Development of digital twin technologies in different types of pig farm to improve management and production efficiency

Summary

Automatic data capture by sensors and other digital devices can complement traditional data already recorded in with current management software or spreadsheets. Existing software is very good at analysing history, keeping inventories and analysing current productivity, but it falls short as an economic and interim management tool.

Thus, the main objective for this project is to develop and implement digital twin (DT) technologies for the pig sector, specifically in the breeding and fattening stages, thus facilitating a significant technological leap forward by implementing smart tools to improve decision-making in the sector and accelerate its digital transformation. In other words, proposing a set of predictive tools to explore the future impact of different production strategies, or even assess the future economic profitability of investments in improvement, taking into account the individual characteristics of each farm.

Objectives

The main project objective is to develop and implement digital twin technologies for the pig sector, thereby facilitating a leap forward in the use of smart tools to improve decision-making in the sector and accelerate its digital transformation. In doing this, it aims to:

- Develop a prototype virtual farm for breeding sows (Sow Farm Digital Twin) and a prototype virtual farm for fattening piglets (Fattening Farm Digital Twin) for the operational group (OG), companies, based on models by the University of Lleida (UdL) for the management of sow and fattening farms.
- Improve farm efficiency by using digital twin replicators.
- Validate the virtual farms through monitoring and the collaboration of technicians from the OG companies.
- Disseminate the results and stimulate the sector to move towards digitisation and the integration of digital solutions to improve: (a) decision-making, (b) animal welfare and (c) respect for the environment by sharing good practices.

Description of the actions planned in the project

Task 1: Design and development of digital technology twins

The existence of data gathered automatically by digital devices, mainly regarding feeding, environmental conditions and growth, or updated on the farm, such as information on piglet registration and animal movements, requires protocols for sending data and communicating with the different models on the server.

Systematic digital twin updates should enable monitoring of the main production indicators and design of production and business intelligence data analytics.

Task 2: Technology validation

The proposed technologies will be validated on breeding and fattening farms, making use of the installed digital devices and analysing other such devices that may also be suitable for automatically collecting relevant data on technical-economic management with digital twins, such as on-farm images.

A feasibility plan will be proposed to identify alternatives for the digitisation of the farms studied. Analyses will also be conducted on the possibility of expanding the number of digital devices, the quality of the

information provided and the benefit or value of this additional information in accelerating the implementation of a digital twin-based virtual farm. On-farm tests will be carried out to do this, obtaining the opinion of the technicians and operators.

Task 3: Dissemination activities
Both virtual and face-to-face dissemination actions will be carried out, supported by publications in major and medium-sized media outlets, targeting both the general public and the pig sector. Disseminating a roadmap for the progressive digitalisation of farms, similar to those of companies participating in the OG, will also be proposed. The University of Lleida (UdL) will actively work on disseminating the project so that it reaches the entire sector. The UdL press department will be actively involved in this process, as it has the necessary tools and capacities to reach a large number of people.

Expected results and practical recommendations

The main result consists of hybridising the physical and digital worlds, applying technologies such as virtual reality and advanced visualisation to the pig sector, enabling people to interact with key information in real time and gather accurate real-time information throughout the entire production process, focusing on the farrow-to-wean and fattening phases. This will help speed up decision-making. These new forms of interaction and digital technology skills will help provide significant savings in the production sector.

The expected project results will have a significant impact on each of the OG beneficiary members (CETOSA and Selecció Batallé SA), as they will be able to:

- Use a digital replica for breeder and fattening farms as the basis for improving decision-making, as it will facilitate more precise assessment of production alternatives.
- Use the results by extending the digitisation of their business structure, after assessing the positive impact of this technological improvement.

The virtual farms will enable better assessment of their environmental impact by optimising water consumption and proper waste management, reducing GHG emissions by 5% and nutrient excretions by 7% and contributing to disseminating best practices in each case. These impact estimates are also supported by previous UdL studies that combine economic and environmental objectives by considering multi-objective models and life-cycle analyses.

For society in general, the aim is to advance in the digitisation of the sector and obtain proof of a digitally viable product. By providing an example of digitisation, it will stimulate economic growth for pig producers and improve the quality of life of rural dwellers, thus enabling a system of sustainable growth. More specifically, it will help provide recommendations on how to make the leap towards digital transformation in the sector itself by using tools such as digital twins.

Leader of the Operational Group

ORGANISATION: CEREALES TORREMORELL, SA

Coordinator of the Operational Group

ORGANISATION: UNIVERSITY OF LLEIDA

Other members of the Operational Group (grant recipients)

ORGANISATION: SELECCIÓN BATALLÉ, SA

Subject area(s) of application

☒	Agricultural production system
☐	Agricultural practice
☐	Agricultural equipment and machinery
☐	Livestock farming and animal welfare
☐	Vegetable production and horticulture
☐	Landscape / Territorial management
☐	Pest and disease control
☐	Fertilisation and nutrient management
☐	Soil management
☐	Genetic resources
☐	Forestry
☐	Water management
☐	Climate and Climate Change
☐	Energy management
☐	Waste and by-product management
☐	Biodiversity and environmental management
☐	Food quality/processing and nutrition
☐	Supply chain, marketing and consumption
☒	Competitiveness and agricultural and forestry diversification
☐	General

Geographical area(s) of application

PROVINCE(S)	**REGION(S)**
Lleida and Girona	Noguera and Selva

Dissemination of the project (publications, conferences, multimedia, etc.)

Technical demonstration workshop of the Annual Technology Transfer Plan (PATT) at the UdL.
Dissemination material and publications on the UdL i+Porc and INNOVAC cluster websites and on RURALCAT Portal, and UdL social media. Attending fairs, congresses and dissemination events.

A Dissemination and Communication Plan designed to inform and disseminate the experience in the SMARTFARMS innovative pilot project will be implemented, both internally for OG members and externally through the transfer of results to society in general and, especially, to the sectors involved and specific stakeholders: technology and business centres, the agrifood sector (particularly the pig sector), economic and sectoral agents, farming professionals and vocational training centres, among others. In implementing the dissemination plan, support will be given to the i+Porc cluster to disseminate the results among cluster members and the INNOVACC Association, of which Selección Batallé is a member, to publicise the most significant results of the project.

The communication strategy will emphasise disseminating the innovative advances obtained, future opportunities for the pig and agrifood sector and the project's contribution to the social and economic development of the national territory, strengthening farming and providing environmental benefits. The main characteristics will be disseminated through external communication actions: objectives, axes, work methodology and potential benefits, among others aspects. Designing a website, publishing content on social media, video conferences and PATT technical conferences are also proposed.

Project website

www.smartfarms.udl.cat **(under construction)**

More information on the project

PROJECT DATES	TOTAL BUDGET
Starting date: July 2021	**Total budget:** €186,283.56
	DACC funding: €86,147.36
Current status: Under way	**EU funding:** €64,988.36
	Own funding: €35,147.84

With funding from:

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Order ARP/113/2021 of 20 May, approving the regulatory bases for grants for cooperation for innovation by promoting the creation of European Association for Innovation operational groups in the areas of agricultural productivity and sustainability and the execution of innovative pilot projects by those groups, and Resolution ACC/1660/2021, of 27 May, announcing the call for the grant.

Generalitat de Catalunya
Departament d'Acció Climàtica, Alimentació i Agenda Rural

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