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SMART AGRIFOOD AND SMART WATER

AgriSpace4Trust optimises energy inputs in olive production

With the contribution of

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Background

Since September 2020, FIWARE has been leading **the successful i4Trust project around Data Spaces**, which has been receiving funding by the European Commission under the Grant Agreement of 951975. Thanks to the extraordinary collaboration of partners such as iShare and FundingBox, **32 selected solutions on Data Spaces have been awarded and funded**. With the first impacting results available, FIWARE has decided to publish a fine selection of Impact Stories **showcasing FIWARE-based solutions created by awarded and funded consortium of DIHs and SMEs**. Agrispace4Trust must ensure responsible and accountable data circulation. The AgriSpace4Trust project aims to create data hubs that utilize local weather stations or agro-environmental sensors and make them accessible to a wider community of local users contributing to the objective to create a Data Spaces Community as well.

Challenge & Context

Climate change[1] is heavily impacting the AgriFood sector, more severely than other many industries. Traditionally, experience-based practices can no longer tackle the changing weather conditions and their impact on crop health[2]. The seasonality of pests has changed due to temperature variations, and water stress is a problem in permanent crops.

These issues have led farmers to start investing in digital tools to mitigate weather related-risks. IoT has made it possible for low-cost sensor systems to remotely monitor through cloud applications and algorithmic models, providing farmers with data that alerts them of potential challenges. However, this data needs to

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[1] Science Direct – Journal and books, Future Foods, Global Trends, Opportunities, and Sustainability Challenges, 2022, Pages 49-79.
[2] MDPI, The Impact of Climate Change on Agricultural Insect Pests,2022.

be interpreted by a field expert, such as a farm advisor, who may not always be physically available. Additionally, data ownership[3] and access conditions raise ethical and financial concerns. Also, end-users often don't fully understand the implications of "GDPR waiver" or "terms and conditions" agreements for their privacy, security, and investment in data creation[4]. In the future, a system that guarantees data owners' sovereignty and the freedom to transfer their data and network services from one provider to another will be essential.

Smart Farming faces the challenge of avoiding the creation of additional data silos. At the same time, farmers are reluctant to share their data due to a lack of tangible and valuable incentives[5]. And the market is missing an on-demand, subscription-based data access service that facilitates communication with an expert to provide data-driven consultation to farmers. For example, a cooperative could offer its data to a nearby smart city to adjust irrigation in public green spaces based on the area's real-time precipitation. The potential benefits of sharing data within the AgriFood sector and across industries are numerous. Agrispace4Trust, with the support of i4Trust technical tools, must ensure responsible and accountable data circulation.

Solution

The AgriSpace4Trust project aims to create **data hubs** that utilize **local weather stations or agro-environmental sensors** and make them **accessible to a wider community of local users**. This will incentivize **opinion leaders and tech-savvy farmers to invest in specialized equipment and share their data** with whomever they choose, such as **cooperatives and farm advisors/agronomists**. These advisors can then access the **local data space to obtain raw data and metadata**, making

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[3-4] Science Direct – Journal and books, Security challenges to smart agriculture: Current state, key issues, and future directions 2022.
[5] Springer link, Towards Comprehensive European Agricultural Data Governance: Moving Beyond the "Data Ownership" Debate, 2019.

Figure 1 - Device (a)

their services more precise, accurate, and tailored to the real-time microclimate conditions of the area.

Data and services offered in the local data hub **must comply with GDPR regulations and be easily findable, accessible, identifiable, reusable, and credible**. This will prevent data consumers from becoming lost in the maze of open data repositories, while subscriptions to data owners will guarantee modern and constant access to real-time data. Additionally, data owners can use the data sharing services designed within i4Trust[6] to share their device data on-demand and transform their hardware into pay-per-demand data services that serve the nearby community.

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[6] i4Trust has been building a sustainable ecosystem where companies are able to create innovative services by means of breaking "data silos" through sharing, re-using and trading of data assets. As part of its scope, 32 bottom-up experiments involving at least 150 SMEs and 32 Digital Innovation Hubs are contributing to the digital transformation of industrial value chains across multiple domains, such as Smart Cities, Smart Mobility, Smart Manufacturing, Smart AgriFood, Smart Energy, Smart Water, Smart Health, and Smart Logistics.

Figure 2 - Device (b)

AgriSpace4Trust will also create an open source Software-Agent Enablement Framework to interoperate with various vendor data models, **eliminating the risk of vendor lock-in or business discontinuities**. The replicability of AgriSpace4Trust will act as a trusted intermediary layer that Agri-Tech providers must follow to ensure their solutions' interoperability and exploitability in the long term.

AgriSpace4Trust will address two common issues encountered when **Future Intelligence (FINT)[7]** commercializes a Smart Farming solution that consists of hardware and software units. First, cooperatives may invest in weather stations, but individual members may not embrace them, even though they understand the value of real-time farm data. **AgriSpace4Trust** aims to **provide *à la carte* access to data for authorized**

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[7] Future Intelligence Ltd offers innovative telecom engineering products and services for the most demanding end users scenarios. Their vision is to remain at the cutting edge of technology progress in areas of IoT, 4/5Gs and distributed architectures through continuous learning and partnering.

individuals under a subscription scheme that compensates the cooperative, the data owner. Secondly, AgriSpace4Trust will reduce vendor lock-in by implementing a third-party trust bubble from **SensorGage (SG)** with a data platform, infrastructure, and all the necessary agents/ adapters. Every tech provider will be invited to interoperate with the AgriSpace4Tust framework, so they can successfully launch their service. This way, future issues with service maintainability will be decoupled from potential solution providers' business discontinuities, such as bankruptcy or limited after-sales support, while ensuring data portability and interoperability are automatically proven.

How it works

AgriSpace4Trust has established three distinct actors within its proof of concept' use cases for the i4Trust experiment: the operating entity (AgriSpace4Trust), farmers as both data providers and service consumers, and agronomists as both data consumers and service providers. The data models used in the system are based on FIWARE's technologies[8] and have been enhanced to include linked data through the latest NGSI-LD specifications[9]. To ensure security and accessibility, iSHARE[10] integration and the Satellite Service validate access, authorize user accounts, and manage relevant policies.

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[8] FIWARE is a curated framework of Open Source Platform components to accelerate the development of Smart Solutions.

[9] The FIWARE NGSI v2 information model has been evolved to better support linked data (entity relationships), property graphs and semantics (exploiting the capabilities offered by JSON-LD). This work has been conducted under the ETSI ISG CIM initiative and has been branded as NGSI-LD. The main constructs of NGSI-LD are: Entity, Property and Relationship. NGSI-LD Entities (instances) can be the subject of Properties or Relationships. In terms of the traditional NGSI v2 data model, Properties can be seen as the combination of an attribute and its value. Relationships allow to establish associations between instances using linked data. In practice, they are conveyed by means of a special NGSI v2 attribute with a special value (relationship's object), which happens to be a URI which points to another entity. They are similar to the ref attributes recommended by the Data Models guidelines.

[10] iSHARE is a trust framework that allows APIs to seamlessly integrate with each other and communicate in a trusted way and only share data when authorized. For developers, it's key to understand the basic principles of iSHARE prior to starting the development of connectors.based on FIWARE technology.

The Minimum Viable Product (MVP) application built showcases the relationships between these actors and highlights the consortium partners' roles in the system.

The diagram and paragraphs below provide a clear understanding of how the system operates and demonstrates the various interactions between the actors.
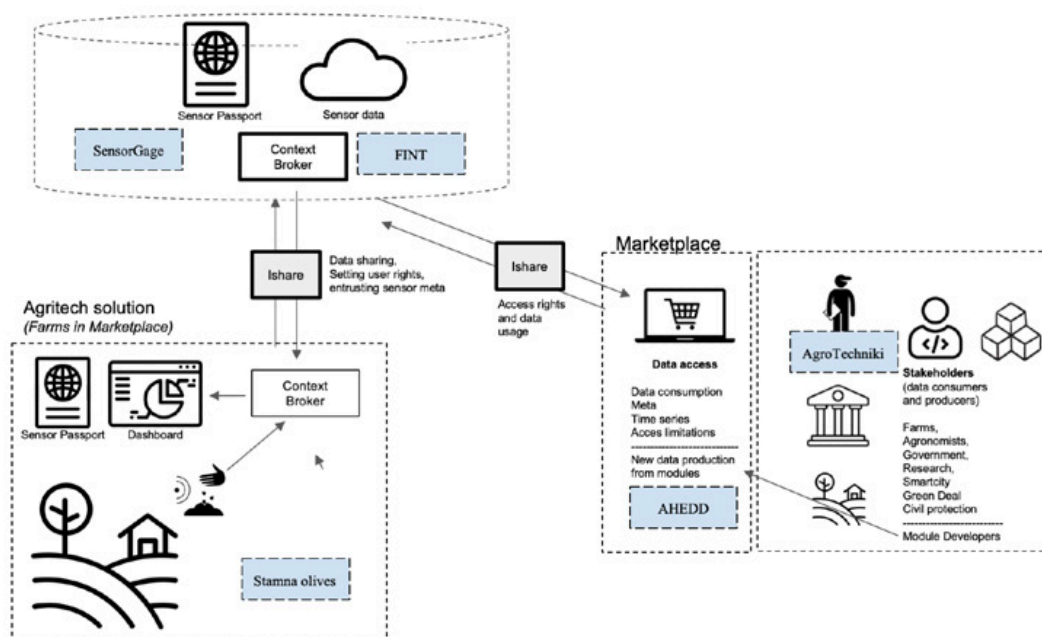

Figure 3 - AgriSpace4Trust conceptual Architecture

Future Intelligence (FINT)

is a FIWARE expert and an iHubs operator (Hellenic [FIWARE iHub](https://)[11]), and co-founder of [ahedd](https://) DIH. FINT designed, implemented, and tested the AgriSpace4Trust software, which includes software agents (adapters) and integrates with the i4Trust ecosystem. With the support of SensorGage (SG), FINT deployed and operates the

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required i4Trust building blocks, allowing for data sharing. Additionally, FINT brings in an existing multi-stakeholder AgriFood community equipped with IoT weather stations and sensors, and data services like weather forecasts, to the Agrispace4Trust Data Marketplace.

SensorGage (SG)

screens incoming data provided by provider entities, as defined by iShare, ensur data consistency and quality meet the required thresholds and measurement alignments. This improves the comparability of datasets from different providers and enhances the value of the data marketplace by establishing common standards. SG also reviews the frequency of measures to minimize risks associated with GDPR. Furthermore, SG promotes the benefits of the AgriSpace4Trust marketplace, such as protection of data ownership and accessibility through rights allocation to local stakeholders in Southern Holland.

Stamna Olives (SO)

is a data and IoT equipment owner that offers raw data to the community. By doing so, SO aims to reap economic benefits and consume data services, such as irrigation schedules.

AgroTechniki (AgroT)

a trusted farm advisor in the region, consumes data to offer more accurate farm consultancy services. With data on wind, air, and solar radiation, agronomists can accurately assess the water index and potential appearance of insects, fungi, or pests in cultivations. AgroT mainly works with olive producers and fruit and vegetable growers in Western Greece.

Attica's Hub for the Economy of Data and Devices (ahedd)

promotes the i4Trust community and its Data Marketplace in the areas where the experiment takes place and beyond. For example, In Western Greece, there is a

growing food processing industry, and ahedd aims to educate and offer services to these entities on how to participate in the developing data ecosystem and reap it's benefits. ahedd also highlights how the AgriSpace4Trust data space affects other nearby sectors, such as environmental protection, given that SOlives olive groves are located next to a Natura-protected lagoon. Additionally, ahedd leverages its strong ties with academic, public, and Industrial sectors to expand AgriSpace4Trust to other markets, such as Smart cities, Smart energy, services, and manufacturing.

Benefits & Impact

In the future, AgriSpace4Trust will transform **QUHOMA[12], a commercial IoT solution powered by FIWARE and accessible through e.g., the [FIWARE Marketplace](13)**, into an i4Trust-enabled data space that will provide added-value services and revenue streams for involved parties and create innovative data services for new players. The team will also broaden the customer base of AgriSpace4Trust by integrating its services into the i4Trust framework and utilizing the diverse background of its members to provide new data circulation modules.

The project involves a third-party service provider that offers a SensorPassport, a service currently utilized in the Smart City domain. This meta-data layer adds

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[12] QUHOMA was created to unveil the competitive advantage of farmers and AgriFood businesses committed to outstanding quality in end-products and farming practices. At the same time, Future Intelligence's solution paves the way for rationalizing the required farm inputs thus maximizing profit margins.
[13] FIWARE Marketplace is there to help users and their customers find innovative and the best open-source-based products and services, and grow revenue by identifying customer needs and repeatable solutions leveraging FIWARE technologies and the FIWARE partner ecosystem, at scale. Offers are provided by the FIWARE community, may it be companies, organizations or cities, and are FIWARE validated. FIWARE Marketplace is the comprehensive shopfront of all validated FIWARE products. Products are regularly promoted and featured through different classical and digital marketing channels such as Social Media, Newsletters, conferences, brochures, and also brought to trade shows and presented to the media, press or to analysts. Product proposals are evaluated by FIWARE Experts (though a mainly technical evaluation) receiving a formal approval by FIWARE.

an extra layer of trust between the sensor/IoT provider and the sensor owner, and has applications in other markets such as logistics, crisis management, and nature preservation.

AgriSpace4Trust's tech partners, FINT and SG, come from the AgriFood and Smart Cities markets, and hold complementary positions within the IoT value chain, however their **value of AgriSpace4Trust is not limited to the agricultural sector**. Data from farms regarding soil moisture levels, for example, is **relevant to the civil protection system in predicting fire risks and to local councils for water management**. Farming data time-series also hold value for the food processing industry in forecasting supply levels, and even for large-scale remote sensing and Copernicus satellite earth observations. AgriSpace4Trust has thus a clear target to exchange data with open data portals[14].

The AgriSpace4Trust project was inspired by a commercial need in the agriculture sector and creates a virtuous data cycle between solution and service producers, data owners, and data consumers, monetizing the sharing of secure, authorized and accountable data.

The outcome of the software sandbox add-on embedded in the QUHOMA application will reach hundreds of farmers in the community, engaging their partners such as agronomists, input suppliers, buyers, and eventually regulators. This creates the dynamics for a successful marketplace and network effects that attract a wider range of participating stakeholders

 The platform will also enable collaboration between software providers (FINT and SG) and i4Trust tools to validate the data lifecycle and ensure the quality of the gathered data. Once the data quality is assured, the platform will connect with open data portals in Smart Cities, Environmental Monitoring, Mobility, and Energy across the EU.

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[14] Some examples of portal: www.data.gov.gr, geodata.gov.gr

Added value through FIWARE

Future Intelligence (FINT), the coordinator of the AgriSpace4Trust project, has been using FIWARE Orion Context Broker[15] since 2015. At that time, the company pivoted its Wireless Sensor Network solution (later called Internet of Things, IoT) FINoT into the agrifood domain. FINT has since experimented with additional Generic Enablers (GEs)[16] and is now capable of conducting FIWARE training and validating such solutions, as well as consulting potential FIWARE adopters on the maturity of GEs, debugging issues, and anything related to the dynamic and growing open-source community. Since then, the company has been selling commercial IoT solutions, like QUHOMA, that are based on the next version of Orion Context Broker's NGSIv2 standard. The i4trust initiative allowed FINT to continue experimenting with FIWARE GEs, and more precisely, successfully use the upgraded Orion-LD. It also incentivized the creation of a proof-of-concept (PoC) Data Space that can serve as the next commercial offering for FINT's customers, turning their IoT devices into revenue-generating services through effective and secure data sharing. As a result, AgriSpace4Trust is pioneering the data space concept in Greece and has already started discussions with like-minded and visionary colleagues, such as the local GAIA-X Hub. FIWARE can act as a central mediator for unifying various data spaces across different applications such as Agrifood and Climate Change, among others. The Hellenic FIWARE iHub project, aimed at promoting the use of FIWARE nationally and regionally, can significantly contribute to the local realization of data spaces and help other companies quickly reap the benefits of FIWARE, either by speeding up their deliveries of IoT solutions or by participating in the emerging data spaces ecosystem.

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[15] FIWARE Context Broker allows to manage the entire lifecycle of context information including updates, queries, registrations and subscriptions. It is an NGSIv2 server implementation to manage context information and its availability. Using the Orion Context Broker, one is able to create context elements and manage them through updates and queries. In addition, one can subscribe to context information so when a specific condition occurs (e.g. the context elements have changed) the user receives a notification. These usage scenarios and the FIWARE Context Broker features are described in this documentation.

[16] A GE (which stands for "Generic Enabler") is a software component definition based on an open specification. For example, the Publish/Subscribe Context Broker (sometimes referred as Context Broker for short) is one of the FIWARE GEs.

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Categories

Domains (s)	Smart AgriFood, Smart AgriTech, Smart Water
User (s)	Farmers, Advisors, Value Chain Stakeholders, Tech Providers Regional/ Municipal DPOs
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