CONTENTS

✳ **NEW USE CASES**

IoF2020
IN A NUTSHELL

The Internet of Food and Farm 2020 (IoF2020) project aims to consolidate Europe's leading position in the Internet of Things (IoT) technology applied to the agri-food sector. We develop an ecosystem consisting of farmers, food companies, policy-makers, technology providers, research institutes and end-users. The project aims to solve the European food and farming sectors' social challenges, maintain their competitiveness and increase their sustainability.

FOR MORE INFO:
IOF2020.EU

LEAN MULTI-ACTOR APPROACH

IoF2020 uses a lean multi-actor approach focusing on user acceptability, stakeholder engagement and the development of sustainable business models. IoF2020 aims to increase the economic viability and market share of developed technologies, while bringing end-users' and farmers' adoption of these technological solutions to the next stage.

THE STANDARDS

With an open ecosystem and collaboration space, the project relies on existing standards, as well as security and privacy platforms, applying these to the food production chains.

TOWARDS AN ECOSYSTEM

Led by the Wageningen University and Research (WUR), the 120+ members consortium includes partners from agriculture as well as ICT sectors and uses open source technology provided by other initiatives (e.g. FIWARE). Together we build an innovation ecosystem in which technology is validated, knowledge is shared and innovative solutions are brought to market

GOVERNANCE & STRUCTURE

IoF2020 is structured in 6 Work Packages, developed to help IoF2020 deliver its results.

PROJECT MANAGEMENT AND COORDINATION
1

TRIAL MANAGEMENT
2

IOT INTEGRATION & CAPABILITIES
3

BUSINESS SUPPORT
4

ECOSYSTEM DEVELOPMENT
5

(DATA) ETHICS
6
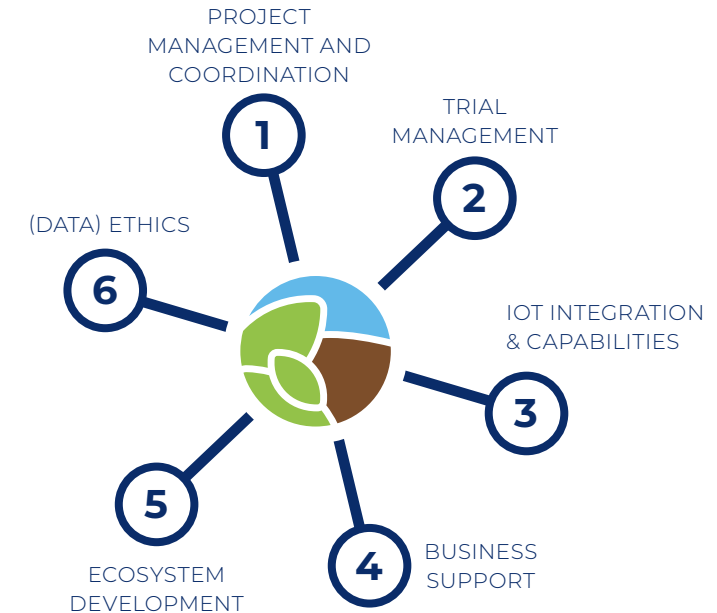
THE FACES BEHIND THE WORK PACKAGES
AND THEIR OBJECTIVES

GEORGE BEERS
LEADER WP 1
PROJECT MANAGEMENT

Our Work Package is in charge of the overall organisation of the project. We coordinate all activities and monitor their progress. We handle the finances and are the contact point for the European Commission. Furthermore, we ensure a smooth and well-organised project, so all Work Packages and use cases can perform optimally. Basically, we try to keep everybody happy: a challenging task!

GRIGORIS CHATZIKOSTAS
LEADER WP 2
TRIAL MANAGEMENT

We monitor and support use cases and trials (sectors). We connect the teams that work in the field with the large pool of experts within the IoF2020 ecosystem. By constantly observing all use cases from a birds-eye view, we identify common challenges, opportunities for collaboration and replicable best practices. These best practices will boost the IoF2020 impact for European farmers and consumers.

HARALD SUNDMAEKER
LEADER WP 3
IOT INTEGRATION & CAPABILITIES

We aim at identifying IoT technologies that offer solutions for the agri-food domain. We support our teams to validate these promising technologies since components used throughout all IoF2020 use cases might be reusable in other situations. Hence, we are working on technological synergies that make the development of IoT based solutions more efficient and effective.

ALEXANDER BERLIN
LEADER WP 4
BUSINESS SUPPORT

Our expert team of consultants and researchers offers individual advice to all use cases on how to monetise their products and services with innovative data-driven business models. The core objective for the business support team is to make all IoF2020 products and services commercially viable in the market and whilst also showing their economic, environmental and social value.

EDWIN HECKER
LEADER WP 5
ECOSYSTEM DEVELOPMENT

We work on a self-sustaining ecosystem that doesn't end up in a drawer but lives on after the project. Dissemination (one-way) and communication (two-way) are a major part of our work. An example is the magazine you're reading right now! Sometimes people are hard to reach and busy with daily things, hence there is a need for experts to develop creative communication materials to connect all IoF2020 partners.

SIMONE VAN DER BURG
LEADER WP 6
(DATA) ETHICS

It is our objective to support use cases in dealing with ethical questions. Moreover, we develop a perspective on responsible data sharing together with stakeholders (policy-makers, farmers, tech service providers, NGOs, researchers). The public goals of IoF2020 may not always coincide with the goals of businesses or other stakeholders. What 'success' means therefore depends on the perspective of the stakeholder that you speak to. Thus, we aim for a well-argued match.

KEY FACTS

- Funding Scheme: Horizon 2020, Industrial Leadership, IOT-01-2016
- Contribution of the European Union: €30 million
- Total costs: €35 million
- Duration: 4 years, 2017-2020
- Consortium: 120+ partners
- 5 trials: arable crops, dairy, fruits, vegetables and meat
- 33 use cases in 22 EU countries

FOR MORE INFO:
IOF2020.EU

A FLOURISHING ECOSYSTEM

5 TRIALS, 33 USE CASES

The IoF2020 project is organised around 5 agriculture sectors: arable crops, dairy, fruits, vegetables and meat. Within each trial several use cases demonstrate the value of IoT solutions for the European food and farming sectors.

FOR INTERACTIVE MAP:
IOF2020.EU/TRIALS

ARABLE   **DAIRY**   **FRUITS**   **VEGETABLES**   **MEAT**

12

13

IOF
2020

THE INTERNET OF ARABLE FARMING

The arable trial focuses on wheat, soy bean and potato production and processing in Europe's different climate zones. It includes activities across the cropping cycle: e.g. with the help of IoT technologies data relevant to growing crops is gathered (e.g. soil condition, humidity and weather conditions). This trial also includes machine-to-machine communication. Overall, the use of IoT in arable farming can help to reduce pesticide, fertilizer and energy use, while increasing transparency and food safety.

FOR MORE INFO:
IOF2020.EU/TRIALS/ARABLE

1.1 WITHIN-FIELD MANAGEMENT ZONING

- 20% SOIL FERTILITY LOSS

+ 5% CROP YIELD

- 70% FIELD ANALYSIS TIME AND COST

Arable farming faces increasing requirements and challenges when it comes to resource efficiency, environmental protection, transparency and chain optimisation.
To address this challenge, this use case seeks to:
• Develop specific IoT devices for acquisition of soil, crop and climate data in production and storage of key arable and vegetable crops;
• Showcase the benefits of the broad IoT implementation at the farm level.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	4TH MVP
APR 2018	MAY/SEPT 2018	NOV 2018	MAY 2019
Flow prepared automatically in Apps, handwork where necessary • Planting • Soil herbicide	Feed trails • Planting • Soil herbicide • Test nitrogen module	Flow includes ordering and results platform on all producs.	Flow ready for broad use • Planting • Soil herbicide • Nitrogen application

PARTNERS

ZLTO · kverneland group · kpn · BAYER · van den burg aardappelen · GRIMME · WAGENINGEN UNIVERSITY & RESEARCH

LOCATION

SCAN FOR MORE

16

1.2 PRECISION CROP MANAGEMENT

50 MILLION EURO MARKET POTENTIAL

14 MILLION HA POTENTIAL AREA COVERED

30 STEMS DEPLOYED IN FRANCE

The development of decision-making tools and services is a priority to help farmers adopt better practices and optimise input management for their fields. The elaboration of precise advice relies on accurate observations of crop status and the growing environment. Existing services use climatic data and satellite imagery that provide valuable information but have their limitations. The improvement of these services requires the highest spatial and temporal resolutions accessible, using ground-based sensors which measure nitrogen and water, the two main limiting factors impacting wheat production. In 2019, 35 systems are deployed in Ile de France and Provence regions to assess the technical and economic value of the IoT technology.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	4TH MVP
APR 2018	OCT 2018	FEB 2019	JUN 2019
• First version of crop dashboard (growth stage) • First of decision support based on localized data	• Combination between IOT and satellite • Second version of crop dashboard	• Real time nitrogen dicision support tool • Real time irrigation dicision support tool	• final version of decision support tool

PARTNERS

ARVALIS Institut du végétal · orange · hi-phen · BOSCH

LOCATION

SCAN FOR MORE

17

1.3
SOYA PROTEIN MANAGEMENT

Soybeans are a major source of high-protein food and feed for livestock. Currently, the EU is highly dependent on imports from soya producing countries. Since an increasing number of farmers start to produce soybeans as protein crop in Europe, this use case addresses the lack of technological innovation in their cultivation and processing of protein plants in order to tap the huge potential in terms of improving the quantitative and qualitative outcome per hectare. IoT technology connects data and information on soil, weather, cultivation and harvest to support producers and to enable better traceability for certified value chains, thereby improving the transparency of plant and animal food products.

USE CASE TIME PLAN

DEMO	1ST MVP	2ND MVP	4TH MVP
MAY 2018	**APR 2019**	**DEC 2019**	**OCT 2020**
• Webbased demo with visualization of soil and meteo sensor data • Irrigation alert	• Irrigation feature • Field management • Wireless connection of meteo, soil and NIR sensors • Documentation	• API to CNHi • Variety selection feature • Improved protein maximization approach through statistically verified correlation	• Tested and improved DSS with connection to all relevant IOT devices • Documentation for quality standard: Connection of field data and quality assurance software

PARTNERS

DONAU SOJA   SOIA ITALIA

1.4
FARM MACHINE INTEROPERABILITY

Every farmer wants his equipment to work seamlessly together, designed as one integrated system that is interoperable regardless of vendor. Interoperability of IoT devices and machinery today is in its infancy. For the farmer it is a challenge to make all devices work together in the digital space, as there are different platforms using vendor specific communication.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	4TH MVP
DEC 2017	**DEC 2018**	**JUN 2019**	**JUN 2020**
Off-line interoperability • First version Proprietary ADAPT Plugin • First version Proprietary ISOXML ADAPT plugin	• Interoperability in real time communication • EFDI standard being developed by AEF	• Interopable file transfers • task data in ADAPT using EFDI	• Bi-directional interopable communication

PARTNERS

CNH INDUSTRIAL   AARHUS UNIVERSITY   kverneland group   AGROINTELLI   365FarmNet   AGCO Your Agriculture Company   WAGENINGEN UNIVERSITY & RESEARCH

+ 10%
INCREASED YIELD

- 10%
FOOD WASTE

- 10%
IN FUEL CONSUMPTION

**LOCATION**

SCAN

FOR MORE

1.5
POTATO DATA PROCESSING EXCHANGE

Being able to track produce back to the field regarding food security and quality, does not only support buyers and processors, it also helps farmers to identify problems and improve their yields in the following years.

As an important step towards smart digital farming, this use case:
- Collects information and opens data flows between stakeholders in the supply chain;
- Measures potato crop growth, yield prediction, caliber yield measurements on the harvester and traceability data from field location to location in the shed;
- Mounts IoT devices on the harvesting machines to gather precise location-based information;
- Facilitates data exchange with the processing industry according to the current state of the art in standardisation.

PARTNERS
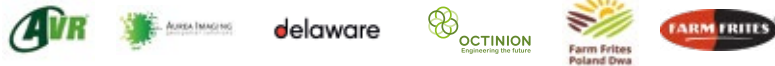
HOW IT WORKS

Different data points will be collected in real time on the different machines and will be analysed, stored and exchanged with other partners in this project. The IoT platforms of Aurea & AVR will be used as gateway.
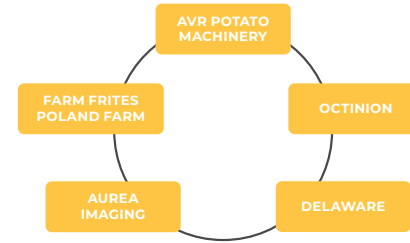
In this use case farmers (Farm Frites Poland DWA) and the processing industry are present (Farm Frites Poland). AVR (potato machine manufacturer), Aurea Imaging (drone image analysis) and Octinion (caliber yield measurement) are developing the sensors and measurement principles supported by the IoT company Delaware.

THE IMPACT

OUR OBJECTIVES
- Cover three test fields in three countries: Sweden, Poland and Belgium;
- Exchange the collected data with Farm Frites Poland, as processing industry partner in this use case;
- Focus on the standardisation of this data exchange.

ECONOMIC IMPACT
- Increase in yield (+10%);
- Reduction in fuel consumption (-10%);
- Gross margin (+5%);
- Reduce costs in processing industry;
- Give fast digital access to important information.

OTHER IMPACT
- Food waste through alignment of supply and demand (-10%);
- Improve harvested potato yield;
- Give farmers more insight in data elements for business optimisation.

- 15%
PESTICIDE USE

- 25%
WATER CONSUMPTION

- 19%
TOTAL INPUT COSTS

LOCATION

1.6 DATA-DRIVEN POTATO PRODUCTION

European potato producers are facing a series of challenges such as crop pests, diseases and climate change. Hence, this use case adopts a holistic approach based on research and a unique blend of cutting-edge technologies while offering inexpensive yet valuable advice to farmers. An innovative, market-ready smart farming solution supports irrigation, pest management and fertilisation. Leveraging a network of telemetric IoT stations combined with satellite data and scientific models tailored to the specificities of the geographic areas, helps small-scale farmers to tackle those challenges.
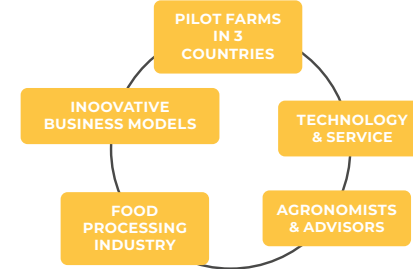
SCAN
FOR MORE

PARTNERS

NEUROPUBLIC

WAGENINGEN UNIVERSITY & RESEARCH

Delphy

Farm Frites Poland Dwa

HOW IT WORKS

Data-driven potato prediction utilises the GAIA sense smart farming solution which provides innovative services, building on state-of-the-art technologies like IoT, Big Data, Earth Observation, Context-based decision support and machine learning.

The GAIA sense solution is extended with FIWARE-powered, standards based, data exchange mechanisms in support of cross-system interoperability and openness.

- PILOT FARMS IN 3 COUNTRIES
- TECHNOLOGY & SERVICE
- AGRONOMISTS & ADVISORS
- FOOD PROCESSING INDUSTRY
- INOOVATIVE BUSINESS MODELS

THE IMPACT

OUR OBJECTIVES
· Demonstrate how the use of IoT-driven smart farming solutions can help reduce the environmental footprint of agriculture;
· Facilitating farmers' compliance with a wide range of European environmental legislation, including water and soil protection;
· Improvement of nitrogen use efficiency (+15%);
· Reduction of pesticides use (-15%);
· Reduction of water consumption (-25%).
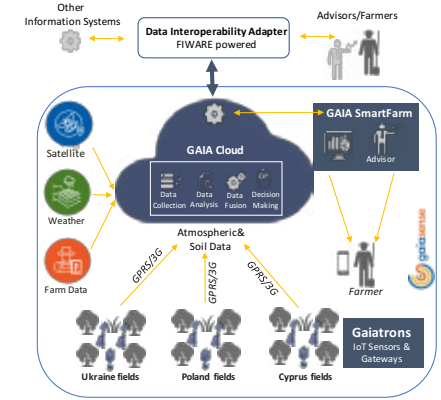
OTHER IMPACT
· Demonstrating the potential benefits derived from the use of IoT-driven solutions;
· Achieve sustainable economic growth and foster innovation;
· Reduction of inputs costs (-18,6%);
· Farmers benefited from the provided advice >500;
· Smart farming advice available up to 1500ha;
· Building on extensive business network in >50 countries.

> 95%
ROBUSTNESS

> 95%
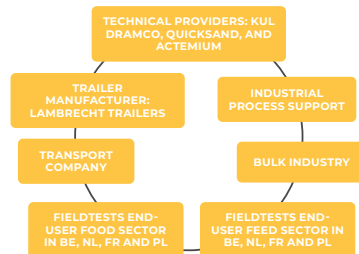SUCCESSFUL DETECTION

0%
CONTAMINATION RATE

LOCATION

SCAN
FOR MORE

1.7
TRACEABILITY FOR FOOD AND FEED LOGISTICS

This use case deploys an innovative approach that secures and authenticates the transport of bulk-goods in the agri-food chain, both for feed and food with zero risk of contamination. There is a need to guarantee the traceability of bulk food and feed deliveries from the moment it leaves the loading station right up to when it is delivered to a farm's silo. A fully automated silo detection system, using IoT solutions, guarantees that the right bulk contents are correctly delivered, and that the specifics of that delivery are registered. This solution thus helps to prevent feed and food wastage caused by wrong deliveries.

TECHNICAL PROVIDERS: KUL DRAMCO, QUICKSAND, AND ACTEMIUM

TRAILER MANUFACTURER: LAMBRECHT TRAILERS

INDUSTRIAL PROCESS SUPPORT

TRANSPORT COMPANY

BULK INDUSTRY

FIELDTESTS END-USER FOOD SECTOR IN BE, NL, FR AND PL

FIELDTESTS END-USER FEED SECTOR IN BE, NL, FR AND PL

PARTNERS

Lambrecht   KU LEUVEN   QUICKSAND   DRAMCC

HOW IT WORKS

The detection system requires the establishment of communication between the loading station and the trailer, using Wi-Fi routers. The transferred data lists which kinds of animal feed are loaded in the different compartments of the trailer.
A base station device, controller and TAG wireless reader are all installed on the bulk trailer. The moment this reader confirms the connection with the right silo, the matching compartment of the trailer can be released and unloaded.
A unique TAG identification is installed on each silo for all delivery addresses.
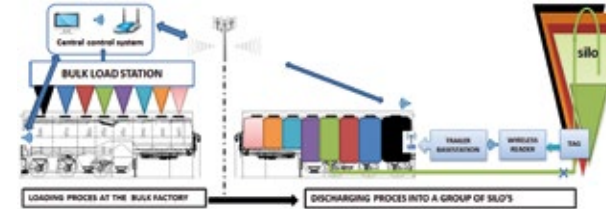
THE IMPACT

OUR OBJECTIVES
· Real time data delivery and localisation of all trailers;
· Secured delivery procedures;
· Establish complete traceability from factory to client;
· Detailed monitoring of the discharging procedure;
· Direct alarm in case of deviations during the deliveries;
· Data concerning preventive maintenance of the end-user's transport fleet.

ON ECONOMY
· Reduce the recovery cost due to wrong deliveries of feed or food (-90%);
· Compatibility due to system interoperability (99%);
· Increase transport efficiency through data analysis;
· Reduce the destruction cost of contaminated silo content (-90%).

OTHER IMPACT
· Reduce the waste of conta-minated silo contents (-90%);
· Lower the need for additional transport (less CO2 emissions), for silo cleaning and re-delivery of new feed by (-90 %);
· Provide guidance and support for truck drivers during the delivery process;
· Increase farmers' trust in the delivery and quality of their feed;
· Improve food safety by securing the supply chain both for animal feed and human food.

2000
SMART SENSORS

- 30%
ENERGY USE

- 35%
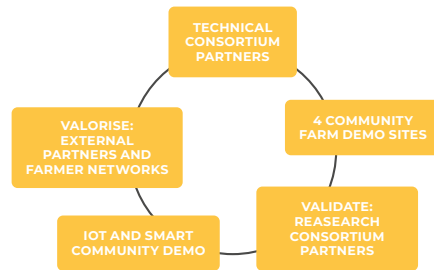FERTILISER INPUT

LOCATION

SCAN

FOR MORE

1.8
SOLAR-POWERED FIELD SENSORS

The lack of access to affordable and scalable on-field diagnostics for small farmers is addressed through:

- Reduced design complexity to facilitate ease of use without the need for additional training;
- Integration of all farm information and devices in one farm manager;
- Development of sustainable marketing strategies to incentivise farmers to implement modern technology;
- Demonstration of sensor-based predictive analytics for diseases;
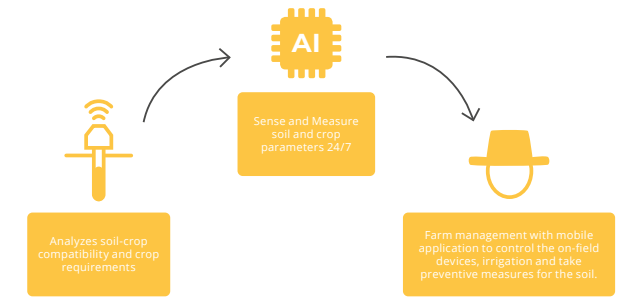- Application of the solution on different crops.

TECHNICAL CONSORTIUM PARTNERS

4 COMMUNITY FARM DEMO SITES

VALORISE: EXTERNAL PARTNERS AND FARMER NETWORKS

VALIDATE: REASEARCH CONSORTIUM PARTNERS

IOT AND SMART COMMUNITY DEMO

PARTNERS

Fraunhofer

SOLARVIBES

ÖMKi

HOW IT WORKS

Solar-powered field sensors offers plug and play IoT devices and AI-based precision farming solutions. The software analyses the soil-crop compatibility, crop requirements and nutrient deficiencies. The solution brings a soil laboratory to the fields and allows end-users to monitor and treat their crops in real time. This directly benefits farmers as it allows them to save water, minimise operating costs and reduce the risk of crop failures.

AI

Sense and Measure soil and crop parameters 24/7

Analyzes soil-crop compatibility and crop requirements

Farm management with mobile application to control the on-field devices, irrigation and take preventive measures for the soil.

THE IMPACT

OUR OBJECTIVES

- Calibrate and certify the devices to demonstrate the product among farmer networks of 4 institutions across 3 countries;
- Conduct micro-level market research;
- Develop a smart network of 2000 sensors to help farmers adopt sustainable farm practices;
- Improve overall agricultural efficiency;
- Build self-sustainable communities.

ECONOMIC IMPACT

- Decreased farm operation and inputs costs (-30%);
- Cost saving on energy and water consumption (-35%);
- Crop productivity increase for potato, wheat, maize (+15-30%).

OTHER IMPACT

- CO2 Emissions reduction (-20%);
- Water conservation (-35% vs previous year);
- Cut down on fertilisers Ammonium Nitrate, Superphosphate, Potassium sulphate, Dolomite, and Magnesium sulphate;
- Soil health restoration;
- Reduction of pesticides usage.

+ 5%
INCREASE IN
CROP YIELD

- 20%
USE OF
PESTICIDES

+ 15%
IN DROP
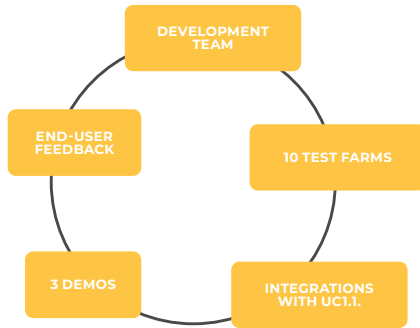QUALITY

LOCATION

SCAN
FOR MORE

1.9
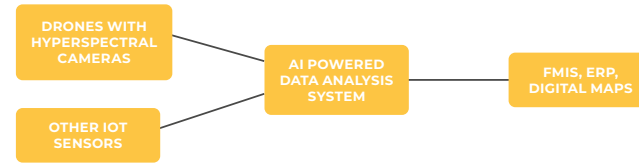# WITHIN-FIELD MANAGEMENT ZONING BALTICS

Spending on fertilisers and agrochemicals represents a considerable part of farmers' overall expenditure. By developing a remote sensing solution to determine which nutritional elements and how much of them a plant is lacking at different stages of its growth, such costs can be reduced. This use case demonstrates the added value of spectral data analysis and IoT technology for precise decision-making and optimised crop management in potato and winter wheat.

DEVELOPMENT TEAM

END-USER FEEDBACK

10 TEST FARMS

3 DEMOS

INTEGRATIONS WITH UC1.1.

PARTNERS

WAGENINGEN UNIVERSITY & RESEARCH

art 21

HOW IT WORKS

DRONES WITH HYPERSPECTRAL CAMERAS

OTHER IOT SENSORS

AI POWERED DATA ANALYSIS SYSTEM

FMIS, ERP, DIGITAL MAPS

Integration of advanced hyperspectral imaging and data analysis technologies to deliver a truly innovative solution to some of the most pressing issues for farmers. It uses Artificial Intelligence technologies (Machine Learning/Neural Networks) to perform complex analyses of crop field hyperspectral images. By analysing big amounts of spectral data the system learns to recognise various indicators or patterns, and identifies the composition of nutrients in crops. The solution integrates with FMIS for mapping of micro- and macronutrients in potato and winter wheat plants.

THE IMPACT

OUR OBJECTIVES
· Fast and cost-efficient way to detect the amounts of micro- and macro-nutritional elements needed in plants;
· Automatic recommendations for agrochemical application through non-invasive, remote sensing technology;
· Display the benefits of soil, crop and yield sensors for yield prediction, arable field management and chain optimisation;
· Demonstrate the added value of hyperspectral imaging and spectral data analysis at the farm level.

ECONOMIC IMPACT
· Yield increase (+5%);
· Field analysis time and cost (-70%);
· Early detection of plant stress and its causes;
· Soil fertility increase (+20%).

OTHER IMPACT
· Fertiliser use reduction (-30%);
· Classified data increase (x8);
· Stress reduction (+20%);
· Fertiliser cost reduction 40€ / ha
· User satisfaction (+33%).

IOF°

2O 2O
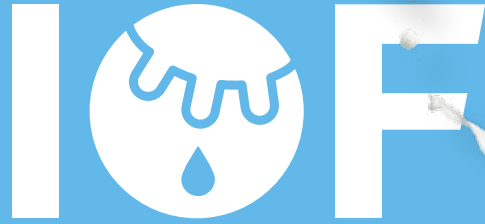
THE INTERNET OF DAIRY FARMING

The dairy trial explores the usefulness of collecting real-time sensor and GPS location data throughout the whole dairy chain–'from grass to glass', using neck collars or movement sensors for livestock. Use cases range from monitoring the outdoor grazing of cows (from 'grass') to the application of machine learning technologies and cloud-based services (to 'glass'), making it possible to ensure the quality of the dairy chain remotely.

**FOR MORE INFO:**
IOF2020.EU/TRIALS/DAIRY

2.1 GRAZING COW MONITOR

The Grazing cow monitor digitally monitors cows' grazing time and grazing location providing an easy way to generate digital reports for farmers, legal controllers and dairy processors. This is important to verify the state and location of cattle, pasturing for ammonia emission reduction and labels of 'milk from pasture'. The system uses the STICKNTRACK low-power indoor-outdoor tracking service that combines the LPWAN SIGFOX network with BLE technology to track individual cows and measure their pasturing time. The system can also track extensively grazed livestock such as dairy cows, beef cattle, horses, sheep, and reindeer, but can also track wildlife.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	4TH MVP
SEPT 2017	**MAR 2018**	**JUL 2018**	**MAY 2019**
• Cow grazing monitor of dairy cows on pasture	• Cow grazing monitor of dairy cows on pasture	• .xls based reports available	• Dedicated dashboard
• Application v1 available to researchers	• Track some farm equipment	• dedicated cow alerts and profiles	• Optimized collar system
• indoor/outdoor algorithm v1	• Webapp v2 available to farmer	• Mobile app available to farmer	• Find my cow feature
	• indoor/outdoor algorithm v2		• Webapp v3 available to farmer

PARTNERS

ILVO sensolus inagro
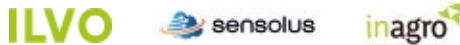
2.2 HAPPY COW

Farmers do not need more data, in fact, farmers require deeper insight into their farm activity. Hence, this use case bridges the existing technology gap for farmers who seek advice on how to increase productivity, improve efficiencies, reduce health incidents and how to better care for a more fertile and happier herd. Through a combination of advanced sensor hardware technology and state of the art deep-learning algorithms, this use case takes the next step in the advancement of farming for the future.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	4TH MVP
COMPANY FOUNDATION	**EXPANSION**	**IoF2020 PARTNERSHIP**	**DATE**
• MVP	• Product development	• Happy cow	• Feature development: partner dashboard & calving insights
• Ida on first farms	• Use case progress	• Farmer use cases	• Team growth
• Pitching and various awards	• Team growth	• Product development	• International expansion

PARTNERS

Connecterra WAGENINGEN UNIVERSITY & RESEARCH ZLTO veteffect

2.3 HERDSMAN

This use case implements, validates and showcases the use of real time data primarily derived from a neck mounted collar together with other relevant data (milk constituent and feed sensors) to create information of value to the dairy supply chain from 'grass to glass'. The impact is a more efficient use of resources and production of quality foods, combined with an enhanced animal health and environmental implementation. Through early intervention strategies stemming from warning systems and quality data that can be used for remote calibration and validation of sensors, this use case's focus is on the welfare of cows. Ultimately, it also optimises the reproduction rate through increasing herd fertility.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	FEATURE ENHANCEMENT 1
JUL 2018	JAN 2019	JUL 2019	JUL 2020
• Initial prediction of Mastitis only • Interrogation of disparate databases • Preliminary user presentation • Housed dairy farming • PC on-farm • Internet access preferred	• Accurate prediction of the onset of Mastitis • Interrogation of disparate databases • Alerts generated • Housed dairy farming • PC on-farm and cloud storage • Internet access	• Accurate prediction of the onset of Mastitis • Integrated database • Alerts generated • Housed dairy farming • PC on-farm and cloud storage • Internet access	• Accurate prediction of Ketosis • Addition of location • Housed/free-grazing farm systems • PC on-farm and cloud storage • Internet access

PARTNERS

University of Strathclyde Glasgow

34

2.4 REMOTE MILK QUALITY

This use case provides a quality assurance service of locally obtained milk and remote dairy composition analyses by using sensor appliances. Analytical instruments are monitored remotely and validated through the use of reference samples, calibration sets and software applications. This use case thus ensures:
• High safety, quality, sustainability and profitability in the dairy chain;
• Reliable results from instrumental analyses (IR) for dairy processors and local testing laboratories;
• Calibration and harmonisation expertise within an organization.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	4TH MVP
Q3 2019	JAN 2020	Q3 2020	2021
• Plan for data communication platform to exchange data with testing device on milk collection truck • Identification of aplicable IOT, communication protocols and datamodels	• First beta version of platform and datamodel available	• First MVP available of integrated communication platform with IoT elements	• Total integration of communication platform with testing devices and info platform for dairy processors

PARTNERS

Qlip
quality assurance in agri-food

35

87%
DETECTION
ACCURACY

- 15%
REQUIRED
TREATMENT TIME
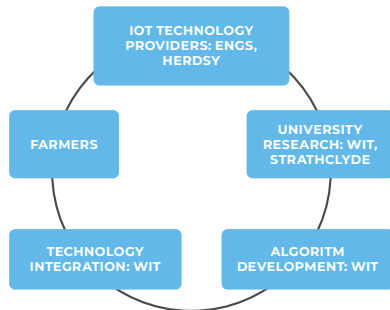
- 7%
MILK YIELD LOSS

LOCATION

SCAN

FOR MORE

2.5
EARLY LAMENESS DETECTION THROUGH MACHINE LEARNING

Lameness is a substantial issue in the dairy industry – it entails pain and discomfort for the cow, and results in decreasing fertility and milk yield for the farmer. Current solutions are cost-intensive and involve complex equipment. Lameness can be addressed without having to spend a high amount of resources. By employing leg mounted sensors and machine learning algorithms lame cattle can be identified at an early stage, and the data acquired can be sent directly to the farmer so that treatment of lameness can start immediately.

IOT TECHNOLOGY PROVIDERS: ENGS, HERDSY

FARMERS

UNIVERSITY RESEARCH: WIT, STRATHCLYDE

TECHNOLOGY INTEGRATION: WIT

ALGORITM DEVELOPMENT: WIT

PARTNERS

HOW IT WORKS

The use case will build upon an existing trial for early lameness detection deployed on a farm in South East Ireland and extend as well as integrate this deployment into other IoF2020 use cases. The current deployment on a farm with 150 cattle utilises leg mounted sensors and uses Machine Learning for early lameness detection. The team will attach sensors from two separate vendors on cattle in dairy and beef herds in three further countries. The approach will thus be validated in different environments and scenarios.

MACHINE LEARNING EARLY LAMENESS DETECTION

DATA

ALERT
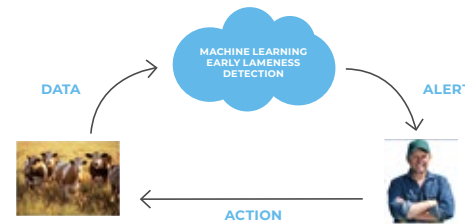
ACTION

THE IMPACT

OUR OBJECTIVES
· Integrate existing Lame Detection as a Service (LDaaS) into IoF2020 architecture;
· Extend the use case to integrate with existing third-party services;
· Expand the use case to new regions;
· Commercially validate the solution with multiple vendors.

ON ECONOMY
· Reduced animal mortality (-5%);
· Decreased milk yield loss due to lameness (-7%);
· Increased beef production (+10%).

OTHER IMPACT
· Lameness detection rate (+7%);
· Detection accuracy (87%);
· Improved reproduction efficiency index (+5%);
· Reduced usage of antibiotics (-5%).

4%
PRODUCTIVITY INCREASE

1500
COWS TRIALLED
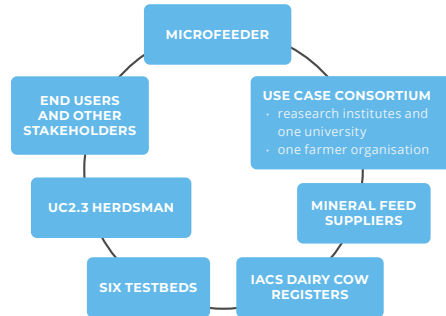
- 10%
HEALTH-RELATED LOSSES

LOCATION

SCAN
FOR MORE

2.6 PRECISION MINERAL SUPPLEMENTATION

Dairy farming faces increasing losses related to diseases and derived mortalities of dairy cows due to the expanding use of Total Mixed Rotations (TMR) and other standardised feeding, combined with increasing productivity. This use case challenges the situation by utilising IoT for precision supplementation, which is also a cost-efficient and practical way of using advanced feed additives. Relying on cloud-based services and data integration combined with the identification of cows via electronic ear tags allows catering to each animal's individual needs. Minerals and vitamins are important for cows' immune status, and feed additives can furthermore have wide impacts on the environment and climate.

MICROFEEDER

END USERS AND OTHER STAKEHOLDERS

USE CASE CONSORTIUM
· reasearch institutes and one university
· one farmer organisation

UC2.3 HERDSMAN

MINERAL FEED SUPPLIERS

SIX TESTBEDS

IACS DAIRY COW REGISTERS

PARTNERS

Organe

Zemnieku Saeima

Landwirtschafts-kammer Schleswig-Holstein

HOW IT WORKS

Pitstop+ is a mineral feeder for dairy cows, to be mounted in the stable or in an outside motion area. The feeder is equipped with electronic components for the identification of the cows via their electronic ear tags which can be delivered with the feeders in case such ear tags are not already used in the herd. The herd manager decides via the user interface which cows shall have dosed mineral supplements in the feeders. Moreover, the user interface enables the supervision of individual transition cow's eating behaviour and is thus a tool for improved herd management. It is expected to prove a connection between those parameters and the cow's performance as well as health.

THE CLOUD AZURE & SQL

WiFi

LoRa

HDX/FDX

THE IMPACT

OUR OBJECTIVES
The use case demonstrates precision mineral supplementation over twelve months in six dairy farms in Latvia, Germany and Lithuania, involving a total of 1,500 cows. Furthermore, it aims to showcase trial interoperability, replicability and the reusability of IoF2020 results or innovations, IoT layers and data flows via the cloud.

ON ECONOMY
Precision Mineral Supplementation is an easy, safe and efficient method:
· Costs for the feeder €4;
· Mineral costs per cow per year €27;
· Increase in milk per cow per day 1.2 kg;
· Reduction of health-related losses (-10%);
· Total savings per cow per year €146.

OTHER IMPACT
The Use Case will directly avoid losses to the nature and environment of 3,977 kg N and 230 kg P as well as 959 kg N in ammonia emissions. The corresponding amount of manure nutrients for the expected market reach of 3,375 million dairy cows is 327 million tonnes of N, 18.9 million tonnes of P and 79 million tonnes of N as ammonia emission. Also, due to higher feed efficiency, less land for growing feed for dairy cows is needed.

> **> 10%**
INSEMINATION
RATE INCREASE

- 15%
VISUAL
MONITORING
TIME

- 10%
MEDICATION/
TREATMENT
COSTS

LOCATION

SCAN

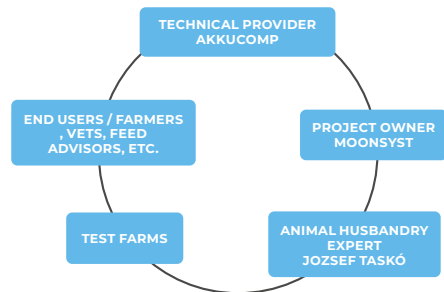**FOR MORE**

2.7
MULTI-SENSOR
COW MONITORING

This use case aims to further develop and promulgate a precise and reliable cattle monitoring ecosystem utilising the needs of multi-country dairy and beef farmers, stemming from previous user feedback analysis. By harmonising their different breeding methods and setting novel as well as customised software features accordingly, a mobile device solution for daily operations on all farm levels is developed. The system is made up of a small rumen bolus and collar, monitoring various physiological data, and a cloud-based server application to provide accurate information for daily operations. It helps farmers to guard, track and monitor all assets with the help of reliable, affordable, low-power, wide-range network technologies and smart sensors.

TECHNICAL PROVIDER
AKKUCOMP

END USERS / FARMERS
, VETS, FEED
ADVISORS, ETC.

PROJECT OWNER
MOONSYST

TEST FARMS

ANIMAL HUSBANDRY
EXPERT
JOZSEF TASKÓ

PARTNERS

moonsyst

GenXsen

YOUR CHAROLAIS

40

HOW IT WORKS

The development of the Moonsyst smart rumen bolus for cattle enables the following key functions and features:
· Accurate heat detection and calving alert
· Indoor and outdoor positioning through the latest technologies (NB-IoT or LoRa Geolocation)
· Monitoring of drinking behaviour
· Harsh environment operation (intraruminal)
· Easy deployment – no additional system devices needed (plug'n'play)
· Theft and roam protection of animals with localisation service
· Cloud-based platform
· Easy, user-friendly data visualization and interpretation
· Machine learning algorithms and Big Data solutions
· Cross platform/system data utilisation

| MOONSYST SMART RUMEN BOLUS & COLLAR | → | MOONSYST CLOUD-BASED DATABASE | → | MACHINE LEARNING AND BIG DATA PROCESSING | → | MOONSYST APP | → | TO DO LISTS, ALERTS AND NOTIFICATIONS |

THE IMPACT

OUR OBJECTIVES
· Improve livestock production processes, yield and quality;
· Increase reproduction rates;
· Decrease the occurrence of animal health problems (heat, stress, rumen acidosis, milk fever, etc.);
· Improve animal welfare through reduced number of veterinary interventions and antibiotics or hormone treatments.

ON ECONOMY
· Insemination rate increase >10%;
· Working time decrease >10%;
· Medication/treatment costs -10%;
· Visual monitoring time -15%.

ON ENVIRONMENT
· Enable better human resource management;
· Improve farmers' work-life balance;
· Optimise breeding selections and methods;
· Improved understanding of cattle behavior

41

IOF²⁰²⁰

THE INTERNET OF FRUITS

The fruit trial aims to improve the use of IoT-technologies in the fruit supply chain, from growing to harvesting and processing. This trial will gather data on pre- and post-harvest losses to increase the yield and quality of fruits. In addition, IoT-technologies is used to ensure better traceability of fruit products in relation to the protected designation of origin. The use cases include, among others, fresh table grapes, wine and olives, while addressing the challenges of automation in the fresh logistics.

FOR MORE INFO:
IOF2020.EU/TRIALS/FRUITS

3.1 FRESH TABLE GRAPES CHAIN

This use case integrates IoT technologies into the – conventional as well as organic - table grapes value chain and deploys them on farms of all scales. The farmers can therefore monitor their crop growth easily, allowing them to take better field operation decisions (e.g. spraying, irrigation, harvest). At field level, the implementation of IoT sensors produces not only economic benefits, it also yields positive environmental impacts due to improved resource management in terms of water, fuel and pesticide inputs. In the transportation process, technology helps to prolong shelf life, thus reducing spoilage.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	4TH MVP
JUL 2017	**OCT 2018**	**JUN 2019**	**MAR 2020**
• First divice installation • First DSS application • First blow trial	• Adaptive DSS (Blue Leaf) • Kc estimation • Blow application improvement	• Improvement of DSS • Kc estimation and calibration • Large scale development of Blow	• DSS data adapted to the whole farm • Kc automatic determination • Blow application on Apofruit products (market diffusion)

PARTNERS

3.2 BIG WINE OPTIMIZATION

Precision viticulture and remote vineyard monitoring are two promising new cultivation methods, allowing to monitor accurate weather data in real time, vine conditions (grape detection, phenological stage determination, and disease status characterisation) and key winery conditions with IoT technology. This use case therefore optimises the application of plant protection products through precise treatment identification and positioning, reducing the environmental impact and resource consumption while efficiently protecting grapes. Furthermore, selective harvesting and data analysis help facilitate decision-making to improve production, accelerate and automate the inspection time while delivering accurate results. In addition, winery monitoring avoids temperature and humidity issues causing wine evaporation especially during summer time.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	4TH MVP
DEC 2017	**DEC 2018**	**APR 2019**	**DEC 2019**
• Specified applications • Database of IR spectra • Jodyn specifications	• End of application software development • FTIR spectra validation in real conditions • Jodyn prototype tested in real shipments	• Alpha Release and validation in one domain • FTIR Software developed • Jodn software developed • NET test ready	• Beta release with larger validation in the five domains • FTIR commercial product available • Jodyn/NET product on the market

PARTNERS

CROP YIELD
INCREASED CROP PRODUCTION

COST
REDUCE CROP COST

QUALITY
INCREASED PRODUCTION QUALITY

LOCATION

SCAN
FOR MORE

3.3 AUTOMATED OLIVE CHAIN

The EU is the largest producer and consumer of olive oil in the world. However, increasing competition from other countries and the rapid decline in olive plantations caused by plant pathogens puts the olive sector under pressure. This use case thus overhauls the olive chain by realising automated field control, product segmentation, processing and commercialisation of olives and olive oil. IoT technologies allow to:

- Automatically take data from crops and postharvest machines, in order to provide inputs for DSS (Decision Support Systems) models;
- Optimise efficiency of resource consumption through monitoring and controlling of agricultural machinery as well as irrigation systems based on agronomic models;
- Measure the fat content and monitor quality during milling process to improve food safety.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	4TH MVP
APR 2018	MAR 2019	DEC 2019	APR 2020
• Fields and crops management with IoT devices connected • IoT devices in olive mills connected	• ERP solution with IoT devices connected along the whole value chain	• Agronomic models integrated in the IT platform. • Advisory Board in fertirrigation running	• Final version

PARTNERS

hispatec · DCOOP · tecnova · SyneLixis · Nπλέας · ΓΕΩΠΟΝΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

46

3.4 INTELLIGENT FRUIT LOGISTICS

Food companies are challenged by public and private demands from different points of the supply network. However, a lot of data is collected at different stages and not well-communicated along the chain. A basic traceability is implemented, to ensure better communication. New mechanisms are required for production and transport of information to improve efficiency of the supply network.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	4TH MVP
OCT 2017	JUN 2018	DEC 2019	2020
• Feature 1: Positioning • Feature 2: Network selection • Data intefacing • Data presentation	• Chip integrated in Tray, 100 Tracker • Rule based Event Management • Location Management Application	• Tracker: Going large scale, 1.000 Tracker • Feature 3: Temperature sensor • Temerature monitoring application	• Collecting data interpreatation

PARTNERS

ATB Institut für angewandte Systemtechnik Bremen GmbH · EUROPOOLSYSTEM · GS1 Germany · MIELCKE ALEXANDER · NXP

47

> 10.000
MEASURED RENTAL TRIPS

> 1.000
TRANSPONDERS

LOCATION

SCAN
FOR MORE

EFFICIENT
RESOURCE USE

- 25%
PLANT PROTECTION PRODUCTS
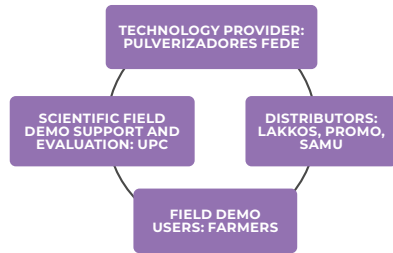
MITIGATED
ENVIRONMENTAL IMPACT

LOCATION

SCAN
FOR MORE

3.5
SMART ORCHARD SPRAY APPLICATION

Agriculture focused on speciality crops faces the challenge of improving the profitability whilst also reducing negative environmental impacts. This use case demonstrates that plant protection products can be significantly reduced through IoT enabled airblast atomising sprayers, adapting automatically to specific field zones as well as individual plant conditions. The integration of the Smart Orchard Spray Application cloud into farmers' existing processes and software solutions further increases operating efficiency.
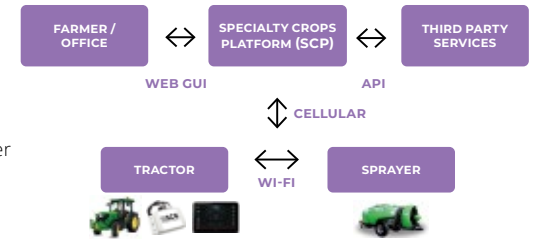
TECHNOLOGY PROVIDER: PULVERIZADORES FEDE

SCIENTIFIC FIELD DEMO SUPPORT AND EVALUATION: UPC

DISTRIBUTORS: LAKKOS, PROMO, SAMU

FIELD DEMO USERS: FARMERS

PARTNERS

HOW IT WORKS

The Smart Orchard Spray Application enables the development of a new integrated market of specialty crops management systems:
· Connection of physical IoT devices to the SCP;
· Configuration of work orders from the SCP;
· Farmer's work based on the use of IoT enabled devices to carry out precise actions;
· Wireless connection of the tractor and the sprayer to the SCP;
· Tracking of all data gathered by the IoT devices;
· Total control of costs and work issues registered from the IoT devices connected to the SCP.

FARMER / OFFICE ↔ SPECIALTY CROPS PLATFORM (SCP) ↔ THIRD PARTY SERVICES

WEB GUI · API

CELLULAR

TRACTOR ↔ SPRAYER

WI-FI

THE IMPACT

OUR OBJECTIVES
· Perform highly efficient, effective and environmentally friendly specialty crops protection in cherry, apple and almond production;
· Increase sustainability and profitability of food production;
· Monitor operations and get instant information on treatment quality;
· Provide traceability to improve the food security standards;
· Monitor costs and bridge the gap between agronomics and company accounting to increase business revenue;
· Assist in documentation tasks related to adherence to farm certification schemes like GLOBALG.A.P.

ON ECONOMY
· Fuel savings of 517€ per hectare/year;
· Savings in pesticides costs (25%);
· Efficient field tasks organisation and supervision;
· Improve revenue through better decision-making.
·

OTHER IMPACT
· Drift reduction (-48%);
· Reduce fuel consumption (-55%);
· Plant protection product reduction (-25%);
· Improve food-security due to pesticide treatment traceability;
· Establish cellular coverage and IoT functionalities in European rural areas.

< 80%
PRODUCTS DELIVERED IN GOOD CONDITION

- 60%
PRODUCTS RETURNED DUE TO DAMAGE
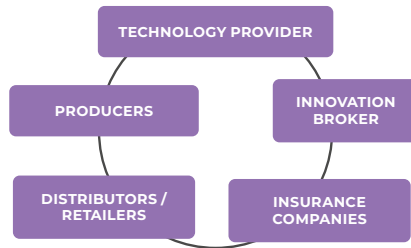
+ 50%
RECOVERED VALUE

LOCATION

SCAN

FOR MORE

3.6 BEVERAGE INTEGRITY TRACKING

The journey from producer to consumer is a process that can negatively affect the quality of the wine. In response to this risk, this use case has created an integrated system that monitors the whole wine and beverage distribution channel to prevent damages caused by integrity-related issues and stress factors such as humidity or shocks during shipping and storage. As a result, a direct relationship between producers and final retailers is established while a large database is created to plan safe shipments thereby allowing new and customised IoT-based insurance policies.

TECHNOLOGY PROVIDER

INNOVATION BROKER

PRODUCERS

DISTRIBUTORS / RETAILERS

INSURANCE COMPANIES

PARTNERS

wenda SIVE VINIDEAs FOR WINE PEOPLE Highclere Consulting VINIDEA

HOW IT WORKS

DATA LOGGERS monitor and record temperature, humidity, box breaching and shocks. Data are stored on an internal memory device, and wirelessly transmitted to the platform via the mobile App.

The **CLOUD-BASED PLATFORM** stores data coming from the devices, conducts elaborate analyses, aggregates trends and delivers information for decision making on customisable interfaces.

The **MOBILE APP** is the command interface of the devices: It turns them on and off, while assigning them to a specific transportation. At any time, with the data logger near, it can read every data and spot alerts.

HOW IT WORKS - SHIPPING

THE IMPACT

OUR OBJECTIVES
· Reduce product damages during distribution.
· Deliver products to consumers in the best possible condition.
· Establish a direct connection between producers and final retailers.
· Build a valuable database on worldwide beverage logistics.
· Test the IoT system in collaboration with a network of about 100 stakeholders.

ON ECONOMY
· Tracking beverage conditions during distribution allows retailers and end-users to gain knowledge on the journey which in turn facilitates:
· Reduction of shipping costs for beverages.
· Decrease of client complaints and commercial disputes.
· Insurance coverage possibilities.

OTHER IMPACT
· Creation of a direct relationship between producer and final retailer.
· Ensure the quality of wine during transport.
· Make the wine distribution process more transparent.
· Increase consumer satisfaction.
· Reduction of GHG emission related to beverage transport.

IOF²⁰²⁰

THE INTERNET OF VEGETABLES

The cultivation of vegetables can be done in different climate conditions, such as (fully) controlled indoor greenhouses with an artificial lighting system, semi-controlled greenhouses or non-regulated open-air cultivation. IoT-technologies can help to increase the efficiency of these production processes, e.g. water and nutrients consumption or the supply of artificial light. The vegetables trial aims to improve the quality and the productivity of lettuce and tomatoes in the controlled cultivation and weeding of the vegetables in organic production.

FOR MORE INFO:
IOF2020.EU/TRIALS/VEGETABLES

SHELF LIFE

EXCELLENT SHELF LIFE AT AN ACCEPTABLE COST

LIGHTING

EFFICIENT LIGHTING TO OPTIMIZE GROWTH

SENSORS

TO CONTROL AND STEER THE PROCESS

LOCATION

SCAN

FOR MORE

4.1 CITY FARMING LEAFY VEGETABLES

Consumers are increasingly critical about the quality, sustainability and traceability of their food. This is especially true for leafy vegetables used in convenience products such as cut lettuce and ready-to-eat salads where tolerance for dirt, insects or other unwanted ingredients is almost zero. This use case thus employs a commercial city farm to demonstrate the smooth integration of IoT technologies into the production of high-quality vegetables in a predictable and reliable manner, leveraging advantages in the production approach such as independence from seasonal influences, absence of plant diseases as well as pesticides.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	4TH MVP
JAN 2018	**JUL 2018**	**JAN 2019**	**JUL 2019**
• 1st implementation of IoT data platform • Architecture of IoT sensing platform • Architecture of lighting control system • 1st implementation of growth data dashboard	• 1st implementation of sensor platform • 1st implementation lighting control system • Growh data dashboard augmented with setpoint and sensor data dashboard	• IoT sensor platform deployed in test facility • Improved version of lighting control system • Growth data dashboard augmented with camera images dashboard • Improved growth recipies	• Lighting control system functionality augmented with light recipe editor • Lighting control system ready for integration with climate control computers via agreed protocol

PARTNERS

PHILIPS   Signify   StaayFoodGroup

4.2 CHAIN-INTEGRATED GREENHOUSE PRODUCTION

The chain-integrated greenhouse production use case aims to develop a web-based Decision Support System (DSS) for the greenhouse tomato supply chain based on IoT technology. The use case helps end-users with the challenges created by climate change and arable land scarcity, and the needs for productivity growth, increasing, fresh water and resource use efficiency. Standardised information alongside the integration of diverse data sources in different time scales increases interoperability throughout the production chain, and allows for easier quality and safety management, improves product and process traceability and reduces the environmental impact.

USE CASE TIME PLAN

2ND MVP	3RD MVP	4TH MVP
FEB 2019	**DEC 2019**	**DEC 2020**
• Test in commercial greenhouses • Include data of cooperatives level • Include data of transport • 1st version of meteorological station adapted for greenhouses • 1st version of solution for transport industries	• final version of the FIWARE-based system • 1st test of the meteorological station • 1st test of the transport solution	• Final test of the meteorological station • Final test of the transport solution • Commercial version of the FIWARE-based system

PARTNERS

COEXPHAL   UNIVERSIDAD DE ALMERÍA   CÁTEDRA COEXPHAL   VALORITALIA

10-50

REMOTELY MONITORED INSTRUMENTS

> 200

CALIBRATION SETS FOR INSTRUMENT

> 12,000

REFERENCE SAMPLES

LOCATION

SCAN

FOR MORE

+ 5%
PRODUCTION
CROP/M2

+ 10%
€/CROP

- 10%
LABOUR
REDUCTION

LOCATION

SCAN
FOR MORE

4.3
ADDED VALUE WEEDING DATA

Weeding is one of the most important and frequent activities in organic vegetable farming. This use case automates the task through an intra-row weeder, detecting the crop and weeds based on machine vision. To elevate (organic) crop production to a higher level, farmers need site-specific information on their crops. Hence, data about the crop and weather are gathered to support the farmer. As the farmers need to perform multiple tasks simultaneously, the decision support regarding their crop management must be user-friendly. By using IoT devices this use case seamlessly combines multiple data sources to support the grower. Furthermore, improved crop and field monitoring results in better field management, reducing the labor required while increasing the yield.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	4TH MVP
APR 2019	**APR 2019**	**JUN 2019**	**SEP/OCT 2019**
• Machine parameters and settings logged during operation	• Auto-uploaded data to FMIS (akkerweb)	• Improved algorithms for crop density, crop size and weed pressure	• Yield prediction using lettuce growth model, weather data and IC-weeder

PARTNERS

Steketee   WAGENINGEN UNIVERSITY & RESEARCH   AGROM   NEWAYS Technologies

4.4
ENHANCED QUALITY CERTIFICATION SYSTEM

QUALITY
TRANSPARANCY
IN FOOD QUALITY

- 10%
REDUCED
CERTIFICATION
TIME

- 50%
REDUCED USE
OF PAPER

LOCATION

SCAN
FOR MORE

The EU quality certification system and protected designation of origin (PDO) is a powerful tool to protect the quality of EU products, especially in foreign markets. The current standardised approach, however, is subject to fraud and the bureaucratic burden hinders its implementation. This use case solves these issues with the help of IoT technology to improve quality certification systems by reducing redundancies (overlap among certification schemes) time and effort of inspections while at the same time increasing their reliability. Sensor data and online registration can further provide solutions for traceability from field to shelf, proof of origin as well as production methods.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP
FEB 2018	**JUN 2018**	**NOV 2018**
• sensor installation • Virtual Reality demo	• Augmented Reality, Virtual Reality and E-learning software released	• Vinifcation testing • Improved Virtual reality

PARTNERS

VALORITALIA   COEXPHAL   UNIVERSIDAD DE ALMERÍA   uqido

4.5 DIGITAL ECOSYSTEM UTILISATION

- 10%
IRRIGATION

+ 20%
EFFICIENCY

- 10%
PLANT PROTECTION PRODUCTS

Currently, only a fraction of the plant protection products applied successfully tackles pests or insects, while the rest unnecessarily pollutes the environment. By utilising data stemming from IoT devices in the field, cloud computing and analytics technologies, this use case timely notifies the farmer to proceed with such activities while addressing challenges related to irrigation. Synergised parameters result in a service which increases the total farm productivity, contributing to food security. By incorporating innovative traceability technology, this use case integrates information from the entire food value chain to a marketplace, offering elaborate value propositions to users. Hence, it enables stakeholders in the agri-food sector to participate in an innovative digital ecosystem.

LOCATION

SCAN
FOR MORE

IOT PLATFORM DEVELOPERS (FINT)

END-USERS

MOBILE SERVICE DEVELOPERS (UNRF)

PILOT ORCHESTRATOR (ARI)

PILOT ORCHESTRATOR (ITC)

PARTNERS

58
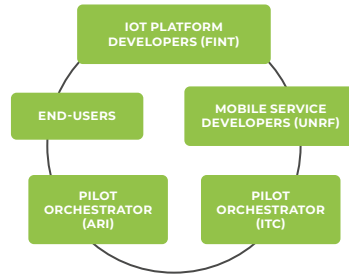
HOW IT WORKS

This use case delivers tailored information to farmers based on the data acquired by IoT devices (low-cost weather stations) regarding high farm input-costs (plant protection, irrigation water). As a result, IoT devices, cloud computing and analytics technologies translate data into services and increase the Total Farm Productivity (TFP) factor which consequently assures food security.

In addition, the use case involves track and trace services and queries incorporating the achievements within IoF2020, being the first solution that delivers on- and post-farm traceability features. Lastly, an innovative marketplace where on- and post-farm information can be published and shared with external business entities to validate food content.

THE IMPACT

OUR OBJECTIVES
· Engage agri-food partners form Cyprus, Slovenia and Greece;
· Deploy more than 25 IoT devices in regions where IoF2020 has not been present so far;
· Provide IoT-enabled irrigation and plant protection services to farmers;
· Expand and evaluate the objectives and results to other use cases in the fruits and vegetables sectors.

ON ENVIRONMENT
· Efficiency improvement – farm visits per farm (-20%);
· Reduction of pesticide use – ratio of initial kg product / kg input (-5-10%);
· Water use reduction – ratio of initial kg product / kg (m3) input (-5-10%);
· Cost reduction / kg input (10%);
· Increased total factor productivity of farms.

SOCIAL IMPACT
· Connected IoT devices (<60);
· Increased IoT uptake among end-users;
· Information provision to consumers on growth and farm supply chain conditions;
· Boosted farm sustainability;
· Strengthened data privacy and security;
· Improved consumer trust.

59
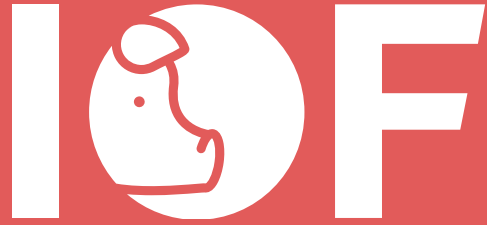
IOF °2020

THE INTERNET OF MEAT

The meat trial aims to improve the meat production chain's value through the application of IoT-technologies. The use cases include the management and optimization of pork production by on-farm sensors and slaughterhouse data. In addition, it will attest the role of IoT-technologies in poultry chain management, and communicate about meat transparency and traceability.

FOR MORE INFO:
IOF2020.EU/TRIALS/MEAT

5.1 PIG FARM MANAGEMENT

The pork sector faces several challenges: high costs, a difficult market and increasing pressure concerning animal welfare and greenhouse gas emissions. Modern technology helps maximize work efficiency on farms, but only by combining the information gathered by individual controlling devices can precision livestock farming really be achieved. This use case's application thus combines on-farm data and slaughterhouse results in one easy tool, providing the current-day pig farmer with crucial information to effectively steer the farm management in real-time. In these regards, this use case contributes to a future where PLF and individual pig monitoring might just be standard practice to guarantee the production efficiency and health of all pigs.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	4TH MVP
MAY 2018	**MAR 2019**	**NOV 2019**	**MAY 2020**
• IoT infrastructure • Individual level hardware and early warning system	• Release BI dashboard group level • Individual level dashboard	• Incl. chain level data • Incl. early warning group level data	• Full Pig Meat BI Dashboard, feat. group level, individual level & chain level data

PARTNERS

ZLTO   ILVO   Vion FOOD GROUP   Porphyrio   ISMB
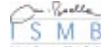
5.2 POULTRY CHAIN MANAGEMENT

Three critical points define the efficiency and product quality of the poultry production chain. This use case thus improves the performance through IoT driven technologies at each different stage, while facilitating linkages between all of them.
- Farm level: Monitor and optimise growing process to achieve a uniform and precisely measured slaughter weight;
- Logistics: Monitor and optimise broiler handling and transport to reduce impacts on the poultry and increase comfort levels;
- Processing plant: Optimise slaughtering and improve profitability and product-market fit, via traceability over all stages.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP	4TH MVP
MAR 2019	**JUN 2019**	**FEB 2020**	**DEC 2020**
• Multimagnitude wireless sensor nodes • Environmental condition Monitoring (farm) • Poultry growth & health manager (farm)	• Manual load monitoring (transport) • Environmental condition Monitoring (transport) • Dynamic scales for weighting (farm) • Poultry chain manager	• Improved models	• Certification of devices • Final models

PARTNERS

exafan   GRUPO SADA   IK4 TEKNIKER   Porphyrio

SHARE DATA
OF PORK QUALITY WITH SUPPLY CHAIN

QUALITY
HIGHER QUALITY OF PRODUCT

REDUCE WASTE
REDUCE OVERALL WASTE

LOCATION

SCAN
FOR MORE

5.3
MEAT TRANSPARENCY AND TRACEABILITY

The pork market increasingly asks for high quality products, considering important aspects such as animal welfare, sustainability and meat free of antibiotics. Through pro-active auditing, quality criteria are checked regularly in order to give constructive feedback to the farmer. This use case supports the pro-active auditing process by offering a dashboard with crucial sustainability KPIs to auditors and advisors. The solution is based on well-established GS1 standards to ensure scalability, including the EPCIS solution for transparency. This leads to less auditing time and costs, shorter control intervals and faster actions in case quality issues occur.

USE CASE TIME PLAN

1ST MVP	2ND MVP	3RD MVP
FEB 2019	**FEB 2020**	**DEC 2020**
· Transparency between farms and slaughterhouses · Data entry interface for farmers · Supports importing Excel and CSV data · Data query interface for involved partners	· Transparency among all partners · Data entry interface for all partners · Integration with FMISs · Comply with FIWARE NGSI (integrate with FIWARE-Orion) · Transparency dashboard	· Final MITS release · Final SLA established · Use of MITS beyond the Iof2020 Project partners

PARTNERS

WAGENINGEN UNIVERSITY & RESEARCH

GS1

EECC European EPC Competence Center

DE HOEVE

WESTFORT

64

65

6
COUNTRIES

> 1000
CONNECTED
ANIMALS
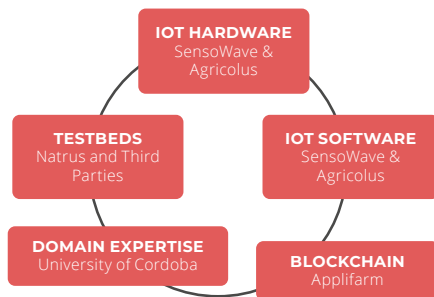
- 15%
TOTAL WORK
EFFORT

LOCATION

SCAN
FOR MORE

5.4
DECISION-MAKING OPTIMISATION IN BEEF SUPPLY CHAIN

The beef supply chain is a complex system, involving crop farms, livestock farms, feedlots, transporters, slaughterhouses, retailers and consumers. Current traceability systems collect few data from every segment of the supply chain, mainly to assure food safety to consumers. Shared value systems based on integrated data allow every segment of the supply chain to improve production efficiency and product quality.

IOT HARDWARE
SensoWave & Agricolus

TESTBEDS
Natrus and Third Parties

IOT SOFTWARE
SensoWave & Agricolus

**DOMAIN EXPERTISE**
University of Cordoba

BLOCKCHAIN
Applifarm

PARTNERS

HOW IT WORKS

- Data acquisition throughout the entire supply chain is carried out through:
  - IoT stations are used for environmental and soil conditions in crop fields;
  - Smart collars and IoT ear tags for beef cows' or calves' location, activity and temperature;
  - IoT scales to gather information about fattening calves' growth rate;
  - IoT multi-sensor stations for transport and slaughtering conditions - temperature, dust, noise, etc;
- A FIWARE-based platform is used for the integration of the collected supply chain data;
- Machine learning algorithms strengthen a decision support system focused on production efficiency and product quality;
- A Hyperledger Fabric blockchain service ensures data traceability and immutability.
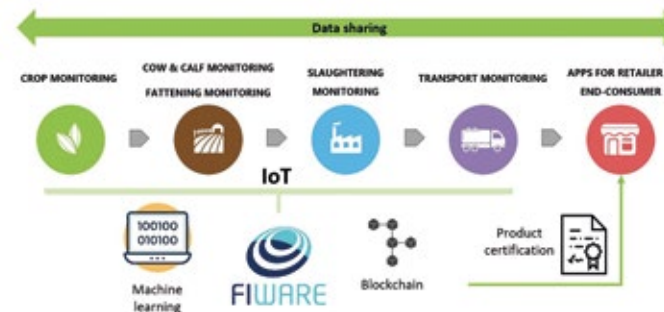
THE IMPACT

OUR OBJECTIVES
- Bridge the gaps in data sharing across every segment of the supply chain through IoT;
- Foster a technological framework that facilitates data sharing to improve decision-making and consumer trust;
- Improve the reliability of data through blockchain technology.

ON ECONOMY
- Fertiliser and water consumption (-10%);
- Reproduction rate (>90%);
- Animal losses (<5%);
- Total work effort (-15 %);
- Selling price through certification (+10%).

OTHER IMPACT
- Resource efficiency improvement: fertiliser, water and feed;
- Average fattening days (-15%);
- Greenhouse gas reduction through optimisation;
- Certification of grass-fed beef;
- Animal welfare improvement.

325
SILO SENSORS

- 15%
CO2 EMISSIONS

- 10%
COSTS

LOCATION

🇩🇪
🇪🇸
🇬🇧

SCAN

FOR MORE

5.5
FEED SUPPLY CHAIN MANAGEMENT

The animal feed industry, mainly represented by feed suppliers and livestock farmers, currently faces great inefficiencies due to outdated supply chain management. Stakeholders struggle with the timing and quantity evaluation when restocking their feed silos, significantly affecting cost and labour efficiency. This use case thus develops an integral feedstock management system to optimise the entire supply chain.
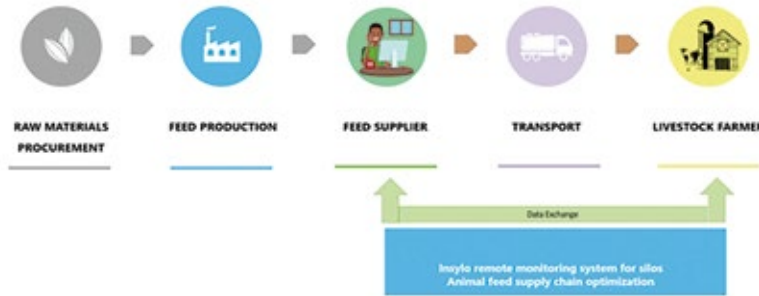

PARTNERS

HOW IT WORKS

Feed Supply Chain Management makes use of an IoT enabled, smart volumetric sensor, to obtain an accurate measure of the silos' stock levels.

The INSYLO technology, consists of a 3D sensor with embedded algorithms that scans the inner silo and calculates the content's volume.

The device is fully independent of the resources available on the farm as it is powered by solar energy and has embedded cloud connectivity systems. The cloud platform collects data from the silos along with relevant production information from livestock farmers and feed suppliers. In combination with Big Data and AI, it enables the optimisation of refilling orders, production batches, shipping routes and raw materials purchases.

The app platform also provides web services to facilitate the transactions between feed suppliers and livestock farmers, allowing stakeholders easier data access. Ultimately, feed suppliers can automatically generate the refilling orders based on cost criteria and send them to the farmers who can accept or reject them with a simple click.
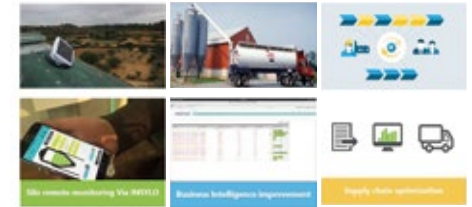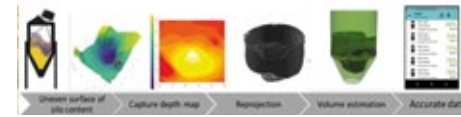
THE IMPACT

OUR OBJECTIVES
· Deploy and test three IoT-based Feed Supply Chain testbeds (2 small-scale + 1 large-scale);
· Demonstrate proposed solution's technological and economic viability;
· Validate exploitation and scalability of the project results.

ON ECONOMY
· By translating silo stock level information into management information, farm efficiency gains are made as farmers and feed suppliers can optimise the supply chain.
· Reduction of feed supplier's logistic costs (-10%);
· Annual savings per silo 250-500€;

· ROI per silo per year 150€;
· Farmer worktime efficiency savings -22 days per year.

OTHER IMPACT
· Reduction of CO2 Emissions (-10 to -15%);
· Logistics optimisation;
· Supplier inventory levels and production lots reduction;
· Decreased feed waste.

IMPROVED
ANIMAL WELFARE

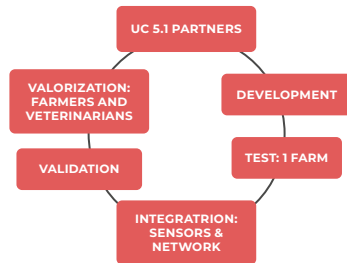**- 20%**
SICK PIGLETS

- 10%
PIG MORTALITY

LOCATION

SCAN
FOR MORE
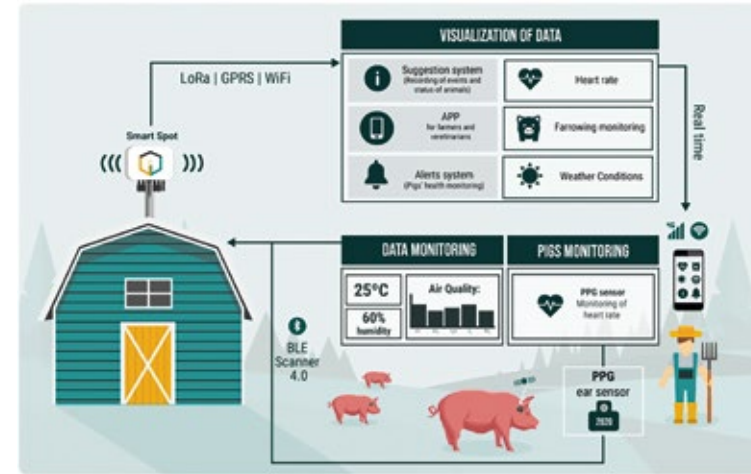
5.6 INTEROPERABLE PIG HEALTH TRACKING

Pig production's substantial advancements over the last couple of decades has resulted in considerable improvements in productivity, allowing farms to be operated at a larger scale without losing efficiency. Changes in physiological parameters of pigs are good indicators for their state of health. This use case thus relies on intensive scrutiny of each animal through IoT sensors, enabling the farmer to swiftly intervene in case health risks or diseases occur. The advantage of sensors, measuring physiological parameters, is that the animals are monitored constantly, and the collected data can further be utilized to assess production management and support decision-making.

UC 5.1 PARTNERS

DEVELOPMENT

TEST: 1 FARM

INTEGRATRION: SENSORS & NETWORK

VALIDATION

VALORIZATION: FARMERS AND VETERINARIANS

PARTNERS

HOW IT WORKS

THE IMPACT

OUR OBJECTIVES
- Reduce risks of virus herd contamination;
- Enhance and optimise meat production;
- Cost-effective monitoring through non-intrusive sensors;
- Provide a data management platform for farmers & veterinarians;
- Management of piglet mortality and reduction of economic risks;
- Periodical health monitoring of the herd & follow-up of diseases.

ON ECONOMY
- Optimise pig production;
- Scalability of IoT sensor deployment in mass production;
- Reduce sick piglets (-15%);
- Replicate the deployment at international level;
- Improve traceability of livestock;
- Reduce antibiotics costs.

OTHER IMPACT
- Improved animal welfare (+50%);
- Reduced piglet mortality (-50%);
- Avoid unnecessary use of preventive antibiotics;
- Earlier detection of health issues (+15%);
- Reduced piglet diseases (-60%).

CONTACT

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