



# Smart farming technologies in service of modernizing agriculture

**Dr. Thanos Balafoutis**  
Researcher C' – CERTH/iBO  
*Agricultural Engineer*





Hellenic Institute  
of Transport (H.I.T.)



36 YEARS  
CPERI  
Chemical  
Process and  
Energy  
Resources  
Institute

## Thessaloniki

10<sup>th</sup> km. Thessalonikis - Thermis  
BALKAN CENTER, Building D  
57001 Thessaloniki | Tel: +302310 498107

<http://ibo.certh.gr> | <http://certh.gr>

## Volos

Dimarhou Georgiadou 118  
38333 Volos  
Tel: +3024210 96740



**CERTH**  
CENTRE FOR  
RESEARCH & TECHNOLOGY  
HELLAS

[ibo.certh.gr](http://ibo.certh.gr) | [www.certh.gr](http://www.certh.gr)



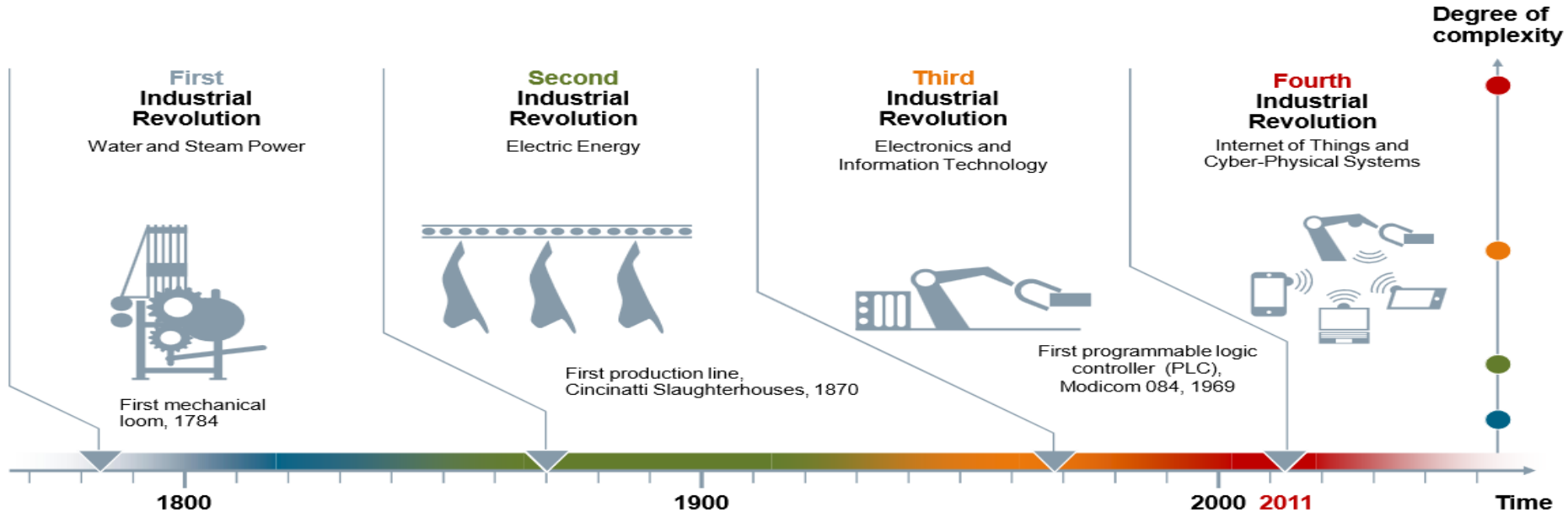
Institute for Bio-economy & Agri-technology





# 4<sup>th</sup> Industrial Revolution

## The Four Industrial Revolutions



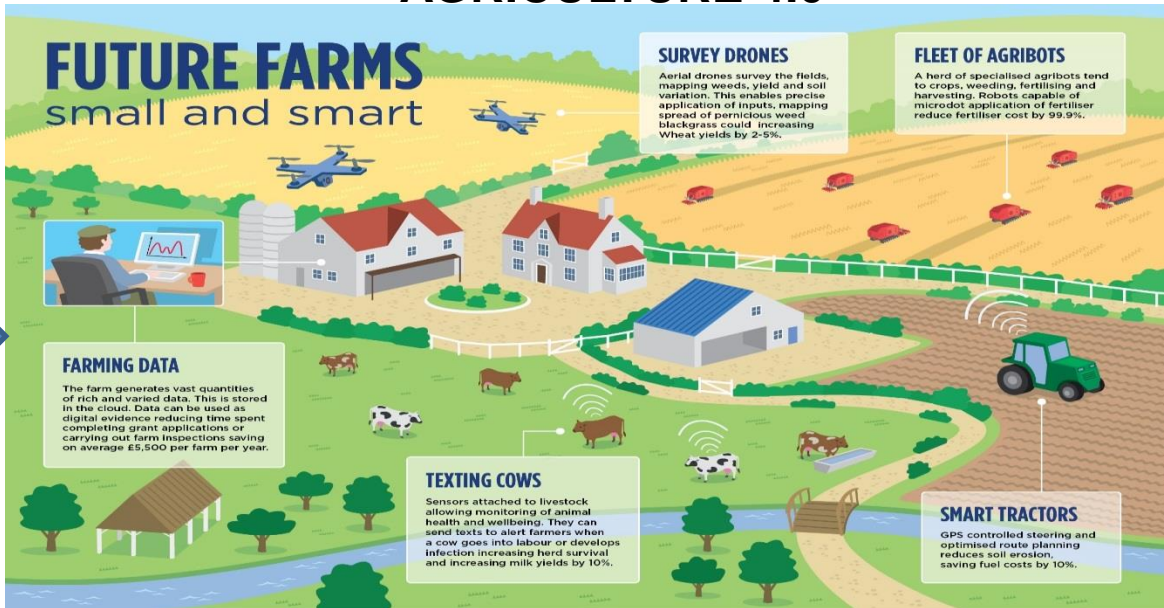
Source: DFKI (2011)



# 4<sup>th</sup> Industrial Revolution and Agriculture



## AGRICULTURE 4.0



# Future Agriculture

## HOW:

Future agriculture will integrate all existing smart farming

technologies into an integrated system for decision

making and actuating with

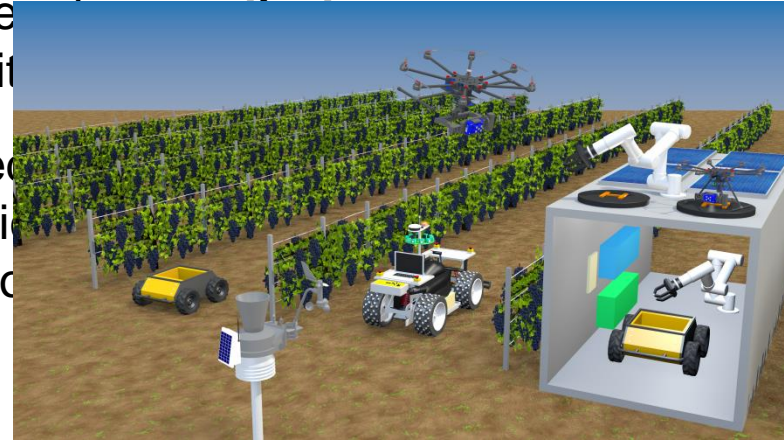
platforms equipped with

**TARGET:** novel integrated

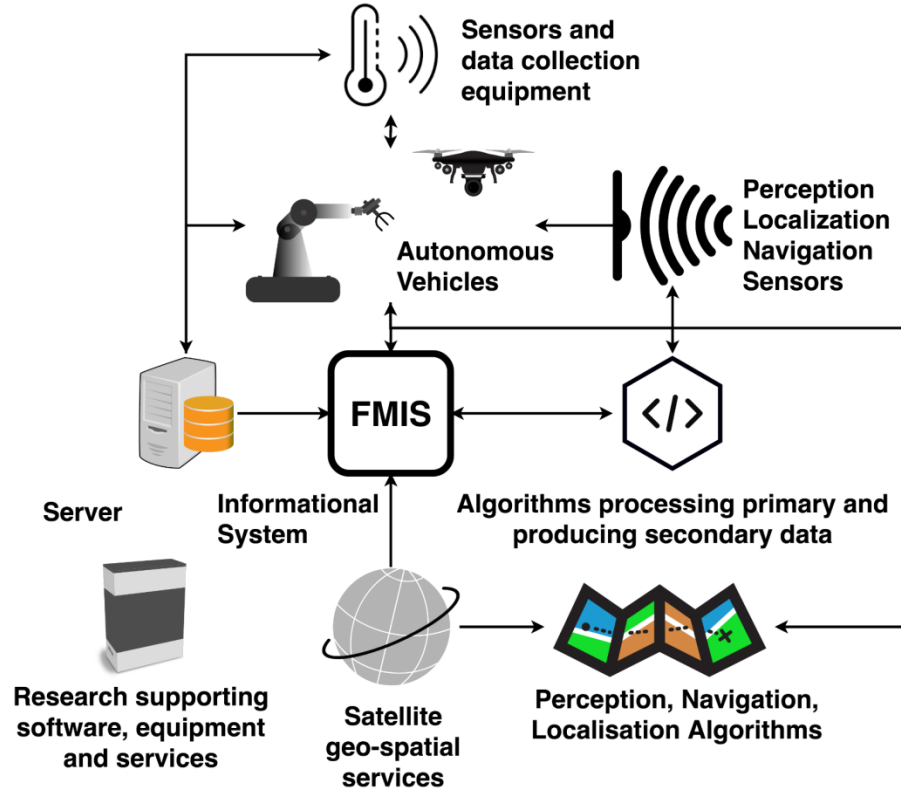
crop, environmental, soil

systems will be used to

(environmental and economic) agricultural practices.



# The Proposed Future Farming Concept



## ❑ **Subject (what)**

Analysis and refinement of technical, agronomic and physiological requirements as prerequisites for the effective development and implementation of the proposed system

## ❑ **Purpose (why)**

- ✓ Creating a system built around the user.
- ✓ Development of applied research.

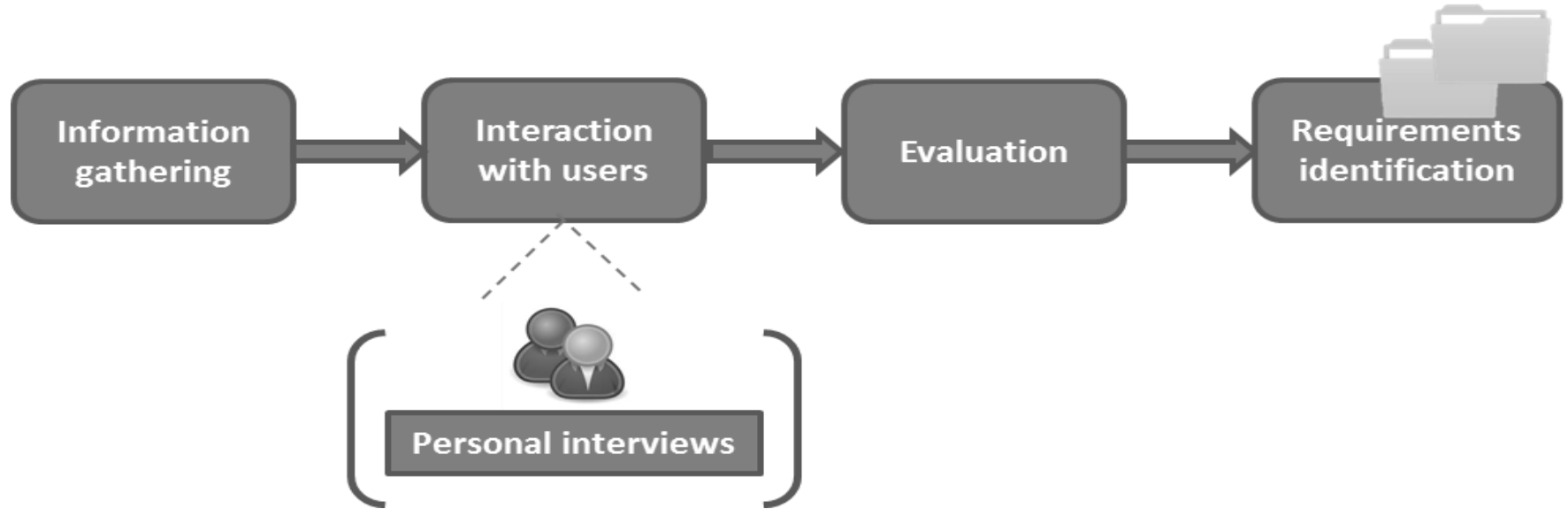
## ❑ **Method (how)**

- ✓ Set user requirements
- ✓ Definition of agronomic, physiological and technological requirements
- ✓ Key Performance Indicators (KPIs) of the system (economic-environmental)
- ✓ System architecture definition





# Requirements Identification





## Data collection and management

- ❑ **Real-time** parameters measurement
- ❑ Farm–field **tracking**
- ❑ Improved general knowledge of the production process
- ❑ Effective **documentation** system
- ❑ Detailed **work time** schedule
- ❑ **Search** engine (fast access to information)
- ❑ Data **exchange** interface





## Predictive planning and optimization

- ❑ Agricultural **input minimization** (fertilisers, pesticides, water, etc.)
- ❑ Series of agricultural practices management (time **schedule**)
- ❑ Environmental benefits (resources/input)
- ❑ Preventive system's components **maintenance**
- ❑ Benchmarking





# End-user requirements (3)

## Software / Technological Infrastructure

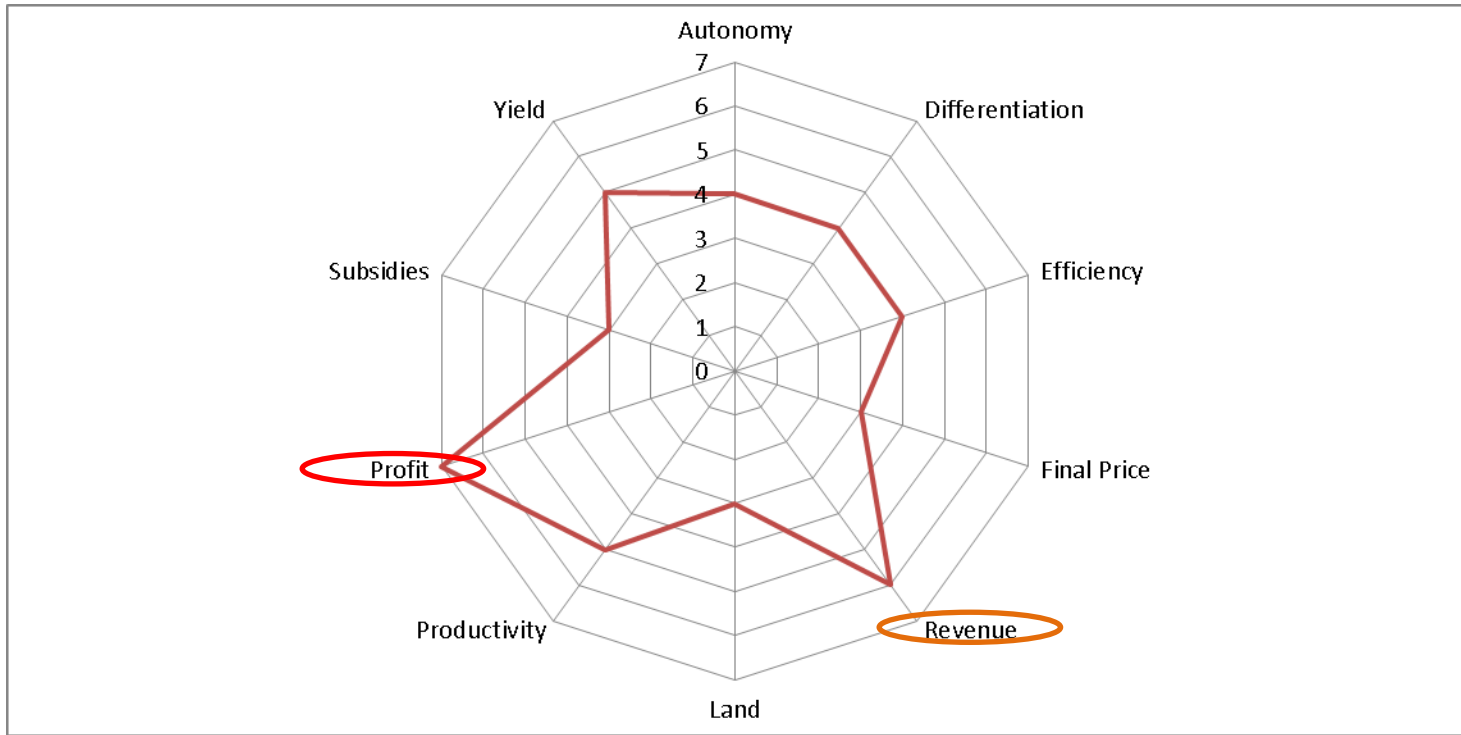
- ❑ Dedicated **user-interface**
- ❑ Agricultural practices **planning agent**
- ❑ Weather conditions **monitoring**
- ❑ **Compatible formats** independent of existing company software solutions
- ❑ **Wireless** connection
- ❑ Sensor system for **continuous crop status** information
- ❑ **Communication** with internal/external databases



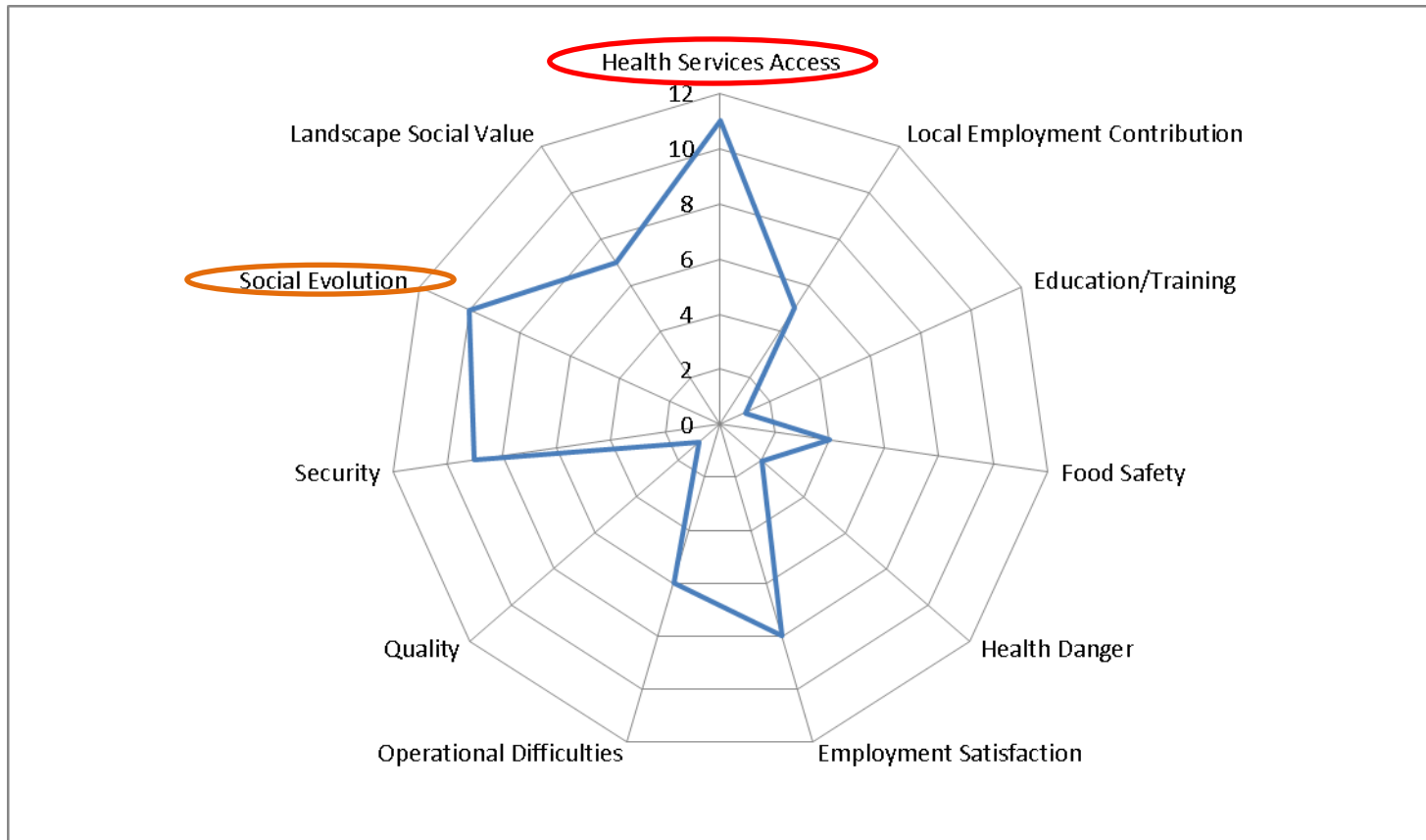
# Frequency Analysis - Environmental Indicators



# Frequency Analysis – Economic Indicators



# Frequency Analysis – Social Indicators





# Specification of the integrated system

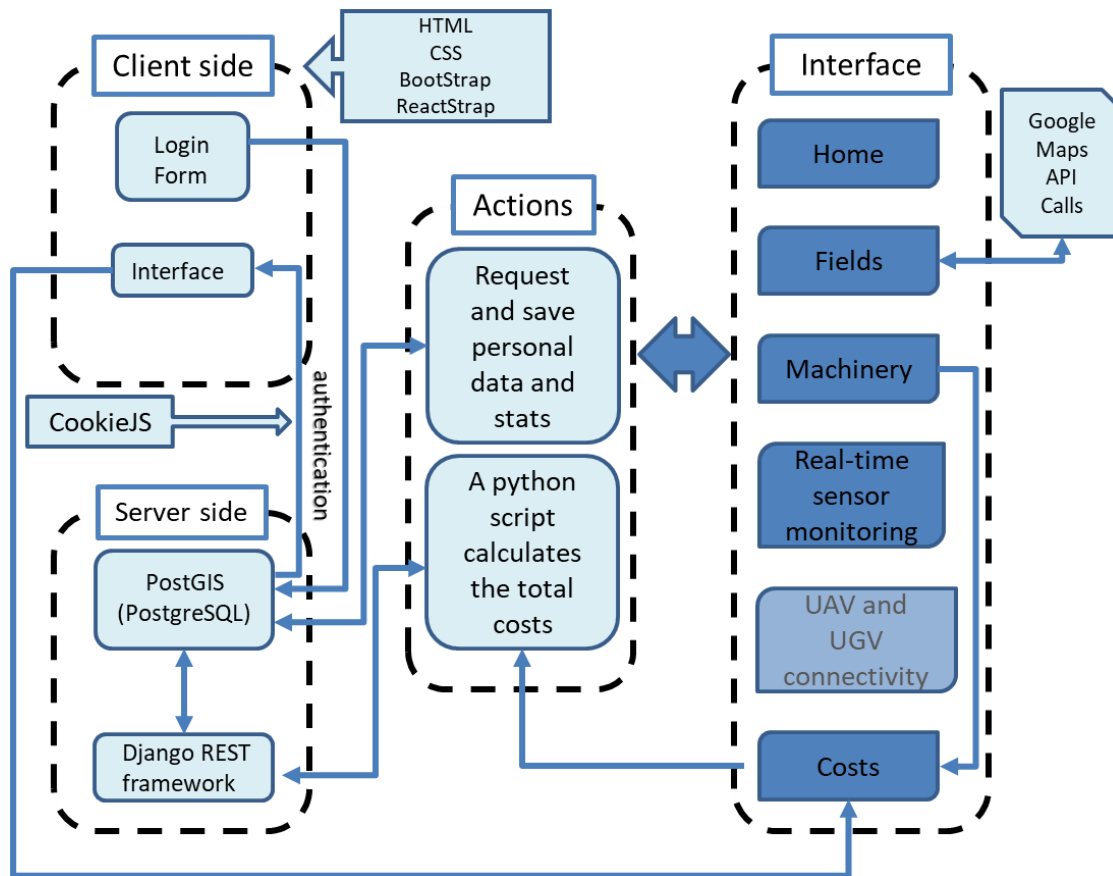
The smart farming integrated system is governed by the following principles:

- ❑ UAV utilization to **avoid time-consuming** terrestrial landscape mapping.
- ❑ Creation of information for **autonomous UGV navigation** in the field.
- ❑ Inform the user about the evolution of the processes **in real-time**.
- ❑ Identification of **dynamic obstacles**.
- ❑ Finding the **best route** in linear crops, orchards and greenhouses.
- ❑ **Interacting** with the **human factor** in the field.
- ❑ **Full feedback** between the system and the user.





# iBO Farm Management Information System Architecture



# iBO Farm Management Information System | Success Story



MY FIELDS  
5

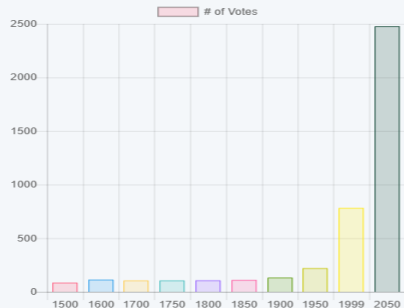
MY MACHINERY  
3

PLANNING  
45

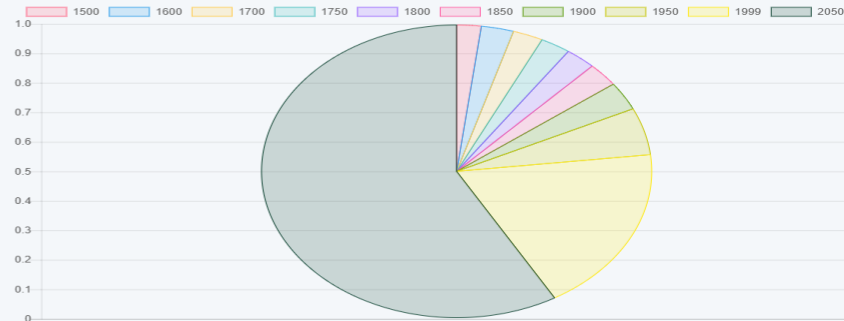
### My notifications

- Irrigation Time
- Fertilizer application
- Pesticide application
- Herbicide application
- Optimum harvest time

### My machinery total emissions



### My fields sales marketing report



  
**64,554**  
**Total Outgoings**  
year 2017-2018

### Most profitable crop

**Wheat**  
consists the 80% of your total production





# iBO Farm Management Information System

**Fields Map** | Fields Overview

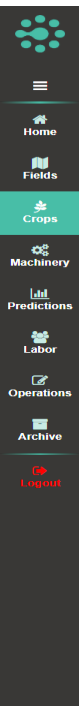
Map | **Satellite** | Search Box

**Name :** My Field  
**Area :** 24048 m<sup>2</sup>  
**Crop :** Corn  
**Temperature :** 23.42 °C  
**Wind Speed:** 3.1 m/s  
**Humidity :** 41%  
**Overview :** Clear sky

Google | Map data ©2018 Google Imagery ©2018 CNES / Airbus DigitalGlobe | Terms of Use | Report a map error



# iBO Farm Management Information System



Cropping overview

Crops

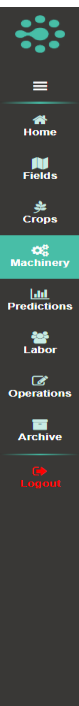
Crop-to-field assignments

Works

Id	Field	Crop	State	Area (m <sup>2</sup> )	Notes	
1	My Field 3	Corn	sowing	25862		<a href="#">Edit</a> <a href="#">End State</a> <a href="#">Delete</a>
2	My Field 2	Tomato	sowing	64318		<a href="#">Edit</a> <a href="#">End State</a> <a href="#">Delete</a>
3	My Field	Wheat	sowing	24048		<a href="#">Edit</a> <a href="#">End State</a> <a href="#">Delete</a>



# iBO Farm Management Information System



Implements

Tractors

Self-propelled

Add Implement

ID	Name	Annual Use (h/year)	Price (€)	Width (cm)	Type	SubType	Power Supply	Description	
1	Imp 4	12	133333	12	Imp 3	Rear-mounted		Imp 3	<a href="#">Edit</a> <a href="#">Delete</a>
2	Imp 3	150	150	50	Imp 3	test		Imp 3	<a href="#">Edit</a> <a href="#">Delete</a>
3	Imp 2	1230	120000	10	Imp 2	Test 4		Imp 2	<a href="#">Edit</a> <a href="#">Delete</a>
4	Imp 1	12	1000000	100	Imp 1	Front-mounted	Non-powered	Imp 1	<a href="#">Edit</a> <a href="#">Delete</a>



# iBO Farm Management Information System



Cost Calculator

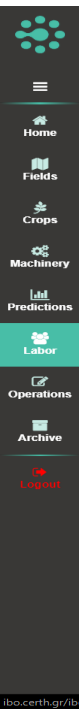
Emission Calculator

Calculate Costs

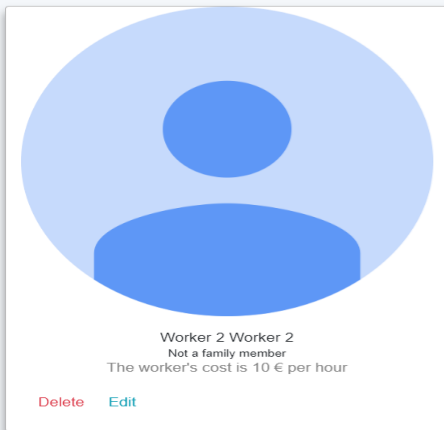
Inflation percentage
<input type="text" value="Enter the inflation percentage"/>
Fuel cost (euro)
<input type="text" value="Enter the fuel cost (€)"/>
Interest rate (percentage)
<input type="text" value="Enter the interest percentage rate"/>
Housing coefficient (percentage)
<input type="text" value="Enter the housing coefficient percentage"/>
Insurance coefficient (percentage)
<input type="text" value="Enter the insurance coefficient percentage"/>
Labor hourly rate (euro)
<input type="text" value="Enter the labor hour rate (eur/hour)"/>
<p>Metrics' Output</p>



# iBO Farm Management Information System

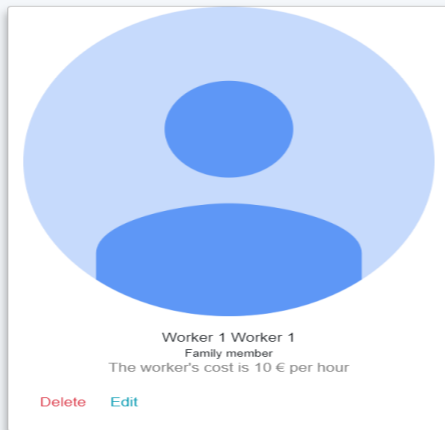


Overview Add a worker



Worker 2 Worker 2  
Not a family member  
The worker's cost is 10 € per hour

Delete Edit



Worker 1 Worker 1  
Family member  
The worker's cost is 10 € per hour

Delete Edit

ibo.certh.gr/ibogis/labor.html#



# iBO Farm Management Information System



Add an Operation More...

Select the crop which the operation will be applied for.

Please select the crop type

Select the operation

Please select the operation

Start Date

dd- ---- yyyy

End Date

dd- ---- yyyy







Fields Map Fields Overview



- Cosmos field
- Field 4
- My Field 3
- My Field 2
- My Field

- Home
- Fields
- Crops
- Machinery
- Predictions
- Labor
- Operations
- Archive
- Settings
- Logout

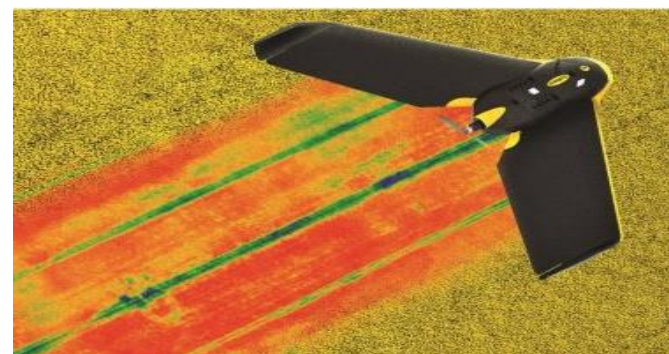




- Field works robotic platform
- Production Parameter Monitoring robotic platform.
- Unmanned Aerial System (UAS)
- Fixed wing Unmanned Aerial Vehicle



- Unmanned Ground Vehicles
- Collection of sensors for data collection (hyperspectral, multispectral, thermal, RTK, GPS, Lidar, etc.)
- Open-source Software Development for Unmanned vehicle mission planning.

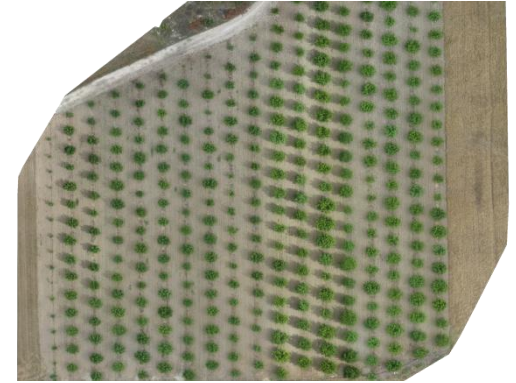


## ❑ Field Mapping using UAVs

- Cost Reduction
- Scouting of points of interest (obstacles, terrain type changes, etc.) to be used for the UGV path planning
- Management zones delineation using aerial NIR and RGB cameras for targeted input application

## ❑ Tasks execution from UGVs

- Bilateral communication with the UAV in real-time
- Dynamic recognition of the neighboring environment
- Agricultural practices execution with high precision
  - ✓ Disease Detection
  - ✓ Targeted spraying
- Time consumption reduction



UGV: Husky, Clearpath Robotics and Thorvald, SAGA

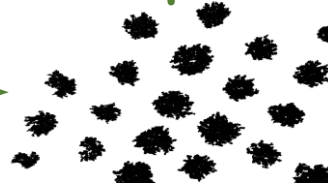
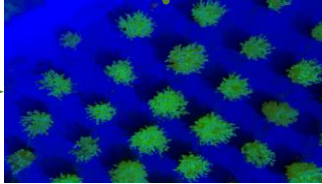
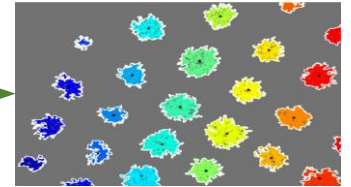
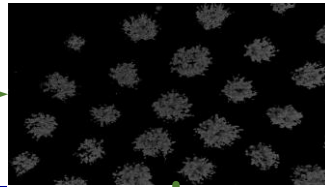
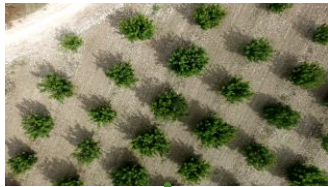
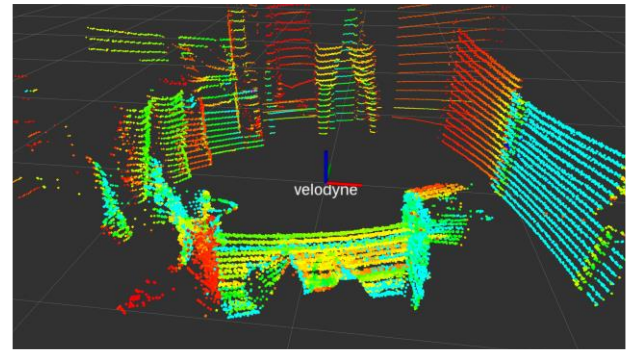
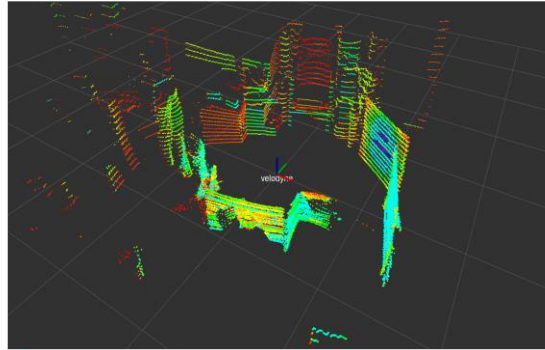
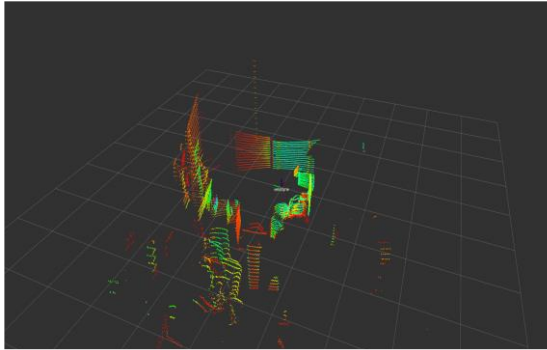
UAV: DJI S1000 Spread Wings, DJI



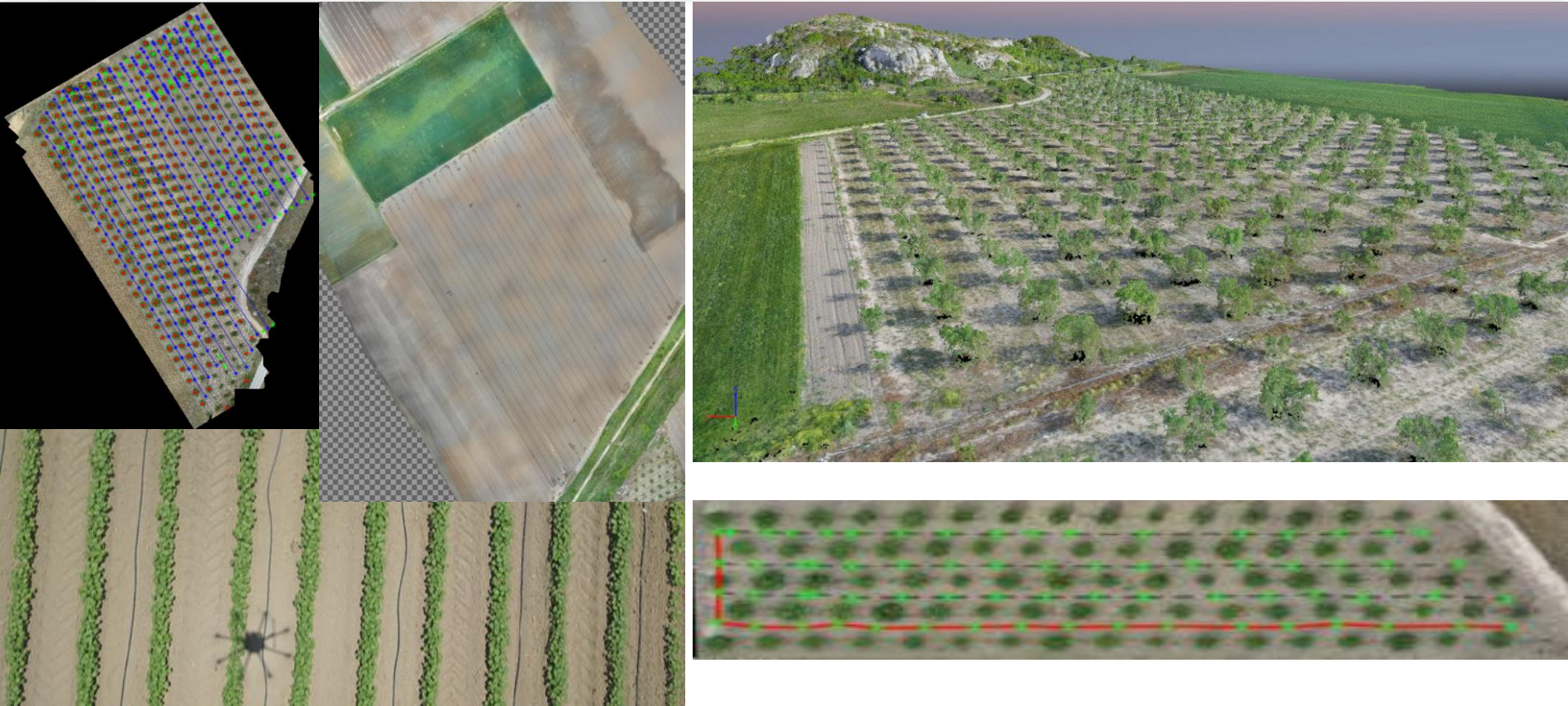
# iBO UAV and other smart farming equipment

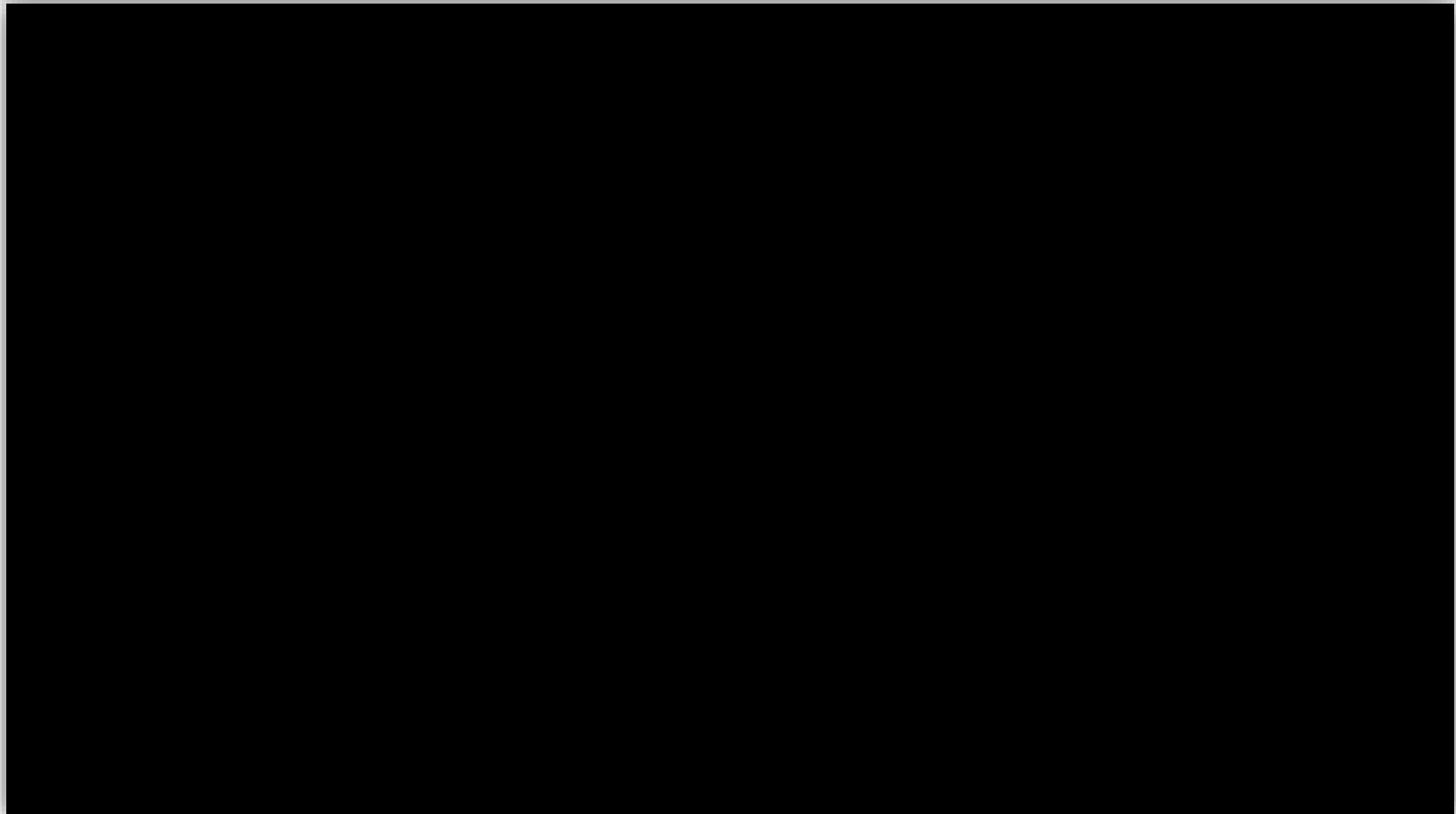
- Fixed-wing UAV eBee, SenseFly
- RTK-GNSS, Spectra
- Sequoia multispectral camera, Parrot
- Hyperspectral VNIR Camera FirefLEYE 185, Cubert





# Creation of a cotton field mosaic and 3D orchard imaging.





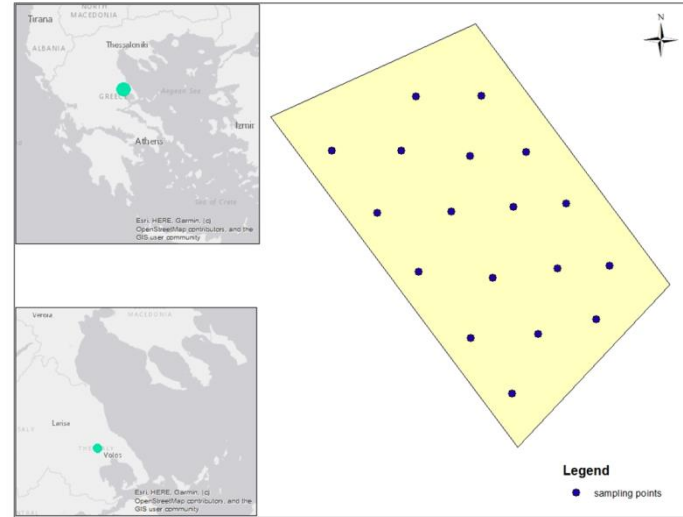


- ❑ Evaluate the capabilities of multispectral imagery predictive ability for SOM estimation acquired in bare soil conditions.
- ❑ A comparative analysis was performed with laboratory spectral measurements of 18 soil samples collected from the same field covering the complete VNIR-SWIR range (400-2500 nm).
- ❑ For model calibration, Support Vector Machine was performed, considering imagery data values and laboratory spectral signatures as input features, as well as a set of produced spectral indices.



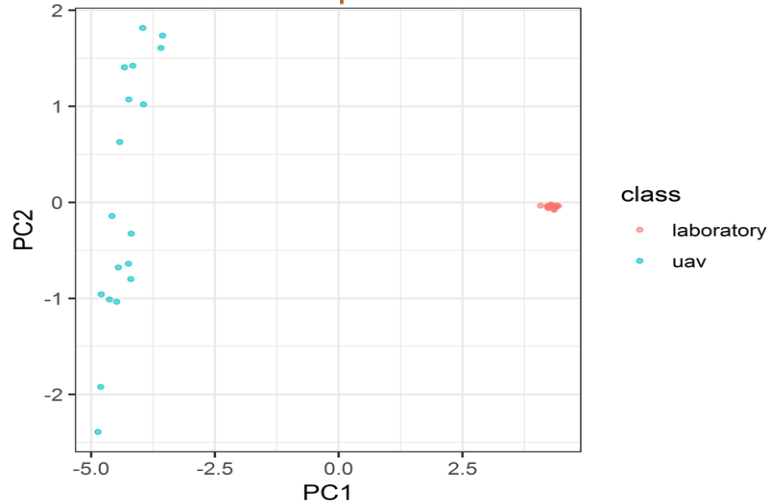
# Materials and methods

- The study area is a **0.6 ha** bare field in Rizomylos, Volos, Greece
- **18 topsoil** (0–30 cm) samples were collected
- **Parrot Sequoia+** camera for multi-spectral images. The camera detects 4 spectral bands with a sensitivity range between 400 and 810 nm. It was mounted in the **eBee UAV** platform. The flight altitude was **50m** and flight duration was 28 min.
- Laboratory spectral reflectance was calculated across the 350–2500 nm wavelength range using a **PSR + Spectral Evolution** in a dark box environment
- Model calibration by **Support Vector Machine** with radial basis kernel
- **Leave one out cross validation** (due to the low number of samples)
- **Inverse Distance Weighting** (for soil attribute mapping in order to generate spatially explicit indicators by point predictions)

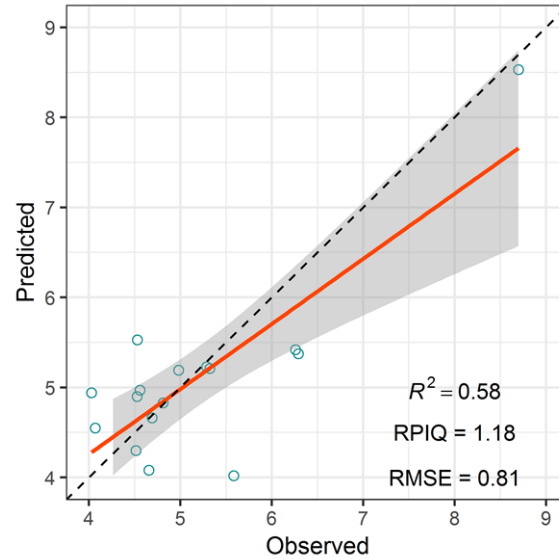


# Results

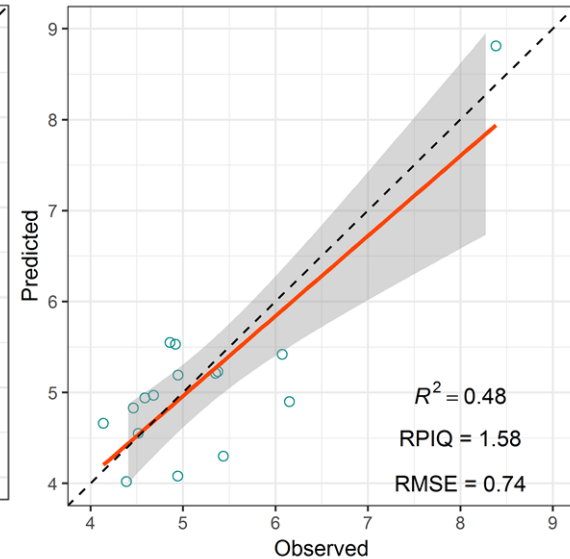
## PCA Comparison



## Laboratory

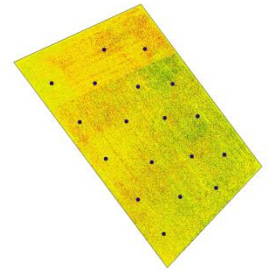
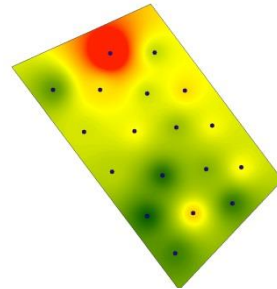


## UAV



The differences between the laboratory spectroscopy and imaging data illustrate variations, due to:

- Atmospheric conditions
- Purity of pixels
- Instrumental noise
- Light conditions
- Soil roughness and moisture



- ❑ **Data acquisition is very important and its usefulness depends on both calibration and corrective tasks occurring in pre- and post-flight stages.**
- ❑ **Need for radiometric and geometric corrections and spectral calibration to preserve scientific rigor of acquired data**
- ❑ **Multispectral imaging lacks in spectral information compared to soil spectroscopy but can provide data with higher spatial resolution**
- ❑ **When using laboratory soil spectroscopy geo-statistical or interpolation techniques are required to infer continuous spatial information**
- ❑ **The lack of spatial variability may lead to low accuracy prediction models**





# Artificial Intelligence for Disease Detection

Fungal diseases such as **anthracnose**, can be catastrophic, can destructively damage the canopies of trees and can also spread easily to nearby trees.



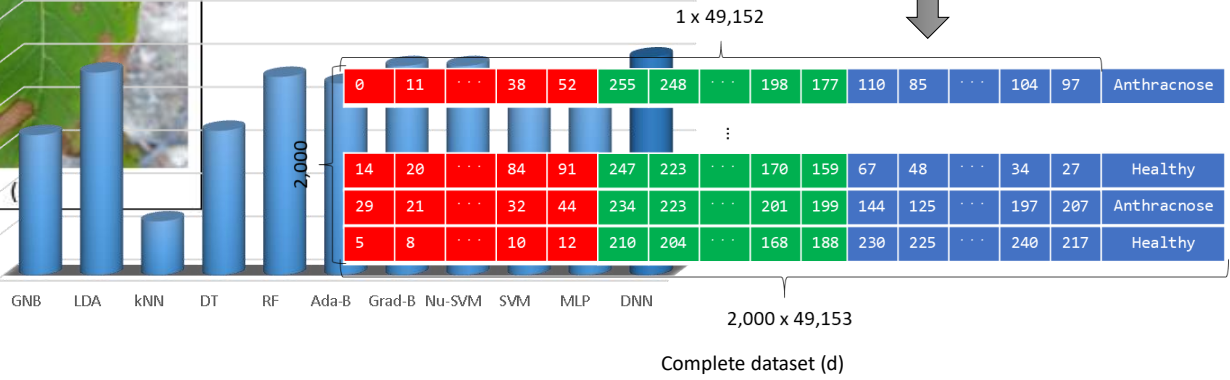
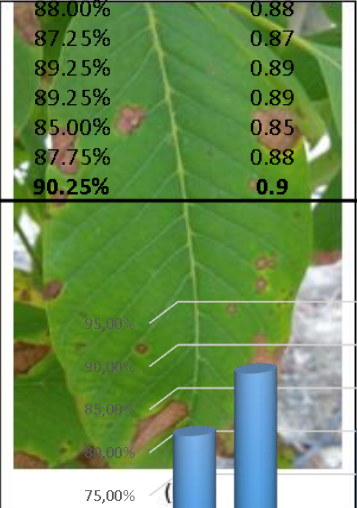
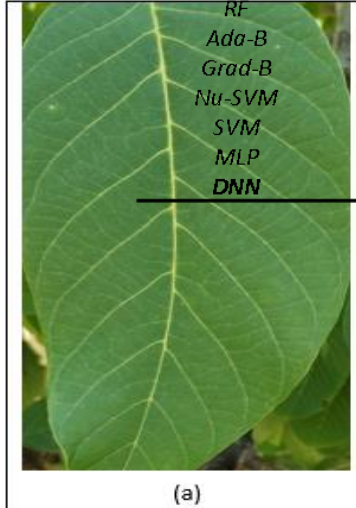
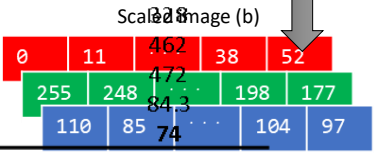
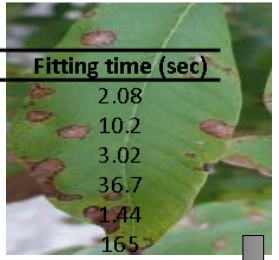
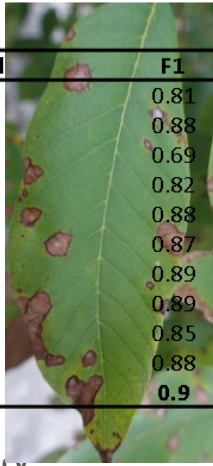
Copper spraying, adequate pruning and proper sanitation, renders the treatment of such diseases as easy, however, the main concern in such cases is the spreading prevention by early detection systems. This can be dealt with automated procedures offered in precision agriculture such as automatic image collection and real-time classification by smart systems.



# Machine Learning for anthracnose detection

Machine learning algorithms comparison for image classification on anthracnose infected walnut tree canopies  
*Anagnostis et al. (under review)*

Algorithms	Accuracy	Precision	Recall	F1	Log Loss	Fitting time (sec)
GNB	81.25%	0.81	0.81	0.81	6.479	2.08
LDA	88.50%	0.89	0.89	0.88	0.582	10.2
kNN	71.25%	0.8	0.71	0.69	4.503	3.02
DT	81.75%	0.82	0.82	0.82	6.303	36.7
RF	88.00%	0.88	0.88	0.88	0.369	1.44
Ada-B	87.25%	0.87	0.87	0.87	0.631	165
Grad-B	89.25%	0.89	0.89	0.89	0.247	128
Nu-SVM	89.25%	0.89	0.89	0.89	0.263	128
SVM	85.00%	0.85	0.85	0.85	0.338	128
MLP	87.75%	0.88	0.88	0.88	3.256	128
<b>DNN</b>	<b>90.25%</b>	<b>0.9</b>	<b>0.9</b>	<b>0.9</b>	<b>0.295</b>	128



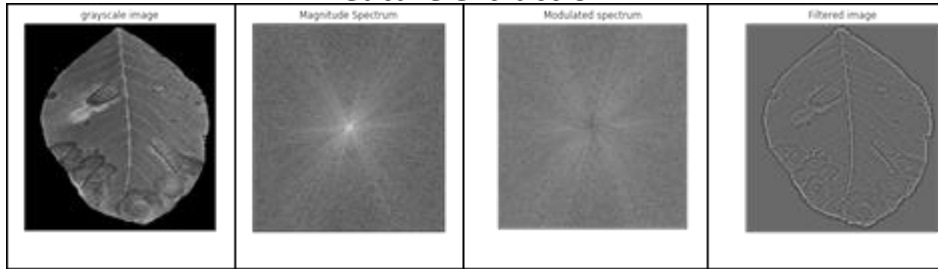
# Convolutional Neural Networks

## Background removal



Images of anthracnose-infected (with (a) and without (c) background) and healthy (with (b) and without (d) background) walnut leaves.

## Feature extraction

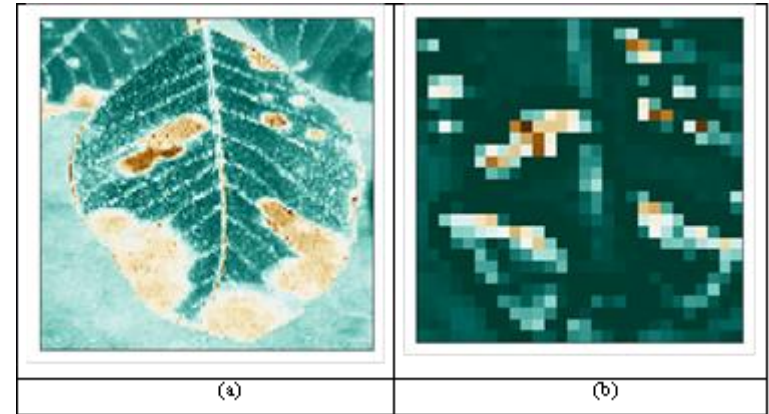


FFT steps where the original image (a) is analyzed into a magnitude spectrum (b), into a modulated spectrum (c) and finally into the feature-rich image (d).

Image classification on anthracnose infected walnut tree leaves with the use of Convolutional Neural Networks

*Anagnostis et al. (to be submitted)*

## Convolutions activation maps

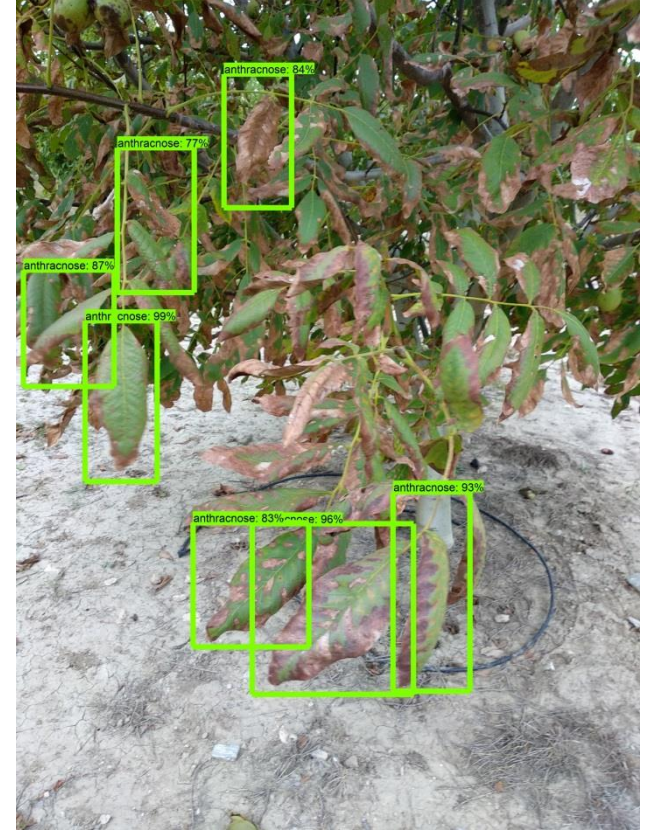
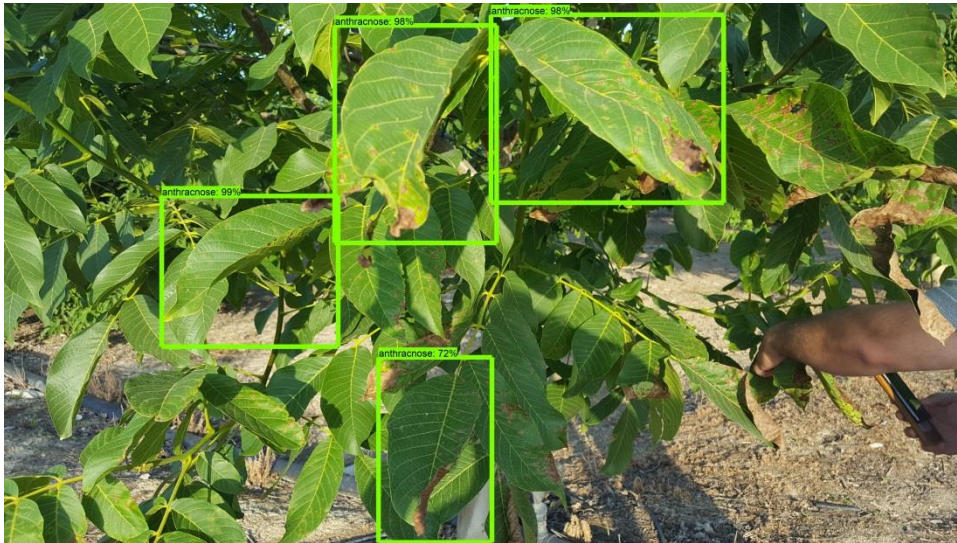


Classification accuracy results: > 99%

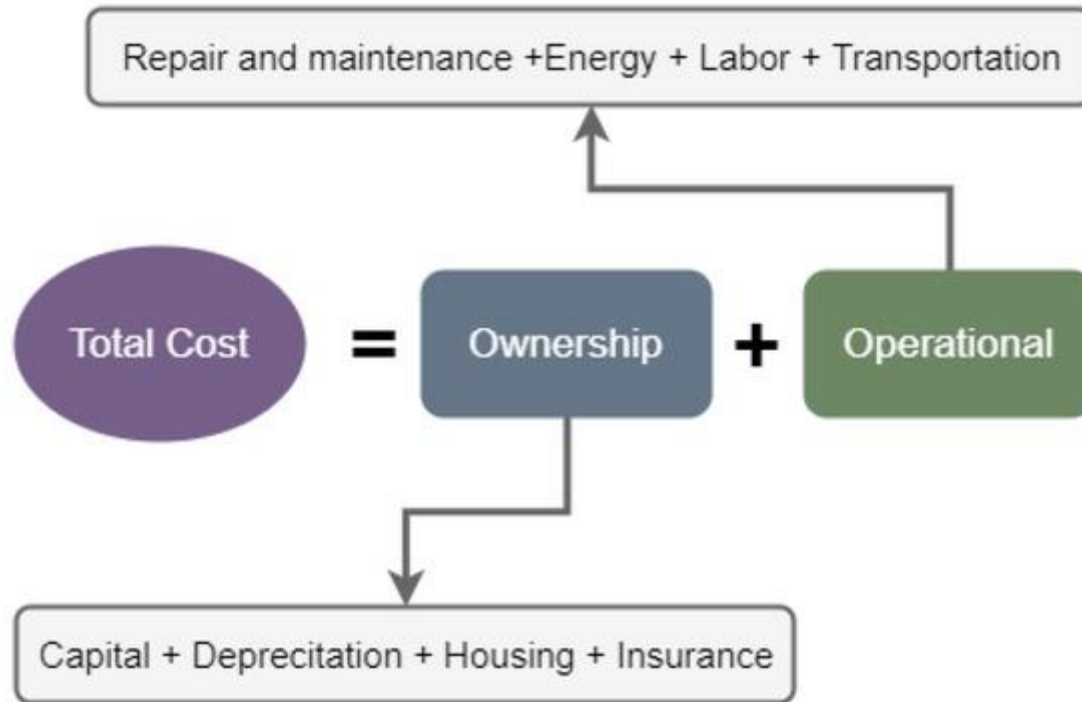


# Object Detection

- *Sliding windows*
- *Single Shot Detector*
- *You Only Look Once*  
(work in progress)







# Machinery energy and cost calculator

**MainUI**

Moldboard Plow

Operation Speed and efficiency

Tractor Parameters

RF1: 0.003

Year: 2

Power: [ ] kW

Max PTO: [ ] kW

PTD ratio: 55 %

Value: [ ] €

Tractor Type

2WD

4WD

Fuel Type

Diesel

Gasoline

LPG

Field Operation Parameters

Field Size: [ ] ha

Working Width: [ ] m

Efficiency: 80 %

Operating Speed: 7 km/h

Transport Speed: [ ] km/h

Farm-Field Distance: [ ] km

Other

Fuel Cost: [ ] €/l

Lubricant Cost: [ ] €/l

Labor Cost: [ ] €/h

Interest Rate: 0.09

Inflation: 0.04

Number of Operations: [ ]

Operation Cost

Repair & Maintenance: [ ] €

Fuel Cost: [ ] €

Lubricant Cost: [ ] €

Labor Cost: [ ] €

Calculate

Operation Cost: [ ] € Cost of the selected Operation

Total Operation Cost: [ ] € Total Cost of all the Operations

Implement Type	Tractor Type	No of Operations	Repair and Maintenance	Fuel	Lubricant	Labor	Total (Single Operation)	Total (Operation)
1								
2								
3								
4								

Main user interface for calculating variable power and costs from an agricultural practice

**MainUI\_Fixed**

operationWidthGUI

Moldboard Plow

Chisel Plow, 5 cm straight point

Chisel Plow, 7.5 cm shovel/35 cm sweep

Chisel Plow, 10 cm twisted shovel

Disk Harrow, Tandem, Primary tillage

Disk Harrow, Tandem, Secondary tillage

Field Cultivator, Single Primary tillage

Field Cultivator, Secondary tillage

Row Crop Cultivator, S-shank

Row Crop Cultivator, C-shank

Row Crop Cultivator, No-till

Rotary Hoe

Spring Tooth Harrow

Roller Packer

Row Crop Planter, prepared seedbed, Mounted, Seeding

Row Crop Planter, prepared seedbed, Drawn, Seeding

Row Crop Planter, prepared seedbed, Drawn, Seeding, fertilizer

Grain Drill w/press wheels, < 2.4 m drill width

Grain Drill w/press wheels, 2.4 to 3.7 m drill width

Grain Drill, no-till, 1 fluted coulter/row

Baler, small rectangular

Baler, large rectangular bales

Baler, large round (no. chamber)

Baler, large round (fx. chamber)

Combine, small grains

Inputs

Ppto: 60

Constants

Coef1: 96 %

TE: 62 %

Load coef.: 95 %

Soil type

Heavy

Medium

Light

Operation depth (cm): 30

Operation width (m): 1

Operation Speed (km/h): 10

Calculate

Max operation width: 1.24121

Main user interface for calculating fixed costs of an agricultural practice required to perform an agricultural practice.

# Agricultural Machinery Management

Matlab user interface for calculating the required number and size of machinery for agricultural practices execution with simultaneous cost calculation

Workability\_Energy\_Cost

Moldboard Plow  
 Chisel Plow, 5 cm straight point  
 Chisel Plow, 7.5 cm shovel/35 cm sweep  
 Chisel Plow, 10 cm twisted shovel  
 Disk Harrow, Tandem, Primary tillage  
 Disk Harrow, Tandem, Secondary tillage  
 Field Cultivator, Single, Primary tillage  
 Field Cultivator, Secondary tillage  
 Row Crop Cultivator, S-tine  
 Row Crop Cultivator, C-shank  
 Row Crop Cultivator, No-till

Workability  
 Work Period: 3 Days  
 Work time: 17 h/day  
 Workability: 0.6  
 Time Available: h

Field Parameters  
 Field Area: ha  
 Soil Coef: 0.7  
 Farm-Field Distance: 1 km  
 Transportation Speed: 40 km/h

Implement Parameters  
 A: 652  
 B: 0  
 C: 5.1  
 RF1: 0.007  
 RF2: 2  
 Economic Life: 15 y  
 Total Life: 2000 hr  
 Age: 1 y

Tractor Parameters  
 Tractor Type:  2WD  4WD  
 Fuel Type:  Diesel  Gasoline  LPG  
 RF1: 0.007  
 RF2: 2  
 PTO: 55 %  
 Economic Life: 15 y  
 Total Life: 2000 hr  
 Age: 1 y  
 Tractive Conditions:  Concrete  Tilled  Firm  Soft

Efficiency: 80 %  
 Speed: 7 km/h  
 Operation Depth: 30 cm

Cost Parameters  
 Hourly Wage: 15 €/h  
 Fuel Cost: 1.038 €  
 Lubricant Cost: 2 €  
 Interest Rate: 8 %  
 Inflation: 4 %  
 Salvage Coef: 10 %  
 Housing Coef: 0.75 %  
 Insurance Coef: 0.25 %

Theoretical Capacity: ha/h  
 Theoretical Width: m  
 Actual Width: m  
 Actual Capacity: ha/h  
 Actual Time: h

Operation Costs  
 Repair and Maintenance: €  
 Fuel: €  
 Lubricants: €  
 Labour: €

Ownership Costs  
 Depreciation: €  
 Interest Charge: €  
 Housing: €  
 Insurance: €

Calculate

Incremental calculation

Total Operation Cost: €  
 Total Ownership Cost: €

Required Tractors

Operation	Width (m)	Implement Value (€)	Required Power (kW)	Actual Power (kW)	Tractor Value (€)	Operation Energy (kWh)
1						
2						
3						
4						

	Repair and Maintenance	Fuel	Lubricant	Labor	Depreciation	Interest Charge	Housing	Insurance
1								
2								
3								
4								





# Sustainability Analysis of UGVs replacing Tractors

## ❖ **Subject (what)**

Economic and Environmental Sustainability Assessment of proposed production systems.

## ❖ **Purpose (why)**

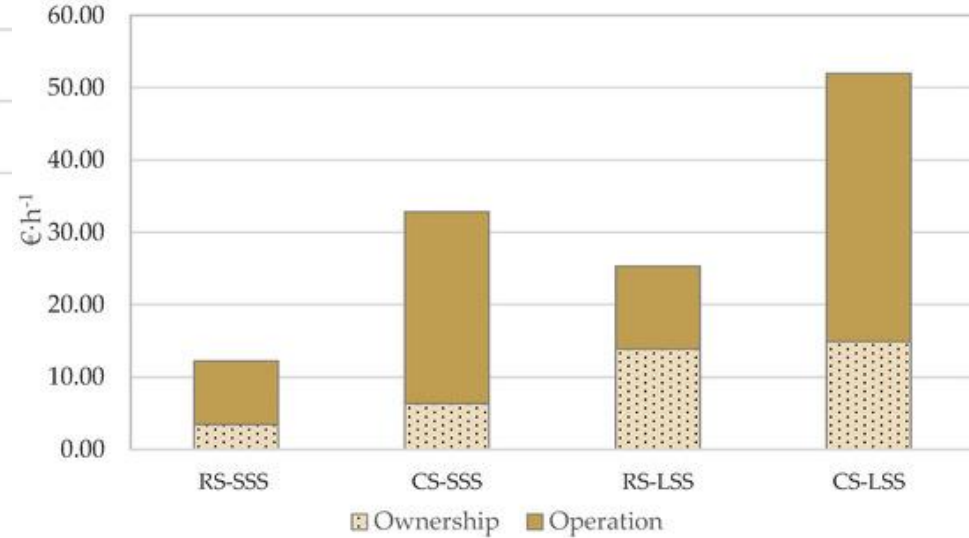
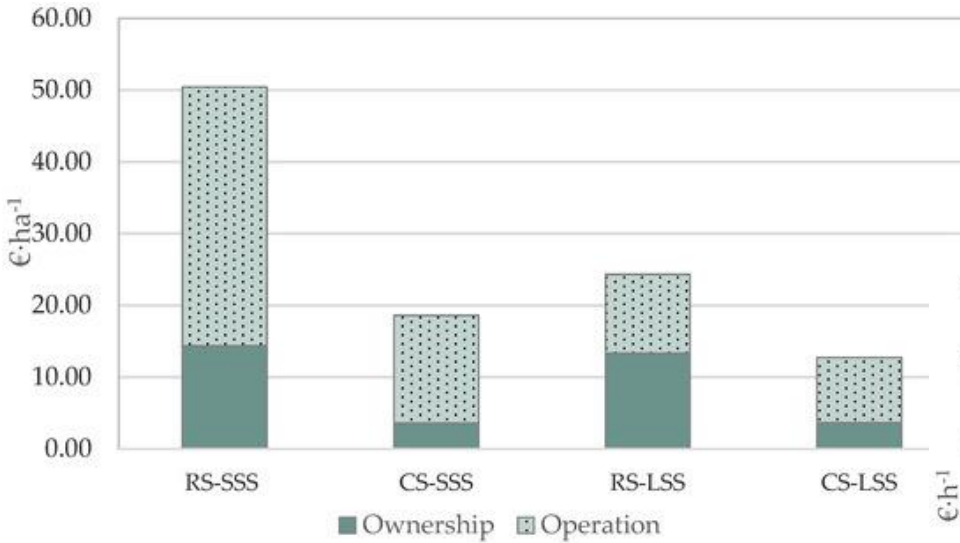
In order to support high-end technology adoption in agriculture, an assessment of the cost and benefits from robotic system application is required.

## ❖ **Methods (how)**

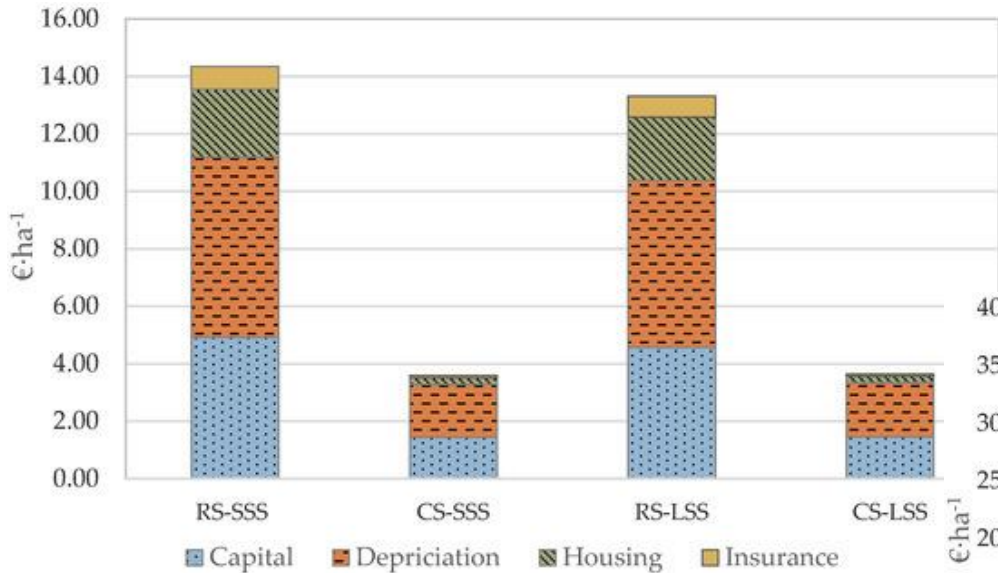
Robotic platforms are not followed with operational parameters specifications, as conventional agricultural machinery. Therefore, preliminary methodology on defining the cost of operation (light tillage) in arable farming was conducted and compared with existing technology. For environmental assessment, LCA is being used.



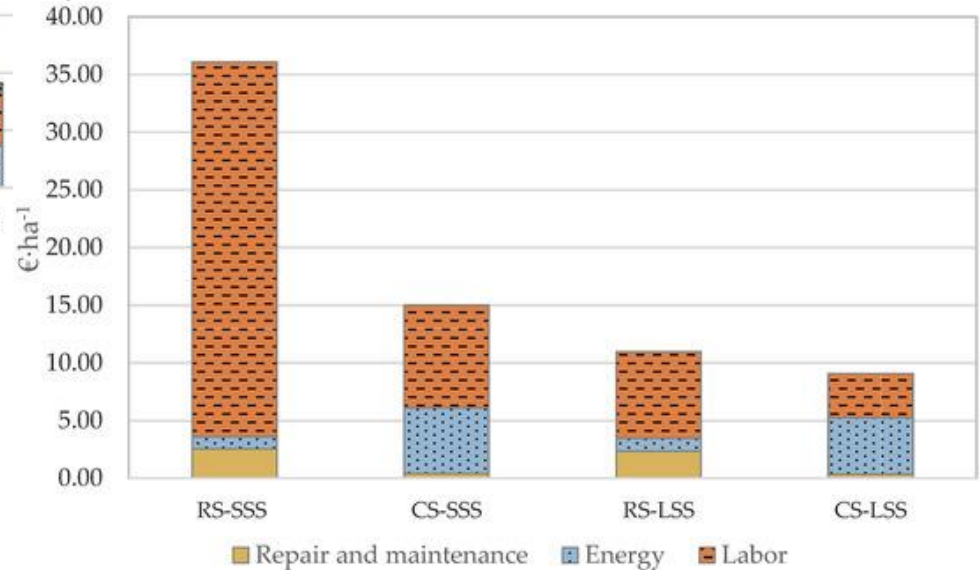
# Sustainability Analysis of UGVs replacing Tractors



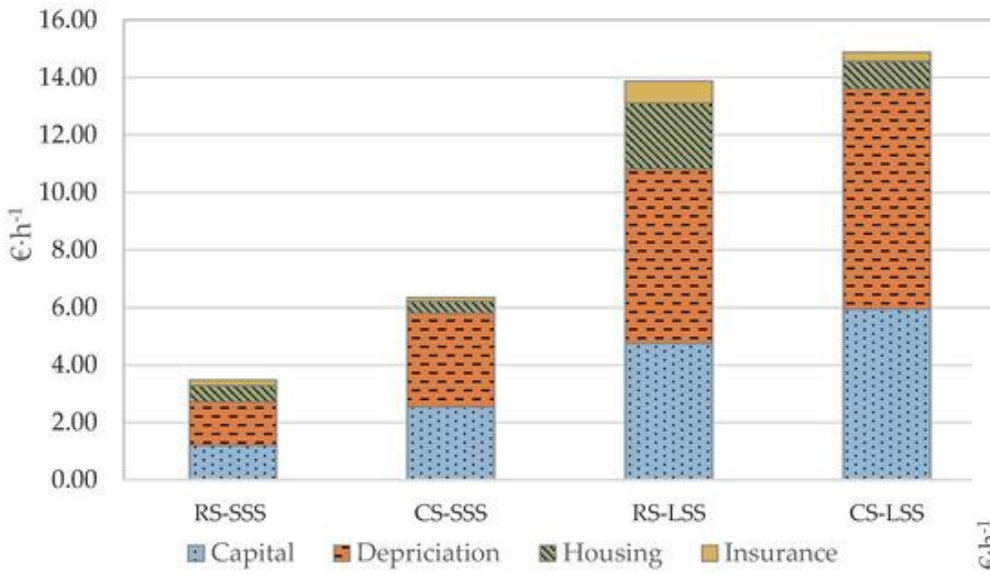
# Sustainability Analysis of UGVs replacing Tractors



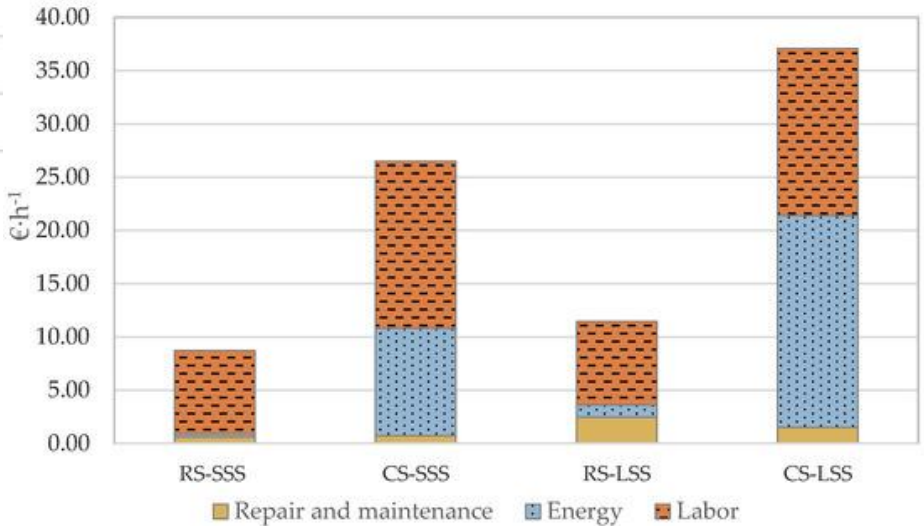
## Ownership Cost per unit area



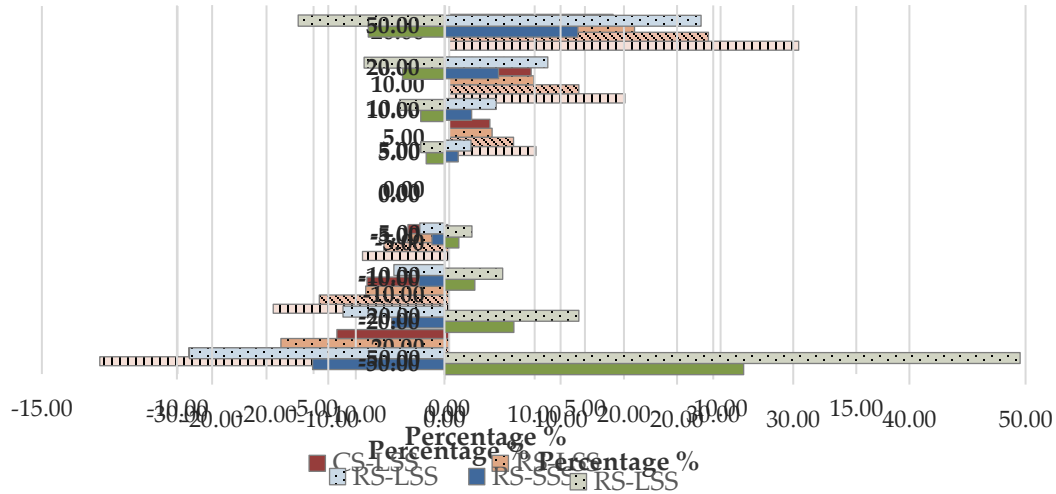
# Sustainability Analysis of UGVs replacing Tractors



Ownership Cost per unit time



# Main Results



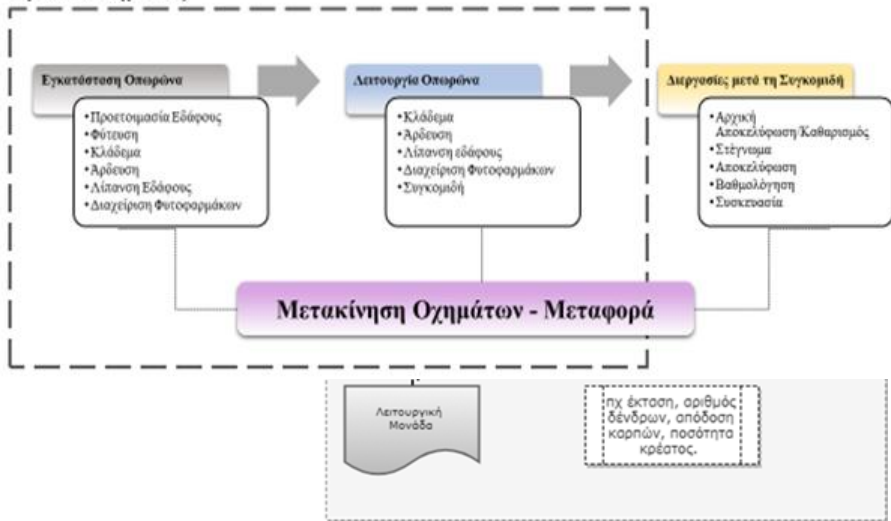
**Sensitivity Analysis**  
 (Total Cost - Primary Cost)

\*RS: Robotic System; CS: Conventional System; SSS: Small Scale Scenario; LSS: Large Scale Scenario



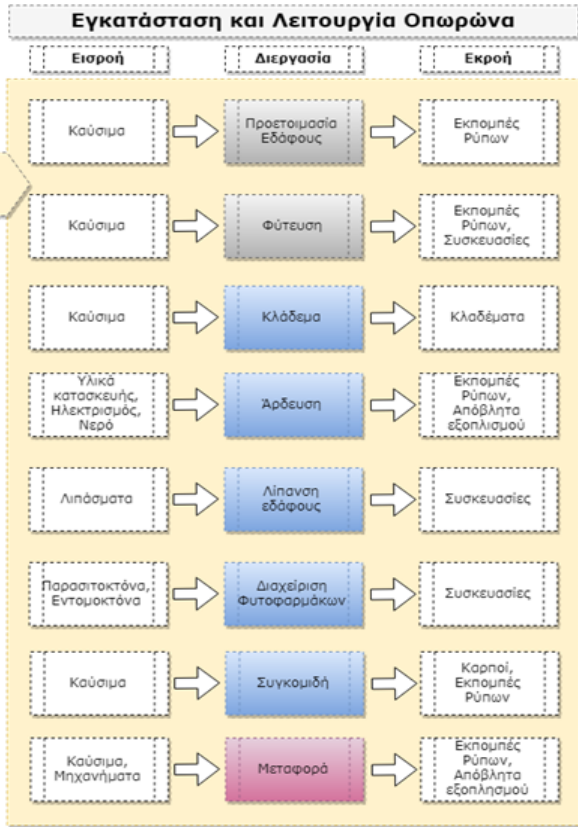
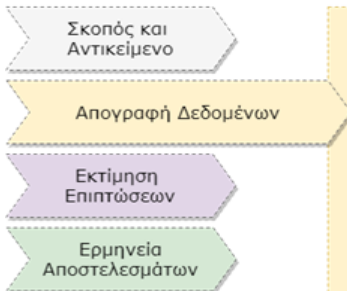


Όρια Συστήματος



Orchard LCA Study  
(Purpose and Subject)

Ανάλυση Κύκλου Ζωής





THIS PROJECT HAS RECEIVED FUNDING FROM  
THE EUROPEAN UNION'S HORIZON 2020 RESEARCH  
AND INNOVATION PROGRAMME UNDER GRANT  
AGREEMENT N. 773718



PTIMA



PTIMA

*Redefining Pest Management - a Holistic Approach*

---

**OPTimised Integrated Pest MAnagement**

**for precise detection and control of plant diseases  
in perennial crops and open-field vegetables**

---

# Current situation

## The present situation about crop protection

Few bio-PPP available

Poor sprayer adjustment

High number of treatments



High losses of PPP out of target

High cost

High environmental impact

## OPTIMA field activities will be carried out in:



**FRANCE**

**Crop:** carrots in open field

**Disease:** Alternaria leaf blight

**OPTIMA Partners:**

IRSTEA, INVENIO, AGROCAMPUS



**SPAIN**

**Crop:** apple orchards

**Disease:** Apple scab

**OPTIMA Partners:** UPC



**ITALY**

**Crop:** vineyards

**Disease:** Grape downy mildew

**OPTIMA Partners:** UNITO, TERRE DA VINO



# Objectives

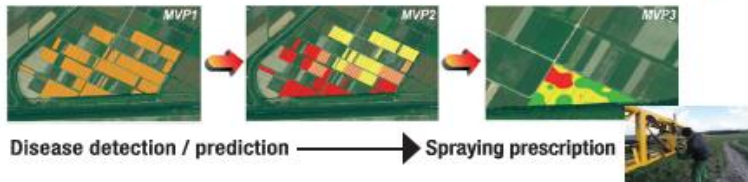


To develop an environmentally friendly Integrated Pest Management (IPM) framework for orchards, vineyards and open-field vegetables through:

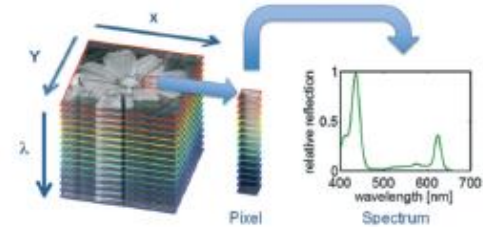
## A. Combined use of bio-PPPs and synthetic PPPs



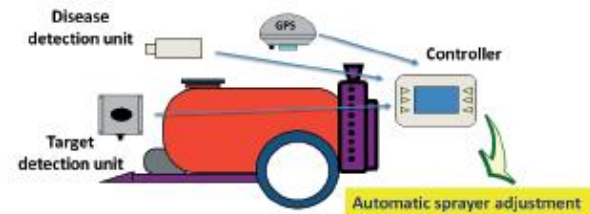
## B. Decision Support System (DSS) for disease prediction and to address product choice, time of application and sprayer settings



## C. Spectral disease detection systems



## D. Precision spraying techniques



# Actions



## 1 Optimise early disease detection method and disease prediction models



Crop

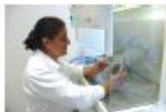


Disease detector



Predise prediction of when, where and how much the disease will be present in the field

## 2 Screen and evaluate, first in lab then in field, biological and synthetic PPPs for maximal disease control



Carrot leaf blight



Vine downy mildew



Apple scab

## 3 Implement new precision spraying technologies on smart sprayer prototypes



Boom sprayer for carrots



Air assisted sprayer for vineyards



Air assisted sprayer for apple orchards

## 4 Create a DSS for supporting the operator in selecting appropriate time, PPP type and sprayer settings for each application



- Date of treatment
- Type of PPP
- Volume application rate (L/ha)
- Droplet size (fine, medium, coarse)
- Number of active nozzles
- Air flow rate
- Etc.

## 5 Evaluation of new IPM elements in the field



IPM SYSTEM

### FIELD TESTS



## 6 Assess health, environmental and socioeconomic impacts of the proposed IPM system



IPM SYSTEM

IMPACTS



# Expected results



**A** Earlier detection and precise prediction of crop diseases in the field

**B** Improved IPM strategy to prevent and control crop diseases

**C** Optimised combination of biological and synthetic PPP to control crop diseases

**D** Adoption and spreading of smart technologies among farmers to optimise spray application

**E** Reduction of plant protection costs

**F** Reduction of environmental impact of PPP use

**G** Increase of agricultural products quality and minimisation of PPP residues

# OPTIMA – Optimised Pest Integrated Management



**PREDICTION** of plant  
disease outbreak

**DETECTION** of symptoms

**SELECTION** of a mix of bio and chemical PPPs

**EMPLOYMENT** of smart spraying solutions

**ASSESSMENT** of proposed  
IPM system

*Pest Management as it ought to be...*

 @OptimalIPM 

 @Optima\_IPM 

@optima\_ipm optima-ipm



<http://optima-h2020.eu/>



THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 773718



Accelerating **INNO**vative practices for **Spray Equipment, Training and Advising** in European agriculture through the mobilization of agricultural knowledge and innovation systems

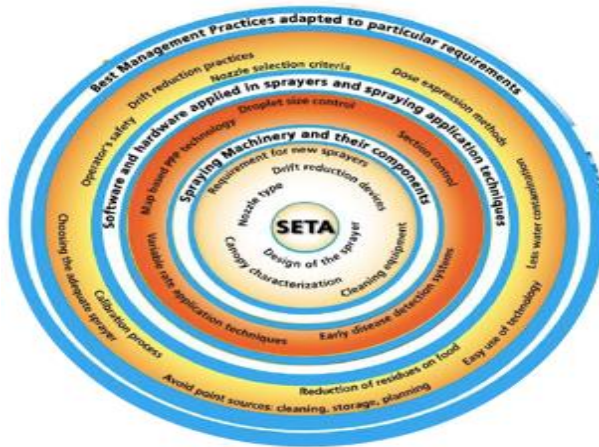


THIS PROJECT HAS RECEIVED FUNDING FROM THE  
**EUROPEAN UNION'S HORIZON 2020 RESEARCH AND  
INNOVATION PROGRAMME** UNDER GRANT  
AGREEMENT NO.773864



# SETA

**Spraying, Equipment, Training and Advising (SETA)** refers to the circle of tools that are required to cover the PPP use for crop protection including **Spraying Machinery and their components**, **electronic technologies** (software and hardware) applied in sprayers and **spray application techniques** and **Best Management Practices** adapted to particular requirements.



# Objectives

**Objective 1. Create an inventory** of directly applicable spraying equipment and technologies, training materials and advisory tools available from the large stock of research results and commercial applications.

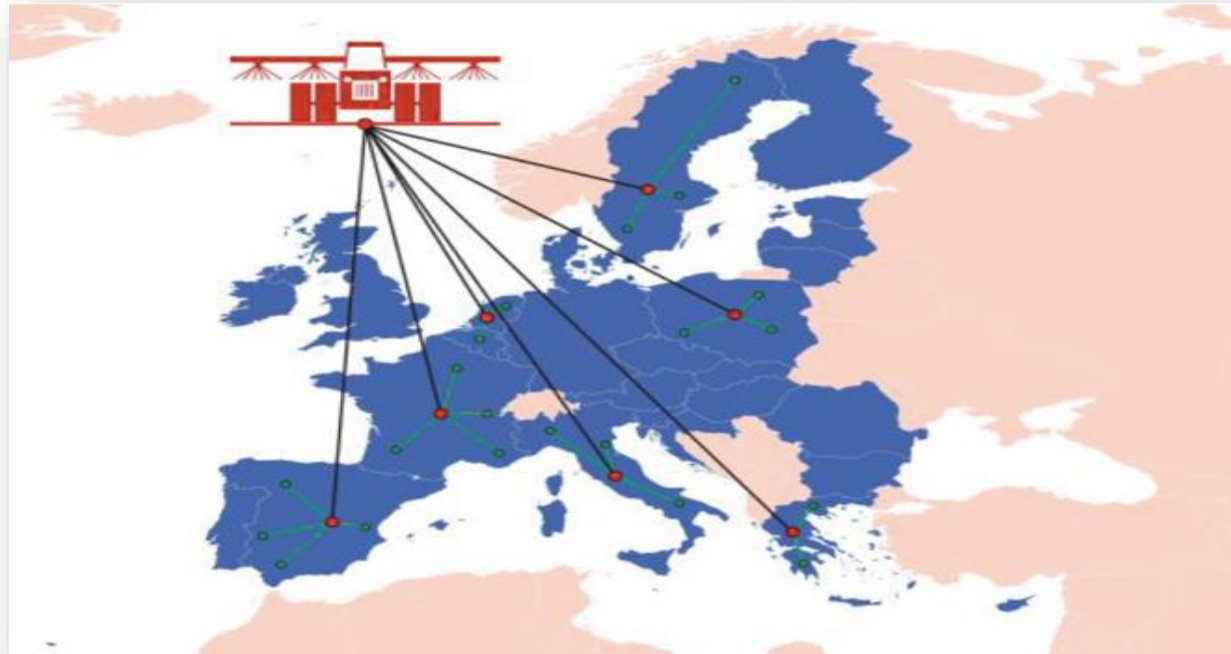
**Objective 2. Assess end-user needs and interests**, and identify factors influencing adoption taking into account regional specificities.

**Objective 3. Generate interactive multi-actor, innovation-based collaborations** among different stakeholders.

**Objective 4. Set up of an ICT tool** for the on-line assessment of the Spraying Equipment, Training and Advising and the crowdsourcing of grassroots-level ideas and needs.

**Objective 5.** Liaise with EIP-AGRI and its structures

- ❑ 7 countries, 15 partners
- ❑ **Field crops, orchards, greenhouses**
- ❑ **Academia, Research, EU associations, farmer's associations, advisors**



# Structure of platform



INNOSETA web application

http://www.innoseta.eu

**INNOSETA**  
INNOVATIVE SPRAYING EQUIPMENT TRAINING ADVISING

## SETA Technology Title

**#** Technology Acronym

 <http://www.technology-website>

**@** [technology@coordinator.c](mailto:technology@coordinator.c)

 TRL7 (System Development)



On hover an image of the scale will be presented with the equivalent description

Technology Objective | Technology Identity | Technology Specifications

Technology Objective

Technology Identity

Technology Specifications

On Hover the previous technology will appear in a small popupbox (Title, Image).  
On click, the browser will navigate to the previous technology/

Previous

Next

On Hover the new technology will appear in a small popupbox (Title, Image).  
On click, the browser will navigate to the next technology/

INNOSETA web application  
http://www.innoseta.eu

**INNOSETA**  
INNOVATIVE SPRAYING EQUIPMENT TRAINING ADVISING

## SETA Technology Title

**Previous** **Next**

**#** Technology Acronym

**http://www.technology-website**

**@** technology@coordinator.c

**TRL7 (System Development)**

On Hover the previous technology will appear in a small popupbox (Title, Image).  
On click, the browser will navigate to the previous technology/

On Hover the new technology will appear in a small popupbox (Title, Image).  
On click, the browser will navigate to the next technology/

On hover an image of the scale will be presented with the equivalent description

Technology Objective | **Technology Identity** | Technology Specifications

In which cropping system(s) can this SETA be used?

Arable Crops | Open field Vegetables | Orchards & Vineyards | Greenhouses

What is the technology readiness level (TRL) of this SETA?

TRL 4 - Full commercial platform

Who will use the SETA?

Farmer | Supplier

This SETA has the following effect on:

Productivity ↑ | Input costs ↑ | CO2 emission ↓ | N2O emission ↓

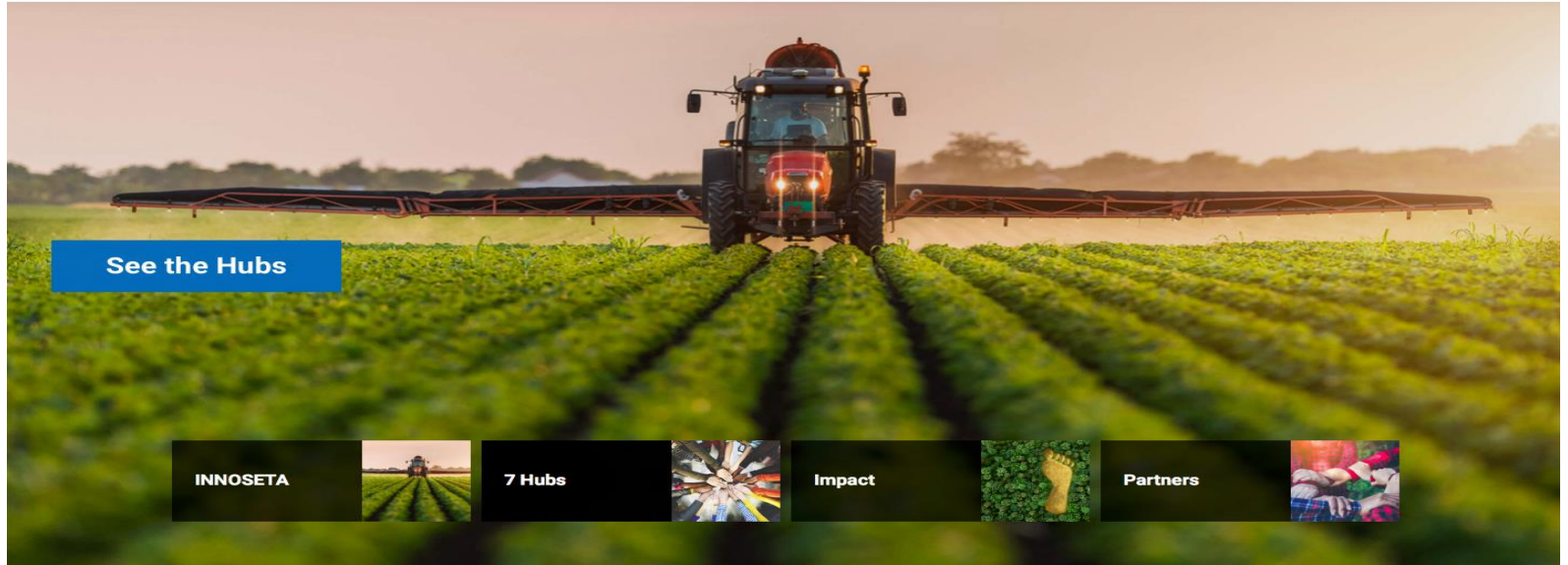
When decrease is a negative effect

Large Decrease	Some Decrease	Some Increase	Some Decrease	Large Increase
1	2	3	4	5

When decrease is a positive effect

Large Decrease	Some Decrease	Some Increase	Some Decrease	Large Increase
1	2	3	4	5

This is the legend for the KPI indicator arrows.  
When the user hovers on an arrow, this image will be presented in the form of popup to let the user know of the scale that is used.



[See the Hubs](#)

[INNOSETA](#)

[7 Hubs](#)

[Impact](#)

[Partners](#)

web site  
[www.innoseta.eu](http://www.innoseta.eu)

 **facebook.**  
[@InnosetaNetwork](#)

 **twitter**  
[@InnosetaNetwork](#)

 **Instagram**  
[@innoseta\\_thematicnetwork](#)

 **LinkedIn**  
Innoseta - Thematic Network



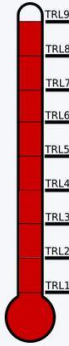

smart**AKIS**  
Smart Farming Thematic Network

Dashboard Technologies Short survey Help

Type your email address Type your password Log in

Shielded sprayers

Back to search Previous Next






**Basic information**


- Vendor:** Micron Group ([website](#))
- Country:** United Kingdom
- Technology:** Robotic system or smart machine
- Cropping system:** /
- Technology description:** A shield extending to within 5cm of the ground is placed over a nozzle/atomizer to contain the spray in weed control applications, thereby reducing the risk of spray drift. The design/shape of the shield is critical for the amount of drift reduction achieved, with all Micron shield designs giving over 90% drift reduction potential (based on UK testing). Micron shielded sprayers allow spraying right up to sensitive areas or crops since the risk of spray drift is virtually eliminated and allows reductions in pesticide use by applying in bands. Micron offer both vehicle (tractor and ATV/UTV mounted) and portable shielded sprayers. The shields can be used with Micron CDA atomisers in most instances, which allow low volumes thereby improving productivity of the spraying operation.


**Find out more**

- Website:** /
- Videos:** /
- Downloads:** /

**Variable costs**  Large decrease

**Pesticide use**  Large decrease

**Pesticide residue on product**  Large decrease

**Weed pressure**  Large decrease

Please rate this technology

Question 1: Is this a useful innovation?  No  Maybe/Don't know  Yes

Question 2: Are you interested in this innovation?  Not at all  Maybe  Yes

Question 3: Do you know other people [colleagues, neighbors, ...] who would be interested in this innovation?  Nobody  A few  Many

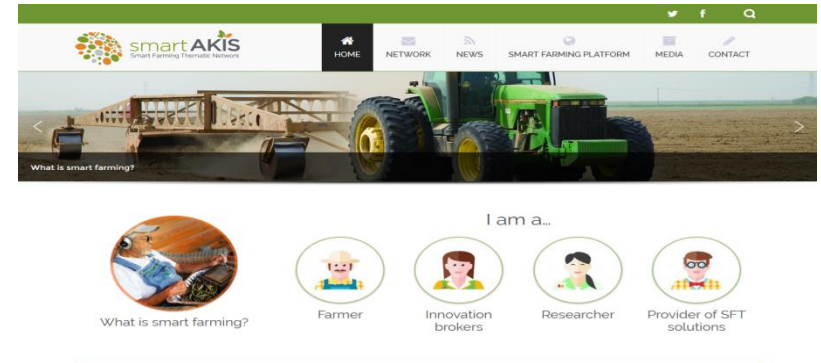
- 1094 SFTs have been included already in the Platform
- 172 entries are for commercial products (**FREE of charge promotion of SFTs**)



## RESULTS IN FIGURES:

- **1100 Smart Farming solutions** showcased and assessed on Smart Farming Platform.
- **+ 50 Smart Farming solutions adopted** by farmers and practitioners.
- **>1000 stakeholders** engaged in 21 regional and 2 transnational Innovation Workshops through 7 Innovation Hubs.
- **35 collaborative innovation projects** on Smart Farming.
- **10 transnational collaborative innovation projects** on Smart Farming.
- **50 links** created with Operational Groups.
- **>700 users** of the Smart Farming Community Platform.

- **WEBPORTAL:** [www.smart-akis.com](http://www.smart-akis.com)
- **FACEBOOK:** @SmartFarmingNetwork
- **TWITTER:** @smart\_akis

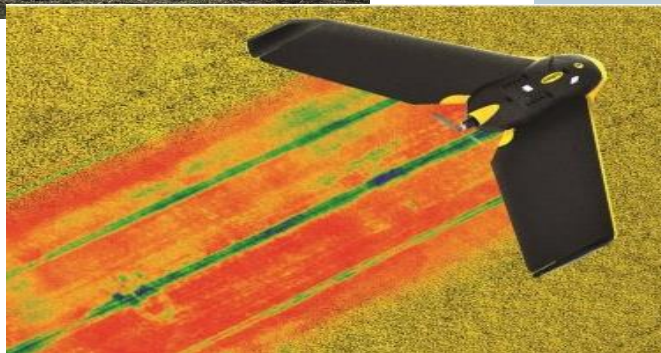
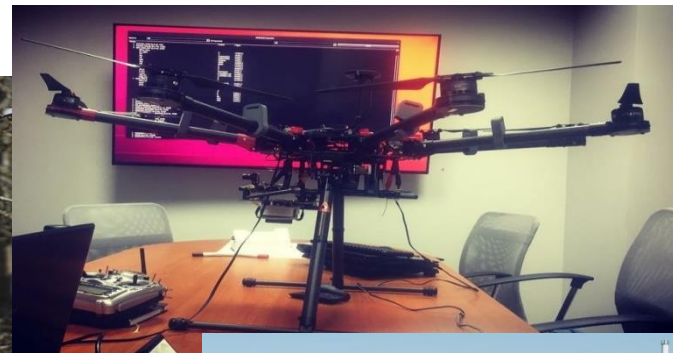


# Conclusion – Knowledge society

- **Knowledge Triangle** => The 3 basic development strategy coefficients in the modern era are:



- **Research** creates knowledge
- New knowledge, on its behalf, is transferred through **education and training** to the society
- Human resources are obliged to be in a position to **apply new technology** and **managerial methods and processes**



***Thank you for your attention!***

For more details: [a.balafoutis@certh.gr](mailto:a.balafoutis@certh.gr)

Smart farming technologies in service of modernizing agriculture

page 64

