FAME: A Federated Secured, Trusted and Interoperable Marketplace and Data Space

Data Spaces are strategic data infrastructures to promote the European data economy's growth while minimizing human and environmental carbon footprints. Data marketplaces typically born to operate within deregulated markets, while Europe favours regulated markets with strict supervision. This document presents FAME in the context of Data Marketplaces and Data Spaces for Europe.

Contents

1. Executive Summary

The European Union (EU) has prioritized the establishment of a European Single Market for data, aiming to ensure Europe's global competitiveness and data sovereignty. One of the primary objectives is to foster data trading in a transparent, secure, reliable, and sustainable way, in line with the European values, that will contribute to the digital society, creating growth and benefits for all the relevant stakeholders. The EU has also stressed the significance of data not only in the context of data-driven economy and innovation, but also in reference to data-driven policy making and legislation.

Data marketplaces allow buying, selling, and exchanging data, mainly datasets. They work like traditional markets with buyers, sellers, and transactions. The more valuable the marketplace, the more buyers it attracts, which then increases value for sellers. These marketplaces ensure data sharing based on agreed principles, but face several challenges:

- **Business/Organizational Challenges:** Companies need to build trust, follow EU rules, and adapt to changes of the economic environment.
- **Legal Compliance Challenges:** GDPR and other laws protect privacy and define data ownership according to EU policies.
- **Technical Challenges:** Issues like interoperability, data quality, and scalability in data sharing need to be addressed.

FAME is a special type of data marketplace focused on creating a data space for the financial sector. It stands out in several ways:

- **Market Focus:** FAME is tailored for the financial sector, offering a platform for using customized data assets, fostering innovation, and improving service delivery.
- **Product Diversity:** FAME offers a variety of data assets, including datasets, AI models, analytics, algorithms, services, and educational content.
- **Governance Model:** FAME uses a federated governance model to ensure data transactions are trustworthy, private, and secure, following EU regulations.
- **Cutting-edge Technologies:** FAME employs advanced technologies like semantic interoperability, AI, machine learning, blockchain, and adaptive authentication to enhance data analytics, ensure secure transactions, and manage dynamic identities.
- **Regulatory Compliance:** FAME provides tools to ensure compliance with laws like GDPR, Data Act, Payment Service Regulation (PSR), Markets in Crypto-Assets (MiCA) Regulation and 4th AntiMoney Laundering directive (4AML). These tools help ensure FAME's functionalities meet security and regulatory requirements, following EU regulations and security-by-design principles.

2. Trends for Data Market, Marketplaces & European Data Spaces

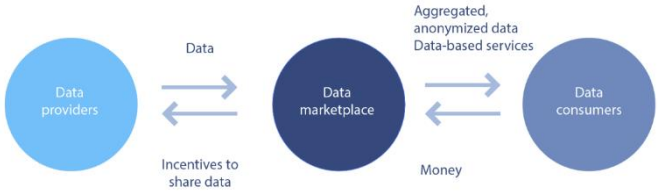
2.1 Data Market Overview

Data marketplaces provide a place to buy, sell, or exchange various types of data assets, like datasets, algorithms, software, tutorials, etc. These marketplaces facilitate the trading of data assets, allowing providers to share and ultimately monetize their data assets and consumers to access valuable datasets for analysis, research, and business purposes.

2.2 Data Market and Players

The data marketplace industry features a variety of players including Amazon AWS Data Exchange, Snowflake Data Marketplace, Databricks Marketplace, and others. These entities contribute to a highly competitive landscape characterized by a diverse range of services, mainly focused on dataset, from open dataset repositories to specialized dataset provisions. The differentiation among these players often revolves around their market focus—be it general-purpose data or niche segments. These marketplaces generally derive as additional services of platforms for the storage of data and generally created for non-regulated markets and for interchange mainly of basic datasets

Figure – Classic Data Marketplace



2.3 European Vision and regulation on Data Markets

The European Union's 2020 data strategy aims to create a unified European Data Space by 2030, promoting economic growth and environmental sustainability. This involves legislative measures, governance frameworks, and investments in digital infrastructure to ensure secure data exchange aligned with European values.

Sector-specific Data Spaces are being developed to drive innovation, with the finance sector being one of the 14 identified by the EU Commission. Key legislative actions, such as the Data Governance Act, Data Act, Data Service Act, and AI Act, regulate these spaces to ensure transparency, trustworthiness, and data sovereignty.

Significant progress has been made, especially in financial services, with initiatives like the legislative proposal for a framework for access to financial data (FIDA), aiming to regulate financial data exchange within Europe and ensure secure, fair, and transparent data sharing.

2.4 Data Space Players and initiatives

Several players are seeking to translate the EU's vision into more tangible artifacts for the market. Among these, Gaia-X, IDSA, DSSC, FIWARE and others, and associations such as BDVA are certainly worth mentioning. Each of these has brought forth proposals for implementation, addressing the various challenges of bringing the European data vision to the market with different approaches. Some are more focused on the technological and federative integration of data, while others concentrate on providing reference architectures to be implemented within the Data Spaces. Still, others are primarily concerned with business, organizational, and governance aspects. The listed initiatives are individually funded by the EU, today, spurred on by EU funding of the initiative with some established convergence.

3. Data Space Contextual Challenges

Navigating the data marketplace and Data Space landscape involves challenges from regulatory complexities, market fragmentation, technological advancements, and data privacy concerns. Business, legal, and technical issues require careful consideration and strategic responses from platforms like FAME to stay competitive and compliant.

3.1 Trading and Monetization Gap in Data Spaces

Early data spaces specifications (e.g., [Nagel21], [Usländer22]) and related reference architecture models (e.g., [Otto19]) do not make adequate provisions for data assets as well as trading and monetization. More recent initiatives (e.g., the Simpl data space middleware (https://digital-strategy.ec.europa.eu/en/policies/simpl)) specify accounting functions, without however concrete implementations of infrastructures and strategies for data trading and monetization. Also, most European data spaces do not incorporate data trading mechanisms at all. Moreover, state of the art federated data marketplaces platforms tend to offer simple flat pricing schemes, without any financial market-like trading mechanisms.

As a prominent example, Data Owners that possess or produce high-value data assets are not provided with some data space where they can monetize their assets based on dynamic pricing schemes. **No easy way for Industrial actors (notable smaller actors (e.g., SMEs) to connect with Data Spaces.** Data Spaces infrastructure like connectors specify and facilitate the integration of data providers/consumers in federated data management infrastructures. Nevertheless, the process of implementing or deploying a data space connector can be quite challenging, especially for smaller enterprises that lack the knowhow and equity capital to invest in data spaces integration. For instance a small private equity firm has no easy way to join a financial data and lack knowledge and expertise to properly deploy a connector from its financial platform.

3.2 Regulatory Compliance and Data Governance

The evolving regulatory environment in Europe, shaped by initiatives such as the Data Governance Act and the Data Act, sets a high standard for compliance. These regulations are designed to ensure data privacy, security, and sovereignty, creating a trustworthy environment for data exchange. However, compliance can be burdensome for data marketplace operators who must navigate these complex legal frameworks and implement robust data governance mechanisms. Compliance to directives and regulations can slow down innovation and operational flexibility, as adapting to new or amended regulations requires time and resources. The challenges are very intense in the case of Finance, where operators are faced with a complex and volatile regulatory environment that comprises many and frequently challenging regulations such as PSR, 4AML, MiFIDII and more.

3.3 Market Fragmentation

The data marketplace sector is highly fragmented with numerous players ranging from large corporations to niche startups. This fragmentation can lead to inconsistencies in data formats, standards, and quality, making it challenging for users to find and utilize data effectively. Furthermore, the presence of numerous competitors makes it difficult for any single platform to gain a dominant market position, leading to fierce competition over market share and customer loyalty.

3.4 Rapid Technological Advancements

The pace of technological change in data handling and analytics is another significant challenge. Keeping up with the latest developments in artificial intelligence, machine learning, blockchain technology, and data security measures is essential for maintaining a competitive edge. However, continuous investment in technology upgrades and innovations can be costly and resource-intensive.

Additionally, the adoption of new technologies often equires significant changes to existing systems and can disrupt service continuity.

3.5 Data Privacy and Security Concerns

With the increasing volume of data being exchanged and monetized, privacy and security concerns are paramount. Users of data marketplaces are justifiably cautious about how their data is handled, who has access to it, and how it is protected. Ensuring data privacy and security is not only a regulatory requirement but also a critical factor in building and maintaining trust with users. Data breaches or lapses in data security can have severe repercussions, including legal penalties, loss of user trust, intellectual property or assets, and reputational damage.

3.6 Technological Integration and Interoperability

Integrating diverse technologies and ensuring interoperability between different data ecosystems is a considerable challenge. Data marketplaces must be able to seamlessly connect with various data providers and consumers who may use different technologies and standards. Achieving this level of interoperability requires sophisticated technical solutions and often the adoption of shared standards or protocols which can be difficult to implement universally.

3.7 Economic and Financial Viability

Ensuring the economic and financial viability of a data marketplace is also challenging. The need to balance revenue generation with providing value to users can be tricky. Pricing models must be competitive yet sustainable, and marketplaces need to innovate continually to offer valuable services that users are willing to pay for. Additionally, managing the costs associated with technology, compliance, and operations without compromising service quality is a delicate balancing act.3.8 Decentralized Dynamicity and Adaptivity

Data markets are characterized by dynamic ever-changing availability of decentralized data sources, users and accesses where data can be access can be granted and revoked at any time, data sources can become faulty or simply unavailable over time, new data sources might be added, etc. This dynamicity requires that AAI needs to be created with great flexibility and adaptivity offering secure and dynamic authentication, authorization and access control services. While user management policies provide the foundation for identity and access management (IAM) system, dynamic policy management process enables policy adaptability for dynamic IAM using contextual user management data and key performance indicators for policy detection and refinement, and for sustainable adoption of SSI (self-sovereign identity).

4. FAME

4.1 General Overview

The FAME Federated Marketplace is a Data Space, according to the definition of the EU. FAME provides a technology platform, the Federated Data Asset Marketplace, customized for buying and selling federated data assets in the financial sector. In addition to this marketplace, FAME also offers a Federative Business/Governance model to ensure sovereignty and the sharing and exchange of trusted data assets resources within the digital ecosystems, all grounded on commonly agreed principles.

The Federated Data Asset Marketplace component of FAME is accessible through a unified entry point, facilitating secure data access, sharing, trading, and analysis for finance and non-finance organizations, Data Marketplaces/Data Spaces, and individual users. The ecosystem prioritizes data privacy, security, environmental considerations, and carbon footprint monitoring. FAME is a collaborative effort integrating expertise in data management, analytics, and digital finance to deliver a reliable, energy-efficient, and secure platform for Finance applications.

Among its fundamental components, FAME features a Federated Data Assets Catalogue, enhancing existing marketplaces infrastructures by supporting decentralized data trading and monetization. It introduces novel functionalities across three core areas: secure data exchange, decentralized data trading, and energy-efficient analytics. These functionalities are supported by fundamental components like Authorization & Authentication, Federation of External Sources, Assets Policy Management, Assets Provenance & Tracing, Assets Pricing, Assets Trading & Monetization, Assets Searching, Machine Learning and Artificial Intelligence Analytics, SAX Analytics, Analytics CO2 Monitoring, FML Deployment, and Training. These components address various challenges including security, data sharing, regulatory compliance, data sovereignty, valuation standards, decentralization, and user training needs within the context of Finance applications.

In addition to these functionalities FAME, with the Federative Business/Governance model, embraces the European vision of data sharing by providing a framework for Regulatory Compliance and Data Governance, closely following the principles of European Data Spaces.

FAME enables and stimulates the development of Data Value Chains for Financial market, keeping sovereignty and trustworthiness under European strategy and values.

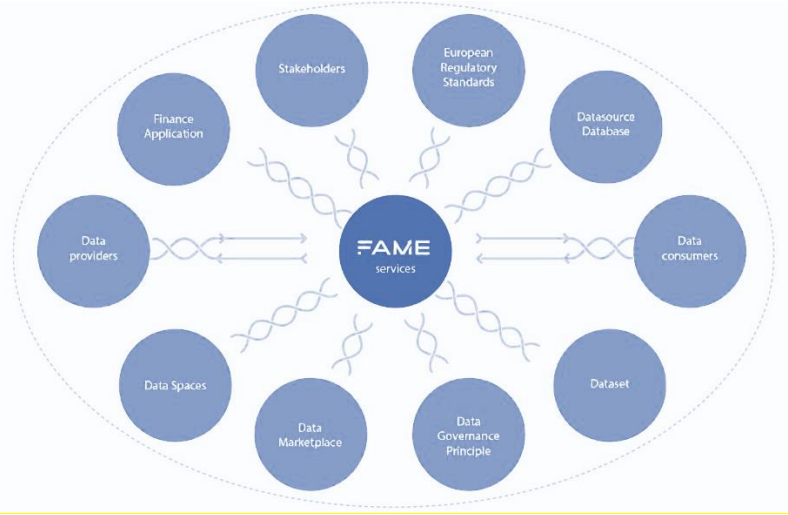


Figure 1- FAME in a nutshell

4.2 Innovation and Unique Approach Value

The FAME project stands out in the crowded data marketplace landscape through its unique approach in several key areas: the market focus, the types of assets it provides, its governance model, the underlying business model, and the advanced technologies it employs. Each of these aspects contributes significantly to FAME's distinctive positioning in the market.

4.3 Market Focus

The FAME component Federated Data Asset Marketplace is not just another data marketplace; it is specifically engineered to support the burgeoning field of Data-Driven Finance Applications. This focus allows FAME to cater to a niche yet rapidly expanding segment of the financial industry. By providing a unified platform, FAME facilitates the discovery and utilization of diverse Data Assets. These assets are tailored to meet the specific needs of various entities within the financial sector, ranging from banking institutions to fintech startups, enabling them to innovate and deliver services efficiently.

4.4 Data Assets

The variety and richness of the data assets offered by FAME set it apart from traditional data marketplaces. FAME's assets include:

- **Classical Data and Datasets:** These are the foundational elements that include raw and processed data applicable across various scenarios in finance.
- **Value-Added Assets:** Beyond standard datasets, FAME integrates models, algorithms, and technology components, such as code snippets and software modules, which are ready for deployment in financial applications.
- **Running Services:** FAME offers services that are currently operational and can be integrated directly into the users' environments. These include, but are not limited to, Energy Efficient (EE) Analytics, Artificial Intelligence (AI), Machine Learning (ML) models, Situation Aware Explainability (SAX) and Explainable AI (XAI) models.
- **Digital Content:** This includes educational and training materials such as courseware and tutorials, which support the onboarding and continuous development of users on the platform.

FAME's approach to federating data assets—that is, hosting these data assets in their native environments without unnecessary replication—reduces the environmental impact and the costs associated with large-scale data transfers.

4.5 Governance Model

FAME promotes a federated governance model, which is a departure from the centralized governance seen in many data marketplaces. This model ensures that data sovereignty, privacy, security, and trustworthiness are maintained, aligning with European values and regulations. The participants—both consumers and producers of data assets—agree to adhere to principles and policies that are compliant with EU regulations.

The FAME governance module supports the FAME federation principles, manage verified credential accounts, ensuring easy joining and leaving of members, quickly resolves user queries and improves security and efficiency of transactions, interact with trading partners and access historical data, while adhering to EU regulations for data protection and financial transactions.

4.6 Business Model

FAME operates on a multi-sided market business model, which effectively serves both data asset providers, data asset consumers:

- **Data asset provider side:** Data asset providers list their assets in an extensive catalogue, making them available for discovery and purchase to a wide audience.
- **Data asset consumer side:** Data asset consumers can discover and purchase these assets.

This model supports dynamic interactions between multiple stakeholders in the marketplace, including scientific community and non-Financial organizations to access data assets and formulate solutions and/or provide algorithms/models/solutions for the financial market, fostering a vibrant ecosystem where data assets can be exchanged efficiently. Trading transactions are automated using blockchain technology, which ensures transparency and security.

4.7 Pricing Advisory Tool

Since data is an experience and non-rivalrous good and its value is inherently combinatorial due to other potentially correlated data available in the market, FAME offers a pricing advisory for data assets published on it using similarity analysis. Pricing advisory tool considers the intrinsic and extrinsic properties of a focal data asset (or digital product) in comparison to other similar data assets (or digital products) so as to recommend a price for focal data asset (or digital product). The pricing advisory tool of FAME utilizes the information available about data assets (or digital products) in the form of numeric, logical, ordinal or text data to derive similar data assets (or digital products) and considers their prices from historical trades to recommend the price of focal data asset (or digital product). Currently, FAME considers properties of data assets (or digital products) such as accuracy, validity, completeness, uniqueness, environmental sustainability, estimated costs for deriving similarity while advising the price. In future, other characteristics of data assets such as dispersion, separability, class overlap, and class imbalance can also be incorporated in PAT for advising the price of data assets.

5. Technologies

FAME leverages cutting-edge technologies to enhance functionality and user experience:

- **Secured and Trusted, Adaptive Identity and Access**: FAME's Authentication and Authorisation is managed in a secured manner through Digital Identities (DIDs). Adaptive trust using decentralized technologies between infrastructures and services dynamically for ensuring the protection of the confidentiality in federated security domains for different applications are also used. This ensures adaptive policies enforcement for restricting unauthorized accesses.
- **Semantic Interoperability** – FAME promotes adoption of the extended Data Catalog Vocabulary (DCAT) standards and financial sector-specific ontologies like FIBO/FIGI, FAME ensuring that data can be seamlessly exchanged across different platforms and marketplaces without semantic discrepancies.
- **Artificial Intelligence and Machine Learning** – FAME provides advanced AI technologies for analytics and decision-making support, including Quantitative Explainable AI and Situation Aware Explainability (SAX), which enhance the analytical capabilities of the platform. It also offers other AI-related solutions, such as a Federated Learning approach to guarantee data privacy while training models, or a smart deployment service that considers CO2 emissions to adapt the deployments of the AI models.
- **Blockchain** – applications rooted in Distributed Ledger Technologies are used to achieve several goals:
  - Enhance transparency and trust in the FAME ecosystem, by tracking the provenance of data assets and securing the integrity of the catalogue.
  - Enable the decentralized trading of data assets, by means of automated provider/consumer transactions (Smart Contracts), asset tokenization (Non-Fungible Tokens), and an internal digital currency (Stablecoin).
  - Improve the reliability and resilience of the communication infrastructure between the stakeholders.
- **Self-Sovereign Identities** – FAME has a privacy-preserving, user-centric approach to identity management, as it adopts the European Digital Identities framework as the foundation of its online access control system.
- **Regulatory Compliance and Law** – FAME's ambition is to deliver Europe's first standards-based, secure, regulatory compliant, interoperable, and federated data marketplace platform for Embedded Finance (EmFi) applications. Apart from unique feature of the FAME project, which is federated access control, the project provides a unified access to all related regulations in the field. In that sense, it provides a harmonious ecosystem of the laws and regulations according to the need of different stakeholders.

Recently, some of the most advanced marketplaces have been developed in Europe which provides functionalities for data catalogues, search, analytics, trading, and accounting. Marketplaces such as i3-MARKET, DataVaults, MOSAICrOWN, MUSKETEER provide value-added features for integrating, accessing, and trading data assets, such as data assets monetization, data sovereignty, personal data protection, compliance to regulations (e.g., to GDPR (General Data Protection Regulation), the Data Act, etc.).

These technologies not only boost the operational efficiency of FAME, but also ensure that the platform remains at the forefront of the data marketplace industry, capable of meeting the sophisticated demands of modern financial services.

6. FAME Use cases

FAME Data Space and Marketplace ensures data sovereignty, integrity and trustworthiness, enabling the creation of new products and services. To understand the advantages and value of the FAME DataSpace ecosystem let's consider the following examples.

An insurance company targets to develop a specialised insurance product that covers flood risks for specific geographical areas. The primary challenge is obtaining accurate and localised climate prediction data and correlating it with regional insurance and mortgage data to establish the best premium. FAME addresses this need by providing access to climate prediction models tailored for specific regions and integrating them with relevant insurance and banking data.

In this scenario, data producers play a crucial role. One producer supplies a service that provides local geographical climate predictions, while another offers an IT service that estimates the local value of homes based on historical and current mortgage data provided by banks in the area. Another provider uses previous mortgage information and market analysis to predict property values. The insurance company then integrates the IT services provided by these producers to evaluate flood risk and assign the appropriate premium.

Through the innovative utilisation of data, FAME enables the insurance company to offer a specialised flood risk insurance product tailored for specific zones. This enhances their market offering by addressing a specific need with precision and reliability.

An example of compliance with AI regulation is as follows. A company is developing a new artificial intelligence model to automate customer support services. The challenge lies in ensuring that the AI model meets the stringent requirements of the EU AI Act. FAME addresses this by providing a pre-validated AI model that complies with the AI Act. This enables the company to integrate the compliant model seamlessly into their system and bring their product to market more quickly. The models and algorithms are provided by federated and trusted partners within the FAME Federation, ensuring their reliability and adherence to regulations.

Another example is a GDPR-compliant data utilisation. An organisation needs to use personal data for customer behaviour analysis to improve their service offerings. The challenge is to ensure that their data handling processes comply with the General Data Protection Regulation (GDPR). FAME provides GDPR-compliant data sets and processes, allowing the organisation to utilise the data confidently without risking regulatory breaches. These data sets are also supplied by federated and trusted partners within the FAME Federation, guaranteeing their compliance and integrity.

This use case exemplifies how leveraging untapped data can lead to the development of innovative services that meet unique market demands.

7. FAME Advantages

FAME project is advancing the state of play in digital technologies providing large efforts in developing data spaces and marketplace support tools and demonstrators (pilots) for the financial sector Ecosystem. FAME is transforming the financial sector by introducing trusted and secured, efficient, cost-effective, and regulation-compliant solutions. A brief summary of FAME project advantages are listed as follow:

7.1 Support for FinTech and InsuranceTech

Transforms the financial sector by offering efficient, cost-effective, and regulation-compliant solutions for Finance applications using a common vocabulary and semantic.

7.2 Compliance with EU Regulations

Adheres to European values and regulations, contributing to the European data strategy and supporting the development of specific Data Spaces for Finance. FAME also provides the data trading and monetization component as well as dynamic data schemas, which are currently absent in the context of Data Spaces

7.3 Cutting-Edge Technology – Batteries Included

FAME provides off-the-shelf, ready to use, ready to deploy AI/SAX/XAI, ML/DL modules to support EmFi applications, leveraging the development and integration costs.

7.4 Secure and Interoperable

Offers a secure, standard-based, and interoperable data asset marketplace ensuring data sovereignty, privacy, security, and trustworthiness.

7.5 Multisided Data Marketplace

Bridges consumers and providers of data and technology assets, incorporating trading security and trust mechanisms, while minimizing risks associated with data exchange and sustainability impact.

7.6 Adaptative Authentication and Authorization

Enables robust authentication and authorization in a multi-domain resources environments offering secure and dynamic access control system.

8. Conclusions

FAME positions itself in the European Data Spaces landscape, as infrastructure that adds data trading and monetization capabilities over conventional data spaces infrastructure. It also lowers the barriers for different actors (including SMEs and smaller companies of the EmFi ecosystem) to integrate their data assets in a marketplace regardless of the level of sophistication of their data management infrastructures and of their knowledge of data spaces.

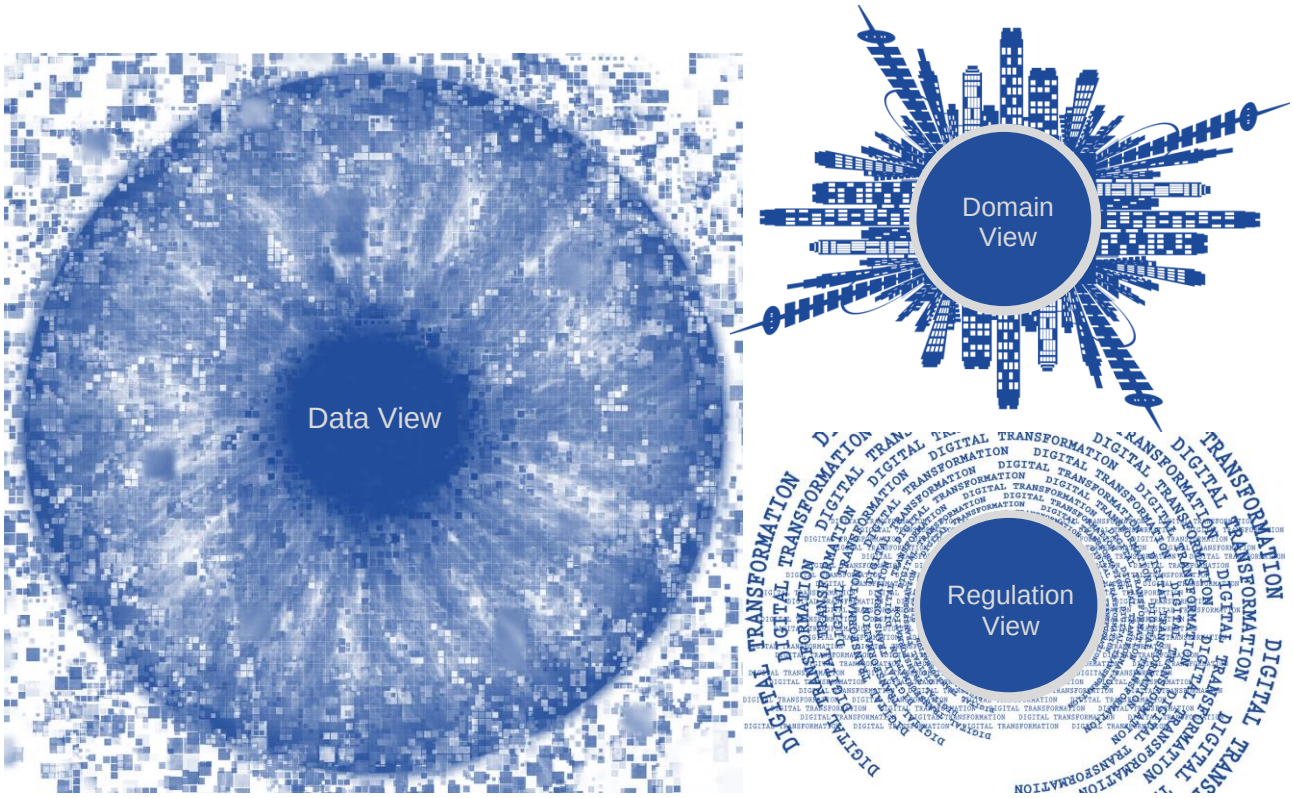
FAME offers multiple advantages, including, data sovereignty, source trust, and efficient technical integration. Its unique advantages lie in its ability to provide a secure, scalable, and efficient platform, the Federated Data Asset Marketplace, for trading and using financial data assets. In addition, with the Federative Governance model, it tends to ensure the most complete implementation of European directives and regulatory standards.

The FAME project stands as a beacon in the Financial Data Space looking at the Banking and Insurance sectors and businesses embedding financial services in their applications to provide the assets needed to create innovative solutions.

By addressing the specific needs of the financial services industry through a federated, compliant, and technologically advanced model and platform, FAME is poised to revolutionize the way data is exchanged in the digital data economy.

FAME is an EU-funded project and with other sister projects such as DATAMITE [D], PISTIS [P], UPCAST [U] has the ambition to enrich the current artifacts/implementation of Data Spaces by including the trading components already foreseen by the EU that are currently missing.

https://www.fame-horizon.eu



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Common European data spaces: "Second staff working document on data spaces " (2024)

[D] DATAMITE: https://datamite-horizon.eu/

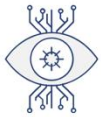
[P] PISTIS: https://www.pistis-project.eu/

[U] UPCAST: https://www.upcast-project.eu/

Single federated data marketplace platform.

Discover, Exchange and Trade Data Assets across heterogeneous data platforms and Marketplaces.

Managing Data in-line with European Values.



Learning Center (LC) for tech and non-tech users.

Transparency and Flexibility in Market-Driven Value-based Monetization.

Interconnected marketplace with more than twelve (12+) existing data marketplaces