TEADAL

D7.2 EXPLOITATION AND SUSTAINABILITY PLAN

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EXECUTIVE SUMMARY

Exploitation and long-term sustainability of research and development projects is a key concern of all project stakeholders whose end goals extend beyond the mere completion of the project.

This document provides an overview of the exploitation plans of the TEADAL consortium for the project outcomes. The plan is presented from two viewpoints: the side of the TEADAL consortium as a whole (joint exploitation plan) and the perspective of the single partners. These plans will facilitate future collaborations with partners and other running initiatives, with the aim of increasing the socio-economic impact of TEADAL on the co-creating ecosystem.

In joint exploitation analysis starts by outlining the key exploitable results (KERs) spanning different project domains. We use elements from a largely used business model description approach (Business Model Canvas) to structure the joint exploitation plan for these results, looking at the key partners, key activities, key resources, value propositions, customer relationships, customer segments and channels to reach them, cost structure and revenue streams of each key exploitable result. In addition, a short stakeholders, competition and potential barrier analysis is provided. Then, each partner defines its individual plan according to its own strategy and its own resources.

All project partners have agreed on clear rules related to intellectual property rights (IPRs). These rules encompass the ownership of IP, access rights to any background and results for the execution of the project, as well as the protection of IPRs and confidential information. These rules were established before the inception of the project.

Standardisation for Horizon Europe projects involves actively engaging in the process of creating or influencing technical specifications and other formal documents. This promotes European values, accelerates innovation, facilitates market uptake, and ensures the interoperability and consistency of project results within their respective fields. The TEADAL project is also using standardisation as one means of community outreach and the efforts are also discussed in this document.

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ABBREVIATIONS

CA	Consortium agreement
CAGR	Compound annual growth rate
GA	Grant agreement
IPR	Intellectual property rights
KER	Key exploitable result
TRL	Technical readiness level

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1 INTRODUCTION

An exploitation plan describes how the outcomes, knowledge, and innovations generated from a project will be used, disseminated, and capitalised upon, both during and after the project lifecycle. This plan is particularly crucial in research and development projects where the end goal extends beyond the mere completion of the project. The exploitation plan aims to ensure that the results of the project deliver tangible benefits and contribute to the broader objectives of the organizations and stakeholders involved.

TEADAL's exploitation plan supports the consortium in ensuring the project's sustainability, maximising the impact of project outcomes on partners' individual businesses, and, where possible, fostering new business collaborations, while preserving potential intellectual property rights (IPRs). The exploitation actions will build on a set of exploitable assets and tangible outcomes the project plans to deliver during its lifespan.

The document views exploitation from two perspectives: the key exploitable result (KER) and the partner perspective. Some expected KERs were identified in in the project proposal. We have reviewed these and base our joint exploitation plan on these results. These KERs are joint results that span different tasks and work packages. We use elements from a predefined business model to structure the exploitation plans for these results, looking at the key partners, key activities, key resources, value propositions, customer relationships, channels to reach customer segments, customer segments, cost structure and revenue streams of each KER. In addition, we give a short stakeholder, competitors and potential barriers analysis.

TEADAL has partners from different sectors (academia, SMEs, large enterprises, industry), hence the exploitation of the results differs from partner to partner. To document this difference, we have also asked each partner to document their exploitation plans from the point of view of their organization. Where applicable, the partners have referenced the relevant KERs.

This document also discusses the intellectual property and data management and gives an overview of the community outreach activities carried out so far.

The document consists of 6 sections. Section 2 gives an overview of the methodology used for compiling the exploitation plan, including a short description of the Business Model Canvas template. Section 3 describes the exploitation plans both at consortium level and for individual partners, together with a market analysis. In section **Error! Reference source not found.** the intellectual property rights are summarised. Section **Error! Reference source not found.** gives a progress report on the standardisation and community outreach activities that TEADAL has carried out thus far. The document ends with a conclusion and discussion of the next steps.

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2 METHODOLOGY AND EXPLOITATION STRATEGY

This section describes the methodology for the exploitation strategy adopted for the key exploitable results (KERs). KERs are the main project results that represent significant and innovative contributions that can have a practical and economic impact. The exploitation of TEADAL results is foreseen from two perspectives: the joint KER exploitation and the partners' individual exploitation plans.

Market trend analysis identifies the emerging trends in the data management industry that may influence demand or supply, and assess new technologies that could influence the market and the way consumers interact with products or services. For the TEADAL project, market trends are presented in Section 0.

The joint exploitation plan describes an agreement between different project partners to foster market related activities based on TEADAL's exploitable assets and/or outcomes outlined in the proposal. The joint exploitation plan can be found in Section 3.3.

We use elements from the Business Model Canvas (described in Section 2.1) for analysing and structuring the joint plans. The development for a joint exploitation plan for each KER is led by the partner (or group of partners) who leads the relevant work in the project. Other partners have contributed during workshops or dedicated meetings.

The individual exploitation plans document the current plans that TEADAL partners have for exploiting the project assets and/or outcomes in their products and/or services. The individual exploitation plan can be found in Section 3.4. These plans have been compiled by partners individually as they reflect mostly their interests and ambitions.

2.1 BUSINESS MODEL CANVAS TEMPLATE

The adopted Business Model template is based on the Business model Canvas[1], a widely used template for creating product/service business models. It is a strategic business design tool that uses visual language to create and develop innovative, high-value business models. The Business Model Canvas enables a visual representation of how a company creates, distributes, and captures value for its customers.

Figure 1 shows a typical canvas with its nine areas that compose the model. In this deliverable we use the template in textual form.

[1] https://search.worldcat.org/it/title/648031756

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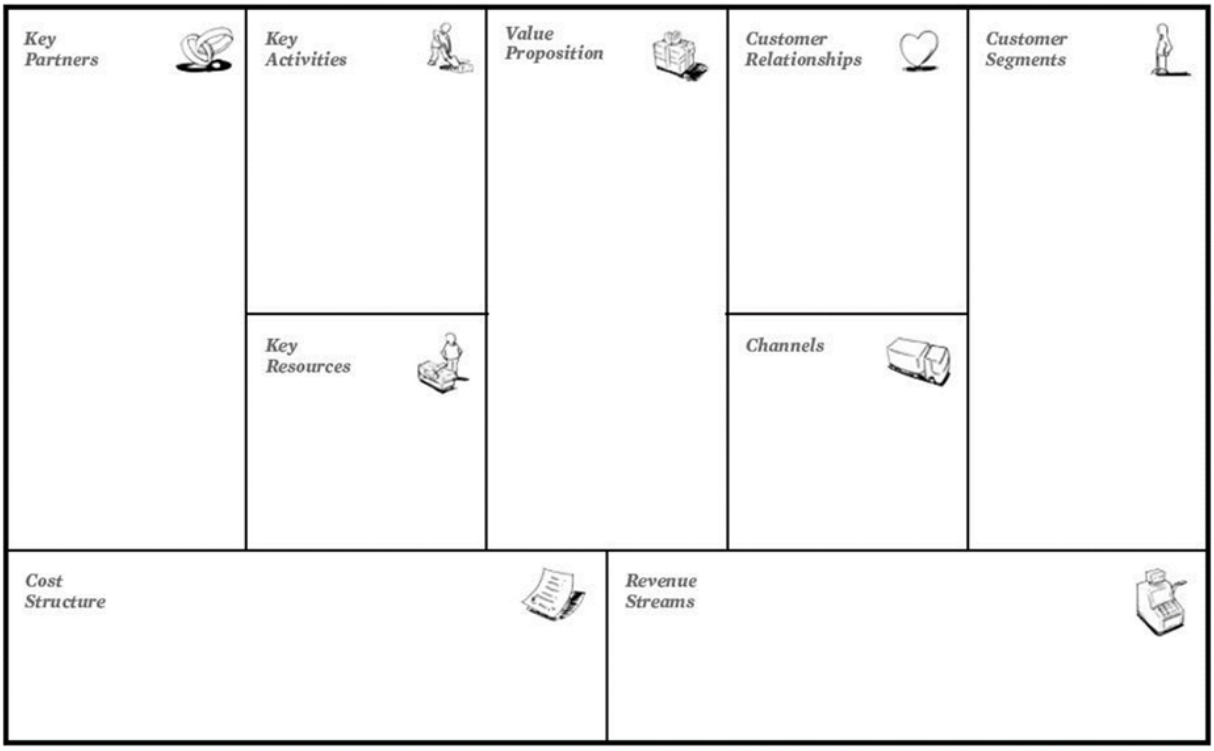

FIGURE 1: BUSINESS MODEL CANVAS TEMPLATE

The areas that compose the template are the following.

1. Customer segments contain information about the customer. The organizations must determine who their target customers are, can they be divided into groups that have unique needs, and whether they are targeting single customers or organizations.
2. Value proposition describes what makes the product unique and explains why a customer should choose the KER over something else.
3. Channels describe how an organization will reach their customers and how a customer can find the organization or its products.
4. Customer relationships indicate the way the organization communicates with their customers.
5. Key resources describe the technology and human resources that are most relevant for the development of the product.
6. Key activities document the necessary actions that have to be carried out to make the business model work.
7. Key partners list vital external collaborations, e.g., component suppliers and distribution channels.
8. Cost structure identifies the primary costs associated with operating your business and providing your services, then details the relationship between these costs and other business functions.
9. Revenue streams describe how your business generates revenue through the delivery of your value proposition.

In addition to the Business Model Canvas, we analyse the stakeholders, competitors and potential barriers for each KER. Stakeholder analysis identifies and collects information about

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people, groups, or organizations that can be influenced, or that can influence the project results. Competitor analysis considers the current and potential competitors in the field. It identifies the competitors within a specific market to understand the environment and competitiveness, helping companies develop a strategic market positioning. Potential barriers describe issues that could hinder the achievement of project goals. It also encompasses the barriers to entering the data management market, helps determine whether a barrier is critical in nature or not, classifies barriers according to their nature and origin. They can be classified as internal or external, technological or regulatory, temporary or persistent barriers. Based on this analysis, it is possible to develop specific strategies to manage or overcome the identified barriers.

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3 EXPLOITATION PLANS

Projects generate different results with different lifespans and TRLs. Some of the results are intended to be used only within the project, while others last longer than the project, perhaps giving rise to subsequent collaborations or developing in unexpected directions. Exploitation plans offer partners a way to start evaluating, already during the project, how the results of the project will be used.

All the partners are committed to the exploitation of the project results beyond its end, ensuring the sustainability of the results. Creating an exploitation plan guarantees the overall continuity and sustainability of the KERs by ensuring target audiences receive and understand the concepts, function and application of the results.

The exploitation plan also facilitates future continued collaboration with partners and other initiatives realized or started during the project to increase the socio-economic impact of TEADAL on the co-creation ecosystem. Furthermore, the exploitation plan is a basis for the development of the TEADAL business model.

This section presents the exploitation plans developed so far. As the project evolves and continuously produces new results, they could be updated in the future and may evolve after the end of the project.

3.1 KEY EXPLOITABLE RESULTS

The TEADAL key exploitable results (KERs) are listed in the following Table 1. They are introduced in the project proposal as Exploitable Assets and Tangible Outcomes.

TABLE 1: KEY EXPLOITABLE RESULT OVERVIEW

# KER	KER Name	Target Market
1	Data Lake control plane	Data lake solution providers
2	Trustworthy data lake federation	Data lake solution providers
3	Energy-aware data management	Data lake solution providers
4	Policy definition tool for managing data use	Data management and data driven businesses
5	Privacy-preserving computation toolbox	Regulated industries. Statistics and research institutes (responding to calls from public sector, or industry associations)
6	Testbed	End-users interested in testing the proposed solution
7	Code	End-users interested in adopting the proposed solution
8	Datasets	End-users interested in testing the proposed solution

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3.2 MARKET ANALYSIS

The ambition of TEADAL is to provide key cornerstone technologies that will enable the creation of trustworthy mediator-less federations of data lakes, to improve trusted, verifiable, and energy-efficient data-sharing to help foster a sustainable European Digital Single Market.

To better understand the environment in which TEADAL result will be used. We give an overview of current market trends relevant to the technologies and KERs of TEADAL.

As stated in a Fortune Business Insights report on the Data Lake Market[2], the global data lake market size was valued at $5.80 billion in 2022. The market is projected to reach $34.07 billion by 2030 with an expected compound annual growth rate (CAGR) of 25.4% from 2023 to 2030. The North American region holds the largest share of the global market. The region's growth is driven by the increasing use of big data technology, the growing adoption of data across all industrial sectors, and the increasing investments of companies in solutions. Companies, especially in the United States, have begun implementing these solutions to extract useful information from structured and unstructured data and remain competitive in the market.

During the forecast period (2023-2030), the Asia Pacific region is expected to experience the highest growth in terms of CAGR. This growth can be attributed to the increasing investments made by major technology companies in countries such as China, India, Australia, and Japan. Other factors that are expected to drive the market growth in the region include growing digitisation and the increasing adoption of advanced big data analytics technology. Additionally, government initiatives and regulations are also among the key factors that are driving the market growth in the region.

South America is experiencing significant growth in this market, primarily due to the ever-increasing adoption of cloud computing technologies. On the other hand, the Middle East and Africa (MEA) market is expected to witness prominent growth in the coming years, thanks to increased investment and government funding for digitization initiatives.

The European Data Lake Market is expected to grow at a CAGR of 19.8% during the forecast period of 2023-2030, according to a report by KBV Research[3]. The report segments market analysis by component (solution and services), enterprise size (large enterprises and small & medium enterprises), deployment type (on-premises and cloud), vertical (IT, media & entertainment, healthcare, BFSI, manufacturing, retail and ecommerce, and others), and country (Germany, UK, France, Russia, Spain, Italy, and the rest of Europe).

The Germany market dominated the European Data Lake Market in 2022 and is expected to continue its dominance until 2030. The UK market is showing a CAGR of 18.5% between 2023 and 2030. The France market is expected to grow at a CAGR of 20.5% between 2023 and 2030. The healthcare sector in France is expected to adopt data lakes to improve patient care, operational efficiency, and medical research, which will contribute to the market growth. The implementation of data lakes is less expensive than the implementation of a data warehouse, which is expected to increase its adoption over the forecast period.

The following cloud services and providers dominate the global and European market:

[2] https://www.fortunebusinessinsights.com/data-lake-market-108761
[3] https://www.kbvresearch.com/data-lake-market/

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Amazon Web Service (AWS) is the Amazon public cloud that provides among a number of cloud resources a data lake architecture that is inexpensive and offers high availability. It comes with a user-friendly interface that makes it easy to search for and request datasets on the AWS Cloud. The architecture sets up the basic AWS services required to tag, search, deploy, analyse, convert, and adjust specific subsets of data within a company or with external users automatically.

Azure Data Lake is part of the Microsoft Azure public cloud service, designed to simplify data storage, processing, and analysis for developers, analysts, and data scientists. It enables customers to avoid the complexity of managing data of various shapes, sizes, and speeds by providing a unified platform for batch, streaming, and interactive analysis across different languages and platforms. With Azure Data Lake, users can easily import and store data, as well as perform all types of analysis, without any hassle.

Google Cloud Platform (GCP) is a suite of cloud computing tools that manages data lakes through autoscaling services, allowing users to develop data lakes that interact with their existing IT investments, applications, and technologies. Dataflow, BigQuery, Cloud Data Fusion, Cloud Storage, and Dataproc are examples of autoscaling services. Data lake modernisation, on the other hand, is Google Cloud's data lake solution, which enables teams to acquire, store, and analyse large amounts of heterogeneous data at full fidelity securely and cost-effectively.

However, these services do not allow to solve issues such as data sharing, privacy-preserving analysis, and stretched data lakes. The solution developed in TEADAL can solve them, as described within the following section.

3.3 JOINT EXPLOITATION PLAN

The following joint exploitation plan has being defined during project development, basing on the identified KERs and following the Business Model Template described in Section 2.1.

3.3.1 KER 1 – Data Lake Control Plane

The TEADAL project develops and matures technology and practices to manage workloads that run on a multicloud data lake that spans from edge, on-premises, to the cloud. The TEADAL approach for such workloads is for the developer to be oblivious to the fact that the workload runs at multiple locations.

We are collaborating with open-source projects that develop mechanisms to manage workloads and configurations across clouds and clusters. Specifically, we collaborate with the Kubestellar[4] open-source project, experiment and apply Kubestellar features to manage the stretched data lake. TEADAL data lake is a use-case for Kubestellar, and we provide requirements, experiment, and validate Kubestellar features, and share feedback about Kubestellar features.

In addition to control plane software, TEADAL integrates between the control plane and workload pipelines. Namely, we show how a Kubeflow[5] Pipeline is deployed across multiple clusters without the involvement of the pipeline developer. In TEADAL we develop integration between Kubeflow pipelines and Kubestellar, to facilitate for the developer the seamless experience.

[4] https://docs.kubestellar.io/

[5] https://www.kubeflow.org/docs/components/pipelines/v2/introduction/

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TEADAL also provides reference implementation for a multicloud data lake that stretches multiple clusters, demonstrating how organizations can seamlessly leverage geographical distribution — making the geographical distribution, not a liability, but rather a feature.

The business model dimensions are analysed below. For each dimension a bullet list with possible targets is presented.

Key partners

- Researchers and software providers that create software that manage workloads on multiple clusters and locations.
- Consumers of software that would benefit from running workload on multiple clusters and locations.

Key activities

- Continued usage of multi-cluster workload and configuration tools, sharing inputs and feedback, helping to share these tools.
- Integration between workloads (e.g., Kubeflow pipelines) and multi-cluster workload management tools (such as Kubestellar).

Key resources

- Developers and researchers.

Value propositions

- Usage patterns and reference architecture for data lake workload running in a cloud continuum across multiple clusters and locations.
- Seamless experience for running data lake workloads on multiple clusters and locations.

Customer relationships

- Not relevant.

Channels (to reach customer segments)

- Scientific community (publications).
- Developers (web/blogs/social media).

Customer segments

- Businesses operating and developing software that needs to run in multiple clusters and locations.

Cost structure

- Research, development and maintenance costs for open-source software.
- Support team.

Revenue streams

- Providing solutions and integrations on top of a multi-cloud data lake.

Stakeholders

- Developers of supporting tools.
- Researchers and development improving the concept.
- Data lake platform providers.

Competitors

- Potential proprietary and other open-source control plane tools.

Potential barriers

- Contributing code and features to open-source projects.

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- Adoption of open-source project by organizations requires internal skills.

3.3.2 KER 2 – Trustworthy Data Lake Federation

Sharing confidential, possibly personally identifiable data within a federation demands a transparent, understandable, predictable, and verifiable record of all actions that happened during a data exchange. Existing approaches rely on few providers for trust, such as public auditors or governmental reviews. In the TEADAL project, we aim to provide these properties during all steps of the data exchange and to enable all stakeholders to act as auditors and reviewers. For this, we adopt the approach of TrustOps, the integration of automated verifiable traceability throughout the software development lifecycle, including comprehensive auditing mechanisms that track changes, scrutinise development choices and provide indisputable and provable execution of tests and policy compliance checks. This approach requires holistic consideration of the entire development process, starting from planning software artifacts to continuous delivery (CI/CD) pipelines and ending with software execution. Moreover, building trust relies on providing publicly verifiable immutable evidence at each step.

Within this framework, we develop a variety of tooling and guidelines that can be exploited beyond the scope of the project.

To provide verifiable and immutable records of execution, we developed Advocate, a Kubernetes-aware component that turns observability data into verifiable credentials. As part of the TrustOps model, this component can create records based on the use of software artifacts in Kubernetes. These records can be used to build proofs of execution or providence of data within a data exchange environment.

To enable verifiability in various sharing networks, including private companies or globally accessible platforms, we are developing methods to implement blockchains in a flexible manner. This includes the ability to operate these blockchains in a private capacity, ideal for internal company use, as well as the option to anchor them to public blockchains. Public anchoring allows for the secure and verifiable recording of selected data or states from the private blockchain onto the public blockchain. The benefit of this approach lies in its ability to leverage the transparency and immutability of public blockchains while maintaining the privacy and control of a private network. By anchoring to a public blockchain, the private blockchain's integrity is enhanced, as the anchored records are accessible and verifiable by anyone, providing an additional layer of trust and security.

This flexible approach ensures broader accessibility and transparency, making the data verifiable by specific closed groups or by anyone around the world, depending on the chosen configuration. This dual functionality caters to diverse needs, from tight internal data control to global, open data verification.

Furthermore, the trustworthy data lake federation provides a catalogue to identify and share data with external consumers (following FAIR principles). In particular, the data catalogue holds the description of a federated data product, creates a sharable version of the federated data product using the TEADAL pipeline, and also includes the access mechanism after the deployment.

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Finally, the TEADAL project has been developing a cloud foundation on which data lake tools run. This is an Istio service mesh backed by a GitOps approach to deployment. The service mesh provides much of the infrastructure required for the TEADAL TrustOps implementation. Observability and mutual TLS are two key features in this regard since the former allows the TrustOps tools to gather evidence to prove that the intended parties exchange data according to an agreed-on workflow whereas the latter ensures the integrity and confidentiality of collected data as well as their provenance. The GitOps approach complements runtime observability by providing the ability to audit both software and configuration changes. Also note that the service mesh provides the components to develop, deploy and enforce data policies (e.g., OIDC, OPA, Rego) which are part of KER 4. Policy enforcement also complements the privacy-preserving computation tools (KER 5) since it protects data by granting access only to users and services having suitable permissions. Each of the above features can be exploited on its own or in combination with the wider TEADAL toolset – see individual exploitation plans.

The business model dimensions are analysed below. For each dimension a bullet list with possible targets is presented.

Key partners

- Researchers and software providers that create software relying on trust, e.g., operating system vendors, banking software, data exchange platforms.
- Consumers of software that would benefit from more trust.
- Governmental agencies that oversee software platforms.

Key activities

- Continued development of the TrustOps concepts, developing different approaches to enhance adoption for the different use cases and pilots. This, includes and extends the development of the Advocate component, the blockchain anchoring, the integration of the privacy-preserving toolbox and other approaches developed in the scope of trust of the TEADAL project.

Key resources

- Developers and researchers.

Value propositions

- Enhanced trust in software artifacts that enable semi-automatic attestation of behaviour or policy compliance.

Customer relationships

- Not relevant.

Channels (to reach customer segments)

- Scientific community (publications).
- Data space communities (IDSA Forums).
- Developers (web/social media).

Customer segments

- Businesses operating and developing software that requires special trust, e.g., banking.
- Users of federated systems, such as TEADAL.

Cost structure

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- Research, development and maintenance costs.
- Support team.
- Marketing.

Revenue streams

- Providing of supporting services, e.g., IDE / CI-CD plugins.
- Certification organizations, e.g., TÜV.

Stakeholders

- Developers of supporting tools.
- Researchers and development improving the concept.
- Data lake platform providers.
- DevOps infrastructure providers, e.g., GitLab.

Competitors

- Certification authorities.

Potential barriers

- Legal uncertainty.
- Organizational trust.

3.3.3 KER 3 – Energy-Aware Data Management

Energy-aware data management is a critical framework addressing the environmental repercussions of data-related activities. TEADAL stands out as a major contributor, providing real-time monitoring tools for energy consumption in federated environments. This enables organizations to precisely identify areas for optimisation, fostering heightened energy efficiency throughout data processing stages.

TEADAL goes beyond monitoring, introducing techniques to actively mitigate the environmental impact of data management. By optimising workflows and advocating for the adoption of energy-efficient storage solutions, TEADAL contributes significantly to the reduction of energy consumption during data ingestion, storage, and processing.

Complementing TEADAL, industry solutions like IBM Cloud, Pak for Data, Apache StreamPipes, and TerraviewOS play a pivotal role. These platforms not only provide robust services but also offer tools specifically designed to optimise energy usage in various data processes. This alignment reflects UBIWHERE's overarching commitment to promoting energy-awareness activities and advocating for sustainable data management practices.

In summary, energy-aware data management encompasses sophisticated monitoring, active optimisation techniques, and the integration of industry solutions. This multifaceted approach aims to minimise the environmental impact of data activities, contributing to the establishment of a more sustainable and eco-friendly computing environment.

The business model dimensions are analysed below. For each dimension a bullet list with possible targets is presented.

Key partners

- Researchers and companies interested in providing energy-aware solutions to data management.

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- Data providers that want to automate the data sharing while ensuring a limited environmental impact.
- Data consumers that want to access data with high quality and low latency while minimising the energy footprint.

Key activities

- Development and evaluation of energy-aware data management strategies, such as data classification, data placement, and data replication.
- Validation of the approach with various use cases, such as smart cities, smart grids, and smart agriculture.
- Dissemination and exploitation of the TEADAL project and its outcomes.

Key resources

- Developers and researchers with expertise in data management, energy efficiency, and cloud computing.
- Data sources and platforms that support energy monitoring and optimisation.
- Hardware and software infrastructure that enable data collection, analysis, and visualisation.

Value propositions

- The possibility for data providers and data consumers to monitor the environmental impact of the data sharing activities and to set requirements for the reduction of the energy consumption.
- The possibility to improve the performance, reliability, and security of data systems by applying energy-aware data management techniques.
- The possibility to contribute to the sustainability and social responsibility goals of the data stakeholders and the society.

Customer relationships

- Scientific community (e.g., publications, conferences, workshops).
- Data space communities (e.g., IDSA Forums, EDS initiatives).
- Developers (e.g., web/social media, open-source repositories).

Customer segments

- Researchers interested in data governance, data quality, and data analytics.
- Data providers and data consumers that operate in various domains, such as industry, energy, agriculture, health.

Cost structure

- Research, development and maintenance costs of the TEADAL tools and techniques.
- Support team costs for providing assistance and guidance to the data stakeholders.
- Marketing costs for promoting and disseminating the TEADAL project and its outcomes.

Revenue streams

- Providing solutions for integrating energy monitoring and optimisation in existing data sharing platforms.
- Offering energy-awareness as a service, such as providing energy reports, recommendations, and alerts to the data stakeholders.
- Licensing or selling the TEADAL tools and techniques to interested parties.

Stakeholders

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- Developers of supporting tools, that provide the infrastructure and the framework for data management and processing.
- Researchers and developers improving the concept, that provide the innovation and the expertise for energy-aware data management.
- Data lake platform providers, that provide the data sources and the platforms that support energy monitoring and optimisation.

Competitors

- Other energy-aware tools providers, such as Energy Aware Database Management or QoS-Aware and Energy Data Management in Industrial IoT, that provide similar solutions for reducing the energy consumption of data systems.
- Other data management solutions, such as Google Cloud Platform or Amazon Web Services, that provide alternative platforms for data storage, processing, and sharing.

Potential barriers

- High energy consumption of data integrity technologies.
- Adopting public cloud resources with unknown energy efficiency management (especially for smaller cloud providers or in-house private cloud solutions).

3.3.4 KER 4 – Policy Definition Tool for Managing Data Use

The sharing of data necessarily requires mediation between two complementary perspectives involving those who provide the data and those who consume it. From the data provider's perspective, sovereignty over the data must be ensured, meaning complete control over the data throughout its lifecycle, including shared data and during the sharing process. From the consumer's perspective, reliability of the data must be guaranteed, so it should be possible to verify that the data is true and of high quality.

In this context, TEADAL provides a framework for the definition of policies for both the data provider and the data consumer. This framework is structured into three levels of abstraction: the first allows the definition of high-level policies without concern for the technical and technological implications for configuring the tools needed to control the policies themselves. The second level deals with the configuration of the platform so that policies can be verified. Finally, the third level carries out the actual enforcement of policies. The three levels also differ in the language used for policy definition. At a high level, TEADAL develops a graphical language akin to a conceptual model. In the second level, OPA Rego is used as a declarative language for ABAC/RBAC policies to control access and define data transformation operations. At the third level, OPA Rego policies are enriched with additional policies to control the entire data management process.

The business model dimensions are analysed below. For each dimension a bullet list with possible targets is presented.

Key partners

- Researchers and company interested in providing easy way to define and manage policies.
- Data providers that want to automate the data sharing while ensuring the right level of protection of the shared data.

Key activities

- Validation of the approach with various use cases.
- Integration with the blockchain solution for the monitoring of the data sharing policies when the data are no longer under the direct control of the data provider.

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Key resources

- Developers and researchers.

Value propositions

- The possibility for data providers and data consumer to have a common framework for policy definition.
- The possibility to isolate the business policies which are specific for each data sharing from the technical policies that is more focused on the way the platform has to manage the data sharing.

Customer relationships

- Scientific community (publications).
- Data space communities (IDSA Forums, EDS initiatives).
- Developers (web/social media).

Customer segments

- Association of organizations that are based on data sharing.
- Data trustees.
- Researchers interested on data governance.

Cost structure

- Research, development and maintenance costs.
- Support team.
- Marketing.

Revenue streams

- Providing solutions for integrating policy management in existing data sharing platforms.
- Offering policy management as a service.

Stakeholders

- Developers of supporting tools.
- Researchers and development improving the concept.
- Data lake platform providers.

Competitors

- Other ABAC/RCAB policy management tools providers.

Potential barriers

- Complication of updating data policies according to the changing environment.

3.3.5 KER 5 – Privacy-Preserving Computation Toolbox

The pilots in TEADAL process various kinds of data, including personally identifiable data and business secrets. As part of this effort, we are in the process of developing sophisticated tools utilising secure multi-party computation, trusted execution environments, and zero-knowledge proofs to facilitate privacy-preserving computations. This enables the pilots to allow parties to use their federated data while maintaining a strong control over what can be computed and revealed.

In addition, we plan to include privacy-preserving computations as part of the TrustOps idea described for KER 2. This strategic move allows us to establish a comprehensive toolbox that enhances the development and practical application of the overarching framework for all involved parties.

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Technologies for privacy-preserving computations has been available for some time, however, they have yet to gain extensive acceptance due to a high barrier to entry. Our work in TEADAL simplifies this adoption by integrating these tools as an intrinsic part of the comprehensive framework. Furthermore, the pilot use cases and use of privacy-enhancing technologies for ensuring trust in the framework are good landmarks for future applications.

The business model dimensions are analysed below. For each dimension a bullet list with possible targets is presented.

Key partners

- Researchers and technology companies that are developing new tools for privacy-preserving computation that we can use to enhance our toolbox.
- Regulators, as we have to meet the regulatory needs and the technologies need to gain support in order to be accepted as valid solutions for analysing private information.

Key activities

- Continuous development of the toolbox and supporting users in its adoption.
- Marketing the toolbox.
- Continuous research of novel methods and optimization of the technology.

Key resources

- Experienced research and development team putting the toolbox together.
- The computation algorithms and tools included in the toolbox.
- The research material backing the formalisation of the methods and algorithms.

Value propositions

- Reliable security measures with easy adoption that are supported in the data lake architecture.
- Reliable, trustworthy, and secure federated data processing enabled by cutting-edge privacy-preserving technologies.

Customer relationships

- Good support system and regular updates to the toolbox.
- Comprehensive documentation, terms of service, and other support material.

Channels (to reach customer segments)

- Project website.
- Digital marketing.
- Open-source repositories.

Customer segments

- Large businesses holding data that may be beneficial to a larger public but that cannot be entirely published.
- Government agencies managing confidential public records.

Cost structure

- Research, development and maintenance costs.
- Support team.
- Marketing.

Revenue streams

- Support services.

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- Licensing.
- Project execution.

Stakeholders

- Team members building the toolbox.
- Researchers and development teams building secure computing solutions.
- Technology providers.
- Data lake platform providers.

Competitors

- Companies providing solutions for privacy-preserving computation.
- Trusted research environments.
- Other providers of privacy-preserving technologies.

Potential Barriers

The main barrier of the adoption of the toolbox is that the consumers are not aware what could be achieved with this toolbox and therefore do not know to ask for it. In addition, it may be complicated to come up with solutions that can be supported with privacy-preserving computations but are so far considered impossible due to data protection regulations. Other factors are the rapid shifts in research directions and market focus which may prevent novel technologies from gaining wide adoption.

3.3.6 KER 6 – Testbed

To validate the TEADAL project results, a testbed infrastructure has been designed and realised, as described in detail in the deliverable “D6.1 Testbed Design”. One testbed for each of the six pilots has been implemented. This testbed environment enables running the six pilots in all planned project iterations to certify that the project results match the project objectives.

Testbed sites are the central hubs that provide resources for the pilot cases. There are four main testbed sites – POLIMI, MARINA, BOX2M, TERRAVIEW – sharing resources, with flexibility for possible other partners to contribute with new resources. Testbed sites ensure operational flexibility, operating as virtual machines and managing local Kubernetes clusters.

Each pilot runs on a dedicated integrated application environment built using the resources of the four testbed sites. This environment is defined as pilot testbed. TEADAL tools (the software artifacts produced by the TEADAL project) enhance a baseline data lake with additional functionalities that make it a stretched and federated data lake. TEADAL tools are, for example, the Data Catalog, the Control Plane for data distribution optimisation, the Policy Management tool for governance, and the blockchain-based Trust Plan.

A data lake enhanced with TEADAL tools and deployed over the physical infrastructure (i.e., in Kubernetes) is a TEADAL node. The organized system of Kubernetes-deployed TEADAL nodes and, if applicable, edge components needed to realise one generic pilot use case, is called a pilot testbed

The abstraction of the concept of a TEADAL node and its use, as a module, to provide a simple and affective description of the testbed architecture is a powerful and flexible methodological accelerator for the quick definition of new testbed systems.

The re-use of the concepts of testbed architecture makes it possible for stakeholders to quickly design and effectively set-up validation testbed architectures where it is possible to realise and test prototype TEADAL-based applications featuring different scenarios, to demonstrate

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potential and feasible uses cases of the TEADAL project to different stakeholders possibly from different domains. The final architectural solutions for the project have not been defined yet at this stage as it is currently a work in progress.

The business model dimensions are analysed below. For each dimension a bullet list with possible targets is presented.

Key partners

- Researchers and technology companies that are developing new data lakes use cases. We can apply these use cases to our testbed to enrich our demos.
- Developers who use our testbed in the life cycle of their software can contribute to improving the testbed by sending us feedback and tips.

Key activities

- Continuous development of the testbed and supporting users in its adoption.
- Using the testbed for pre-sales showcases.
- Continuous research of new use cases and optimisation of the technology.

Key resources

- Experienced research and development team improve and extend testbed together.
- The showcases covered by the testbed.
- The research material backing the formalisation of the testbed architecture.

Value propositions

- Modularity, reliability, and cross-context applicability.
- The abstraction of the concept of a TEADAL node and its use as a powerful and flexible methodological accelerator for the quick definition of new testbed systems.

Customer relationships

- Good support system and regular updates to the testbeds.
- Comprehensive documentation, terms of service, and other support material.

Customer segments

- Developers and researchers to quickly design and effectively set up validation testbed architectures where it is possible to realize and test prototype TEADAL-based applications featuring different scenarios.

Cost structure

- Research, development and maintenance costs.
- Support team.
- Marketing.

Revenue streams

- Support services.
- Licensing.
- Project execution.

Stakeholders

- Data specialist in business environments – providing a demo application based on TEADAL testbed architectures to showcase the effectiveness of the TEADAL technology developed in the business domain can be useful for expanding its reach.

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- Public sector organizations – providing demo applications based on TEADAL testbed architectures to public sector stakeholders can effectively showcase TEADAL technology and inspire innovative ideas for its potential applications.
- Policymakers engaged in defining regulatory frameworks and data governance mechanisms and digital security and privacy protection organizations - presenting demo applications based on TEADAL testbed architectures is a useful way to showcase the wide range of possibilities in configuring big-data management and security policies through data lakes.
- Civil society organizations – the security of TEADAL data lakes federations can be very effective in ensuring the privacy and security of personal data.
- Data scientists and data analysts at research institutions – if data specialists want to develop a product using TEADAL technology, they should use testbeds based on TEADAL testbed architectures that are modular, reliable, and cross-context applicable. On the other hand, if the data specialists want to acquire turnkey applications, demo applications based on TEADAL testbed architectures can be provided to showcase all the features based on TEADAL technology.
- Open-source communities, such as CNFC, the Linux Foundation, and Apache (Arrow, Parquet, Ranger, Atlas, Egeria). Standards Developing Organizations (SDOs), such as ETSI – these communities and organizations follow a rigorous software development life cycle. Since their products require testing and validation, they require TEADAL testbed architectures to quickly ensure that their systems can be deployed when they decide to develop systems based on TEADAL technologies.
- Private individuals interested in data management – TEADAL's activities and results may be of interest to individuals seeking data management.

Competitors

- Companies providing solutions for privacy-preserving computation.
- Trusted research environments.
- Other providers of privacy-preserving technologies.
- System Integration companies.

Potential barriers

- Companies providing solutions for privacy.

3.3.7 KER 7 – Code

The results of the TEADAL project include software components capable of providing the functionality required to support data sharing. The related code is made available in open-source mode in dedicated repositories. Alongside this code, documentation is also offered that allows those interested in adopting or contributing to the project to do so. In addition to the code, to simplify deployment operations, TEADAL offers a repository of docker images. A concrete plan outlining how TEADAL is publishing the code, documentation, guides and images will be finalized and included within the final exploitation plan.

The business model dimensions are analysed below. For each dimension a bullet list with possible targets is presented.

Key partners

- Technical partners developing the solutions to be adopted in the proposed infrastructure.

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Key activities
- Publish the code.
- Maintain the code.
- Provide documentation and contribution guide.

Key resources
- Code repository.
- Image repository.

Value propositions
- To increase the adoption of the developed tools and the contribution from the community.

Customer relationships
- Self-service through the code repository.

Customer segments
- Developers.

Cost structure
- If needed, the cost of using a publicly available code repository.

Revenue streams
- None.

Stakeholders
- TEADAL adopter.
- developer community.

Competitors
- Communities around solutions related to the same topic.

Potential barriers
- The technical expertise that is needed to be able to understand and manage the code.

3.3.8 KER 8 – Datasets

The TEADAL project operates with datasets from several pilots. Some of the data used in the project is synthetic data generated based on the real data of the pilots, some is open data and some is the real data from the pilots. The pilot partners will publish their data through their TEADAL data lakes and the control plane is used to regulate how the data can be used. In the project, we are considering specific use cases for each of the datasets, but, in principle, a TEADAL data lake can be used to allow various consumers access to the data of the pilots. However, such access is always in accordance with the policies attached to the data and agreements between the data provider and the consumer. Furthermore, partners using real data can also directly use their organised data for internal purposes.

The business model dimensions are analysed below. For each dimension a bullet list with possible targets is presented.

Key partners
- Pilot partners providing the data.
- Technical partners maintaining, improving, or hosting the infrastructure.

Key activities
- Making the data available with desired access policies.
- Data maintenance.

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- Augmenting the datasets with new data, transformations, or access policies.

Key resources

- Datasets.
- Data Lake.
- Infrastructure providers.

Value propositions

- Data as a service.

Customer relationships

- Self-service through the catalogue.
- Fast and efficient data retrieval.
- Transparent and secure data sharing.

Channels (to reach customer segments)

- Project website.
- Partner's websites and marketing.
- Online and public data catalogue.

Customer segments

- Researchers.
- Government entities.
- Citizens.
- Business partners.
- Data producers (pilot partners).

Cost structure

- Costs for data storage, maintenance of the datasets, and infrastructure.

Revenue Streams

- None.

Stakeholders

- Partners publishing the data.
- Infrastructure management teams.
- Consumers fulfilling the agreement rules.

Competitors

- Public databases.
- Data brokers.
- Data marketplaces.
- Businesses providing similar data.

Potential barriers

- MARINA – data is open for access, clinical data storage, used internally in the hospital.
- Mobility – national access points (NAP) enable data sharing, direct connection from TEADAL to NAP.

3.4 Partners' Individual Exploitation Plans

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In the following section, each partner of the consortium will describe in detail how it envisages its role in the exploitation of the results of the TEADAL project. Each of the partners will define its individual plan according to its own strategy and its own resources.

3.4.1 UW– Exploitation Plan

UBIWHERE (UW), a leading technology SME specialising in smart cities and IoT solutions is strategically positioned to exploit the (KERs) of the TEADAL project, focusing on KER 1 and KER 3.

By incorporating the TEADAL data lake control plane into its powerful smart city solutions, UBIWHERE hopes to accomplish KER 1 (building efficient data lake solutions). The organization plans to implement advanced data management protocols, guaranteeing the best use of resources and raising the general effectiveness of data lakes. This integration aligns with UBIWHERE's mission to be at the forefront of technical development, especially in light of the European projects centred around 5G and 6G. By integrating TEADAL's capabilities, UBIWHERE aims to provide a state-of-the-art framework for data-driven projects in the context of smart cities, encouraging creativity and sustainable growth.

Utilising cutting-edge technologies and approaches that give energy efficiency a top priority in its smart city solutions, UBIWHERE is dedicated to tackling KER 3 (reducing environmental impact via energy-efficient federation). The organization seeks to practice cutting-edge federated strategies that greatly lessen environmental effects while optimising resource usage. UBIWHERE's commitment to this KPI illustrates how strategically aligned it is with European projects centred around 5G and 6G, where energy efficiency and sustainability are critical. By adopting innovative solutions, UBIWHERE endeavours to establish novel benchmarks in ecological accountability, guaranteeing that its smart city projects make a meaningful contribution towards a more environmentally conscious and sustainable future.

Furthermore, UBIWHERE is committed to contributing to European research and initiatives. The company plans to actively disseminate knowledge, provide concrete demonstrator solutions, and engage with stakeholders beyond the project scope. This collaborative approach addresses additional trustworthy data-sharing challenges, further influencing the European research and development landscape.

3.4.2 POLIMI – Exploitation Plan

Politecnico di Milano (POLIMI) is a public university that focuses on research and teaching. It will contribute to the dissemination activity by spreading results and useful knowledge through scientific papers and presentations oriented to both academic and industrial communities.

POLIMI will also promote the use of the TEADAL tools in courses related to data managements and cloud-based solutions. In particular, the Process and Service Design course, as well as the Data and Information Quality course are good candidates to introduce the TEADAL technologies and, if possible, to allow the student to experiment on the platform.

POLIMI will also exploit the knowledge acquired in the TEADAL project in preparing other proposals to both national and international funding bodies. Moreover, the results of TEADAL can be significantly validated in other contexts related to projects in which POLIMI is involved. Notably, projects related to the healthcare at the national (Italian) level (e.g., the Health Big Data Project) that has connections with European initiatives (e.g., one million genome and beyond one million genome). Moreover, POLIMI based on its participation and contribution to EOSC and EOSC4Cancer, can promote the TEADAL results.

3.4.3 Cybernetica AS – Exploitation Plan

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Cybernetica AS (CYB), an Estonian technology company, has distinguished itself as a key player in the realm of research and development (R&D), with a specialised focus on cryptography, security, and privacy-enhancing technologies. Known for its innovative solutions, Cybernetica is at the forefront of advancing secure information exchange and e-governance infrastructure. With a notable expertise in cryptography, Cybernetica's commitment to R&D manifests in its dedication to creating robust privacy-centric technologies that align with the evolving needs of secure digital ecosystems, making it a pivotal contributor to the landscape of information security and privacy engineering. In alignment with the key exploitable results identified by the TEADAL project, with a particular emphasis on advancing data synthesis and secure computing, Cybernetica is strategically positioned to exploit synergies between the two.

Firstly, drawing insights from the data synthesis automation and ingestion activities developed in TEADAL, Cybernetica envisions harnessing the power of innovative technologies to seamlessly integrate and orchestrate data synthesis processes, ensuring the generation of meaningful insights while upholding the highest standards of privacy and security. This aligns with the work done in KER 5 and for parts of KER 8.

Secondly, driving the work in KER 5 and aligning with KER 2, Cybernetica focuses on the continuous development and refinement of privacy-enhancing technologies (PETs), encompassing key targets such as secure multi-party computation (MPC), trusted execution environments (TEEs), and zero-knowledge proofs (ZKPs). Following the developments of TEADAL, Cybernetica recognises the imperative to adapt these advanced cryptographic techniques to address emerging challenges in sectors critical to society, including medicine, energy, and mobility. Collaborating with industry partners and stakeholders, Cybernetica aims to tailor PETs to specific use cases within these sectors, fortifying privacy and security measures in data-intensive applications. Concurrently, Cybernetica is invested in making efforts to integrate these cutting-edge technologies into mainstream software engineering practices. This includes the horizontal integration with the cloud-native ecosystem and the systematic onboarding of PETs within development workflows, ensuring seamless adoption and adherence to privacy standards. Through this multifaceted approach, Cybernetica anticipates not only contributing to the evolution of PETs, but also shaping their practical implementation and integration across diverse domains, thereby reinforcing its position as a leader in the intersection of engineering, cryptography, security, and privacy-focused R&D.

3.4.4 CEFRIEL – Exploitation Plan

Cefriel is a non-profit research and innovation centre whose aim is to support the digital transformation of its partners, stakeholders and customers.

KCONG is an integral part of Cefriel strategy in digital ecosystems and is currently proposed as a way to implement proof-of-concept governance tools in data fabric architectures. Within the scope of the TEADAL project, KCONG is being enhanced to allow it to participate in federated environments, where each company can provide its own catalogue and benefit from what is made available by other companies. Since Cefriel is part of IDSA and Gaia-X, the implementation of federation capabilities in KCONG will also be instrumental in providing dataspaces solutions for companies, as it will enable the catalogue to become the main way for users to browse the data products offerings and to enact any complex processes for gaining access to them.

3.4.5 IBM – Exploitation Plan

IBM is a global hybrid cloud and AI technology provider to multiple enterprises across the globe, and has multiple offerings for enterprises who run and operate data lakes and data repositories.

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Within the scope of the TEADAL project, IBM is exploring how to simplify the effort and burden for organizations that need to invest to build data analytics pipelines. IBM is investing in both open-source technologies and commercial offerings. Examples of open-source projects are Kubestellar and Kubeflow pipelines. Examples of commercial offerings are solutions like Openshift AI6, Cloud Pak for Data7 and others.

The technologies developed in TEADAL are shared, integrated or contributed to open-source projects (e.g., Kubeflow pipelines, Kubestellar) and also may be included in future versions of IBM commercial offerings.

3.4.6 TUB – Exploitation Plan

TU Berlin (TUB) is a globally renowned university with a record of research excellence and is committed to advancing scientific knowledge and technological innovation. The Information Systems Engineering (ISE) chair, under the stewardship of Prof. Dr. Stefan Tai, leads WP5. ISE boasts a distinguished track record of developing trustworthy applications by seamlessly integrating cutting-edge blockchain and cloud technologies.

Within the scope of the TEADAL project, TU Berlin is furthering its research in the domains of federated data sharing and verifiable trustworthy applications (KER 2, KER 5). By leveraging synergies with other European and national initiatives, such as GAIA-X, the university aims to foster standardisation and adoption of evidence-based trust, utilising successful research prototypes like ZoKrates. TUB aims to further develop these areas in future projects and potential future spin-offs. Additionally, the concepts and approaches explored in TEADAL are incorporated into the instruction and teaching of students, enriching their learning experiences in both regular courses and final thesis projects.

3.4.7 MARINA – Exploitation Plan

MARINA SALUD (MARINA) is a hospital that belongs to the Denia Health department depending on the Conselleria de Sanitat of Valencia (Spain). MARINA is a fully paperless hospital with all its activity based on digitalised processes. This produces large amounts of data that could be used to perform analytics and generate medical evidence. But analytics in healthcare related data has barriers that make it difficult to share information and limit its potentialities.

In the scope of TEADAL, MARINA will explore the possibilities to overcome those barriers and find ways to improve the current state of the art of healthcare data analytics, allowing collaboration through federation while ensuring that data subject privacy is preserved.

3.4.8 UITP – Exploitation Plan

UITP is the leading association advocating for sustainable urban and regional travel. The association gathers all types of stakeholders active in the urban mobility ecosystem, including public transport operating companies (such as AMTS), transport authorities at urban or metropolitan urban level, technology providers and manufacturers. At the end of 2023, recognising its increasing weight in the sector, UITP launched its new Shared Mobility Division. UITP member companies stand in various committees and working groups according to their area of activity and interests.

In such a diverse urban mobility ecosystem, it is quite often the case that UITP members are active within the same geographical area, potentially with an authority needing to control or

[6] https://www.redhat.com/en/technologies/cloud-computing/openshift/openshift-ai
[7] https://www.ibm.com/products/cloud-pak-for-data

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regulate the activities and services provided by several operating companies. In this context, TEADAL KER 2 related to the trustworthiness of data lakes, while preserving the confidentiality of personal information is of high interest to the UITP members. Additionally, several companies who are members of UITP may compete against each other, or provide complementary services in the same metropolitan area, e.g., bus service, metro service and car sharing services in the same city. Being able to preserve the privacy of business-confidential information, as per TEADAL KER 5 is thus highly relevant.

UITP has two committees for whom the results of TEADAL may particularly hold value: the first is the Information and Telecommunication Technology Committee. Members of this group are IT system suppliers, software and telecoms companies and equipment manufacturers. The second UITP committee interested is the Information Technology and Innovation Committee, which gathers public transport operators and authorities who implement IT and digital systems.

3.4.9 AMTS – Exploitation Plan

AZIENDA METROPOLITANA TRASPORTI E SOSTA CATANIA (AMTS) is an in-house company concessionaire for the management of the urban bus network of the city of Catania, as well as bike and car sharing services and paid parking in the city.

The European Commission, through specific directives, is requesting the implementation of National Access Points (NAPs) from the transport authorities of each EU country to facilitate the sharing and re-use of transport and mobility data. A NAP represents a single national access point for data that can be used to develop new applications for innovative, efficient and sustainable mobility.

TEADAL can be a powerful tool to address the technical and bureaucratic challenges currently faced by NAPs and mobility operators. On the other hand, the project hopes for community and social improvement through the sharing and analysis of data collected in areas such as real-time traffic management, public transport optimisation and urban planning.

3.4.10 TUW – Exploitation Plan

TU Wien (TUW) is the leading technological university in Austria, and the Distributed Systems Group (DSG) within TUW develops its research and education programs around cloud and edge distributed computing systems. TUW aims to improve its educational programs further with the latest research advances obtained within the scope of TEADAL, including the development of new master's and PhD theses. University students will first acquire this new knowledge, which will ultimately be incorporated into our society. Further, TEADAL enhances TUW links with other top research European institutions, enabling the development of new joint research and future projects.

3.4.11 ALMAVIVA – Exploitation Plan

AlmavivA is an Italian enterprise company that has been providing IT services and solutions as the Italian leader in the field of information and communication technology for more than 40 years. AlmavivA commitment manifests itself in actively driving the digital transformation of sectors that are fundamental to the Italian economy. From finance to public administrations, from transport to defence and security, from agriculture to telecommunications, AlmavivA contributes significantly to development and innovation in Italy.

AlmavivA's is mainly interested in exploiting KER 1, KER 2 and KER 3. Based on the company's activities and profile, AlmavivA plans to exploit TEADAL results in maturing the developed intelligent algorithms in the data management and analysis from KER 1 (data lake control plane) and KER 3 (energy-aware data management). AlmavivA will incorporate them

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into solutions for its customers, public administrations in most cases, contributing to the transfer of innovative solutions into the market especially in the big data management and intelligent data analysis domain.

AlmavivA will also enhance its architectures to allow for decentralisation, employing the TEADAL project results. This will also enhance AlmavivA's big data solutions and allow it to leverage the possible integrations between big data and blockchain. The blockchain technologies proposed and developed KER 2 (trustworthy data lake federation) will be exploited to increase the offer of solutions where it is necessary to protect decentralised networks and improve privacy, control and efficiency. AlmavivA is also considering applying such technologies to support consortia and organizations that need efficient collaboration, data sharing, and streamlined processes.

3.4.12 MARTEL – Exploitation Plan

Martel Innovate is a dynamic digital innovation company specialising in ICT research and development. Cloud and edge computing, Internet of things, artificial intelligence and open-source software engineering are at the core of Martel's R&D activities, but, as a business, Martel also offers an IoT platform as well as a wide array of communication, marketing, media and training services. With over two decades of experience in European Commission funded R&D programmes and a successful track record of innovation projects delivery, Martel has established itself in the Swiss and Dutch markets as a company that can turn research ideas into useful products.

Martel would like to improve its IoT platform, Orchestra Cities, in view of commercial expansion in the Swiss market. To this end, Martel has planned to exploit some of the architectural design, technology and software components being developed by the TEADAL project to modernise its IoT platform. Martel's exploitation plan aims to achieve the following objectives:

- Data mesh architecture. Orchestra Cities is currently based on an API Gateway architecture which makes it difficult to implement data products. To overcome this, Martel envisions transitioning Orchestra Cities to a data mesh architecture similar to that investigated in TEADAL. The first steps towards that transition involve implementing the TEADAL Istio service mesh and replacing the existing Helm/Flux CI/CD pipeline with the Kustomize/Argo CD one developed for TEADAL. Thus, Martel will exploit part of the software developed as part of KER 2 and KER 7.
- Flexible security policies. Presently Orchestra Cities protects web resources using coarse-grained, non-programmable, ad-hoc access control in Keycloak. This approach does not scale well, in terms of development and maintenance effort, as the size of resources increases and so does the need for fine-grained resource access. Along with it increases the need to support a variety of security patterns. A programming language is needed to keep complexity at bay through abstraction and modularity. For this reason, Martel plans to adopt the TEADAL authentication and authorisation design in its IoT platform. Transitioning to an Istio service mesh (see above) will enable Martel to replace its current security implementation with the OPA/OIDC one developed as part of KER 4 and KER 7.
- Zero-trust microservices. At the moment, IoT services behind the API gateway exchange unencrypted messages and have no means to reliably identify each other. To make Orchestra Cities more secure, Martel will implement mutual TLS through Istio, mirroring the work done as part of KER 2 and KER 7.

3.4.13 TERRAVIEW – Exploitation Plan

Terraview will exploit project innovations in future commercial activities and apply them in the domain of agriculture, specifically viticulture for TerraviewOS and in food security, Aquaview.

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The outputs as well as the use case specifics will be brought through an innovation process to tailor the created software according to the needs of Terraview's customers. Once this is done both technically and business-wise, the resulting output will be delivered to Terraview Engineering for deployment. Some of these key outputs will be the data space and potentially edge-related innovations that use new TEADAL developments and also the understanding and use of these new advancements into our product roadmap.

3.4.14 ERT – Exploitation Plan

ERT, will exploit mainly KER 7, KER 8, and some other knowledge developed under the project. ERT will use the normalised datasets from both of its plants. ERT also will use the developed code and other artifacts from the project to implement consolidated reports with key performance indicators computed based on datasets from both plants.

3.4.15 I2CAT – Exploitation Plan

I2CAT will exploit KER 1, KER 3 and any additional R&D assets developed in the TEADAL project by I2CAT through scientific publications, and through further research projects funded through European, national and regional programmes. I2CAT will also actively explore the commercial exploitation of these technologies by means of IPR licensing agreements with the industrial partners of the project, especially the SMEs, or with external data lake solution providers.

3.4.16 BOX2M – Exploitation Plan

BOX2M, a forward-thinking small and medium-sized enterprise, is at the forefront of tackling the intricate challenges associated with energy monitoring within industrial infrastructures. In the rapidly evolving industrial landscape, BOX2M recognises the indispensable nature of real-time monitoring and data-driven insights for optimising performance and ushering in the Industry 4.0 era. BOX2M is committed to providing state-of-the-art solutions for energy monitoring, playing a pivotal role in the digital transformation of factories and buildings. The company acknowledges the mission-critical role of energy monitoring in industrial settings, and its innovative approach aims to overcome existing limitations faced by businesses.

Industries grapple with challenges such as the absence of real-time monitoring, reliance on offline/location-specific systems, and the diversity of industrial agents involved in the production process. Conventional solutions, such as SCADA and BMS, are often deemed rigid, closed, and expensive, creating technical and operational dependencies on suppliers. Additionally, the diversity of machines and gear, coupled with the correlation issues between energy consumption and environmental impact, hinders the seamless implementation of monitoring systems. With the TEADAL project, BOX2M plans to further refine and utilise the KER 6 testbed as a stepping stone to larger scale industrial validation and adoption.

BOX2M identifies key opportunities for transformation in various sectors, offering tailored solutions for high-to-medium, medium-to-medium, and medium-to-low voltage substations. The company's focus extends to main grid feeders, local energy production/storage, and infrastructure internal consumer circuits. BOX2M targets industrial energy and utilities infrastructures, encompassing production lines, facilities subsystems, and legacy submetering systems for retrofitting industrial agents and utilities. Part of the TEADAL project, BOX2M will get a significant competitive advantage by leveraging the technologies developed in KER 3.

BOX2M goes beyond traditional monitoring by addressing critical support systems, including health, safety, security, and environmental concerns. The company's solutions cover a spectrum of areas, including ITC gear, lightning, power supply, and utility feeds for buildings, warehouses, and municipalities. Due to the sensitivity of the data processed, KER 5 from the

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TEADAL project will refine and improve the privacy and security commercial offerings of BOX2M.

3.4.17 RT – Exploitation Plan

Regione Toscana's (RT) TEADAL team comes from the Information Systems, Technological Infrastructure and Innovation Directorate, whose expertise is considered relevant to the thematic content of the project and in particular to the knowledge of the regional information society and the management of technological and digital infrastructures. The historical mission of the Department of Directorate has been the design and implementation of policies and strategies for the development of Information Society in Tuscany, both within the citizenry and the cooperative networks of social and institutional agents that substantiate the governance model of the Region.

Regione Toscana is involved in the TEADAL project to define a use case on environmental sustainability. The use case aims at reconstructing a mapping of the level of energy efficiency and air quality by territorial area, obtaining insights also through the application of machine learning techniques. The difficulties of this integration, apart from the technical aspects, lie in the fact that the data held by the public administration may contain personal information (concerning, for example, the owners of the buildings and plants, or the technicians who drew up the certificates) that should not be shared for the purposes indicated.

The TEADAL project will provide a consistent and reliable method and basis for improving data sharing compliance with GDPR. Regione Toscana will thus promote the enrichment and enhancement of public information assets while ensuring the highest level of protection of personal and confidential data. Regione Toscana will also promote specific communication and dissemination events of the project results within the Internet Festival.

3.5 Sustainability Strategy

The sustainability plan describes how the project will continue to produce benefits for the recipients and for society after the end of the funding (2-5 years).

As the project is in progress, the sustainability strategy will be detailed in a next deliverable at the end of the project (M36) as part of the deliverable D7.3, based on the results achieved and future opportunities.

The sustainability plan will be constructed through the collaboration of all consortium partners, according to the following:

- The sustainability strategy will include the project's sustainability goals, activities, resources, partners, and indicators.
- The sustainability strategy should also foresee the risks and challenges that could compromise the sustainability of the project and possible solutions to address them.

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4 Intellectual Property Rights and Confidentiality

The TEADAL project recognizes the critical importance of managing knowledge and intellectual property rights (IPR) to safeguard the project results and encourage innovation. To address these concerns, a dedicated intellectual property strategy has been established within the consortium agreement (CA). It ensures the identification, protection, and appropriate utilization of the project results (i.e. foreground) and innovations, including background. In particular, the exploitation of the access right is regulated in the CA section "9.4. Access rights for exploitation".

The partners are developing and sharing their know-how and innovations in many forms, including but not limited to guidelines, methodologies, software, prototypes and experiences, in order to carry out the project activities. The consortium defined the obligations and rights of the participants in the Grant Agreement (GA), with explicit reference to important administrative points such as decision-making procedures within the project, risk management strategies, legal aspects with regard to software to be used/produced in the project, possible trademarks, patents or rights of each partner in the exploitation of results. In addition, the GA specifies all administrative procedures and defines access rights to pre-existing know-how, knowledge, dissemination rules and IPR.

4.1 Existing Intellectual Property

Beneficiaries shall grant other participants access to their background identified as necessary for carrying out the action, subject to specific rules the GA. Background means any data, know-how or information, regardless of its form or nature (tangible or intangible), including any rights such as intellectual property rights, which is:

- held by the beneficiaries prior to their accession to the GA; and
- necessary for carrying out the action or exploiting the results.

In general, access rights to results and background needed for the performance of the own work of a party under the project shall be granted on a royalty-free basis, unless otherwise agreed in the CA.

Access rights to background if needed for exploitation of a party’s own results, including for research on behalf of a third party shall be granted on fair and reasonable conditions under a separate written agreement between the Parties concerned.

4.2 Intellectual Property Developed During the Project

The results developed in the project are owned by the party that generates them. In accordance with the relevant legal provisions, and with due regard to the legitimate interests of all participants (in particular the commercial interests of the participants) if the results developed during project activities, are expected to have an industrial or commercial application in accordance with the exploitation strategy (even if it involves further research and development and/or private investment), they can be protected in an appropriate and effective manner.

Access rights to results if needed for exploitation of a party's own results shall be granted on fair and reasonable conditions upon signature of a written agreement between the parties

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concerned. Access rights to results for internal research and for teaching activities shall be granted on a royalty-free basis.

A request for access rights may be made up to twelve months after the end of the project or, in the case of non-defaulting party, after the termination of the requesting party's participation in the project.

4.3 CONFIDENTIALITY

Confidential information is protected by specific articles in the GA and in CA. The partners treat as confidential any information identified as proprietary and/or confidential by the disclosing Partner during the project and will maintain confidentiality for five years after the project will be ended.

The confidentiality of information is conveyed by an appropriate stamp, legend or other written indication (an email is sufficient).

If the information is disclosed orally and identified as confidential, this is to be confirmed in writing by the disclosing party and identified as confidential information.

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5 IMPACT CREATION

5.1 STANDARDISATION

In March 2023, TEADAL applied for Category C liaison status with ISO/IEC JTC 1/SC 27 (Information security, cybersecurity, and privacy protection) working group (WG) 5 (Identity management and privacy technologies). This was discussed and approved at the ISO/IEC JTC 1/SC 27 (subcommittee) plenary in October 2023 and approved on the joint technical committee (JTC) level in January 2024. The next meeting of ISO/IEC JTC 1/SC 27/WG 5 will be held in April 2024, and we will present TEADAL there as the new liaison project.

We are in the process of applying for a liaison with ISO/IEC JTC1/SC 38 (Cloud Computing and Distributed Platforms). This has been delayed due to the difficulty and expert of cloud computing who is also familiar with the standardisation process.

After the establishment of the liaison relationship, the liaison representative will participate in the WG meeting, distribute the list of projects in progress to the consortium, collect interest and distribute the working documents to the partners who have expressed interest, gather the feedback, consolidate these and send the consolidated comments to the WG with our liaison statement.

5.2 COMMUNITY OUTREACH

TEADAL has started reaching out to other projects in the data spaces ecosystem to foster collaboration. There have been non-regular meetings since the beginning of the project to exchange ideas. TEADAL partners have participated in different GAIA-X seminars. GAIA-X is a reference in the international data spaces ecosystem, and there are some prospects, among TEADAL technical partners, to integrate and foster interoperability with dataspace protocols developed in those other projects.

No official agreements have been set in place, but some of the proposed ideas have been applied in TEADAL. Similarly, the plans for interoperability are not official, but we hope to have more concrete agreements by the end of 2024.

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6 CONCLUSIONS

This deliverable gives an overview of the exploitation plans of the TEADAL consortium. The exploitation is explored from two angles: joint and individual exploitation.

The joint exploitation plan has been defined based on the eight key exploitable results. Furthermore, the partners have documented the current state of their individual plans for the results of the TEADAL project.

Even though the project may yield further results and some results are still in early stages of development, we see that the partners already have plans for using TEADAL results in their business, in education and as part of future collaboration projects.

The exploitation plans will be updated during the next months of the project life, maturing both the individual and the joint plans. The organizational details at Consortium level will be also investigated. In addition, a detailed sustainability plan will be introduced. All above will be reported at the end of the project in Deliverable 7.3 Communication, dissemination, exploitation, and solution reliability report.

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