Deliverable D500.4.2

Recommendations for new or updated standards

WP500

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The FIspace Project

Leveraging on outcomes of two complementary Phase 1 use case projects (FInest & SmartAgriFood), aim of FIspace is to pioneer towards fundamental changes on how collaborative business networks will work in future. FIspace will develop a multi-domain Business Collaboration Space (short: FIspace) that employs FI technologies for enabling seamless collaboration in open, cross-organizational business networks, establish eight working Experimentation Sites in Europe where Pilot Applications are tested in Early Trials for Agri-Food, Transport & Logistics and prepare for industrial uptake by engaging with players & associations from relevant industry sectors and IT industry.

Project Summary

As a use case project in Phase 2 of the FI PPP, FIspace aims at developing and validating novel Future-Internet-enabled solutions to address the pressing challenges arising in collaborative business networks, focussing on use cases from the Agri-Food, Transport and Logistics industries. FIspace will focus on exploiting, incorporating and validating the Generic Enablers provided by the FI PPP Core Platform with the aim of realising an extensible collaboration service for business networks together with a set of innovative test applications that allow for radical improvements in how networked businesses can work in the future. Those solutions will be demonstrated and tested through early trials on experimentation sites across Europe. The project results will be open to the FI PPP program and the general public, and the pro-active engagement of larger user communities and external solution providers will foster innovation and industrial uptake planned for Phase 3 of the FI PPP.

Project Consortium

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- KocSistem; Turkey
- Aston University; United Kingdom
- ENoLL; Belgium
- KTBL; Germany
- NKUA; Greece
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Dissemination Level

PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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Document Summary

This document summarizes the recommendations made as result of the Sub-Task 542 “Recommendations, collaboration and dissemination”. The use of standards in each trial has been evaluated with a focus on how products, business partners and locations are identified. Based on the gap analysis, recommendations for future work were made. As a conclusion, open standards, a focus of interoperability and the implementation of Linked Open Data are recommended.

Abbreviations

AEF	Agricultural Electronics Foundation
API	Application Programming Interface
App	Software Application
AS2	Applicability Statement 2 (a data transport specification)
D	Deliverable
DOOR	Database of Origin and Registration
DoW	Description of Work
EC	European Commission
e.g.	Exempli gratia = for example
ELS	Electronic Logistic Status
EPB	Electronic Packing List
EPCIS	Electronic Product Code Information Services
ERP	Enterprise resource planning
ETO	Electronic Transport Order
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FIA	Future Internet Assembly
FI PPP	Future Internet Public Private Partnership
FMIS	Farm Management Information Systems
FP7	Framework Programme 7
GA	Grant Agreement
GRAI	Global Returnable Asset Identifier
GDSN	Global Data Synchronisation Network
GML	Geography Markup Language
GPC	Global Product Classification
GLN	Global Location Number
GTIN	Global Trade Item Number
HI-Tier	Herkunftssicherungs- und Informationssystem für Tiere (German), Identification and Information System for Animals
HTTP	Hypertext Transfer Protocol
ICT	Information and Communication Technology
i.e.	id est = that is to say
IP	Intellectual Property
IPR	Intellectual Property Rights
JAXB	Java Architecture for XML Binding
JSON	JavaScript Object Notation
KPI	Key Performance Indicator
M	Month
OGC	Open Geospatial Consortium
PDO	Protected Designation of Origin
PGI	Protected Geographical Indication
RDF	Resource Description Framework
RFID	Radio-Frequency Identification
RTD	Research and Technological Development
RTI	Returnable Transport Item
SDK	Software Development Kit
SGLN	Serialised GLN
SGTIN	Serialised GTIN
SME	Small and Medium Sized Enterprise
SOAP	Simple Object Access Protocol
SPARQL	SPARQL Protocol and RDF Query Language
SSCC	Serial Shipping Container Code
ST	Sub-Task
T	Task
TSG	Traditional specialities guaranteed
URL	Uniform resource locator
VBN	Vereniging van Bloemenveilingen in Nederland (Dutch), Dutch Flower Auctions Association
VVVO	Europäische Viehverkehrsordnung (German), European Livestock Movement Order
WP	Work Package
XML	Extensible Markup Language

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1 Introduction

1.1 Purpose and content

This document covers Deliverable D500.4.2 “Recommendations for new or updated Standards”. Therefore it is a report with a formulation of proposals towards developments in standards. It is one of three deliverables describing the outcome of Task 540: “Standardization”, which aims to ensure standards are used throughout the FIspace project and to identify where standards need to be modified or extended. The other deliverables are

- D500.4.1 Guidelines to use of Standards in FIspace (available since M3), which provided a review of the relevant standards.
- D500.4.3 Activities and results of the validation with other standardisation organisations and relevant networks (due in M24)

The focus of this document is on the results of Sub-Task 542 “Recommendations, collaboration and dissemination” which examined whether additional standards and specifications will be required for the implementation and roll-out of FIspace. Outputs from the individual trials were collected to identify requirements for changes and improvements in existing standards.
This document is also a follow-up of Deliverable D 600.2 “Plan for standardisation for large scale experimentation” of the Phase I project SmartAgriFood. The recommendations made in the earlier document are addressed also in this document.
The first part of this document evaluates how standards are used in each trial.
There are eight use case trials (subtasks = ST), organized along three themes:

- T 420 Farming in the Cloud
    - ST 421 Crop protection Information Sharing
    - ST 422 Greenhouse Management & Control
- T 430 Intelligent Perishable Goods Logistics
    - ST 431 Fish Distribution (Re)Planning
    - ST 432 Fresh Fruit & Vegetables Quality Assurance
    - ST 433 Flowers & Plants Chain Monitoring
- T440 Smart Distribution and Consumption
    - ST 441 Meat Information Provenance
    - ST 442 Import and Export of Consumer Goods
    - ST 443 Tailored Information for Consumers

In the next part, gaps are analysed and recommendations for further work are made, which will lead to an improvement of standards in practical use. Finally, more general recommendations for the use of standards are made.

1.2 Approach to standardisation process

The basis of this document is the use of data standards in the trials and their needs for formats and protocols to exchange data. In order to collect the input from the trials and to learn about their experiences, a questionnaire was sent to all trial leads or the responsible technical contact.

Table 1: Structure of questionnaire

ID	Question
1.	Do you have any questions or comments on D500.4.1 Guidelines for the use of Standards in FIspace?
2.	Please give us access to the API or documentation of your trial or point us to it on OwnCloud (xml schema, or even code, etc.).
3.	Are you planning to use the baseline apps developed by WP 450?
4.	Are you using any standards in designing your API or naming data field (If yes which ones)?

5.	Are you using any identifiers for product batches or individual items? If so what is the system?
6.	How are you identifying business partners and locations in your API?
7.	Are there any issues regarding access to information on standards?
8.	Did you experience any problems referring to standards or specifications?

Based on the outcome of this questionnaire, gaps where no standards exist were identified and possible solutions to fill these gaps were analysed. Additionally, ad hoc-solutions which were realised during the trial implementation led to proposals for new standards. The analysis focused on the trials related to agriculture and the food chain. This focus is caused mainly by the availabilty of expert on this domain.

2 Use of standards in the trials

This chapter summarizes the results of a questionnaire, which has been issued to all trials.

2.1 Comments on D500.4.1 “Guidelines for the use of standards in FIspace”

In general, these guidelines are accepted, and the trial partners plan to use related e-business, identification and communication standards whenever possible.

The trial on Transparency in the Meat Supply Chain (Meat Information on Provenance, MIP) for instance is based on the EPCIS Standard cited in D500.4.1 with its new features Instance/Lot Master Data and Transformation Event. This enables all business partners involved to refer to individual items as well as to groups of items with the same parameter values like the same lot number. Identification of locations and parties with a (Serialized) Global Location Number (SGLN) and Products (SGTIN), including medicine identification in case an animal has been treated with it, build the unique reference to Products, Parties and Locations. The VVVO Number (Cattle Identification System) is inherently part of the GLN and country of origin and can be derived on demand. It is worth mentioning that also living animals are identified by their unique SGTIN.

In the Flower and Plant supply chain worldwide growers, auctions, traders (importers, exporters and their customers), carriers and governmental organizations are using the Floricode (semantic) standards that partly consists of GS1 Standards cited in D500.4.1. The participants in Flowers and Plants Supply Chain Monitoring trial are also using these standards in their (ERP) applications. New functionality that will be developed within this trial needs to connect to these existing standards and systems to ensure the usefulness of the trial in practice. For this trial project Floricode is developing and improving the standard messages to support the logistic processes in the supply chain. Together with GS1 Netherlands a recommendation for the labelling of the logistic units (trolleys) based on the use of the SSCC coding is under development. This might lead into requests for improving the GS1 Standards globally accordingly.

According to the Fresh Fruit & Vegetables Quality Assurance the enumerated standards on master data and master data communication are not explained as explicitly as needed for the trial app development. Additional sources such as the standards themselves must be referred to.

2.2 Use of identifiers

For each trial, the use of identifiers is described in Table 2. The second column describes how the data fields are structured and relates to the standards used for this. The third column gives the standards or data formats for the product itself, the last column those for the business partners involved in the relevant supply chain.

Table 2: Identifiers and standards used in each trial

Trial	Standards in designing the API or naming data field	Product batches / individual items	Business partners and locations
ST 421 Crop Protection	drmCrop	Global Unique Identifier (GUID), based on ISO15459.	Business Partners are identified by the GUID.

Information Sharing		Structure and definition of that identifier in the package DataTypes of drmCrop and the corresponding xsd schema for datatypes.	Business Partner's will be a Party in the drmCrop reference model and can either be a person or an organization. The latter can be a "father" organization (for example Holding) of "children" (for example departments). A Party has a GUID, so the business partner is identified by the GUID.
ST 422 Greenhouse Management and Control	drmCrop	URI based identifiers with following setup: [Issuing agency]/[enterprise id]/[Item type]/[item id] For example for a CropField this could be: ANL/12345678/CFD/1234	Same as Crop Protection Information Sharing
ST 431 Fish Distribution and (Re-) Planning	Data model for bookings derived from the stakeholder's Softship installation Data exchange between legacy applications and CargoSwApp by Excel files	Global Unique Identifier (GUID)	Business Partners are identified by GUID. Locations are encoded in longitude and latitude by decimal degrees. Ports are identified by their port codes.
ST 432 Fresh Fruit and Vegetables Quality Assurance	Pilot Implementation Guide for Masterdata in the Fruit and Vegetable Business, provided by GS1 Other standards for identifying the deliveries in PIA	GTIN for identifying type of box in Europool app, GRAI for individual boxes. GLIN and Global Gap numbers for identifying farmer (not everyone has both). There is also company identification number from Ministries for agriculture e.g. DPA in Netherlands for fruit companies, etc.	Cf. Product batches / individual items
ST 433 Flowers and Plants Supply Chain Monitoring	Partners (e.g. growers) are identified via GLN, products (plants) via GTIN, trolleys via GRAI and logistic units (based on lots) via SSCC. EPC will also be used since events are planned to be communicated via EPCIS compatible interfaces.	In data communication in our supply chain the VBN article numbering system is the leading standard worldwide for product identification in the sense of classification. For certain types of products (garden plants) the use of GTINs starts to develop, although customers (like retail and garden centres) are not often demanding this code type up until now. With the new GTIN guide and the GPC for Plants and Flowers in place a rise in the demand	GLN for partner and location identification

		of the unique GTIN is expected.	
ST 441 Meat Information Provenance	EPCIS is used to capture and retrieve event data within the meat supply chain. Partners are identified via (S)GLN and products via (S)GTIN. EPC is used to communicate all events via EPCIS. Additional references and terms will be based on GDD explanations and definitions.	GS1 article numbering schemes: GLN and GTIN for master data, LGTIN /SGTIN (Serialized GTIN) and SGLN for event related data. VVVO number as basis for capture of birth events.	GS1 partner and location numbering schemes: GLN for partner identification, SGLN for more granularity such as read point identification.
ST 442 Import and Export of Consumer Goods	Data model for transport demand web app and the shipment status mo-bile app derived from the LPA Solution in order to ensure the integration between these modules Data exchange between legacy applications (SAP Extraction – Order item inputs for the transport Demand) and Transport Demand Web Application by Excel files	Global Unique Identifier (GUID), based on ISO15459.	The Business Entities are identified by GUID standard. In the Shipment Status Mobile App and in the Manual Event & Deviation Reporting App the checkpoint details associated to location data are encoded in longitude and latitude by decimal degrees. Receiver, Sender, Item are identified by codes provided by SAP system. Pick Up and delivery location (Ports details) are identified by their codes.
ST 443 Tailored Information for Consumers	Partners are identified via GLN and products via GTIN. EPC will be used for identifying products and/or batches (events) and will be communicated via EPCIS compatible interfaces (mainly mobile phones). Product data structure is built on xml and data field names are based on GDSN from GS1.	For packed non-fresh products: GTIN, for fresh products (vegetables, fruit, daily products, etc): internal EPCIS.	GLN for partner and location identification

2.3 Problems concerning the use of standards or access to standards

In general, the trial partners had little or no issues regarding access to information on standards. Software developers seem to be familiar with the standards relevant to their field. However ST 431 the trial “Fish

Distribution and (Re-)Planning” reports a lack of information from from the baseline apps and the platformon the standards used by them.

Regarding the use of standards, the trial developers reported a number of issues, such as lacking continuity and compatibility and cross-sectorial differences. In detail, the following gaps were identified:

- ISO11783 deviates from OGC/gml, gives wrong interpretation of some Time types and is (too) abstract on some aspects. Corrections or improvements are rejected for reasons of backward compatibility.
- Within OGC; gml and ISO19123 are not in line. Gml uses identical names for some complex elements, resulting in errors by JAXB compilers, which must be overcome by special binding files.
- Issue of the data exchange of actual data of temperature, humidity and radiation measured with intelligent RFID chips on locations and during transport to be able to combine these data with scanning data. The Plants and Flowers Trial (ST 433) requires the capture of ambient data like temperature or humidity. EPCIS serves as a basis for the trial. But since ambient data are not event related they were not in the development of EPCIS focus so far. A general approach to solve this issue was developed within the trial (see 3.3).
- Registration numbers demanded by authorities like the German VVVO Number for the identification of farms or the ear tag number should be aligned with identification schemes relevant for B2B or B2C business. In the Meat Information on Transparency Trial (MIP, ST 441) an approach towards an integration of the ear tag number into the GTIN has been developed (see 3.5).
- No standard for the description of Geographical indications and traditional specialities (see 3.4)

3 FIspace initiatives impacting standardisation

3.1 Arable farming

Technically, it is possible to capture a considerable amount of data already on-farm in primary production using either stationary sensor devices, logging facilities on mobile agricultural equipment or data captured by mobile phones. However, only part of this data can be turned into useful information in the business context, mostly due to lack of interfaces that are extensible and flexible enough to accommodate individual user’s needs and environment and to allow for merging a number of data sources. Evaluation and data interpretation logic building upon that infrastructure fails in that it can often only cover specific use cases and misses important information that would be relevant for adequate decision support in a heterogeneous environment.

3.1.1 Developments in and demand from industry

In parallel to the activities within the FIspace project, companies within the agricultural industry and machinery construction sector and farm management information system providers alike have realized the potential that lies in integration of existing data sources, capturing and evaluation of mass data and provision of service networks and frameworks, that allow users to flexibly combine modules and/or apps to an ecosystem tailored to their needs.

Apart from FIspace, several initiatives worldwide have therefore started out to develop and provide cloud FMISes, data capturing and distribution platforms like telemetry systems or web based open sensor networks for e. g. weather data and modular app frameworks including SDKs for partners to implement their own modules. There is however also a growing awareness, that farmers’ needs can only be satisfied by networking several systems. As a consequence, an increasing number of system providers have started to provide APIs. Currently, a number of solutions are built using ReSTful web services (REST: a set of architectural principles for web services, e.g. use of the HTTP methods POST and GET) and JSON as a serialization format, however there are also approaches that lean towards different technologies for a number of reasons, e. g. using POST against a single service URL or using other serialization formats like XML or more efficient binary encodings. Especially within the agricultural machinery sector, there is also considerable effort to enable the most important existing standard for tractor-implement communication, the ISOBUS (ISO 11783) for internet based communication and to reuse experience and components created there.

None of the publicly available specifications in production services currently uses semantic technologies in the strict sense of the word (which would mean e. g. basing the APIs on an open lightweight, graph-oriented agricultural knowledge model and auto-generating interfaces based on that semantic network). Although matters regarding ease of exchanging data and networking between different systems have improved considerably, real data integration, mapping data content between different systems' interpretations and creating holistic data views in interfaces for the users still requires a considerable amount of bilateral discussions, agreements and engineering and programming efforts.

3.1.2 Existing Approaches

3.1.2.1 API Standardization/Recommendation Efforts

ISO 11783 and 16867: Currently, within ISO SC19 WG5, standardization efforts are conducted on a component called the agricultural activity server, which should enable providing planned- and capturing realized working tasks, collecting sensor data from agricultural fields and in the future also information on grazing animals at a central entity for requests and distribution.

Agricultural Electronics Foundation (AEF): The AEF is an association consisting mainly of representatives from agricultural machinery industry and management and control software systems and electronics providers. It maintains a project group (PG9) dealing with farm management system issues and is currently working on interfaces to enable cloud based systems to interact with mobile farm equipment. By member overlap, there is a direct relation to the ISO 11783 committees, i. e. approaches developed in AEF are for the parts, for which it makes sense, likely to be carried on into the ISO. Some partners in FIspace are also members of the AEF. Based on demand and requirements, specifications from FIspace may be discussed, improved and – depending on outcome – standardized via ISO through this path.

AgGateway: AgGateway is an US American association defining its role mainly in recommending existing standards to use to facilitate business communication in agriculture but also to a certain degree conducting pilot projects to draft new solutions. Together with John Deere, AgGateway is currently working on the ADAPT APIs (see e. g. http://infoag.org/abstract_papers/papers/paper_257.pdf). There are a number of sound concepts developed within these projects like e. g. ISOBUS XML to JSON conversion rules for webservice operation. On the other hand approaches also seem to differ from the paths taken in Europe, e. g. with regard to using the AEMP telematics protocol that plays no significant role in agricultural telematics systems in Europe. Also, there is a certain overlap in members of AgGateway and AEF, thus facilitating exchange between these organizations.

OpenAg Data Alliance: The Open Ag data alliance is a relatively new organization (activities can be tracked roughly until mid 2014) founded in the US, also promising to provide agricultural APIs. Members seem to be mainly agricultural software and data providers but also including industry players like Monsanto.

EDI-Teelt version 4: AgroConnect is responsible for standardisation of agricultural information exchange in the Netherlands. These standards are based on SOAP web services using XML elements. For crop production these elements are based on a common reference data model drmCrop. At this moment web services are defined for: Cropping schemes, Advice, Laboratory results and Crop production specification.

3.1.2.2 APIs provided by companies

Here, only some of the most notable and publicly visible efforts are described with no claim for completeness nor endorsement for or against a specific implementation. Activities include the ones conducted by John Deere in the US around the myjohndeere.com platform and in Europe around the 365farmnet.com platform. Both provide API interfaces and specifications or parts/drafts thereof have been circulated among people involved in standardization in AEF or AgGateway. Implementations are based on ReSTful web services to be called via HTTP.

3.1.2.3 Agricultural Knowledge Models

Already more than a decade ago, farm management system providers discussed potentials of a common data exchange format accompanied by a flexible, extensible knowledge model, an ontology of agriculture. These activities resulted in agroXML being developed in Germany. The exchange format was based on XML and there have been efforts to create an ontology in parallel, describing semantic meanings of data items. However, a technological analysis at the time of creation of agroXML revealed, that there were neither tools nor ontology specification methods available, that were able to fulfil the cross-platform, cross-programming environment requirements necessary to cover the variety of agricultural software systems. With more recent semantic web developments and simple, but powerful graph representation formats like

RDF including programming libraries and tools available in almost any major programming language being available, the situation has improved considerably. That resulted in efforts within the German iGreen project to create a semantic knowledge model of agriculture called agroRDF, that would allow for multiple serialization formats to be generated out of a single model, for easily created extensions, even beyond arable farming only, multilingual support by using standard RDF constructs and that reuses existing standards and vocabularies and provides for a standardized mapping mechanism against existing APIs and data formats. The most notable problem around agroRDF is currently its lack of documentation, examples and tutorials and prototype implementations.

On the other hand, in the Netherlands the drmCrop-Model has been developed, also covering most of arable farming and worked out to a high level of detail. drmCrop is currently bound to a fixed toolchain using Enterprise Architect as the interface to create the model and generate serializations and API interfaces. Although its use is thus limited to a certain set of environments, the use of GUI tool provides an easy path to dive into the model and derive other implementations.

3.1.3 Implementation and Alignment Path

The most promising approach to alignment probably lies within strengthening the activities within the AEF on creation of web based APIs and interfaces for agriculture. Major stakeholders – also from FIspace – are represented within the committees there and there is a chance of aligning European initiatives with efforts undertaken abroad. While currently, the awareness of advantages of a knowledge model based approach is not yet developed to a high enough degree, eventually, an introduction of these concepts within work conducted at AEF might drive industry and companies to pick up methods that would allow for much more lightweight implementation and facilitated development using semantic technologies.

3.2 Improvements in data exchange in the Dutch flower chain

3.2.1 Business collaboration for the logistics in the supply chain of flowers & plants

The logistic processes in the supply chain of flowers & plants cause a large part of the total costs of the products. Before a bunch of flowers (or a potted plant) reaches the consumer this bunch has passed through a number of logistic steps in the international supply chain. From the original producer who might be located in Kenya or Ethiopia to the airport in Nairobi, a flight to Amsterdam, transport to the wholesaler located at a Dutch auction, road transport again to an importer in a country like Norway and finally to the flower shop in Bergen or Oslo. Apart from all these logistic steps flowers & plants are extremely vulnerable and have a short lifespan with a vase life after harvesting of on average 10 days. This means that all these steps have to take place in a few days in the most effective way.

3.2.2 Floricode develops standards for the logistics

Floricode develops and maintains standard business models, business 'languages', electronic messages and code lists for all partners who are involved in the logistic processes in the supply chain like producers, marketplaces (the auctions), traders, logistic service providers and carriers. These standards give opportunities for these partners to set up effective ways of business collaboration with electronic messaging with their business partners to improve the logistic processes. A platform like FIspace can support this business collaboration.

For more information see:

http://www.floricode.com/en-us/standardization.aspx

The technical specifications of the standards are available mostly in English, although some older documents might only be available in the Dutch language.

As part of this trial project of FIspace Floricode together with GS1 Netherlands and several business partners from the industry developed a new standard for the logistic label to be used in the supply chain of Flowers & Plants (see § 3.2.6). This new standard was introduced officially on the yearly relation day of Floricode on January 23 2015:

(http://www.floricode.com/Default.aspx?tabid=86&novusact=viewarticle&articleid=34).

Also the latest version of the standard messages for the logistic domain (see § 3.2.4) were developed and published on Floricode's website:

http://www.floricode.com/nl-nl/partijen/softwareleverancier/softwaredevelopmentkit(sdk)/xmldocumentatiemethodiek/xmllogistiek.aspx

Software developers can make use of our Test Center to test the implementation of these logistic standard messages:

http://www.floricode.com/en-us/partijen/softwareleverancier/testcenter.aspx

Code list (see § 3.2.5) are available both on the website and on the FTP site. A username and password are necessary to get access to these code lists:

http://www.floricode.com/en-us/distribution/downloadingcodes.aspx

3.2.3 Process model

Standardization starts with the setup of a general process model for the international supply chain of flowers & plants. The actors and logistic locations involved can be presented as follows:

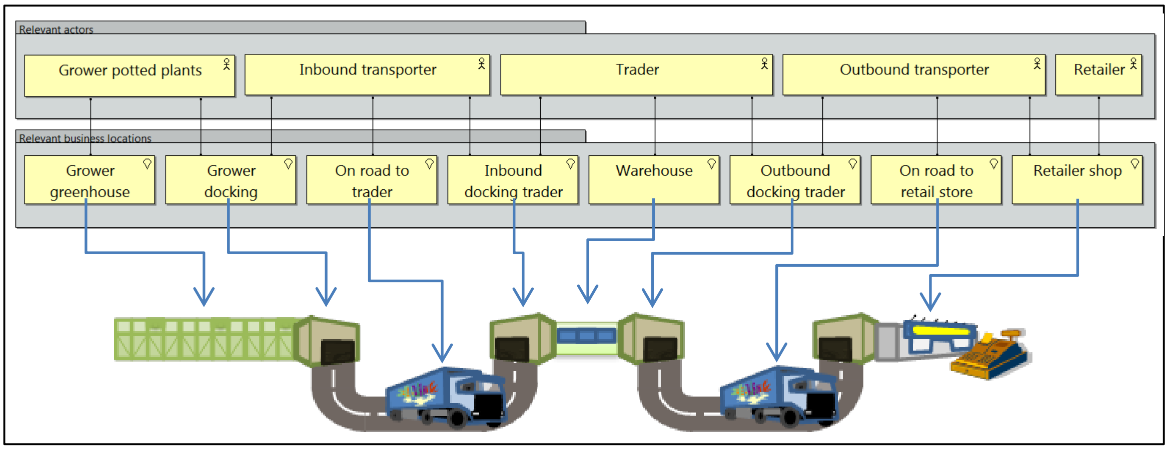


Figure 1. The actors and logistic locations in the supply chain of potted plants

Next step is to define the logistic processes and the information flows between the partners involved. Partners in logistic processes have a role as consigner, consignee, logistic agent and/or carrier.

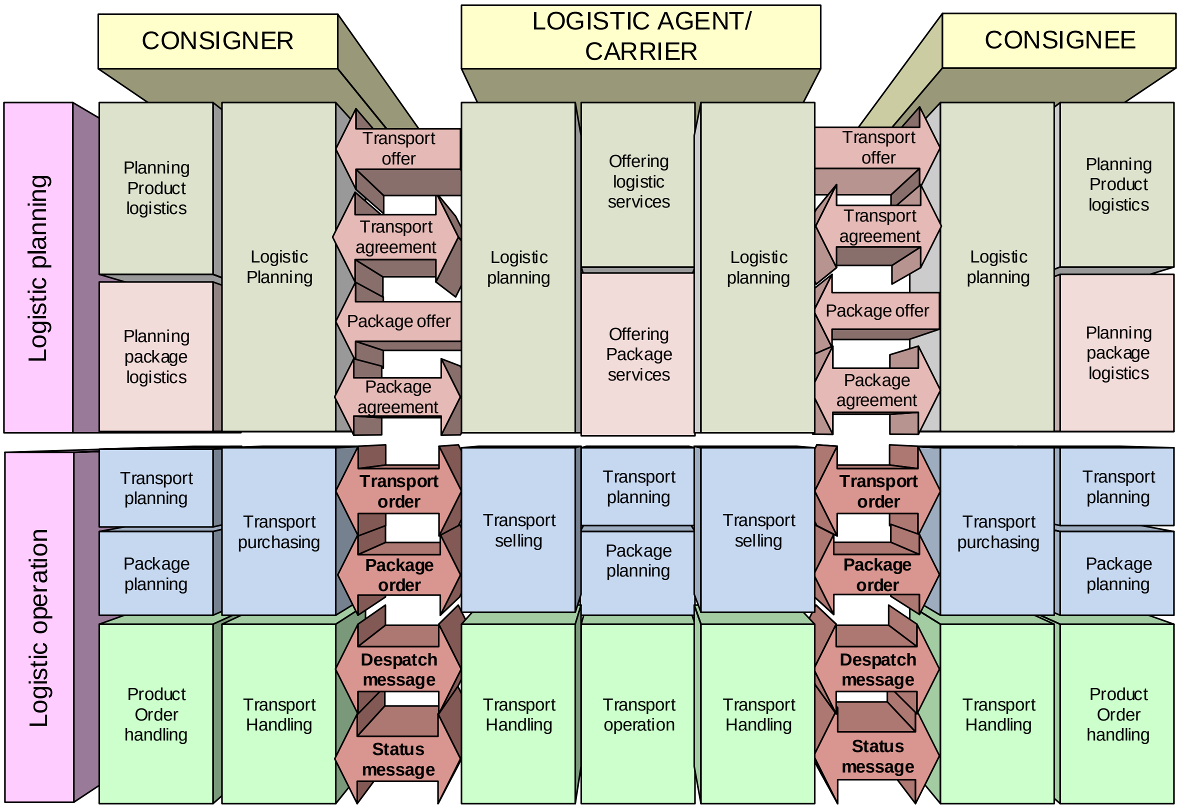


Figure 2: Logistic processes in the supply chain of flowers & plants

In the phase of **logistic planning,** most of the time there will be no exchange of electronic data. Consigners and consignees can ask logistic agents and carriers for their offers both for logistic services as well as for package services. In this supply chain logistic agents (like the auctions) and carriers can offer services to stock and deliver RTI's for their customers. Both consigners and consignees (e.g. producers and exporters) need RTI's and single-use packaging to perform their logistic processes. Based on these offers consigners and consignees will come to agreements or contracts how they will cooperate and execute the logistic processes in the operational phase.

3.2.4 Standard messages

In the **operational phase** of the logistic processes a data exchange based on standard messages will become common business in the supply chain of flowers & plants. Floricode has developed three specific logistic electronic messages bases on the UN/CEFACT EbXML standards:

- The Electronic Transport Order (ETO):
  - Consigner or consignee can send an order for the execution of a consignment to his logistic agent or carrier
  - The order will be acknowledged by the logistic agent/carrier
  - The order will be planned by the logistic agent/carrier
  - The order can be changed or withdrawn
  - The same is applicable for the order of package services like the delivering of RTI's
- The Electronic Packing List (EPB):
  - Based on the ETO and the original purchase order of the customer the definitive composition of the complete consignment with the exact loading of all the load carriers with (SSCC) codes, lot numbers, packing list numbers etc. is exchanged from consigner to carrier and consignee.
  - The consignee has the opportunity to send an EPB-delivery advice to the consigner in advance to demand for the exact loading of the different products on the load carriers.
  - The EPB can be changed or withdrawn.
- The Electronic Logistic Status (ELS):
  - All the partners involved in the execution of each transport order can deliver actual status information to the other partners; some relevant statuses are:
    - Ready for pickup

- Exception
- Planned transport
- Pickup done
- Delivered
- Hub in
- Hub out

3.2.5 Logistic code lists

Floricode develops and maintains a relevant code list which must be used in the electronic data exchange for logistic processes mentioned above. All companies involved in the supply chain have a Global Location Number (GLN) company code and all relevant logistic locations for loading and unloading shipments have a GLN. Floricode also maintains a code list for RTI types and packaging types which are in use in this supply chain.

3.2.6 Logistic labels

Up to now the 'auction packing list' is used as the standard to support the execution of almost all the logistic processes in the Dutch supply chain. Because of the internationalization of the supply chain in the last years it is of importance to have a general international standard for the use of logistic labels. Therefore Floricode together with GS1 has developed an implementation guideline for the use of standard logistic labels (with SSCC codes) for the logistic processes in the supply chain of flowers & plants (http://www.floricode.com/en-us/coding/floriculturelogisticlabel.aspx).

Figure 3: Logistic label for a package of plants

3.3 Capturing and storing ambient data during transport

The plants and flowers supply chain is a good example for the need of ambient data on every step of the supply chain. As described in the process model in chapter 3.2.3 the path from the grower to the consumer comprises several steps. Nonetheless, consumers want to have fresh and high quality flowers. A quality management system capturing and documenting ambient data like humidity, temperature or luminosity can help to monitor storage and transport condition and avoid deterioration or spoilage of the plants and flowers and thus help to save resources.

This implies the data must be captured, stored in a semantically consistent manner and communicated via standardised interfaces. To meet these requirements a showcase based on EPCIS and implemented on a small single board computer ("Raspberry Pi") was developed. This computer provides several communication interfaces to establish connection between the physical and the digital world.

Figure 4: Showcase systematic IT structure

In the scenario sensors capturing temperature, humidity and luminosity were attached to the Raspberry Pi in order to document these quality determining data during transport. The computer also allows for decoding barcodes or RFID tags through a reader connected via Bluetooth. This allows for the linkage between the captured data and the product ID (GTIN) or the ID of the logistic unit (SSCC) or the RTI (GRAI). The documented data can be shared in FI based systems like FIspace and checked against the optimal data, either by a person or by means of an automated alert system.

In case the conditions do not meet the requirements of the flowers and plants, the lorry driver can be informed and he can act accordingly. During loading and unloading processes the SSCC should be decoded and condition data should be communicated through the system.

These fine granular data captured during transport and storage allows for ex post data analysis e.g.: on the transport duration, external impacts and the quality of the products. To guarantee semantic interoperability of this cross-company communication it is based on GS1 Standards: Event data structures are EPCIS compliant and the capture and query interfaces for interactions with EPCIS repositories are standardised as well. Moreover the events are communicated via XML as also defined in EPCIS. This allows for the combination of numerous technologies and application systems such as ERP, Supply Chain Management or Warehouse Management systems. Events like the transport of flowers or temperature measurement are captured according to the four dimensions "what, when, where and why?" and documented in an EPCIS repository. For data transfer the EPCIS repository uses HTTP in the capture interface. The query interface exploits SOAP, XML via AS2 and XML via HTTP(S). The free of charge EPCIS Fosstrak System and three sensors and a touch display were installed on the Raspberry Pi (see Figure 5).

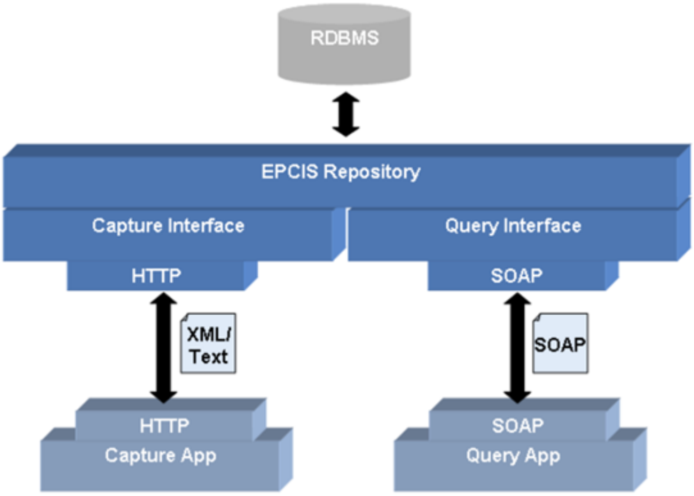


Figure 5: Overview on Fosstrak EPCIS System

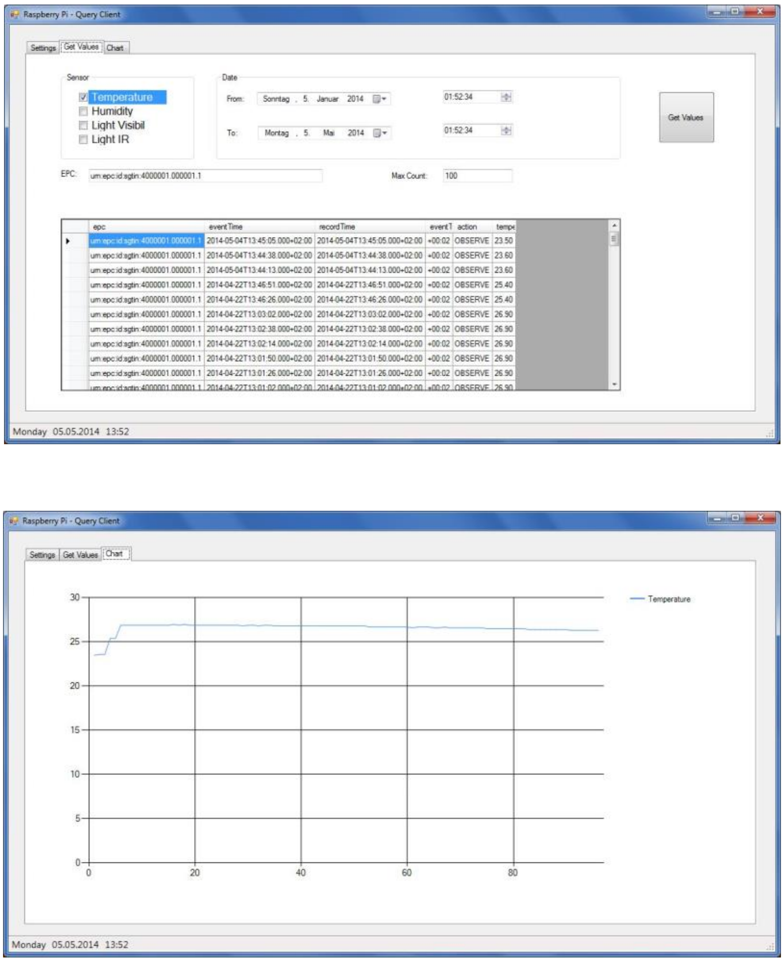


Figure 6: Clients with temperature, humidity and luminosity

In all, the combination of the Raspberry Pi accompanying the products during transport and capturing ambient data and reporting the real-time data to a system via standardised interfaces and in a standardised semantic allows for low-cost quality monitoring of plants and products and can add to less quality decrease in the domain.

3.4 EU Geographical indications and traditional specialities

Three EU schemes known as PDO (protected designation of origin), PGI (protected geographical indication) and TSG (traditional speciality guaranteed) promote and protect names of quality agricultural products and foodstuffs.

Figure 7: Geographical Indications – PDO; PGI and TSG (Source: http://ec.europa.eu/agriculture/quality/schemes/index_en.htm)

The registration procedure involves three main steps: application, publication and registration. The user can find out which product names are registered or have been applied for in the DOOR database ("Database of Origin and Registration). The DOOR database (link: http://ec.europa.eu/agriculture/quality/door/list.html) is openly available. It can be browsed in a web interface or downloaded as an Excel sheet with the following fields:

Table 3: Structure of DOOR database

Field name	**Comment**	**Searchable and sortable in web interface**
Dossier Number		x
Designation	Name, e.g. "Stornoway Black Pudding"	x
Country		x
ISO		
Status	Applied Published Registered	
Type	PDO - Protected Designation of Origin PGI - Protected Geographical Indication TSG - Traditional Speciality Guaranteed	x
Last relevant date	The date when the current status was acquired	x
Product Category	e.g. "2.1 Beer"	x
Latin Transcription	Needed for e.g. Greek product names	

Submission date		
Publication date		
Registration date		
1st Amendment date		
2nd Amendment date		
3rd Amendment date		

The database contains a few multi-country entries, which refer to meat products from the Slovak Republic and Czech Republic.

Each entry links to the official documents for publication and registration.

The publication document covers the relevant information for the product in a number of paragraphs followed by free text. The documents are available as PDF in 22 official languages. The 'BAYERISCHE BREZE'/'BAYERISCHE BREZN'/'BAYERISCHE BREZ'N'/'BAYERISCHE BREZEL' will be used here as an example .

The structure of this document is as follows.

PGI /PDO

1 Name
2 Member State or Third Country
3 Description of the agricultural product or foodstuff
   3.1. Type of product (e.g. "Class 2.4. Bread, pastry, cakes, confectionery and other baker's ware")
   3.2. Description of product to which the name in point 1 applies
   3.3. Raw materials (for processed products only)
   3.4. Feed (for products of animal origin only)
   3.5. Specific steps in production that must take place in the identified geographical area (as in 5.1 below)
   3.6. Specific rules concerning slicing, grating, packaging, etc.
   3.7. Specific rules concerning labelling
4 Concise definition of the geographical area
5 Link to the geographical area
   5.1. Specifity of the geographical area
   5.2. Specifity of the product
   5.3. Causal link between the geographical area and the quality or characteristics of the product (for PDO) or a specific quality, the reputation or other characteristic of the product (for PGI)

The geographical area as described here might be a political entity like "Bavaria", or defined by other borders such as "Ottersburg municipality, bordered to the south-east by the A1".

The documentation of the geographical indications is far from being machine readable. The key information for each product is available as PDF only. The structure of these documents seems to vary. Notably the last paragraph might include historical anecdotes and other information which can be interesting to read but might have little legal relevance.

Though an ISO standard exists to describe geographic regions like countries or areas within a country and GS1 data fields and application identifiers referring to those codes, from trial perspective more granularity is needed to reflect provenance of specialities with regional background. Efforts should be made to make the information available no only as text but as machine readable structured data.

3.5 Improvements in the Meat Supply Chain

The meat supply chain has many intermediate stages with several complex processes. From slaughtering to deboning the meat is processed several times. The processing can involve cutting and/or mixing steps in which the logical link between inputs and outputs might get lost. It is therefore vital to capture information at critical processing steps.

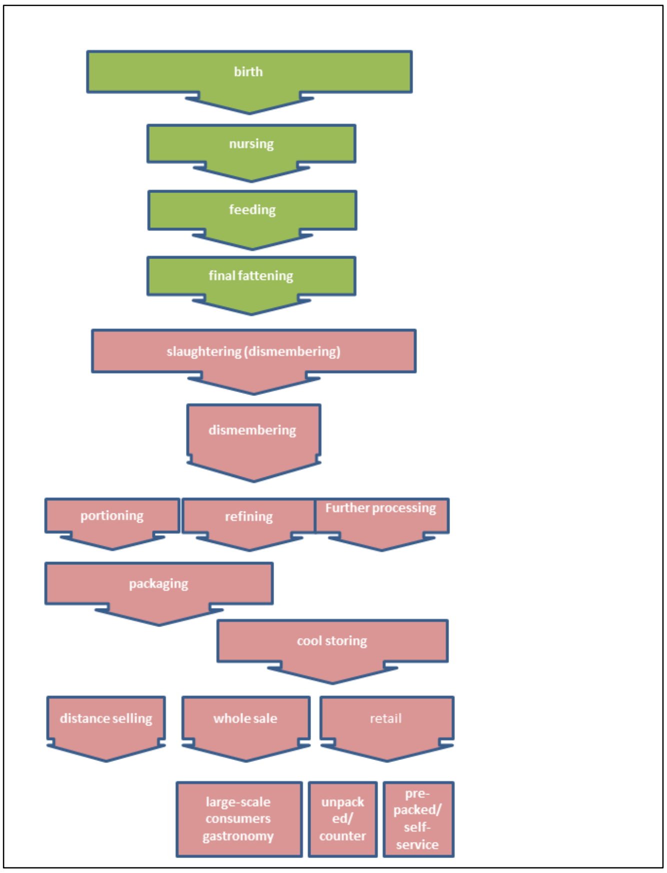


Figure 8: Scheme of Meat supply chain

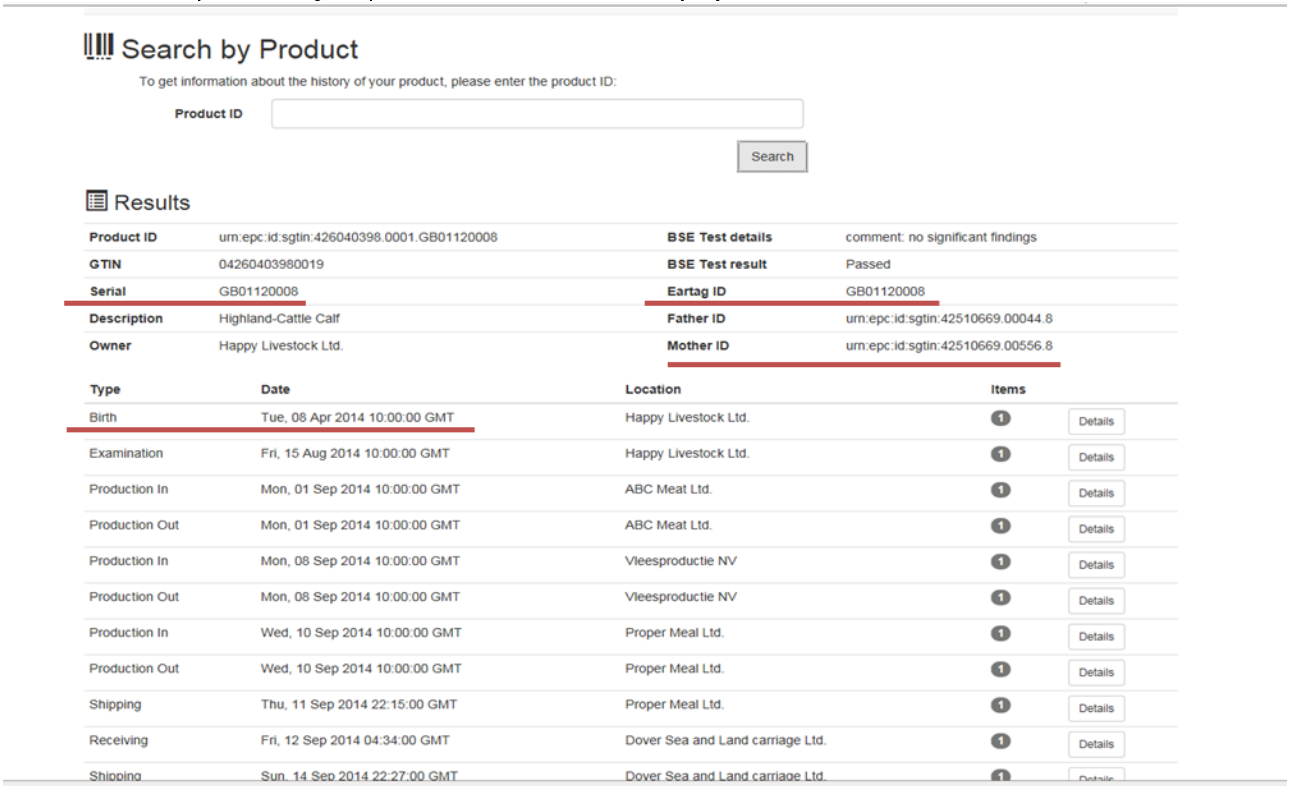
The trial Meat Information on Provenance (MIP) aims at bringing more transparency to meat and meat products within the entire meat supply chain by using EPCIS. All meat supply chain processes are stored in one or more repositories that are designed to store EPCIS events.

Following the EPCIS standard, each time a data item is read, an event is generated containing fine-granular visibility data encompassing four dimensions: what (uniquely identified objects), where (location and read point), when (time of event) and why (status and business process). The events are stored in a database (called EPCIS repository). The solution based on EPCIS within the MIP trial is based on the latest EPCIS 1.1 version (http://www.gs1.org/docs/epc/epcis_1_1-standard-20140520.pdf). It allows for capturing events related to a group of animals or products that have undergone the same process (LGTIN) and the transformation event such as the slaughter of a calf or a processing step.

Compared to conventional traceability procedures the user can retrieve information beyond those he receives from his direct supply chain partners. Even upstream information on live animals like the birth of a calf or an inspection and information requested by law stay accessible throughout the entire supply chain can be queried.

Figure 9: Example of an eartag ID (Source: Angela Schillings-Schmitz)

The screenshot of the MIP Aggregation App shows the linkage between the Eartag ID (requested by law) and the (S)GTIN. Whereas the Eartag ID is displayed in a dedicated data field it is also the serial part of the SGTIN. For all downstream processes the SGTIN as state of the art ID will be sufficient and the Eartag ID can easily be derived. This screenshot also shows that when entering the ID of a calf all events related to this calf like processing steps or examinations are displayed.



Search by Product

To get information about the history of your product, please enter the product ID:

Product ID

Search

Results

Product ID	urn:epc:id:sgtin:426040398.0001.GB01120008	BSE Test details	comment: no significant findings
GTIN	04260403980019	BSE Test result	Passed
Serial	GB01120008	Eartag ID	GB01120008
Description	Highland-Cattle Calf	Father ID	urn:epc:id:sgtin:42510669.00044.8
Owner	Happy Livestock Ltd.	Mother ID	urn:epc:id:sgtin:42510669.00556.8

Type	Date	Location	Items	
Birth	Tue, 08 Apr 2014 10:00:00 GMT	Happy Livestock Ltd.	1	Details
Examination	Fri, 15 Aug 2014 10:00:00 GMT	Happy Livestock Ltd.	1	Details
Production In	Mon, 01 Sep 2014 10:00:00 GMT	ABC Meat Ltd.	1	Details
Production Out	Mon, 01 Sep 2014 10:00:00 GMT	ABC Meat Ltd.	1	Details
Production In	Mon, 08 Sep 2014 10:00:00 GMT	Vleesproductie NV	1	Details
Production Out	Mon, 08 Sep 2014 10:00:00 GMT	Vleesproductie NV	1	Details
Production In	Wed, 10 Sep 2014 10:00:00 GMT	Proper Meal Ltd.	1	Details
Production Out	Wed, 10 Sep 2014 10:00:00 GMT	Proper Meal Ltd.	1	Details
Shipping	Thu, 11 Sep 2014 22:15:00 GMT	Proper Meal Ltd.	1	Details
Receiving	Fri, 12 Sep 2014 04:34:00 GMT	Dover Sea and Land carriage Ltd.	1	Details
Shipping	Sun, 14 Sep 2014 22:27:00 GMT	Dover Sea and Land carriage Ltd.	1	Details

Figure 10: Screen Shot MIP Aggregation App

The slaughter event includes data like the slaughtering number and the identification of the mother, as requested by the German HI-Tier database (http://www2.hi-tier.de/Entwicklung/Grundlagen/Default.htm). Thus once authorities accept FIspace as reliable and sufficient data source and implement it the pieces of information mentioned above can be used to populate authority data bases and need to be captured by the farmer only once in a system.

With its established data fields like (S)GTIN and S(GLN) the information can be used as input to B2C applications such as a consumer app.

3.6 Fish logistic data

To meet the legal requirements on fish traceability in Europe (see

Figure 11: Fish supply chain below for the fish supply chain), the following attributes/key data elements are of special interest:

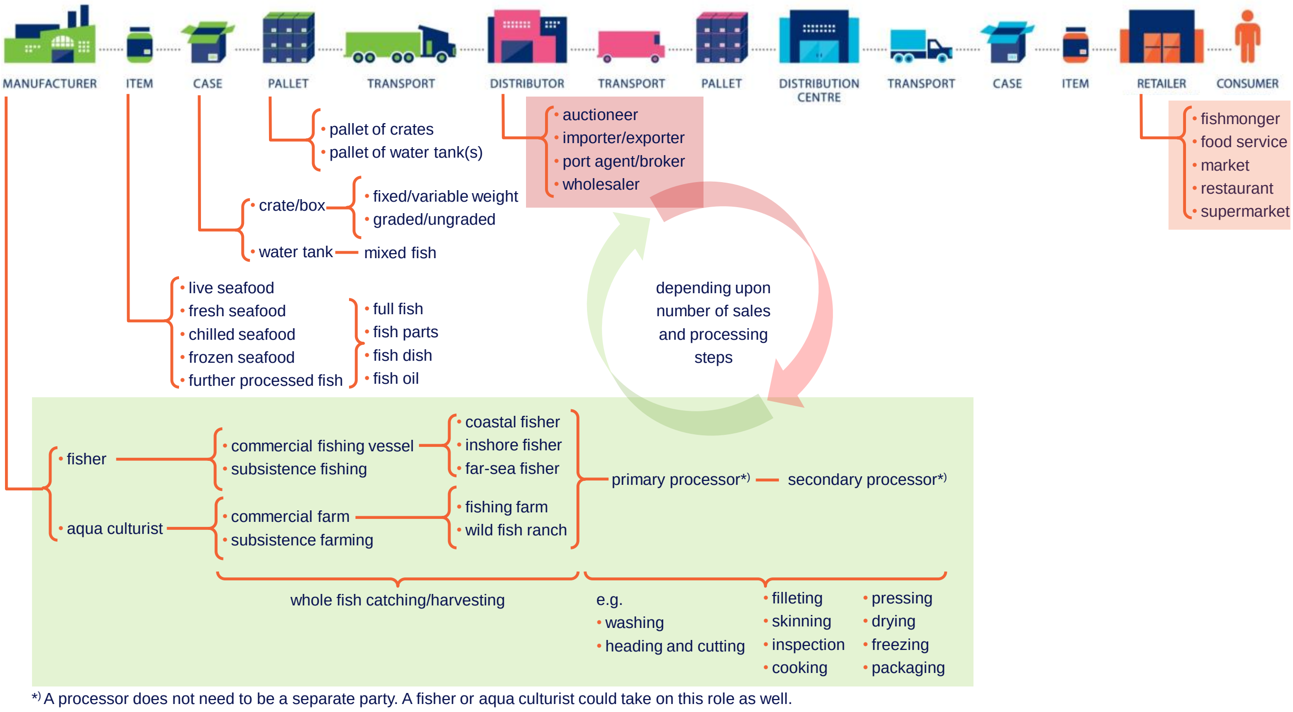


Figure 11: Fish supply chain

GTIN, lot, quantity or net weight, expiration or best before date (dependent upon product of concern), fishing vessel GLN, production unit name, fish species, scientific name, commercial designation, catch area, catch date(s), supplier GLN, supplier name and address, production method, first freeze date, storage state code, fishing gear type, fish quality grade, fish size and fish presentation.

In order to support the business processes on each of these data elements GS1 provides automatic identification data capture (AIDC), electronic data interchange (EDI) (both EANCOM and XML), EPCIS as well as GDSN standards.

Instead of exchanging data manually via Excel files, the use of GS1 standards could significantly improve business processes in this context.

4 Conclusions

4.1 Open standards / Open Supply Chains

An *open* supply chain is one in which the complete set of trading partners (including service providers) is *not* known in advance and changes continually. This is because:

- trading partnerships change so that new relationships have to be accommodated
- an organisation may be unaware of the destination or provenance of its products and other relevant entities because it is unaware of the (upstream) trading relationships of its trading partners.

GS1 standards that are applied at the interfaces between trading partners are defined outside the context of any particular trading relationship. This provides interoperability without the need for organisations on each side of the interface to negotiate individually in advance.

At the heart of this, the GS1 Identification Keys provide identification that is not dependent on any particular business relationship or process. Identification of trade items, services, locations, assets and other business objects can be communicated to anybody anywhere in the world without any limitation and without requiring qualification by one of the parties. This means that identification is portable across the entire trading partner base including into unforeseen relationships and processes.

The acceptance of standards is expected to be higher, if the pre-conditions to access them are lower. Free access and no or only nominal fees are therefore recommended.

4.2 Interoperability

Interoperability is the capability of different systems to exchange data based on a shared understanding of business processes, to read and write in compatible formats and use compatible protocols. If competitors' products are not interoperable (due to causes such as patents, trade secrets or coordination failures) the result may be a monopoly, market failure, or costly inefficiency.
As for GS1 Standards it is requested that the GS1 System Architecture should promote interoperability. This can be achieved in four ways:

1. Through product engineering,
2. Industry/community partnership,
3. Access to technology and intellectual property and
4. Implementation of standards.

Apart from this GS1 System components and any underlying processes that are developed must strive to be interoperable in their design, development, and implementation to enable the widest adoption and usage by the GS1 community.

The GS1 System Architecture should support the integration of information and physical flows into trading partners' systems, so that as far as possible the business process can be supported by automated machine-to machine messaging, providing a seamless flow of information through to the end user.

There is evidence of interoperability between applied standards within and across the FIspace trials. Here are some examples:

- Floricode closely works together with GS1 (More information: http://www.floricode.com/en-us/coding.aspx). The VBN Code for flowers and plants traded in auctions is transformed into a GS1 data structure and encoded in an EAN/UPC Code when sold at Point of Sale.
- Though VBN is used to categorize plants and flowers the need to enhance the Global Product Classification (GPC) developed under the umbrella of GS1 was anticipated in the domain. Thus from the end of 2014 GPC on bricks for the most common (appr. 800) plants and flower types exist. Whereas VBN maintains to be relevant in case full comprehensiveness is needed it will be complemented by the GPC especially in case of downstream/retail business (More information: http://www.gs1.org/1/productssolutions/gdsn/gpc/browser/index.html).
- All GS1 Identification standards have an ISO equivalent or are referenced by ISO standards (http://www.gs1.org/1/productssolutions/gdsn/gpc/browser/index.).
- ISO/IEC 15459 is a series of standards specifying identification rules for logistic units, items, returnable assets and groupings. This ISO/IEC standard is used in the Crop Protection Information Sharing Trial. The standards make provision for Issuing Agencies Codes (IAC) that create uniqueness between identification schemes from various bodies by prefixing the identifiers with a code assigned by a registration authority. The IAC 0 to 9 have been assigned to GS1 (More information: http://www.gs1.org/1/productssolutions/gdsn/gpc/browser/index.html).
- GS1 uses ISO 3166 Country Codes in the relevant data fields and application identifiers such as the country of origin or the country of production.

The GS1 System Architecture should support the integration of information and physical flows into trading partners' systems, so that as far as possible the business process can be supported by automated machine-to machine messaging, providing a seamless flow of information through to the end user.

Besides openness and interoperability further principles are of relevance. A good overview could be found at http://www.gs1.org/docs/architecture/GS1_Architecture_Principles.pdf.

4.3 Use of available Linked Open Data resources on food and agriculture

Tim Berners-Lee suggested a 5 star deployment scheme for Linked Data (see http://5stardata.info).

1. Data is available on the Web, in whatever format (1 star)
2. Available as machine-readable structured data, (i.e., not a scanned image) (2 stars)
3. Available in a non-proprietary format, (i.e. CSV, not Microsoft Excel) (3 stars)
4. Published using open standards from the W3C (RDF and SPARQL) (4 stars)
5. All of the above and links to other Linked Open Data (5 stars)

Some data on agriculture, food production and logistics can be already classed into one of those levels – each marked with one up to five stars. However, only a few resources reach the upper levels, especially four or five stars. A directory of Linked Data can be found at datahub.io. There is also a well-known and ever-growing graphical representation available (see Figure 12).

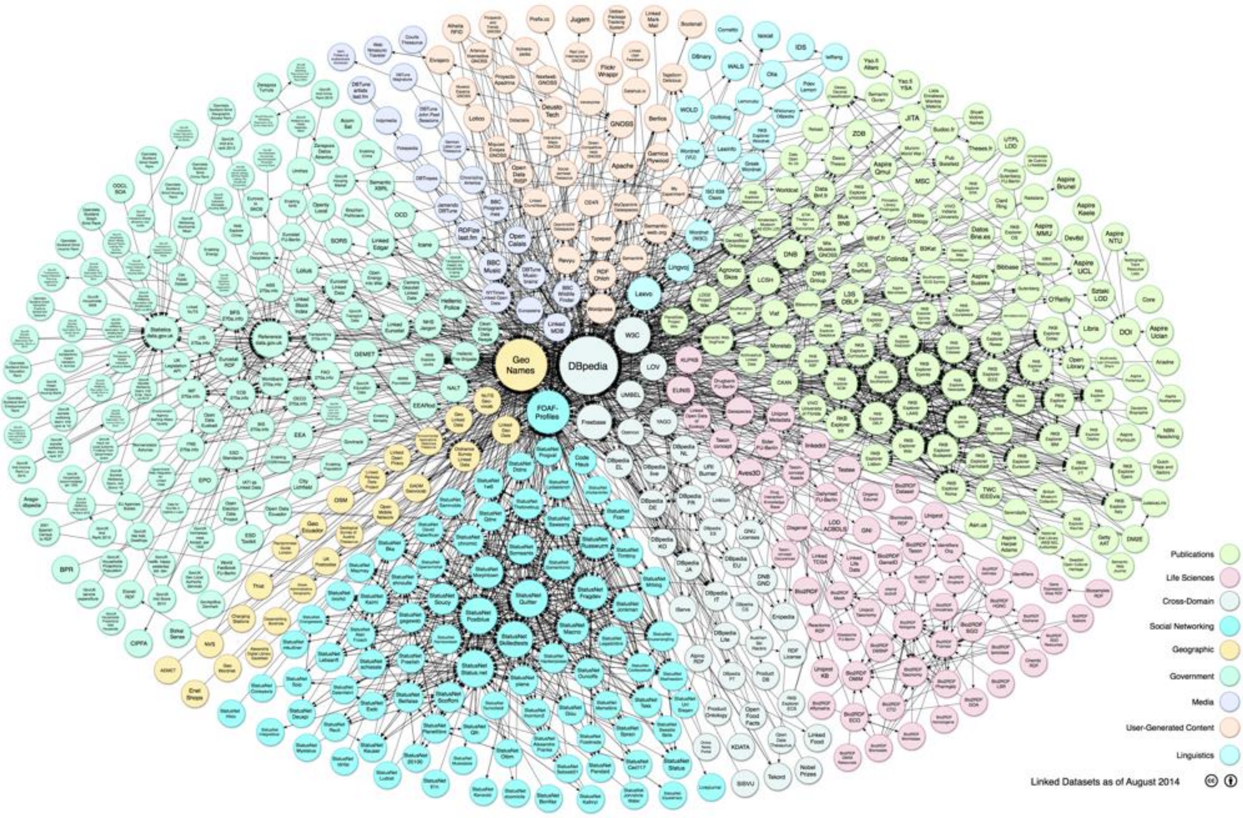


Figure 12: The Linking Open Data cloud diagram (Linking Open Data cloud diagram 2014, by Max Schmachtenberg, Christian Bizer, Anja Jentzsch and Richard Cyganiak. http://lod-cloud.net/)

The open standards RDF and SPARQL are the core of the semantic web. RDF (Resource description framework) is a syntax for defining a data model describing triples of subject, predicate, object. SPARQL is a query language for querying RDF datasets. A SPARQL endpoint accepts queries and returns results via HTTP.

A central resource for agriculture within the semantic web is CIARDRING, a directory of information services and datasets in agriculture (http://ring.ciard.net/sparql1). The FAO's multilingual thesaurus Agrovoc is also available a SPARQL endpoint (202.45.139.84:10035/catalogs/fao/repositories/agrovoc). Denmark published its agricultural government data as semantic web data (http://extbi.lab.aau.dk:8080/sparql/). A domain-specific project is the ontology on beef production (http://onto.beef.org.pl/sparql.html). Another useful resource for the agrifood domain is the European Environment Agency: http://semantic.eea.europa.eu/sparql,

The approach followed by the given examples facilitates the sharing of data and the generation of knowledge based on the available information. **The publication of data as Linked Open Data and the implementation of SPARQL endpoints are therefore recommended.**

FIspace

Business Collaboration