



D7.1 Market Analysis and Standardisation Plans – Public Version

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Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version	Page:	2 of 24
Reference:	D7.1	Dissemination:	PU
	Version:	1.0	Status:
			Final

Table of Contents

Document Information	2
Table of Contents	3
List of Tables.....	4
List of Figures	5
List of Acronyms.....	6
1. Executive Summary	8
2. Introduction.....	9
2.1 Structure of the document	9
3. Product Definition.....	10
4. EUXDAT Value Chain	11
5. EUXDAT Innovations	17
6. Standardisation Report.....	18
7. Conclusions.....	19
8. References.....	21

Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	3 of 24		
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status:	Final

List of Tables

Table 1: Matching between EUXDAT scenarios and farming applications _____ 16

Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	4 of 24		
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status:	Final

List of Figures

<i>Figure 1: Precision farming applications value chain and EUXDAT results</i>	13
<i>Figure 2: Precision farming main players</i>	15
<i>Figure 3: EUXDAT customised workflows</i>	17

Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	5 of 24		
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status:	Final

List of Acronyms

Abbreviation / acronym	Description
API	Application programming interfaces
ASP	Application service provider
B2B	Business to Business
CAGR	Compound annual growth rate
CAP	Common Agricultural Policy
Dx.y	Deliverable number y belonging to WP x
EC	European Commission
EIB	European Investment Bank
EO	Earth Observation
GIS	Geospatial Information System
GPS	Global positioning system
HPC	High Performance Computing
IaaS	Internet as a service
IoT	Internet of things
IT	Information technologies
LPIS	Land parcel information system
NDVI	normalised difference vegetation index
OGC	Open Geospatial Consortium
OLU	Open Land Use Map on the rebound
RGB	Red green blue
UAV	Unmanned aerial vehicle
USD	United States Dollar currency
VRA	Variable rate application
VRT	Variable rate technology
WP	Work Package
XML	Extensible markup language

Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version	Page:	6 of 24
Reference:	D7.1	Dissemination:	PU
	Version:	1.0	Status: Final

Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	7 of 24		
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status:	Final

1. Executive Summary

This document is a synthesis of the initial market analysis undertaken by the EUXDAT consortium. This market analysis is the starting point for the commercialisation strategy of the EUXDAT's results. This activity will then lead to the development of the exploitation plan.

At this stage of the project the exploitation team has to deal with some uncertainty regarding the final products; however there is a clear idea towards the development of a HPC infrastructure and data processing and analytic components useful for the agricultural domain. It will be a customised workflow environment for application service providers (ASP) of the agriculture sector, so they can build new services and applications for farmers. EUXDAT's main strength will be the capacity to integrate industry standard hardware (sensors), third party applications (service providers' resources) and EUXDAT platform modules (platform resources) in an innovative modelling workflow environment. Such modularity and flexibility will allow generating much customised outputs. The platform resources will include different processing, analytic and visualisation resources as well as access to relevant datasets, e.g. Sentinel satellite system.

The objective of this study is to understand the precision farming industry to determine the role and opportunities for EUXDAT. The first task to be done is to position EUXDAT in the value chain and match the potential resulting products with precision farming applications. The actors involved along the value chain, either as providers or as consumers, include farmers, experts in remote sensing technologies, engineering and environmental agricultural companies, agronomists, IT providers, machinery manufacturers, input providers (fertilisers, chemicals), traders and food companies, banks and insurance agencies.

The starting premise is that EUXDAT can take the roles of (processing and analytic) software and cloud platform provider. From this, different strategic partnerships could take place. EUXDAT can collaborate with other providers (data, software and even cloud providers) and EUXDAT necessarily will need a service provider that sells the final products and services directly to the farmers. The yield monitoring and weather tracking and forecasting seem to be the two more promising application domains for EUXDAT.

The study actually shows promising opportunities for EUXDAT. The market is very dynamic, growing and not yet consolidated: IoT, connectivity and big data analytics are allowing new entrants, traditional players are acquiring start-ups to position themselves in new segments and there is no clear dominant company.

In this context, EUXDAT has the opportunity to provide actors of other segments (not analytic software) with solutions to extend their services to new segments of the chain. For example new start-ups, food companies, traders or drone manufacturers.

The deliverable also contains a short report on the standardisation activities conducted within the project. The functional and technical requirement definition process did not reveal at the current time any major discrepancy between what EUXDAT wants to achieve and the existing standards, thus no contribution to standard is considered for the time being

Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	8 of 24	
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status: Final

2. Introduction

This document presents a synthesis of the market analysis task as the starting point for the commercialisation of the project results. The main findings are confidential for internal use of the EUXDAT consortium.

The market analysis first describes the value proposition based on preliminary assessment of results. The results have been derived from the requirements in D2.1 [7]. It should be noted that at this stage of the project there is still some uncertainty regarding the final products, its scope and functionality. However there is a clear idea towards the development of a HPC infrastructure and data processing and analytic components useful for the agricultural domain. The market research therefore focuses on the precision farming industry. The different precision farming technologies, barriers, trends and main players are examined to better understand the opportunities for EUXDAT in such a complex ecosystem.

The research has been conducted through literature review accessed via Internet.

The deliverable also contains a short report on the standardisation activities conducted within the project.

2.1 Structure of the document

This document is structured in 9 major chapters:

- The chapter 3 begins with the **product definition**, i.e. what is EUXDAT, and what it will do from the market point of view.
- Chapter 4 **value chain** puts the platform in context of the whole value chain where it is inserted.
- Chapter 5 **EUXDAT innovation** describes further EUXDAT platform with emphasis on the innovative aspects and competitive advantages.
- Chapter 6 includes a report about the **standardisation activities**.
- The document ends with the **conclusions**.

Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	9 of 24		
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status:	Final

3. Product Definition

EUXDAT platform provides application service providers (ASP) with access to agriculture, forestry and territorial planning data and facilitates the fast development of new services and applications for farmers, food and bio-based industries which in turn need enhanced information in order to compete in a challenging economic environment.

More specifically, EUXDAT platform offers:

- access to heterogeneous data,
- access to complex models
- access to analytic tools
- access to visualisation tools
- storage of huge volumes of data
- computing capabilities to execute chains of models (model composition) and data processing services.

Furthermore, EUXDAT offers an environment with API to access data, processing capabilities and basics tools to build services on top of it. The resulting **customised workflow environment** allows creating new models and services by combining the existing ones. The result of the model or the selected component is delivered to the ASP to be integrated into their operational services. EUXDAT platform also offers hosting service, predefined user interface and billing service that together make EUXDAT platform a one-stop shop for the development of precision farming applications by ASPs using only the platform components.

EUXDAT aims to test and exploit its results for the case of agriculture, forestry or territorial planning, but it should be taken into account that many core results (related with IT big data infrastructure), once developed, can easily be adapted for other industries addressing high computing research such as bio-sciences and human genome, chemical engineering, economics and financial and others.

Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	10 of 24		
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status:	Final

4. EUXDAT Value Chain

EUXDAT results can be positioned within the **precision farming applications B2B industry**. The value chain is segmented into four steps needed to develop a decision support system:

- 1) **Data collection** of heterogeneous types and sources.
- 2) **Data processing**, data formatting, integration, etc.
- 3) **Data analysis** producing information ready for expert assessment.
- 4) **Visualisation and communication**, user interface of software or app, or delivery of alert messages.

Figure 1 shows a tentative list of EUXDAT results (depicted in green boxes) and also shows how each result contributes to each step of the chain¹. In addition to the four steps of the data chain, an underlying **IT infrastructure** is also considered to support all the steps above (hence it is represented as a horizontal resource) by optimising big data management (storage, processing), security and user management capacities.

By using the EUXDAT IT infrastructure and combining the desired processing components, a customised product (i.e. information, dataset, service) is finally provided, which can be plugged to other system or platform using an API-based interface. This product can be the input needed by another precision farming company, or taken to the extreme, EUXDAT could provide a full precision farming application (e.g. a private labelled for another company).

The actors involved along the value chain, either as providers or as consumers, include farmers, experts in remote sensing technologies, engineering and environmental agricultural companies, agronomists, IT providers, machinery manufacturers, input providers (fertilisers, chemicals), traders and food companies, banks and insurance agencies. Experts of different domains along the whole value chain must team up in order to develop a precision farming application. Then other actors will benefit from these applications: farmers can take informed decisions regarding their crops, advisors can sell services to farmers, banks can benefit from soil and yield maps of their farmer customers lowering the risk of the lending, and input providers can use a weather and soil maps to predict the demand of fertilizer.

Figure 2 represents a possible market organisation². It shows that EUXDAT potentially can take the roles of software and cloud platform provider. From this, different strategic partnerships could take place. EUXDAT can collaborate with other providers of resources for the platform (data, software or even cloud providers) and in any case EUXDAT will need a service provider that sells the final products and services directly to the farmers. This ASP normally will offer software and advice on how to take better decisions. In this document any company that approaches directly a farmer to sell

¹ Precision farming can be better described as a cycle rather than as a sequence. After the communication there is a decision and action by the farmer, and data is collected again.

² it should be noted that other configurations can be found. Further details are provided in chapter 8

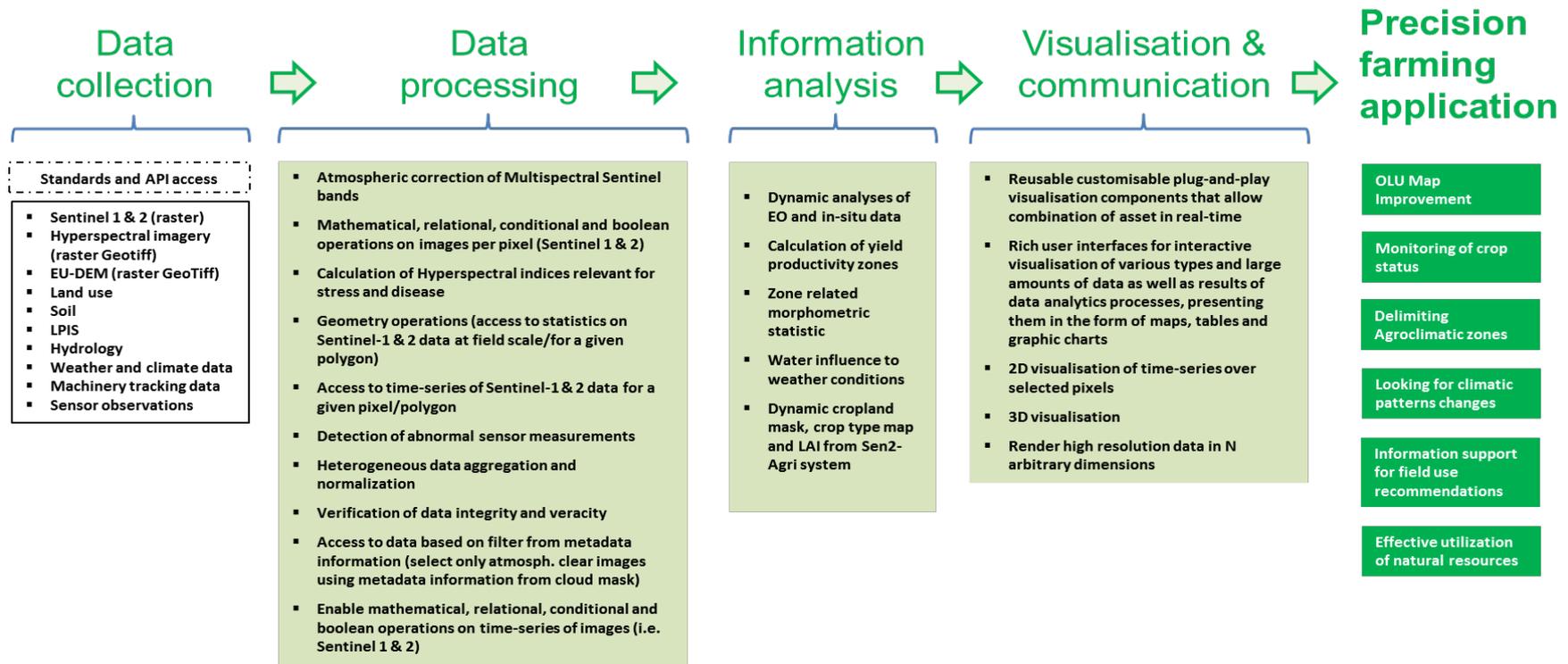
Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	11 of 24		
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status:	Final

products or services will be generally referred as service provider or ASP, considering the role of EUXDAT as provider of the ASP.

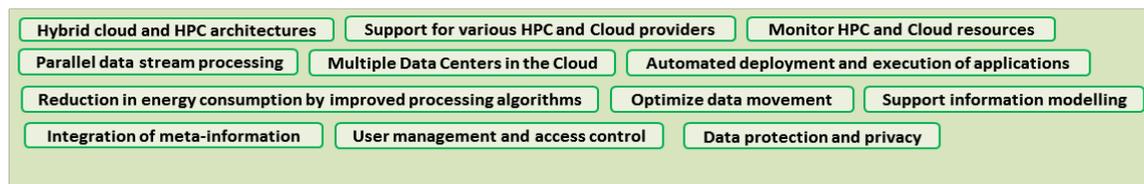
Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	12 of 24		
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status:	Final

Figure 1: Precision farming applications value chain and EUXDAT results

Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version				Page:	13 of 24	
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status:	Final

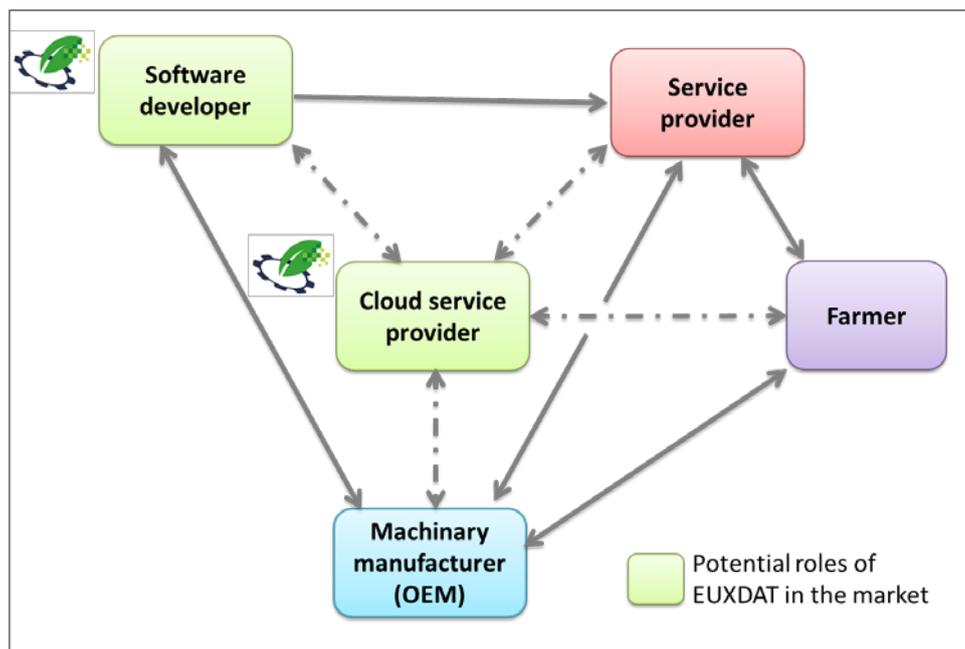


Horizontal IT infrastructure



Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version	Page:	14 of 24
Reference:	D7.1	Dissemination:	PU
	Version:	1.0	Status:
			Final

Figure 2: Precision farming main players



Many farming applications can be found in the market, with 8 distinguishable main categories:

- **Yield monitoring:** calculate the crop yield or view yield and moisture maps while harvesting and observe how field conditions affect yield in real time. Suzacq [50] suggests that the academia should evaluate further the business opportunities of yield monitors, ranging from real-time yield data analysis by traders when speculating with commodity prices to historical yield data for differential land value management.
- **Field mapping:** it includes mapping tools that enable drawing, marking and measuring the area of the field and farm features, manually or importing data from devices.
- **Crop scouting:** assess pest pressure and crop performance to evaluate economic risk from pest infestations and disease, as well as to determine the potential effectiveness of pest and disease control interventions (as defined in Wikipedia [54]).
- **Weather tracking & forecasting:** information regarding the state of the atmosphere for a future time and a given location. An understanding of the atmospheric processes is needed together with accurate data (such as temperature, humidity or wind) provided by sensors, stations, satellites or drones.
- **Inventory management:** tools to keep track of raw materials and finished products in stock. Materials include fertilizers, pesticides, fuel or seeds.
- **Irrigation management:** Irrigation management is about the effective application of water to land for agricultural production. It involves decisions about how much water to supply and when, while the irrigation system ensures uniformity [1].
- **Variable Rate Application (VRA) or variable rate technology (VRT):** seeding, weed control, fertilizer, lime, soil cultivation intensity) (This technology helps farmers to determine areas that need more pesticides and seeds, and thereby distribute them equally across the field. There are two types of VRTs, namely, sensor-based and map-based. [26])

Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version	Page:	15 of 24
Reference:	D7.1	Dissemination:	PU
	Version:	1.0	Status:
			Final

- **Farm labour management:** aiming at the efficient use of human resources.

Within EUXDAT, six application scenarios have been identified as starting point to drive the developments through different pilots. The list of scenarios is the following:

- Open Land Use (OLU) Map Improvement
- Monitoring of crop status
- Delimiting Agro-climatic zones
- Looking for climatic patterns changes
- Information support for field use recommendations
- Effective utilization of natural resources

These application scenarios potentially can lead to the development of different products in the precision farming domain. Table 1 shows a matching assessment between EUXDAT scenarios and the market applications. This assessment will help to examine the possibilities of EUXDAT and identify the market opportunities.

Table 1: Matching between EUXDAT scenarios and farming applications

	Yield monitoring	Field mapping	Crop scouting	Weather tracking & forecasting	Irrigation mgmt	Variable Rate App
OLU Map Improvement	X	X				
crop status monitoring	X		X			
Delimiting Agroclimatic zones	X			X		
climatic patterns changes				X	X	
field use recommendations	X	X		X		X
Effective utilization of natural resources	X	X				

The inventory management and farm labour management applications have been excluded of the analysis, not being directly addressed by any of the scenarios, for not being directly relevant for precision farming. Farm labour is also definitely not within the project scope, since it is subject to local labour laws and extensive data protection regulations.

Table 1 shows that EUXDAT results potentially address all other market applications to a greater or lesser extent. The yield monitoring and weather tracking & forecasting seem to be the two more promising application domains for EUXDAT.

Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	16 of 24	
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status: Final

5. EUXDAT Innovations

EUXDAT consortium covers two aspects: platform infrastructure and data analysis (or data intelligence). EUXDAT plans to position itself primarily as a platform provider for other agriculture service providers, focussing on computing capability, seamless integration of multiple data sources, connection to farming equipment, and visualisation of the information.

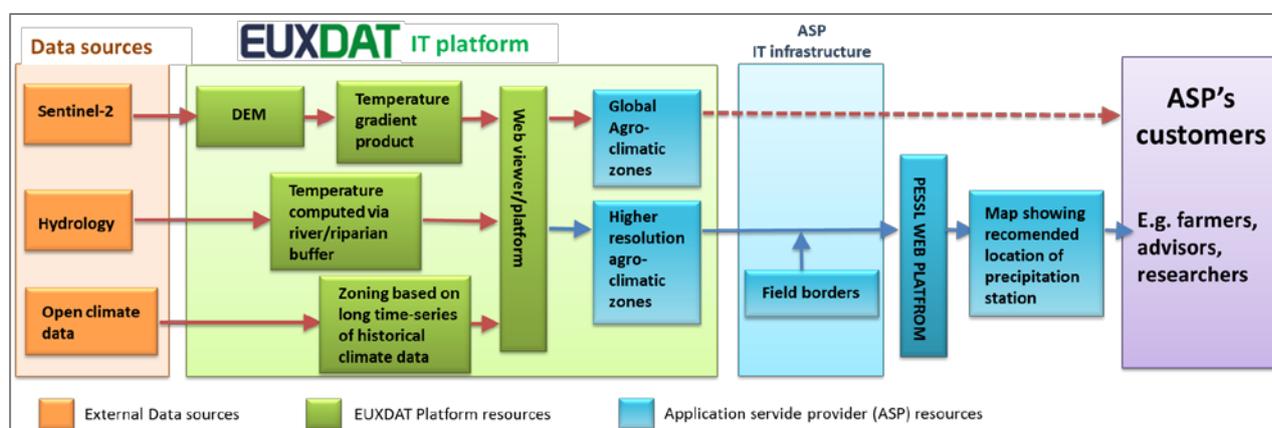
Regarding the data analysis, EUXDAT will prepare or develop relevant data sets and algorithms that can be used by data analysis providers to create application products. Figure 1 in chapter 4 lists the tentative processing and analytic components that will be built during the project. EUXDAT modules will be selected and developed under the criterion of applicability to large areas and different regions.

EUXDAT's main strength is the capacity to integrate industry standard hardware (sensors), third party applications (service providers' resources) and EUXDAT platform modules (platform resources) in an innovative modelling workflow environment. Such modularity and flexibility will allow generating much customised outputs.

Actually EUXDAT can become a one-shop stop solution for agronomists an engineering and environmental agricultural companies that decide to enter the precision farming market, offering advice and diagnosis to farmers, supported with a private labelled application developed with EUXDAT platform

The flexibility of EUXDAT platform is represented in the application examples of Figure 3. The diagram shows two potential workflows, leading to the delivery of final applications (global agroclimatic zones and recommendation map). Each workflow is comprised by a chain of resources (datasets, processing functions, algorithms, analytic tools). A resource will be either a platform's resource (green box) or an ASP's resource (blue box). Platform resources are deployed in EUXDAT infrastructure with IPR owned by consortium, while ASP's resources are owned by the ASP and can be deployed in EUXDAT infrastructure or not. ASP can be i.e. Pessl Instruments, MeteoBlue, Farm Rostenice (farmers with precisión agricultura knowledge). All platform resources are exposed to third parties through API-based interfaces. This flexible environment will be able to provide solutions for many segments of the agricultural technology value chain.

Figure 3: EUXDAT customised workflows



Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version	Page:	17 of 24
Reference:	D7.1	Dissemination:	PU
	Version:	1.0	Status:
			Final

6. Standardisation Report

One of EUXDAT objectives is to create an open-source e-infrastructure gathering as many actors of the agriculture domain as possible. To fulfil this goal, all EUXDAT project contributions should follow standard wherever possible: in the data format, in the interfaces definition, in the communication protocols, etc...

It is not strictly excluded at the beginning of the project to also contribute to existing or new standard if the need arise, however the strategy agreed by all partners is to keep this solution as a last resort and to favour as much as possible mature and well installed standards.

The functional [7] and technical [8] requirement definition process did not reveal at the current time any major discrepancy between what EUXDAT wants to achieve and the existing standards, thus no contribution to standard is considered for the time being.

This process already highlighted some standard that will be used in the EUXDAT e-infrastructure:

- INSPIRE [28] standard for georeferenced product XML metadata (Sentinel data, land use map, soil map, elevation model, land parcel identification model, etc...)
- OGC[39] standards for data visualization (WFS, WMS, WCS, WMTS)

Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	18 of 24		
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status:	Final

7. Conclusions

EUXDAT platform will provide ASPs of the agriculture sector with a technology platform and data analysis resources to build new services and applications for farmers. EUXDAT platform could be defined as a customised workflow environment.

EUXDAT will work on solutions for all steps of the development of precision farming applications: access to relevant data sets, integration and processing tools, analysis tools, and visualisation.

Based on the six scenarios planned in D2.1, the yield monitoring and weather tracking & forecasting seem to be the two more promising precision farming application segments for EUXDAT.

EUXDAT's main strength is planned to be the capacity to integrate industry standard hardware (sensors), third party applications (service providers' resources) and EUXDAT platform modules (platform resources) in an innovative modelling workflow environment. Such modularity and flexibility will allow generating much customised outputs.

The study conducted reveals that agricultural technology does not get to the farmers unless the technology providers partner with local agencies or dealers. In this ecosystem, EUXDAT fits as a one-shop stop solution for agronomists or engineering and environmental agricultural companies that decide to enter the precision farming market, offering advice and diagnosis to farmers, possibly supported with a private labelled application developed with EUXDAT platform.

The study shows many opportunities for innovation in the precision farming market. Although Amazon is the clear leader in the cloud infrastructure segment, the market of other segments is very dynamic, not yet consolidated. IoT, connectivity and big data analytics are allowing new entrants, traditional players are acquiring start-ups to position themselves in new segments and there is no clear dominant company. In this context EUXDAT has the opportunity to provide solutions for start-ups or even food companies or traders that are interested to extend their services to other segments of the chain. For example a drone manufacturer that wants to develop a data analytic application using their datasets, or a farm management provider that wants to add another data intelligence layer to their software. Other scenarios could be explored, like a partnership with other IT companies not active in agriculture interested to enter the market taking advantage of big data possibilities.

As the project makes progress, the results will be clearer and the consortium will be able to better define the targeted customers and the benefits of our services. The next steps will include:

- Definition of a portfolio of products and services
- Identification of internal resources/assets (background and foreground) involved in each service
- Agreement for exploitation of all resources, considering ownership of each resource
- Identification of gaps or potential providers of resources required by the consortium
- Development of a viable business model for EUXDAT platform. A platform as a service (PaaS) application subscription model will be considered, different pricings will be explored.

Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	19 of 24		
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status:	Final

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- Description of individual exploitation plans: each partner can possibly exploit EUXDAT results in other lines of work. EUXDAT's individual results do not have to be commercially exploited, or do not need to be exploited in the agriculture domain.

Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	20 of 24		
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status:	Final

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Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version	Page:	21 of 24
Reference:	D7.1	Dissemination:	PU
	Version:	1.0	Status: Final

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Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	22 of 24
Reference:	D7.1	Dissemination:	PU	Version:	1.0
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Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	23 of 24
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Document name:	D7.1 Market Analysis and Standardisation Plans – Public Version			Page:	24 of 24	
Reference:	D7.1	Dissemination:	PU	Version:	1.0	Status: Final