TITAN

Transparency solutions for transforming the food system

Deliverable 3.5 – Validation of the semantic framework by pilots

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Executive Summary

This report summarizes the findings from an online survey conducted for the completion of **D3.5 – Validation of the Semantic Framework by Pilots** by the TU Delft team. The primary objective of this assessment was to gather detailed information from TITAN beneficiaries involved in the pilots concerning their user experience of the semantic framework. The responses received provide essential input designed to assess the usability, relevance, and overall effectiveness of the framework, and will directly contribute to its refinement and improvement. The data collection and subsequent analysis are integral to our WP partner INRAE's research for **D3.3 – The Framework of Ontologies and Tools to Enable FAIR Agrifood Data Exchange and Interoperability**.

From the survey analysis, the key findings indicate a diverse group of participants spanning multiple European countries and supply chain roles, with a slight majority (56%) currently using some form of semantic resources. While the document detailing the framework is generally perceived as clear and useful, adoption presents moderate to high difficulty due to challenges related to mapping existing proprietary data, a lack of internal semantic web expertise, and the necessity of organizational refactoring and staff training. Recommendations focus heavily on improving the user experience through practical guides, clearer navigation aids, sector-specific examples, and detailed implementation strategies.

This report is structured to present the survey context, profile the participants, analyse their current usage of semantic resources, evaluate the challenges of adopting the TITAN framework, and finally, detail specific feedback and recommendations regarding the framework's documentation.

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Introduction

The European Green Deal is the central strategy of the European Union to transform European society with a modern, resource-efficient and competitive economy while addressing climate and environmental challenges. The Farm to Fork strategy follows the path traced by the European Green Deal while responding to increased public awareness and the growing demand for a Food System capable of providing healthy, sustainable and affordable food. All players in the Food Value Chain are called upon to contribute to this goal thanks to recent technologies and recent discoveries in the sector. Farm to Fork aims to set a global standard that can overturn the current paradigm consisting of air, water and soil pollution, loss of biodiversity, climate change, and excessive consumption of natural resources.

For such an agrifood system to flourish, consumers must have better access to healthy, sustainable and affordable food, with transparent information about the integrity and true value of food, so that they can make the better food choices that are necessary to increase demand. Enhancing transparency is an essential element in achieving this goal. Without transparent (and preferably immutable) proof, sustainability claims run the risk of becoming hollow marketing phrases instead of useful information that all the actors in the value chain (producers, sellers, consumers) can use to make choices that align with their values.

TITAN intends to leverage transparency and digital innovations in the food sector to pursue this paradigm shift: transforming the food system into a demand-driven economy that provides consumers with healthy and sustainable food. To achieve this goal, TITAN will provide a broad platform for the development of pre-identified technologies and pilots that will be selected during the project through an open call for proposals, also by facilitating the involvement of primary and secondary stakeholders in this process, analysing current policy to set up a set of recommendations and finally setting up an inventory to identify current digital innovations and future challenges.

As one of the work packages of TITAN, *WP3 – Digital technologies* aims to create an inventory of technologies and validated approaches to overcome cross-cutting challenges for transparency. This deliverable contributes to the aims of WP3 by validating the semantic framework that could be key to improve transparency in European food systems. This step is key to the further improvement of our project partner INRAE's work on the final deliverable they will publish, D3.3. – The framework of ontologies and tools to enable FAIR Agrifood Data exchange and interoperability.

Objectives of the document

This report aims to provide valuable insight into the improvement of the Network of Semantic Resources framework developed by our project partner INRAE. As the main goal of WP3 is to explore state-of-the-art technologies and methodologies to overcome cross-cutting challenges of transparency creation in food supply chains, the identification of semantic gaps to find suitable strategies carries a significant weight. One of the best methods to reach such insights is to investigate user stories and this report aims to deliver them in collaboration with the TITAN beneficiaries involved in the pilots.

Associated Tasks

This deliverable report builds upon the work carried out by our partner INRAE in D3.2 – State of the art of available semantic resources for supporting the digital food chain and provides support for the completion of D3.3 – The framework of ontologies and tools to enable FAIR Agrifood Data exchange and interoperability, in relation to INRAE's work on T3.4 – Framework of ontologies enabling data interoperability along the supply chain.

How to read this document

This document is put together to provide valuable feedback to our project partner INRAE to further improve their semantics framework and it does not demonstrate the full picture. To develop a more comprehensive understanding, it is recommended to also read D3.3 – The framework of ontologies and tools to enable FAIR Agrifood Data exchange and interoperability, which will be delivered on M48.

1. Background and Methodology

The input provided by TITAN SMEs allows us to see the semantics gap based on real-life examples regarding the exploration of the semantic resources in use and the challenges of incorporating recommended resources, including the possibility of replacing the existing resources. It is also significant for the evaluation of the framework across critical dimensions, such as its usability, relevance, and overall effectiveness. For this, 11 SMEs were contacted, leading to nine responses. The consent of the participants is ensured with an informed consent statement embedded in the survey, and the survey questions[1] were made visible only after the consent is given. The collected data is made accessible only to the research team of TU Delft and is stored in secure institutional storage spaces. The survey data is anonymised and aggregated.

2. Results

2.1 Participant Demographics and Profile

The participants represent a diverse cross-section of beneficiaries involved in the TITAN pilots who provide technological and methodological solutions to various stakeholders in food supply chains. Their demographics span across different organizational roles, geographical locations, and involvement across the agrifood supply chain.

The roles held by the respondents within their respective companies demonstrate high-level technical and managerial involvement:

- Leadership/Executive: CEO (2 respondents), co-founder & Managing Director (1 respondent), Head of Product (1 respondent), CTO (1 respondent).
- Research and Development: R&D coordinator - Agronomist (1 respondent), RnD manager (1 respondent).
- Data/Technical Expertise: Head of Data Science department (1 respondent), Lead Data Scientist (1 respondent).

The diversity in roles, ranging from CEO and Head of Product to Lead Data Scientist and R&D Agronomist, ensures that the feedback captures strategic, technical, and operational perspectives on the semantic framework.

[1] Survey questions are listed in the Appendix.

The companies represented in the survey are based across several European countries, indicating the broad reach of the TITAN project pilots:

- Norway (1 company)
- Switzerland (1 company)
- Germany (1 company)
- Spain (2 companies)
- Greece (2 companies)
- Portugal (1 company)
- Italy (1 company)

This geographical spread is crucial, as the semantic framework aims to enable FAIR agrifood data exchange and interoperability, which requires addressing varied national contexts, regulatory requirements, and local agricultural practices.

Respondents identified various segments of the food supply chain relevant to their operations:

- The full food supply chain covering the entire flow from procurement and inventory management to commercial kitchens and consumers
- The fresh produce supply chain
- Specific crops, such as almonds
- Industry roles, such as processors, manufacturers, and packers
- General mentions of "all" stages

Notably, three respondents indicated N/A for supply chain relevance, suggesting their focus might be primarily on data governance, software architecture, or consultancy, regardless of the type of supply chain. The complexity of these supply chain interactions emphasizes the need for a robust and adaptable semantic framework.

2.2 Current Semantic Resource Use

One of the main objectives of the survey was to understand the current utilization of semantic resources among pilot beneficiaries. This baseline information provides context for the potential adoption of the framework. Out of the nine total responses, five respondents declared that they are already using some semantic resources, and four respondents are not currently using any. This balance suggests that the survey is targeting a mixed audience: some highly familiar with semantics, and others who are novices or currently rely on internal, non-standardized systems.

The five respondents who indicated they use semantic resources listed several industry standards and internal datasets:

- GS1 product data standards
- FoodEx2 classifications
- ESG reporting taxonomies (GRI/UNSDG)
- Codex
- ISO
- RASFF (Rapid Alert System for Food and Feed)
- Agrovoc
- Foodon

One company provided detailed insight into their current situation:

> *"We use semantics resources such as GS1 product data standards, FoodEx2 classifications, and ESG reporting taxonomies (GRI/UNSDG). This ensures interoperability across procurement, kitchen operations, and reporting systems."*

Other examples relate to internal pilot-specific developments, such as one pilot utilizing multilingual food lists aligned across languages, and an internal database of food facts and sustainable food categories. This internal multilingual dataset covers food, categories, topics, and subtopics, and includes unique content like jokes, riddles, and tongue-twisters for a children-oriented chatbot. Another pilot utilizes an internal database of historical allergen presence, structured records of allergen detection in product samples.

These examples demonstrate that current semantic resources in use are highly varied, encompassing widely adopted international standards (GS1, ISO), regulatory resources (Codex, RASFF), domain-specific ontologies (agrovoc, foodon), and internal proprietary datasets tailored to specific pilot needs (multilingual lists, allergen data).

2.2.1 The Use of Different Semantic Resources

The survey asked whether the currently used semantic resources are different from those presented in the framework document. Among five companies that are already using semantic resources, two of them stated that they are using the resources provided in the document, while three of them choose differently. This section is to look closer at the potential reasons for such a difference and the possibility of changing the resources they use.

When listing the different resources and explaining the decision criteria, respondents provided clarity on their preference for actionable, regulatory, or pilot-specific data. One participant detailed the use of resources driven by regulatory and practical needs rather than semantic interoperability goals:

> *"RASFF (Rapid Alert System for Food and Feed) – A practical source for real-time alerts and data on food safety incidents within the EU. I rely on this for up-to-date, actionable information on contamination or non-compliance." "Codex Alimentarius – As a foundational body of internationally recognized food standards, Codex informs regulatory alignment and ensures consistency across jurisdictions." "ISO Standards (e.g., ISO 22000) – Chosen for their structured, widely adopted frameworks for food safety management systems, which are essential in both compliance and operational integration. These resources were selected not for their semantic interoperability per se, but for their regulatory authority, practical relevance, and industry alignment."*

Another reason for utilizing different resources was rooted in necessity due to specific, uncovered requirements:

> *"Our current semantic resources are internal datasets created within the pilot, focused on multilingual food lists, sustainable food categories, and historical allergen data. These differ from the standardized, open ontologies and vocabularies recommended in the document." … "These resources were developed to meet very specific pilot requirements where no existing public or standard resources covered our exact needs."*

2.3 No Use of Semantic Resources

Four respondents elaborated on their reasons for not currently using semantic resources. The reasons cited highlight a combination of immediate technical limitations, organizational readiness, and preference for existing internal systems.

One participant noted simply:

> *"We haven't felt the need for now."*

Another is currently in the evaluation phase, indicating potential future adoption:

> *"We are currently evaluating options, so we haven't used any yet. The shared doc, the current survey, and the expected/upcoming results may help us a lot on this."*

A detailed explanation from one respondent focused on the complexity of implementing new standards versus existing processes:

"We already manage structured data (product databases, supply chain logs, lab results), which makes mapping to semantic resources technically feasible. However, much of the data is still held in spreadsheets or unstructured formats, requiring data cleaning and harmonization before any semantic layer can be applied. The company does not have in-house semantic web expertise, which means implementing ontologies, would require external technical input. While external partnerships (with research groups, consultants, or EU-funded digital projects) could support this transition, adopting semantic resources is not currently a top priority for the company."

A focus on local relevance and existing user familiarity also serves as a strong barrier to entry for standardized resources:

"We currently use our own semantic resources that are tailored to the Italian agricultural context and are more comprehensible to our national users. While we recognize the value of standardized semantic resources for interoperability, replacing our existing system would require significant technical effort and could potentially confuse our user base who are accustomed to Italian terminology and classifications. Our current resources are deeply integrated into our platform and workflow processes."

These responses underscore that non-adoption is often tied not only to technical effort but also to organizational investment, required expertise, and the necessity of maintaining usability and familiarity for specific national user bases.

2.4 Perceived Difficulty of Framework Adoption

The difficulty level associated with adopting the semantic resources framework varied, with a general trend towards moderate to high. Based on the detailed responses, some main themes were identified that would provide more insight into the context.

2.4.1 Context Related to Implementation, Expertise, and Infrastructure:

One respondent noted the necessity of architectural changes:

"The level of difficulty would be medium. At the current stage of our project, adopting the semantic resources would require a welcome refactoring and adaptation of our architecture and database to align with the mentioned ontologies. While this involves effort, it is feasible and would bring long-term benefits in terms of interoperability and data consistency. The analysis for short-term adoption, e.g., by knowing further ontologies from GS1, is a current task at our end, and this document comes at the proper timing."

The complexity of transitioning proprietary systems was cited in relation to data mapping and training:

"Moderately difficult because it would require mapping our current databases to external ontologies, adapting internal workflows and tools, training teams on new standards, and addressing content gaps."

For one company, the transition is predicated on internal changes regarding organisational readiness and expertise:

"As elaborated in the previous section for the moment our company is not organizationally ready to support the adoption of semantic resources. A great effort towards this direction is made through TITAN project, where collaboration with another company led to the development of a traceability platform (FOODAKAI) that could be the beginning for our company to adopt the use of semantic resources in the near future, however this will require recruiting and all the proper experts."

Another noted the specialized knowledge required, which results in a steep learning curve:

"Level of Difficulty: Moderate to High. These ontologies require familiarity with RDF, SPARQL, and knowledge graph modelling. For a consultancy primarily focused on regulatory guidance, this represents a steep learning curve and would likely require collaboration with data engineers or semantic web specialists."

One participant felt the adoption would be manageable due to existing alignments:

"Adoption would be manageable, as many of the recommended resources (GS1, ESG/SDG taxonomies) are already aligned with our current practices. The main challenge would be mapping existing internal data structures to some of the more specialized ontologies, which may require additional integration and staff training."

2.4.2 Context Related to Documentation and Decision-Making

The volume and complexity of the resources presented in the framework was mentioned by a participant in relation to the perceived ambiguity and need for further guidance:

"Some we weren't even able to open and visualize. The biggest undertaking would be to actually look at all of them and understand which one apply to our specific use cases and then interpret potential ambiguities and overlaps between the various ontologies. Then we'd have to implement them in our software, and that would force us to change a number of processes to accommodate them."

By one participant, the adoption was seen as challenging if it requires significant user input:

"The main difficulty is to know the rules to use for each semantic: when and how it should be done. Our product focuses on usability, and it is important the user does not have to think much. Using a specific semantic will require from the user to take a "good decision" and most of the time, he/she does not have neither the knowledge nor the time to do a good guess."

One participant was concerned about losing the nuance regarding national specificity:

"Adopting these semantic resources would be quite challenging for us. It would require substantial technical development to map our existing data structures to the new ontologies, retrain our users on new terminology, and potentially lose some domain-specific nuances that are important for Italian agriculture. The migration process would be time-consuming and costly, requiring careful planning to maintain service continuity while ensuring data integrity during the transition."

In summary, adoption difficulty stems from the requirement for specialized expertise (RDF, SPARQL, semantic web specialists), the large effort required for data migration and refactoring, the potential for loss of local specificity, and the current lack of clear prioritization or practical implementation guidelines within the framework.

2.5 Feedback on Document Structure and Clarity

2.5.1 Ease of Navigation and Structure

The overall structure of the document received positive feedback in general. One participant simply noted:

"The diagram and categorization are helpful for understanding the scope."

Another participant mentioned the clarity of the document:

"The document is well-structured, with a clear division of semantic resources and their respective areas of application."

One participant expressed their contentment of the organizational clarity for their specific needs, especially regarding the production stage:

"In our context, where we work with blockchain-based services, the way the document separates responsibilities between data and software is helpful. This organization makes it easier to identify which resources are most relevant to our needs." … "well-organized with clear categorization (NAMING, CROPS, ANIMAL PRODUCTS, etc.)"

Despite the structural clarity, some participants pointed out the areas of improvement for the document navigation. For example, a participant operating across different supply chain stages mentioned a need for faster navigation with cross-referencing:

> *"The document is fairly well structured, with clear categorization by supply chain stage. However, for companies like ours that work across procurement, kitchens, and guests, cross-references or quick filters by use-case (e.g., 'hospitality operations') would make navigation even faster."*

Another comment on the navigation was as follows:

> *"The document is well-structured conceptually grouping semantic resources by supply chain phases (Production, Transformation, Distribution, etc.) is helpful. Despite the clickable diagram, actual navigation feels nonlinear and somewhat fragmented."*

The same participant also identified gaps in contextual guidance:

> *"Critical context or definitions are dispersed, and linking between related ontologies is minimal. Also, there's no prioritization or use-case alignment—i.e., no guidance on which ontology suits SMEs vs. multinationals, or which are mature vs. experimental."*

One response mentioned the granularity of the sections:

> *"It could benefit from more detailed descriptions of each resource's specific use cases and how they relate to different agricultural contexts. The clickable diagram is helpful, though some sections could use more granular subsections for easier navigation."*

One key piece of advice was to provide practical onboarding assistance:

> *"You should add a practical guide on how to approach and use the downloadable files."*

Overall, the structural effort was appreciated (categorization by supply chain stages), but the implementation requires more user-centric pathways, context, and practical alignment.

2.5.2 Clarity of Purpose and Application

Respondents generally affirmed that the document clearly articulated its purpose, focusing on interoperability, traceability, and standardization goals.

One participant responded:

> *"Yes, the explanation is clear. The purpose of enabling interoperability, traceability, and ESG alignment across the food supply chain is well communicated."*

Another participant summarised:

> *"It is very clear that the goal of the document is to recommend a network of shared semantic resources for agricultural and food supply chains. Its purpose was to create a guidance and reference document to show why semantic resources matter and how they can be deployed."*

The foundational benefits are also considered well-explained:

> *"The purpose is clearly stated and the benefits are well articulated, particularly regarding interoperability and traceability. The introduction effectively explains the standardization goals and potential advantages."*

While the purpose of the document is clear, how it can be applied to practice needs refinement, particularly for operational users:

> *"The explanation of the document's purpose is conceptually clear, but its application narrative could be improved. For a food safety consultancy, the application layer needs more operational translation."*

Another participant requested more concrete examples:

> *"More real-world industry-specific examples (e.g., hospitality or retail) could make the application even more relatable."*

The document is appreciated for balancing theory and application by providing examples of which ontologies can be applied in specific scenarios. However, there is uncertainty about the variety presented:

> *"The document not only presents standard models but also provides concrete examples of which ontologies and vocabularies can be applied in each scenario. This balance between theory and application makes the purpose very clear. We see the variety of sources as a positive input. However, we are unsure whether some kind of filtering would be helpful or not in terms of focusing. I.e., would that limit the scope or bring different options/views?"*

A key missing element identified relates to organizations already using existing resources:

"The document could better address the practical challenges and transition strategies for organizations already using existing semantic resources. More guidance on migration paths and compatibility assessments would be valuable."

2.5.3 Evaluation of the "Applications & Benefits" Section

All respondents agreed on retaining the Applications & Benefits section, and some suggested possible extensions. One participant highlighted this section's importance on translating technical concepts into actionable business value:

"The Applications & Benefits section is very useful and should be kept. It clearly links the technical resources to practical outcomes such as interoperability, traceability, and ESG reporting. For companies, this helps translate abstract ontologies into business value."

Another view was highlighting its importance on providing necessary context for deployment:

"It is essential part to know the different alternatives at the time of implementation. This is the purpose of the document."

One participant found this section helpful to understand its practical utility and from an educational perspective:

"It is useful, and I think it should be kept in the document because it explains the practical value of the semantic resources." … "For us, most of the examples exposed in that section were unknown. And now, we can already know which ones can make (more or any) sense to our application."

Another participant highlighted the benefit of separating different professional roles:

"This section should definitely be kept as it provides concrete value propositions for different stakeholder types. The separation between Software Engineers and Data Managers perspectives is particularly useful as it addresses different concerns and use cases."

Some suggestions for improvement were also identified for this section. For instance, one participant highlighted the need for more context to address technical fluency gaps:

"The section assumes a certain technical fluency. For example, terms like "SPARQL" or "linked data" are used without contextual explanation."

While one participant expressed interest in expanding the document with more concrete examples, another participant recommended adding a shorter summary version detailing "key benefits by stakeholder type", for instance, could enhance its impact. Similarly, one participant mentioned:

> *"It could be enhanced by including more specific examples and perhaps adding a section for business decision-makers who need to understand ROI and implementation costs."*

2.5.4 Evaluation of the "Simplified Use Case" Section

The Simplified Use Case section was also deemed highly useful and should be retained and expanded.

> *"It is useful and should be kept. The use case makes the resources easier to understand in a real-world context and shows how different ontologies can be applied together."*

One participant considered the use case as the bridge between abstract ontologies and practical deployment:

> *"The use case section is very valuable and should be retained. The organic strawberry example effectively demonstrates how multiple semantic resources work together in a real-world scenario. It helps bridge the gap between abstract ontology concepts and practical implementation."*

Regarding the expansion of the examples, one participant mentioned the possibility of generalisability through induction:

> *"Very useful, should be kept and expanded with more examples to see what generalizes across different supply chains and what doesn't."*

Similarly, it was also recommended to expand examples across different sectors:

> *"To make it even stronger, additional examples for different sectors (e.g., hospitality, retail) would broaden relevance beyond agriculture."*

Including different perspectives on the same case was also mentioned to illustrate versatility:

> *"What could be added for companies like ours: include a second use case from another angle – e.g., regulatory reporting or multi-country supply chains—to illustrate versatility."*

One participant recommended including a step-by-step guideline and offered support for the development of new use cases:

> *"It could be improved by including simulated datasets or more concrete examples that show how*

the semantic resources are actually applied step by step. We would be happy to help with a simplified use case for the almond crop tracing, with the carbon footprint calculation/registration at each step of its supply chain."

Greater inclusion of specific standards were also mentioned:

"GS1 Web Vocabulary should be involved also at production level as you need to create the digital object with a standardized naming. It should be kept and maybe as an Annex."

2.5.5 Format Change for Use Case Navigation

The survey asked if the format of the Simplified Use Case should be changed to reflect how users would navigate the document to find relevant resources. Responses were mixed but leaned towards enhancing the navigational linkage. One participant recommended developing pathways guided by the user's role or use case:

"A format that starts with the industry role (e.g., producer, distributor, hospitality operator) and then guides the reader through relevant resources would be helpful. This would better mirror how companies search for applicable solutions in practice."

Another opinion supporting format change is as follows:

"Reformatting the use case to mirror the document navigation would be helpful. It could show step-by-step how a user would move through the diagram sections to find relevant resources for their specific scenario."

One strategy proposed maintaining the narrative while adding navigational aids:

"Keep the original narrative intact but add a parallel navigational path—perhaps as a sidebar or clickable appendix—showing exactly how to trace the use case through the document. This dual approach would support both conceptual understanding and practical execution."

Nevertheless, some participants felt the current format was sufficient:

"No, I think it was very user friendly."

Another example:

"I feel that it is sufficiently clear right now and it is not necessary to change the format."

However, even those satisfied suggested improvement points:

"We would not change the structure itself, but would enrich it with simulated examples, so that users can better visualize the path from the use case to the corresponding resources."

A clear request on how to improve the user experience was:

"You could link the names of the ontologies to their actual websites. Right now, one has to go up and down the document."

2.6 Recommendations and Suggested Improvements

Based on the feedback gathered regarding navigation, clarity, and implementation challenges, respondents offered extensive suggestions for making the document more logical, user-friendly, and actionable.

2.6.1 Enhancing Navigation and Access

Several suggestions targeted improving the user interface and structural access to information. Some participants suggested more use of visualisation for clearer onboarding:

"The content is strong, but the user experience could benefit from clearer pathways, visuals, and contextual onboarding."

One participant provided insight on improving the searchability as well as creating sector-specific pathways:

"Adding a searchable index, visual flow diagrams linking resources to supply chain stages, and sector-specific pathways (e.g., hospitality, retail, logistics) would make the document more intuitive. A short summary table of 'must-know' resources for each sector would also be valuable for quick reference."

The presence of non-functional elements caused confusion, and it needs to be addressed in the final version of the framework:

"I don't understand the purpose of the cards without any ontologies in them."

Further clarification on the target audience was also mentioned:

"Probably it could be useful to clarify the targeted audience and perhaps explain a bit more the ontologies in order not to overwhelm readers who aren't already experts."

One participant recommended adding an annex for quick referencing:

"Maybe it could be helpful to add an annex listing each mentioned resource along a brief description of its content and purpose. In this way we could quickly determine whether a resource fits our needs, without having to access and review each one individually."

Improving decision-support for the users was among the recommendations:

"Consider adding a decision tree or wizard-style guide to help users identify relevant resources based on their specific needs."

2.6.2 Improving Practical Content and Implementation Guidance

A significant portion of the recommendations focused on making the document more practical and operational:

"Including a few worked examples with simulated data would make the document more practical and user-friendly. For instance, tables showing how data would be represented using the recommended ontologies and standards would help bridge the gap between theory and implementation."

Another participant recommended detailing the resource descriptions and developing migration strategies that includes multi-language support:

"Include more detailed resource descriptions with implementation examples and compatibility information. Add a migration guide section for organizations with existing systems. Consider providing resources in multiple languages or with national adaptations to increase adoption in different regions, as terminology and agricultural practices can vary significantly across countries."

Adding an annex was mentioned in relation to this section as well:

"Put practical information into an Annex."

2.6.3 Technical Deep Dive

One participant provided technical detail regarding their current workflow, suggesting areas for potential intersection with the semantic framework:

"We have been using Finite State Machines (FSMs), based on the pytransitions library, to trace the product lots (aka batches) throughout the supply chains, represented by "flows", with eventual splitting or aggregation of such lots at each state (e.g., "cleaning", "processing"). Note: edges generally represent transportation."

3. Conclusion

This report, compiled from the nine responses received to the survey, serves as the foundational input for D3.5 – Validation of the Semantic Framework by Pilots and supports our project partner INRAE's future research for D3.3 – The Framework of Ontologies and Tools to Enable FAIR Agrifood Data Exchange and Interoperability. The aim of the survey is to assess the framework's usability, relevance, and overall effectiveness, and the results confirm it was successfully achieved.

The participants of the survey are highly relevant, encompassing key decision-makers and technical experts across diverse supply chains and countries (Norway, Switzerland, Germany, Spain, Greece, Portugal, Italy). The results indicate a generally positive perception of the document's purpose and structure, especially the crucial Applications & Benefits and Simplified Use Case sections, which were unanimously recommended for retention and expansion.

However, the path to adoption is marked by significant friction, categorized as moderate to high difficulty. Major challenges revolve around the requirement for specialized semantic web expertise (RDF, SPARQL, Knowledge Graph modeling), the organizational effort needed for large-scale data mapping and process change, and the need to preserve existing proprietary data and national nuances (such as those specific to Italian agriculture or specialized content for pilot projects). The finding that current resource usage often prioritizes regulatory authority, practical relevance, and industry alignment (e.g., RASFF, Codex, ISO) over pure semantic interoperability goals is significant.

To ensure the framework's refinement and improvement, future efforts need to address the identified improvement areas in documentation clarity, primarily by providing:

- Practical, sector-specific navigational aids and decision trees.
- Detailed implementation guidance, including migration paths for existing systems and worked examples with simulated data.
- Contextual explanations for technical terms (e.g., SPARQL, linked data) and clearer definition of the target audience.

This report represents a summarised evaluation of the anonymized and aggregated data generated from the survey to be made publicly accessible via the European Commission portal and the TITAN project website. Alse anonymised and aggregated but more detailed version with extensive list of examples will be made available to INRAE to contribute to their research. Valuable insights provided by the beneficiaries will directly inform the optimization of the semantic framework, moving towards achieving effective FAIR Agrifood Data Exchange and Interoperability across the EU.

Appendix

Survey questions:'

1) What is the name of your company?
2) What is your role in your company?
3) In which country is your company based?
4) Which food supply chains are relevant to your company? (If not applicable, type N/A.)
5) Are you using any semantics resources?
6) Please explain why you don't use any semantics resources.
7) Please list the semantics resources you use.
8) Are the semantic resources you currently use different from the ones presented in this document?
9) Please list the different semantic resources you use and explain what made you decide on those instead.
10) Would you consider adopting the semantic resources suggested in this document instead of those? Please explain why/why not.
11) How difficult would it be for you to adopt the semantic resources presented in this document? Please elaborate.
12) Is it easy to navigate the document and locate relevant semantic resources for your company? Please elaborate.
13) Is the explanation clear regarding the purpose and the application of the document? Please elaborate.
14) Do you think the Applications & Benefits section is useful? Should it be kept in or removed from the document? Please elaborate.
15) Do you think the Simplified Use Case section is useful? Should it be kept in or removed from the document? Please elaborate.
16) Should we change the format of the Simplified Use Case to reflect how you would navigate through the document to reach the relevant resources? Please explain why/why not.
17) Do you have suggestions for making the document more logical or user-friendly? Please elaborate.