energy communities?
Did we offer opportunities for monetisation of data owned by the different actors to third parties for use as services over energy?
Demonstration Hub #3
Did we improve Traffic quality assessment?
Did we improve methods for assessing Driving Style & Risks?
Did we increase the availability of data sets to improve AI model training?
Did we reduce the amount of data being transferred from vehicle to data centre?
Cross-cutting Demonstration Hubs
Did the Weather Hub succeed in providing data to the three core hubs?
Did Hub #1 identify open data for: • Use-case enhancement? • To enhance the PISTIS offering?
Did Hub #1 identify open data for: • Use-case enhancement? • To enhance the PISTIS offering?
Did Hub #1 identify open data for: • Use-case enhancement? • To enhance the PISTIS offering?
Did PISTIS help reduce barriers to the utilisation of open data?
Was any value added to open data sets through PISTIS?
Did the Living Lab help identify any open data requirements arising from potential adopters?
Did the Living Lab succeed in involving local SMEs?
Did the Living Labs support the inclusion of Open Data?
Did the demonstrators help to showcase the product?

PISTIS THEORY OF CHANGE
Did we provide methods and tools to transform heterogeneous data and sources into interoperable assets?

Did we provide methods and tool to evaluate and improve the quality of the data?
Did these include: • Sectorial Data Models? • Pistis Metadata Repository? • Methods for Data Ingestion? • Methods for Data Transformation? • Methods for Data Enrichment? • ML-based Data Quality Assessment methods?
Did we provide methods and tools to guarantee data ownership, sovereignty and IPR management, to keep data with the owners, increasing trust and security whilst providing accurate lineage and usage tracking of data in on/off platform scenarios? Did these include: • Federated Data Sharing through peer-to-peer data exchange? • lineage tracking IPR safekeeping and contract enforcement modules, provided all as the background knowledge for the bundles to be part of the PISTIS Data Space Factory environment? • Exchange Log based on Blockchain? • Data Monetisation Options (NFT + Data Investment schemes)? • Data Contract Monitoring and Management? • Data Usage Monitoring and Management? • Interconnection with DataSpaces?
Did we provide methods and tools for High-performance Security, Privacy Preservation and Trust Generation Services for Data Spaces in order to enable high trust guarantees by data sharing services, whilst safeguarding security, privacy, provenance, access, IPR and audit contract terms usage?
Did these include: • Data Security and Trust bundle? • Distributed ledger technologies (DLT)? • Access Policies? • Identity Provider? • Searchable Encryption Scheme?
Did we provide methods and tools to objectively value data and link it to market values, with Trusted and Fair monetisation schemes for Low-energy and resource friendly infrastructures for data management and contract enforcement?
Did these include: • A set of methods to drive the multi-dimensional valuation of data, the fair dynamic pricing of it, the definition of the market dynamics and the core features and the creation of novel data investments schemes (such as the Stablecoin, NFTs and Data Investment), to deliver the necessary data-sharing features that will be provided by the bundles of the PISTIS Data Trading and Value Exchange/Monetisation platform? • Data Market Insights service? • Low Energy Blockchain infrastructure?
Did we provide Multidisciplinary Training material for all actors and the Communication and encouragement to adopt the results widely?
Did these include:

• Demonstrations in six settings (3 demonstrator hubs with 12 partners + 3 more deployments with cross-domain data (weather data/open data)) and be used by the Living Lab as well? • Publications in scientific journals and international conferences? • 1 Business model targeting market entry and adoption of PISTIS by the Data Spaces? • 4 Business Models and Monetisation strategies (3 demo hubs + weather demonstrator)? • MOOC and Training Material? • Engagement of DIHs in the demonstrator dissemination activities? (Box F)
Did the Outcome 1 of providing "Mechanisms for taking back control" improve trust, create more users and encourage communities to develop their own goals and operations?
Did Outcome 2. Technical support to improve the data industry and Outcome 3 have a catalyst effect on the eco-system, combine to create a data-sharing culture, whilst enhancing the EU Data Eco-system and supporting the evolving DataSpaces?
Did achieving these outcomes and their identified scientific, economic, technological and societal impacts pave the way to making progress towards achieving the goals of: • Growing the Data Market? • Growing the Data Economy? • Improving the Data Industry? • Growing the existing data eco-systems? • Creating new data eco-systems? • Making contributions to EU Policy and Strategy? • Sharing Knowledge Generated?

The PISTIS PRODUCT
Did we improve automated ways for extracting meaning and providing insights from data extremely fast?
Did we improve automated ways for extracting meaning and providing insights from data accurately?
Did this contribute to optimising decision making?
Did we adequately consider quality standards and assessment criteria for data generated by simulation?
Did we build a distributed network of existing and new data spaces with built-in governance to eliminate silos?
Did we accrue the actual data value and multiply it through derivative assets in a fair and transparent manner?
Did we consider the data supply and demand perspectives?
Did we demonstrate Federated Data Management, Interoperability & Governance that collects, curates, secures and fully controls the data made available through each organisation's data space?
Did we provide Federated, Secure Data Sharing with effective management and on-chain storage of (multi-party) data contracts in an inherently human-understandable manner?
Did we provide secure peer-to-peer data transfer and usage monitoring mechanisms for appropriately retrieving, provisioning, self-serving on-demand and tracking the appropriate data 'slices' according to the relevant contract provisions?

Did we provide Data Valuation and Monetisation to systematically articulate and recommend an appropriate target value and did we take into consideration the “cost” approach, the “income” approach, and the “market” approach?
Was the data made available in consistent structures and machine-readable formats (syntactic data interoperability)?
Was the data annotated with appropriate metadata based on state-of-the-art metadata standards to facilitate their proper cataloguing within and beyond the PISTIS platform (metadata interoperability)?
Did we ensure the quality of the data that is shared along different quality dimensions, accompanied with appropriately configured data observability and data source certification mechanisms?
Did we eliminate data down-time, safeguard quality and reliability of data and ensure trust of the potential data consumer through automatically assigned metrics?
Have we helped to ameliorate critical trust, confidentiality data privacy and security concerns?
Have we helped to create a pathway to drive richer and more robust insights, improve operations, address concrete business problems and generate new business opportunities?
Have we successfully transformed bilateral trusting relationships into secure, seamless, and trustful data sharing among different stakeholders?
Have we overcome the latency and lower performances encountered in cases where privacy preserving techniques are applied which can be problematic with data-in-motion and real-time analytics?
Have we improved the data quality and reliability coming from data providers so it can be utilised by other stakeholders?
Have we contributed to standards and to the reduction of data interoperability issues?
Has the project succeeded in making exploration of available data easier via access to sample sets of data?
Have we simplified the procedures required regarding IPR and licensing arrangements for the lay person to understand?
Did we succeed in improving automatic enforcement of conditions as agreed within data sharing contracts and the monitoring of the actual data usage in compliance with geography-based data use regulations?
Has the project contributed to improving mechanisms for putting value on data and for building consensus about how to systematically articulate and quantify such value?
Has PISTIS helped organisations to comprehend the value of their existing data assets and the underlying levers that can increase data value?
Have we helped to proceed to a mindset shift: • that goes beyond the mere transactional monetisation of data towards the broader context of value? • towards future opportunities to collaborate and innovate? • and for value to be created for the overall ecosystem?
Have we helped to cultivate the necessary skills to enable this new emphasis to be progressed?
Did we provide the necessary training material: • to educate stakeholders into how they can assess their data sharing maturity? • to proceed with data landscaping to reach their available and missing data? • to deploy/operate the PISTIS technologies?

• to implement an effective and sustainable data sharing strategy?
Has progress been made regarding overcoming uncertainties about “data ownership”?
Has PISTIS successfully demonstrated the use of non-fungible tokens (NFTs) as an irrevocable digital certificate of ownership and authenticity for a given asset as a way to share and distribute value of intangible assets in a more equitable way?
Have energy consumption and sustainability concerns over the consensus process in the blockchain based solution been addressed?
Did we take raw data (as extracted from each stakeholder’s information systems and/or data spaces) and: • Provide enriched data that have been curated in PISTIS to comply with domain specific data models and are ready for consumption by potential data consumers? • Provide aggregated data that include high-level data created by combining or anonymising individual-level enriched data? • Provide derivative data, representing the outcomes of analytics applied over the enriched data that belong to a stakeholder or have been acquired by a stakeholder? • Provide data insights that reflect knowledge, explanations and visualisations gained through an in-depth analysis of the derivative data?
Did we provide a mechanism for data valuation and monetisation which took into consideration the cost approach, the income approach and the market approach?
Did we provide an analysis of available data management and data trading processes, towards extracting knowledge used as input in the requirements elicitation process?
Did we establish and define the requirements stemming from the demonstrators’ perspective, business and Data Spaces needs, data management and trading processes?
Did we align with the most prominent initiatives, identifying artefacts and knowledge, as well as a patent search that helped to shape the technological offering of the project?
Did we document and conduct a data landscaping in the demonstrators?
Did we adequately define and describe end-to end the usage scenarios that shaped the project’s activities.
Did we adequately define the design specifications and early technological considerations that drove the overall development and implementation activities of the project?

SOCIAL ENGAGEMENT
Did we provide: • A Data Sharing Maturity Assessment Framework? • Training Material (Interactive Documentation & Walkthroughs)? • Platform Online Documentation Mini-Site/Wiki? • Open Access MOOC? • Open Training Workshops & Webinars? • End Users Training Days? • End User Performance Assessment? *(BIEO.3)*
Did we manage to reduce barriers through social engagement for stakeholders to share their data and help overcome the lack of trust in data market transactions?
Did we take establish special provisions regarding data subject engagement by providing a strong framework based on key social marketing models?
Did we deliver user-centric and codesigned innovations through the User-Driven Innovation methodology adopted in PISTIS and supported by the establishment of the Living Lab?

Did we facilitate engagement through representation based on new business models and actors that will facilitate data subject involvement in data sharing transactions?
Did we monitor the changing standardisation environment over the wide range of activities we were dealing with?
Which European data sources did we also utilise?
Did we conduct a state-of-play analysis of the PISTIS environment?
Did we conduct a cross-sector analysis and alignment with other projects and strategic initiatives?
Did we identify stakeholder usage barriers?
Did we analyse data needs and AI features of the different components?
Did we provide Early and Open Sharing of research and innovation?
Did we provide Open Access to the project results?
Did we participate in open peer-review processes?
Did we enable co-creation and co-validation of the projects results?
Did the project take all necessary measures to achieve at least 40% representation of women in the project team and in key managerial roles?

MEASURES to MAXIMISE IMPACT.
Did we successfully plan the project's dissemination, exploitation and standardisation approach?
Did we implement and regularly update the project's dissemination, training, and communication plan?
Did we deliver the necessary respective communication material and tools?
Did we participate in events, seminars, and conferences relevant to the scope of the project as planned?
Did we deliver a plan for the active engagement and liaison with standardisation bodies?
Did we deliver appropriate educational and skills cultivation material and MOOC and organise dedicated webinars and open training workshops?
Did we organise the PISTIS Living lab activities engaging SMEs and Digital Innovation Hubs?
Did we define the project's Exploitation Strategy and Plan?
Did we implement and monitor the project's exploitation activities?
Did we ensure an efficient and fair identification and allocation of intellectual rights and ownership of results?
Did we enhance current and anticipated data-driven business models and opportunities arising for the project's demonstrators and other onboarded organisations?
Did we formulate methodological adoption guidelines for the steep uptake of the platform and embody those into the training material?
Did we elaborate on the project's Business Plan and Individual/ Clustered Exploitation Plans?
Did we prepare for market entry of the PISTIS solution?
Did we cultivate Data Sharing Skills by providing the training material to educate stakeholders into how they can assess their data sharing maturity, proceed with data, deploy/operate the PISTIS technologies and implement an effective and sustainable data sharing strategy?

Table 40: Questions arising from the PISTIS Theory of Change, DoA and Deliverables.

APPENDIX 2: THE DEMONSTRATION AND EVALUATION PLAN

This will be a Living Document[45] and be revised periodically as required. A regular schedule of meetings will be established and the table below sets out a flexible schedule providing an overview for the whole evaluation process, alongside the project milestones.

The detailed timetable will evolve as the evaluation process moves forward and will be reviewed regularly, but clearly, it is indicative, as meaningful detail can only be added as the project progresses, particularly in the light of the "agile software development" process.

Chapter 7 sets out the overall setting for planning and carrying out the demonstration activity, and in Figure 9, outlines the organisational structure within WP5, outlining the roles of different partners in this process. Whilst the plan set out below gives the headline actions to be carried out, a much more granular layer will exist and will be formulated within a set of meetings scheduled on both a regular basis and an *ad hoc* basis, to pry into the details of the actions planned. They will take place at a variety of levels including that at a hub level. Outputs from these meetings will shape the agenda for the regular WP5 meetings, which will be interspaced with "core group" meetings to keep a check on progress and deal with specific questions.

Prior to each PISTIS Plenary meeting, the rolling plan for the next period will have been discussed within WP5 and be presented to the whole project.

The Pistis Demonstration and Evaluation Plan needed to take into account several stages at which the demonstration sites needed to be suitably prepared for in order to ensure a successful demonstration and evaluation process. In the early months of WP5 activities, with a focus on **planning the roll-out of the demonstrators,** the main work entailed:

- Performing an analysis in the pilot sites for defining available data assets and relevant interfaces for integration.
- Creating an accurate baseline to be used as a reference for the verification of the impact.
- Coordinating and realising the demonstration/ validation of the PISTIS platform in the project's demonstrators.

Therefore, some of the earlier actions in the demonstration plan are the reporting and feedback from activities carried out prior to M15. For example, feedback from questionnaires distributed in the early months of WP5 operation have produced the required information and this will be reported at early meetings in M15. These incoming questionnaire responses covered such issues as:

- "In relation to hosting the data factories, is the capacity there? Will it be hosted in their own premises of through a cloud provider etc.?"

[45] Demonstration and Evaluation Plan.xlsx (sharepoint.com)

The aim here being to identify what is there and available to use at the moment and conversely, what is missing and needs to be made available. Other similar material received is being digested and will similarly be reported.

Outline Pistis Demonstration and Evaluation Plan at M14.

Month	What	Who	Lead partners	Where reported
Phase 1: Data Sources Connection - Data Collection etc:				
M15	Adoption of first version of "living plan" to be retained on the PISTIS workspace.	All partners	Assentian, Polimi.	WP5 monthly meeting
	Mapping of scenarios against PISTIS components to identify gaps in meeting user needs.	All Partners	Deep Blue	Report at regular WP5 monthly meeting.
	Hub and use case specific action plans provided. "All use cases to be considering what they will provide at the end as dashboards or Apps or something similar"			Reports presented at WP5 monthly meeting
	- Hub specific meetings to be held where required to consider such already identified elements as: Finalising the data format and frequency of data exchange; different integration issues outside PISTIS; future developments; firming up roles; obtaining economic information related to network digitalisation, operation, and maintenance, data costs, etc; Planning Migration of solution to new server environment and testing APIs and working with tiffs; adapting events services; Integration of Data planning; harmonisation, aggregation and historisation of data; theoretical concepts for the FCD to Emission Model etc.	All hub partners	Hub leaders	Report at regular WP5 monthly meeting. Agendas to be structure around issues prevalent according to the needs of the hubs at a specific time.
M16 **(MS4)**	**ALPHA BUNDLES RELEASE.** The Alpha version shall offer basic functionalities. Reporting process at WP5 regular meetings Identification of a small, closed group of users, usually employees of the demonstrator who have also taken part in setting up PISTIS platform at the premises of the demonstrator, with knowledge of the project goals and both the technical details (e.g.		Suite5, SPH Technical leads for the three hubs.	

	connection of the data sources) and the business details. (e.g. the goals that demonstrators aspire to achieve with the adoption of the PISTIS platform)			
	This group interacts with the technical teams to provide iterative feedback			
	Contract templates for M16		ALEGAL	
	Assess if PISTIS can address identified gaps. Define success criteria for each scenario, anticipate potential failure modes, and devise mitigation strategies. Reporting process at WP5 regular meetings	All Partners	Deep Blue	
	[M14] Specify and setting up the requirements for the digital twin system, agree on the interface that will be used for the exchange, explore all relative costs for the implementation.	Hub #1 UC1	AIA	
	License/IPR Management	Demonstration Hubs		
M17	Continuation of user needs work set out above.	All Partners	Deep Blue	
	Preparation of report on activities carried out and planned activities		Deep Blue	Report at WP5 regular meeting
	Preparation and revision of detailed plan for next period		PoliMi	Report at WP5 regular meeting
M18	Presentation and agreement of plan for next period.		PoliMi	PISTIS Plenary Meeting
	The review and consolidation of the scenario with Demonstrators through co-design workshops. Realistic and accurate baseline to be used as a reference for the verification of the impact achieved. Verify objectives, processes, and expected outcomes.		Deep Blue	

	Anticipate potential issues and establish contingency plans. Conduct an in-depth analysis to ensure necessary functionalities for managing both planned actions and unforeseen challenges Reporting of	All partners plus Use Cases/ Demonstrators	Assentian.	
	Hub#1 meeting.		Hub#1 leader	Reports at regular WP5 meeting.
	Hub#2 meeting.		Hub#2 leader	
	Hub#3 meeting.		Hub#3 leader	
	Weather Hub meeting.		Hub leader	
	Open Data Factory report from attendance at meetings.			
M19	Further co-design workshops reviewing scenarios.	All partners plus Use Cases/ Demonstrators	Deep Blue	
	Development of the connectors and necessary customisations at each demonstrator. Integration of the demonstrators' systems with the PISTIS platform, the detailed definition and the acquisition of data from different data sources that need to be provided by the Data Owners, and the gathering of an initial set of individuals which will take up the role of Data Owners to run small-scale validation experiments			
	[M14] Setting up all necessary procurement procedure.	Hub #1 UC1	AIA	
M20	Commence evaluation of the practicality and effectiveness of proposed solutions through to M32.	All Partners	Deep Blue	

	Commence engagement of external stakeholders to review and consolidate project scenarios, ensuring they are robust, realistic, and meet stakeholder needs, through to M40.	All partners and External Stakeholders	Deep Blue	
	Identify risks collaboratively with external stakeholders, leading to comprehensive risk mitigation strategies. Verify PISTIS functionalities align with project goals and expectations. Utilise Living Labs in WP6 for hands-on testing and validation in realistic settings [round 1, from M20 to M25]	All partners and External Stakeholders		
	Testing Group established			
	Release of external repository and API			
	Release of API with population registry			
	Every demonstrator is ready to connect to the Alpha version of the Pistis platform			
	API Test			
	Data verification			
	Preparation and revision of detailed plan for next period		PoliMi	Report at WP5 regular meeting
M21 **(MS5)**	**ALPHA PLATFORM RELEASE** The PISTIS Product - Alpha version is published	WP4, All technical partners	Suite5 SPH	Deliverable D4.2
	Presentation and agreement of plan for next period.		PoliMi	PISTIS Plenary Meeting
	Internal Progress Report and check-list update	All partners	Assentian	Report at WP5 regular meeting

M22	T6.6. Focused Training Activities, Open Training Workshops and Webinars –M22-M42 Full Programme published		Deep Blue	Programme presented at WP5 special meeting.
	User group established			
	Static isolated data transformed			
	Data availability verification, checking all data required is available. Check-list update.			
	Develop upload connector			
	Test of the certificate flow procedure			
M23	Participant Recruitment			
	Test activity on basic platform functionalities			
	The MVP will follow a two-release plan, and a final revised set, with input gathered from the demonstrators will be provided.			
M24	The Beta version shall be evaluated by a larger scale closed group, or a limited open group, depending on the nature of each demonstrator. At this stage, the users should have limited to no knowledge of the technical and business details behind the demonstrator's adoption of the PISTIS platform.			
	Data collected and analysed			
	Develop download connector			
	Develop Back-up			
	Survey feedback			
	Develop data integration			

	Early adopters' data collected.			
	Club stakeholders inspect data.			
	Data sharing facilities tested.			
	Check-list updated for next period			
	Additional mock-up definition			
	Implementation of virtual wallet			
	Collect feedback			
	Expand piloting group			
M25	Perform a gap analysis at the project's demonstrators to define additional activities (e.g. consent collection, deployment of internal infrastructure, connections sensors, compatibility with specific APIs, resolution of network communication issues) which are necessary in order to facilitate the realization of the project's demonstrators.	Demonstration Hubs	Assentian	
M26				
M27	Internal Progress Report	All partners	Assentian	
M28 **(MS6)**	Demonstrators' Activities Evaluation Results - First Report	All WP5 partners	Assentian	**Deliverable D5.2**
M29				
Phase 2. Beta Phase: Extension of Data Owners base- operational readiness testing:				
M30	**BETA BUNDLES RELEASE**	WP4, All technical partners	Suite5	

M32	Completion of the evaluation of the practicality and effectiveness of proposed solutions, initiated in M20.	All Partners	Deep Blue	
	Identify risks collaboratively with external stakeholders, leading to comprehensive risk mitigation strategies. Verify PISTIS functionalities align with project goals and expectations. Utilise Living Labs in WP6 for hands-on testing and validation in realistic settings. [round 2, from M32 to M42]	All partners and External Stakeholders		
M33 **(MS7)**	**BETA PLATFORM RELEASE** The PISTIS Product - Beta version "published	WP4, All technical partners	Suite5 SPH	Deliverable D4.3
	The Beta version shall be evaluated by a larger scale closed group, or a limited open group, depending on the nature of each demonstrator. At this stage, the users should have limited to no knowledge of the technical and business details behind the demonstrator's adoption of the PISTIS platform.			
Phase 3 Scenario A - Final Phase – Operational Deployment of the factories				
M38	FINAL BUNDLES RELEASE In the final version all major defects identified after the evaluation of Alpha and interim versions will be fixed and shall offer full functionality plus mature, experimental-to-functional level of non-critical features. Final version shall be evaluated by a fully open group of users, who could range from invitees of the demonstrator to groups of clients of the demonstrator or even the open public.	WP4, All technical partners	Suite5	
	Potential business models for commercializing PISTIS (refinement of exploitable results - selection of components -, revenue streams, pricing strategies)	Demonstration Hubs		
M39	Interaction with key EU Green Deal. Sustainable Energy initiatives to widen impact	Energy Hub partners	Deep Blue	

	Gathering Lessons Learned from the demonstrators along with any observed weaknesses		Polimi	
	Propose improvement actions, interventions and measures to be applied for successfully paving the exploitation path of the project.			
	Evaluation will also pay special attention on assessing the cost-efficiency and viability of new business models developed by the project.	All WP5 partners	IDC/WP7	
M40	Culmination of the process started in M20,of the engagement of external stakeholders to review and consolidate project scenarios, ensuring they are robust, realistic, and meet stakeholder needs.	All partners and External Stakeholders	Deep Blue	
	Interaction with European Green Deal Strategy and the EU's commitment to global climate action to widen impact further.	Energy Hub partners	Deep Blue	
	Provide individual, aggregated and comparative assessments of pilot results, considering the performance, efficiency and effectiveness of the PISTIS Data Exchange Market, focusing on interoperability, user acceptance and engagement in data sharing, cost-efficiency, etc.	All WP5 partners		
	Partnerships/Alliances, both for research impact and for commercial exploitation (work on mapping of architectures and components vs GAIA—X, etc as relevant input)	Demonstration Hubs		
	Demonstrators' Activities Evaluation Results - Second Report published.	All WP5 partners	Assentian	**Deliverable D5.3**
WP5 is completed.				
M42	The final milestone **(MS8)** is achieved with the release of the **Final Platform** and the concluding of the final results. "D4.4 The PISTIS Product - version 1.0" released.			