

FRAUNHOFER LIGHTHOUSE PROJECT

COGNITIVE AGRICULTURE



FRAUNHOFER IS MAKING AGRICULTURE HIGHLY EFFICIENT AND SUSTAINABLE AT THE SAME TIME



Agricultural technology is not only a branch of industry that is essential for our society – it is also a progressive, highly innovative industry. The use of state-of-the-art information technologies has great potential for making agricultural processes even more efficient in the future. With trends such as “Precision Farming” and “Smart Farming”, agriculture has recognized and made use of the possibilities offered by state-of-the-art technologies early on. However, there is still a lot of room for far-reaching optimization in modern agriculture.

To date, the complex cause-effect relationships in the biosphere have only been

viewed in a fragmentary manner. Agricultural planning and work processes are often still not carried out efficiently and economically. A much deeper and broader understanding of these complex cause-effect relationships could significantly optimize higher-level decision-making and work processes. At the same time, the use of future-oriented digital services can make a crucial contribution to increasing the sustainability of agricultural measures.

Our new Fraunhofer lighthouse project **“Cognitive Agriculture”, “COGNAC”** for short, aims to identify these inter-relationships precisely and to make the results usable across the board. With

“COGNAC”, we interlink machine data from highly automated agricultural machinery and equipment. This will allow, for example, optimized monitoring and quality assurance of agricultural production processes over longer periods of time. These will be evaluated intelligently in order to make new, sustainable control models ready for deployment.

In our new lighthouse project, eight Fraunhofer Institutes have joined forces to use innovative automation concepts and novel sensor technology to build a data-based ecosystem – an **“Agricultural Data Space”** – which

shall become a milestone in digitalized agriculture.

In this way, digital technologies, new research approaches, and the problem-solving competence of Fraunhofer can become the enablers of highly efficient and at the same time sustainable agriculture of the future.

Prof. Dr. Reimund Neugebauer
President of the Fraunhofer-Gesellschaft





FRAUNHOFER LIGHTHOUSE PROJECT "COGNITIVE AGRICULTURE"

In the Fraunhofer lighthouse project **"Cognitive Agriculture"** ("COGNAC" for short), eight Fraunhofer Institutes are doing joint research on basic principles that will enable farmers to achieve high productivity in line with further goals such as sustainability or product quality in our digitalized world.

A uniform value system shall reflect decisions regarding the key aspects sustainability, resource efficiency, costs, and product quality. For this purpose, data on factors related to the agricultural enterprise and to the environment must be collected automatically with state-of-the-art sensor technology and must be evaluated, analyzed, and processed cognitively in agricultural work and business processes in order to make sustainable, fact-based decisions regarding both crop production and livestock farming.

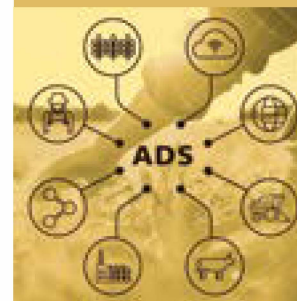
In the lighthouse project **"COGNAC"**, the participating Fraunhofer Institutes will design and implement an integrated platform for information-based (cognitive) agriculture. The goal is to connect the numerous isolated solutions and make them usable as a whole from end to end in order to achieve maximum productivity and sustainability. The value chain begins with crop production and livestock farming, but also includes further process and processing steps in the long term.

The project is therefore expected to deliver crucial innovations in the three areas "Networked Ecosystem", "Sensor Technology", and "Autonomous Field Robotics".

INNOVATION AREAS

AGRICULTURAL DATA SPACE

Open data exchange in an **agriculture-specific, digitally networked ecosystem** that enables multivalent use and linking of complex data volumes in secure data spaces.



NOVEL SENSOR TECHNOLOGY

Automated **interpretation and decision support** based on high-resolution measurement data from airborne or ground-based systems using multi-channel measurement information.



INNOVATIVE AUTOMATION CONCEPTS

Autonomous field robotics for plant-specific field work as well as robot-guided sensor platforms with specific sensor systems.



Piloting and Demonstration

In pilot applications, it will be demonstrated on test fields that the cognitive skills of machine data analysis – illustrated by the example of autonomous field work –

can guarantee high increases in productivity without consequential damage to the environment.



AGRICULTURAL DATA SPACE

The automated support of work and business processes requires easy and fast access to the corresponding information. To this end, an **“Agricultural Data Space”** (**“ADS”** for short) is to be developed and used in order to enable secure, overarching data usage.

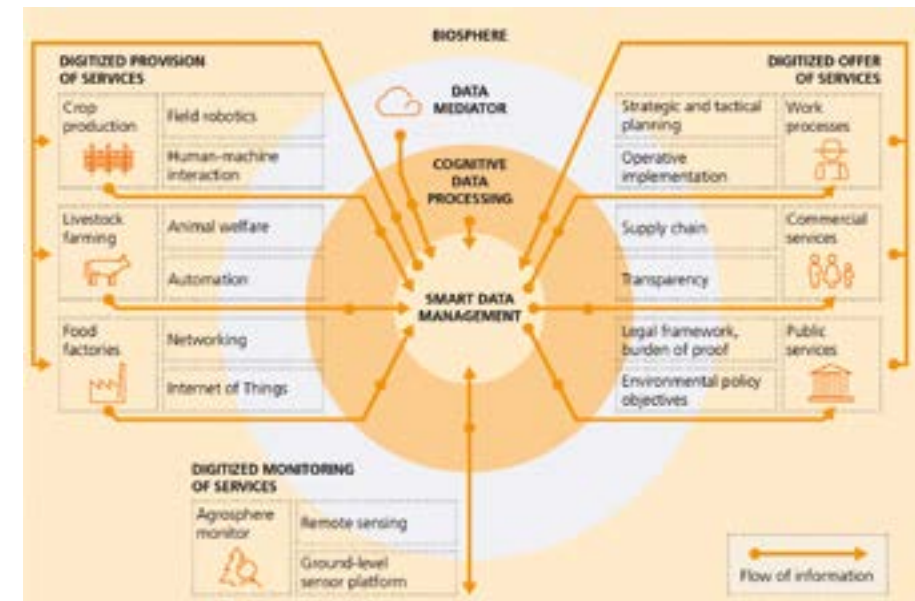
The aim of the **“Agricultural Data Space”** is to make available all the data that is necessary for making decisions in agriculture. The intention is to cover a diversity of value-adding processes and the interaction with the biosphere. As for data analysis, data privacy, and data security, the lighthouse project will rely on innovative methods that use artificial intelligence to master the challenges of data heterogeneity, data quality, and data quantity.

For the design of the **“ADS”**, Fraunhofer can draw on experience from the reference architecture model of the **“Industrial Data Space”** and will use existing solutions for orientation or integrate such solutions.

The project aims to create an information-based ecosystem for the agricultural sector, which, for example,

- offers farmers a basis for decision-making across all levels, from soil conditions to market situation,
- enables machine manufacturers to implement optimal automation solutions based on the underlying data,
- enables manufacturers of seed or crop protection products to flexibly support the selection and dosage of their products,
- allows service providers to offer data-based services, and
- enables cooperatives and government agencies to make informed decisions based on data and to digitalize their processes that relate to farmers.

SOLUTION CORE DIGITALIZATION: “AGRICULTURAL DATA SPACE”





NOVEL SENSOR TECHNOLOGY

For a more comprehensive understanding of cause-effect relationships, different scales regarding both geographical distances and the periods of time considered must be integrated. This is the only way to identify and describe local and remote as well as direct and delayed effects in the biosphere.

This purpose requires the collection of comprehensive data. However, information needed to better understand interrelationships is frequently missing. With appropriate sensors and cognitive analytics, it will be possible to close this gap in the future. In the context of this projects, sensor concepts will therefore be developed further in accordance with the requirements in agricultural technology and raw data will be processed for use in application processes.

This includes, for example, the use of agricultural sensor technology for

- seismic imaging of soil compaction,
- analysis of soil nitrogen content,
- classification of soil areas and vegetation by hyper- and multi-spectral optical methods.

This will lead to the development of methods for soil parameters that cannot be measured yet to date, but which are essential for the planning of agricultural activities.

The data of these airborne and ground-based sensors will be combined with data from existing measurement systems as well as with remote sensing, weather, and yield data. This will provide a comprehensive amount of data for automated interpretation and decision support for different time horizons.



INNOVATIVE AUTOMATION CONCEPTS

Automation via field robotics enables continuous and local data acquisition. With the information derived from this, agricultural work processes can be further optimized. The goal of the development is a lightweight, fully electrified field robot unit consisting of a platform that drives autonomously and a drone. In the context of this project, methods are therefore planned to be developed and implemented for

- cooperative perception of the environment,
- automated path planning, and
- integration into the cognitive process automation from the Agricultural Data Space

Fraunhofer can contribute its long-time expertise in the areas of robotics, drive technology, and quick-charging technologies.

An efficient interplay of technologies will support the agricultural work processes. For example, individual plant treatment can significantly reduce the negative effects of large-scale application of chemicals.

The project's major contributions will include

- continuous measurement data collection and field management through autonomous action,
- introduction of future-oriented drive technology in agriculture,
- reduction of soil compaction due to small, lightweight units,
- more eco-friendliness

and finally

- the use of modular systems that communicate via appropriate interfaces.



SUPPORTERS AND PROJECT PARTNERS SOUGHT

The **“Agricultural Data Space”** developed in the Fraunhofer lighthouse project **“Cognitive Agriculture”** and the technology demonstrators will be open to companies and interested research groups in order to allow them to share solutions in their own projects or to contribute their own issues.

Support for overarching application scenarios mapping complex interrelationships of the biosphere in a networked data-based ecosystem requires the involvement of additional stakeholders.

Support our project!

You can do this in different ways:

- As an **associated partner**, you can be directly involved and be a First Mover.
- As a **participant in the project forum**, you can share your questions and experiences and participate in the results at an early stage.

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About “Cognitive Agriculture”

In the lighthouse project “**Cognitive Agriculture**”, eight Fraunhofer Institutes are conducting joint research on basic principles to produce agricultural products that are as environmentally friendly and resource-saving as they are highly efficient. Solutions include sensor technology for data collection as well as digitalization and automation of agricultural processes. The idea is to make the analysis of highly complex interactions between biosphere and production usable in an ecosystem of networked data and services (“**Agricultural Data Space**”) and to have it provide decision support.

Participating Institutes

Fraunhofer IESE (project management),
Fraunhofer IFF, Fraunhofer IKTS,
Fraunhofer IOSB, Fraunhofer IPA,
Fraunhofer IPM, Fraunhofer ITWM,
Fraunhofer IVI

Do you need further information or are you interested in collaborating with us? Please feel free to contact us!

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