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RPTU Kaiserslautern-Landau

An IT-Perspective on Agricultural Data Exchange

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Presentation of the chair

- Research interests: **Software and Systems Engineering** in the field of Digital Farming
  - **Requirements analysis** for different actors in the agricultural ecosystem and improving the **user acceptance of** digital farming solutions, e.g. FMIS, decision support systems (using explainability in AI), agricultural machinery
  - Improving **interoperability and networking** between actors and systems (e.g., ISOBUS, automated data extraction, and data spaces)
  - **Data management** for **sustainable and transparent solutions** in the value chain (e.g, digital twin/shadow, dashboards, AI solutions)
- Our **application fields**: arable farming, livestock farming, viticulture (to come)








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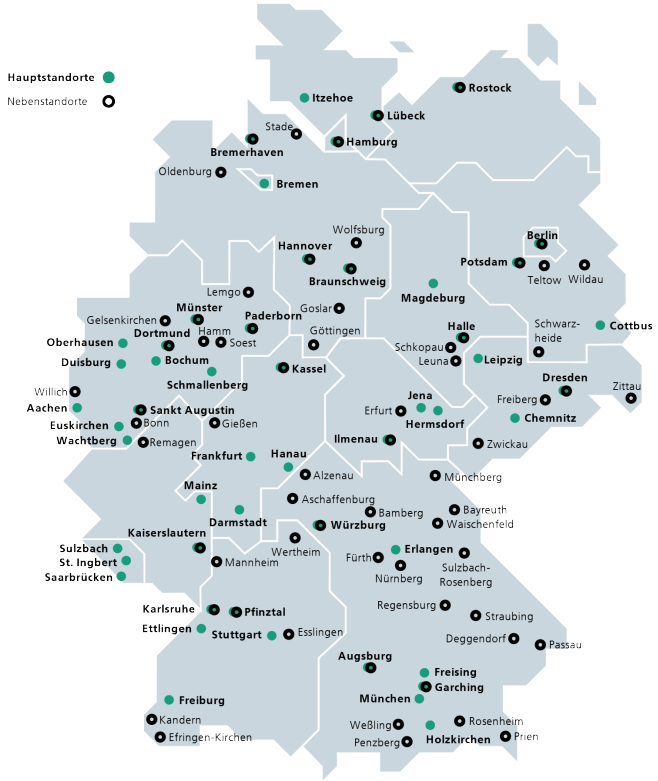
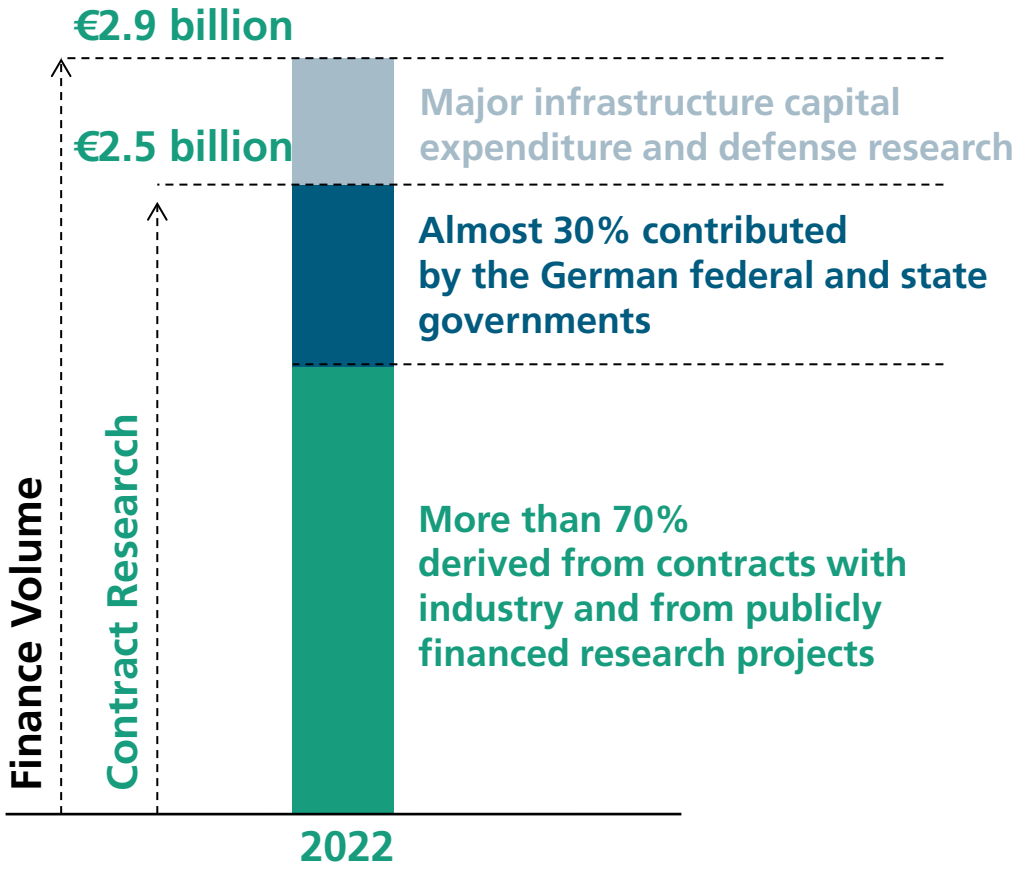
The Fraunhofer-Gesellschaft at a glance

Applied research of direct utility to private and public enterprise and of wide benefit to society

76 institutes and research units

~30.000 staff





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Engineering the Digital Future

Our Mission:
Applied research on innovative solutions for the design of dependable Digital Ecosystems

Our Vision:
A better life, sustainability, and economic success through dependable Digital Ecosystems

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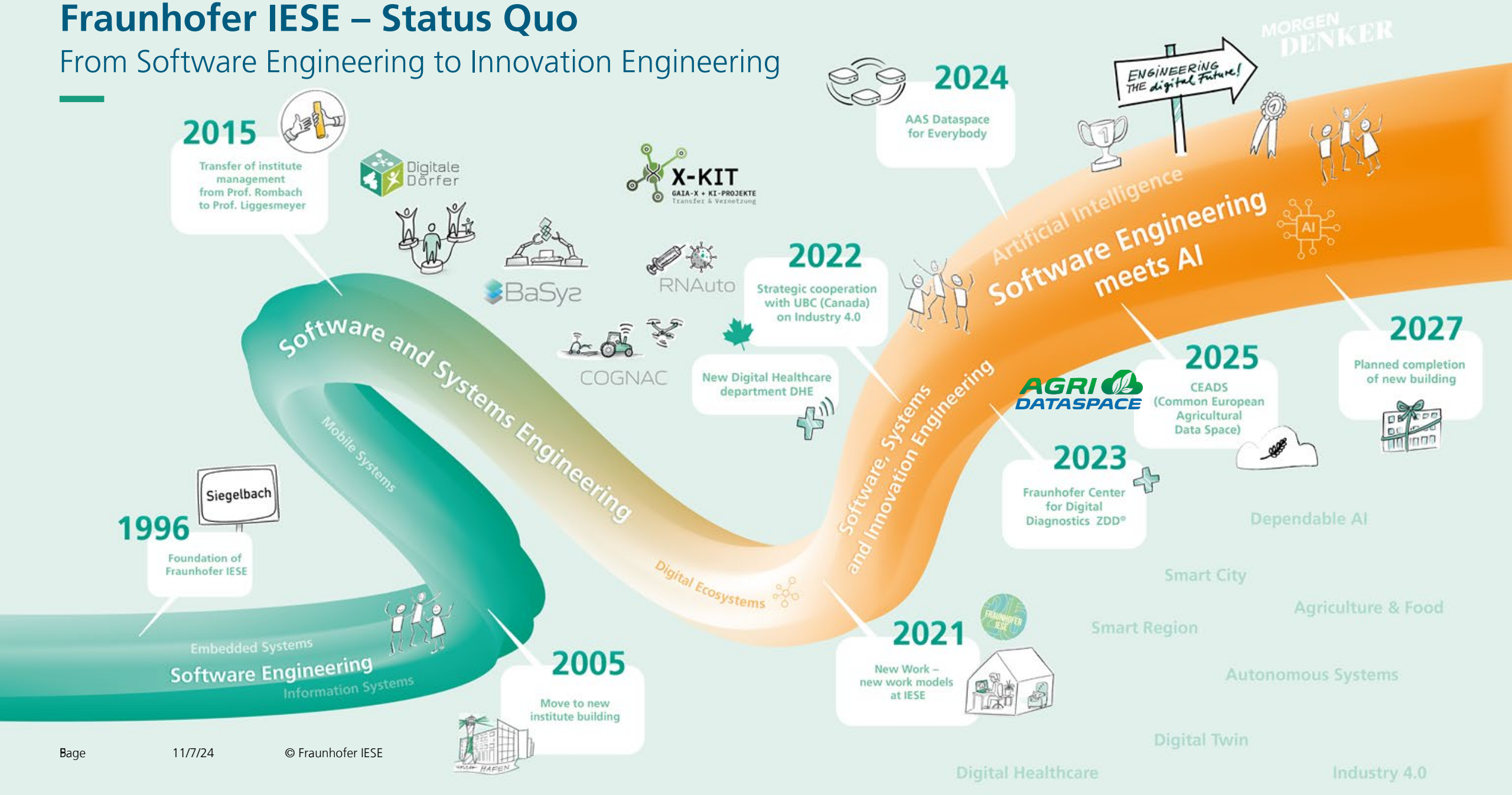
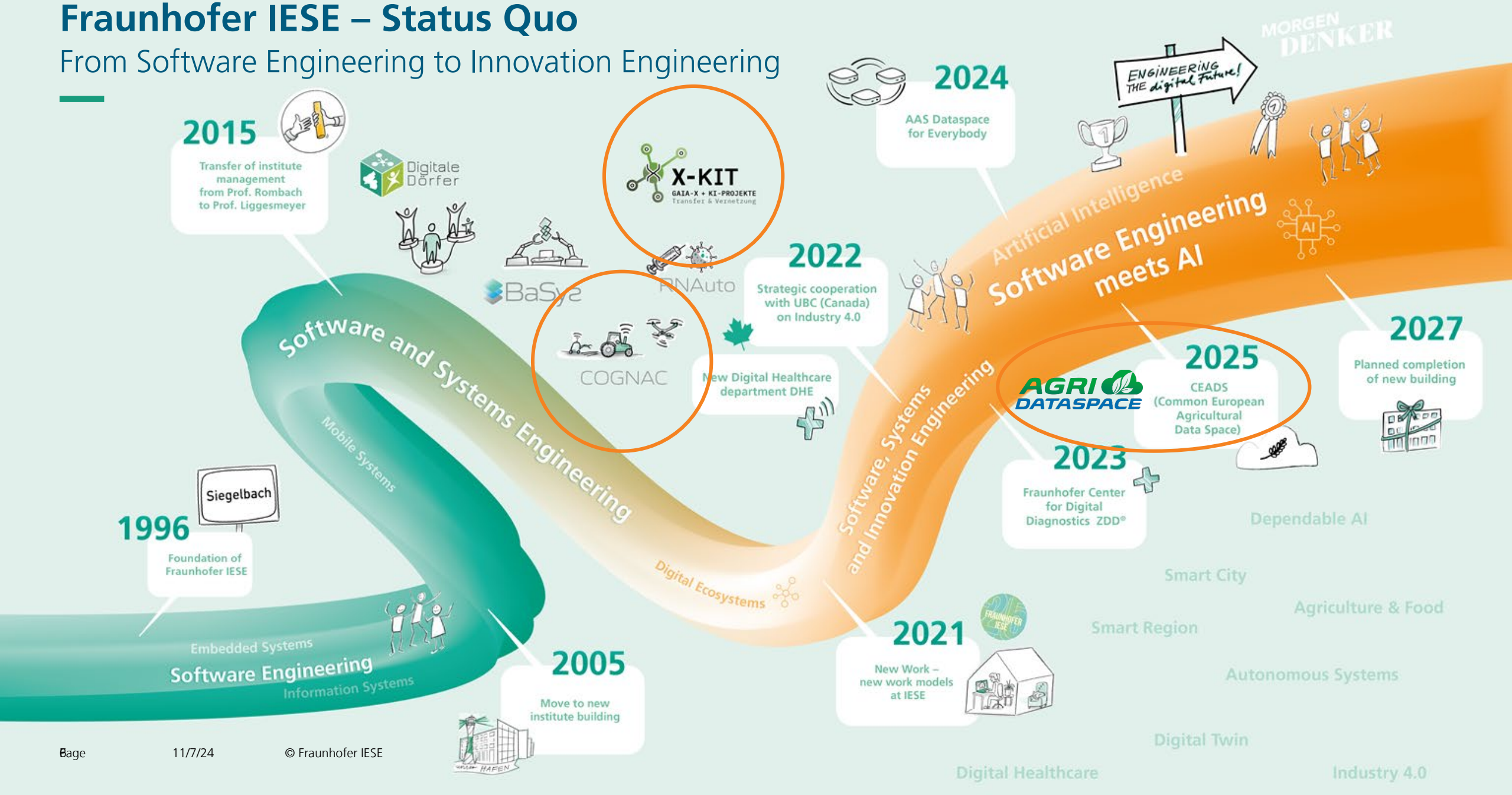
Fraunhofer IESE – Status Quo

From Software Engineering to Innovation Engineering

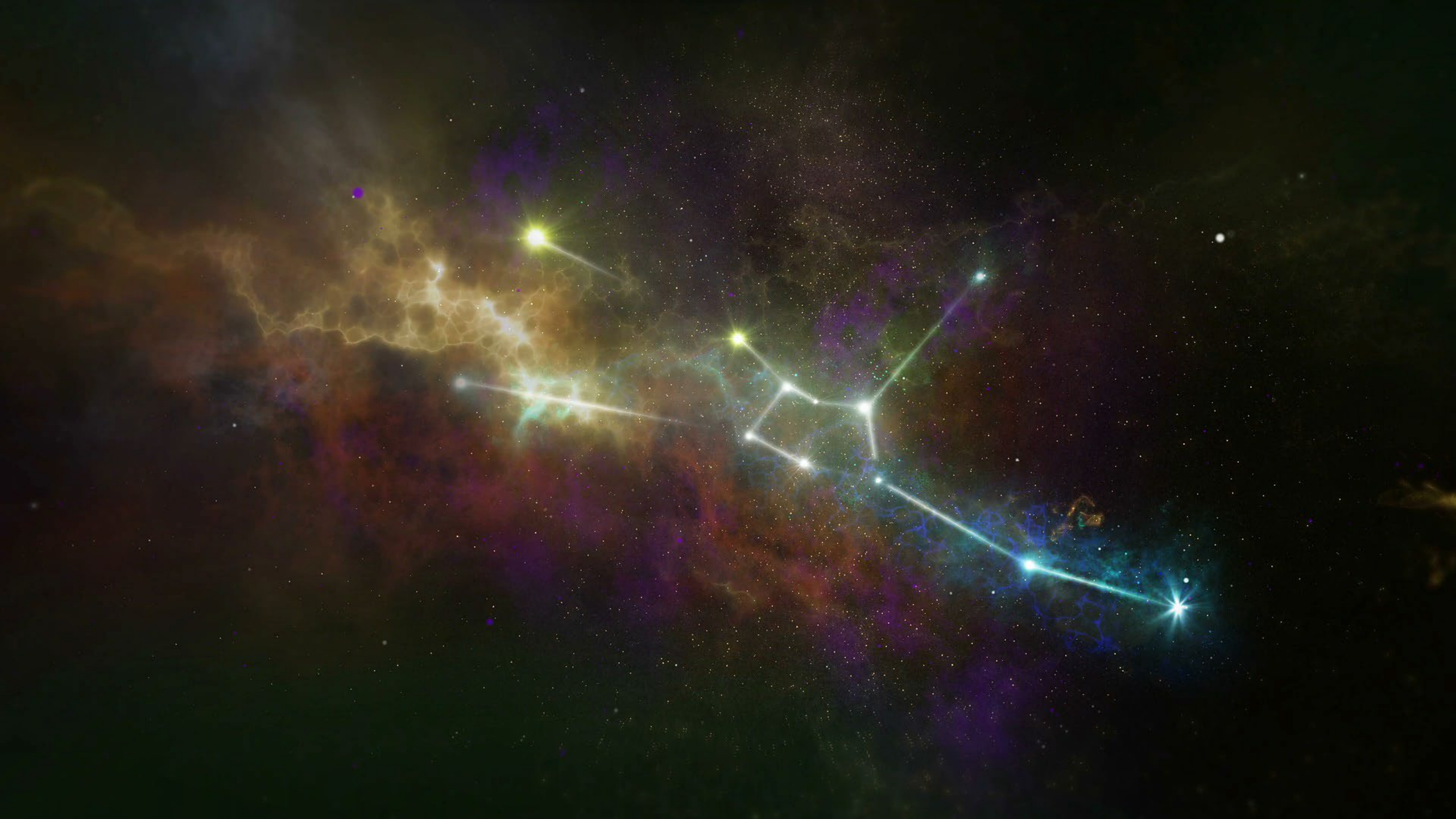


Fraunhofer IESE – Status Quo

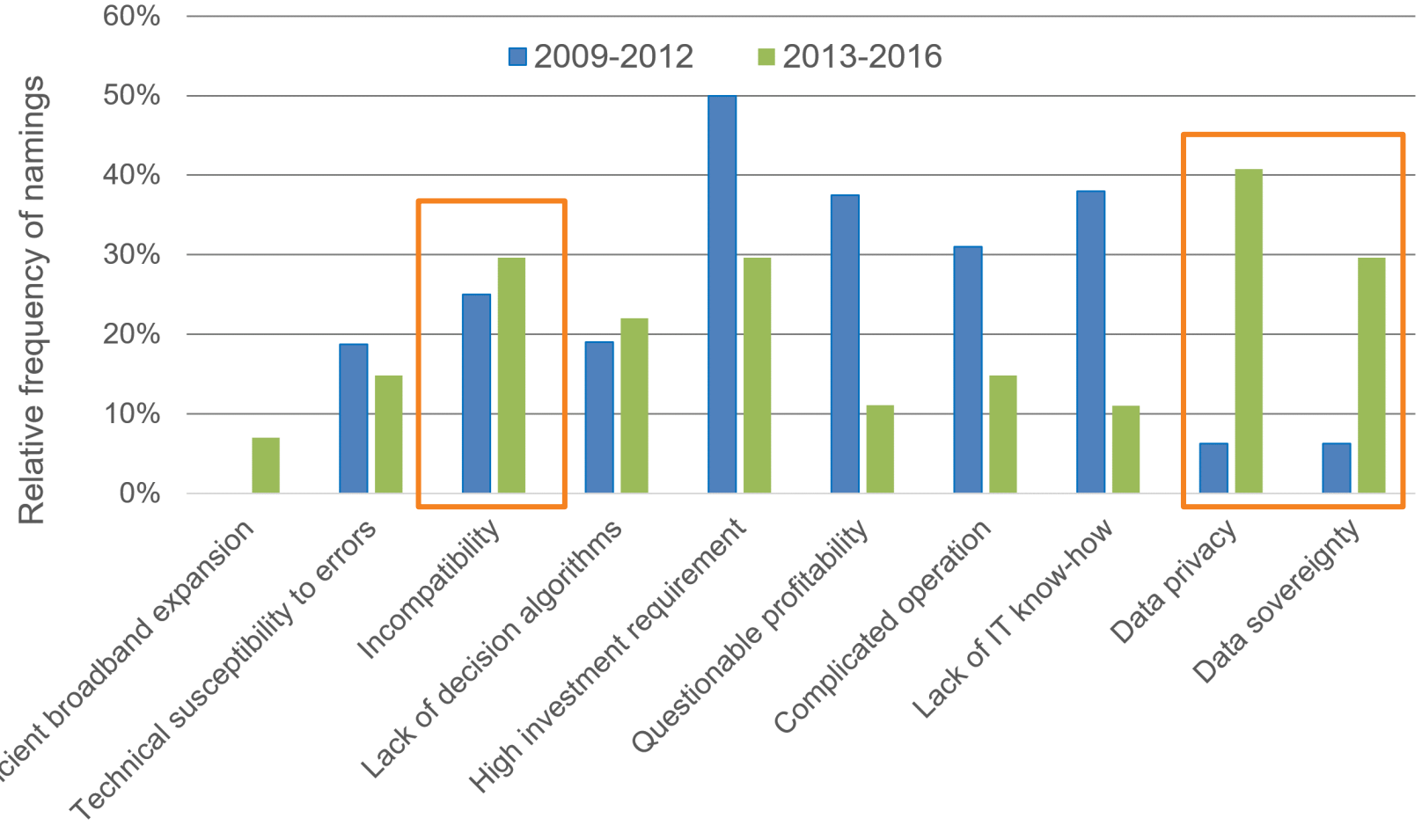
From Software Engineering to Innovation Engineering



Challenge: Interoperability for Data Exchange in Digital Farming



Survey on reasons/barriers for the acceptance of digital technologies in agriculture (Germany)



Main issues (besides ROI):

Farmers' requirements not met

Data protection and data sovereignty

Interoperability of solutions

Source: Sebastian Schleicher, Markus Gandorfer, "Digitalisierung in der Landwirtschaft: Eine Analyse der Akzeptanzhemmnisse", 2018, paper presented at the 38th GIL Annual Conference in Kiel. Ruckelshausen et al. (Eds.), pp. 203-206.

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More recent study with different design but same results…

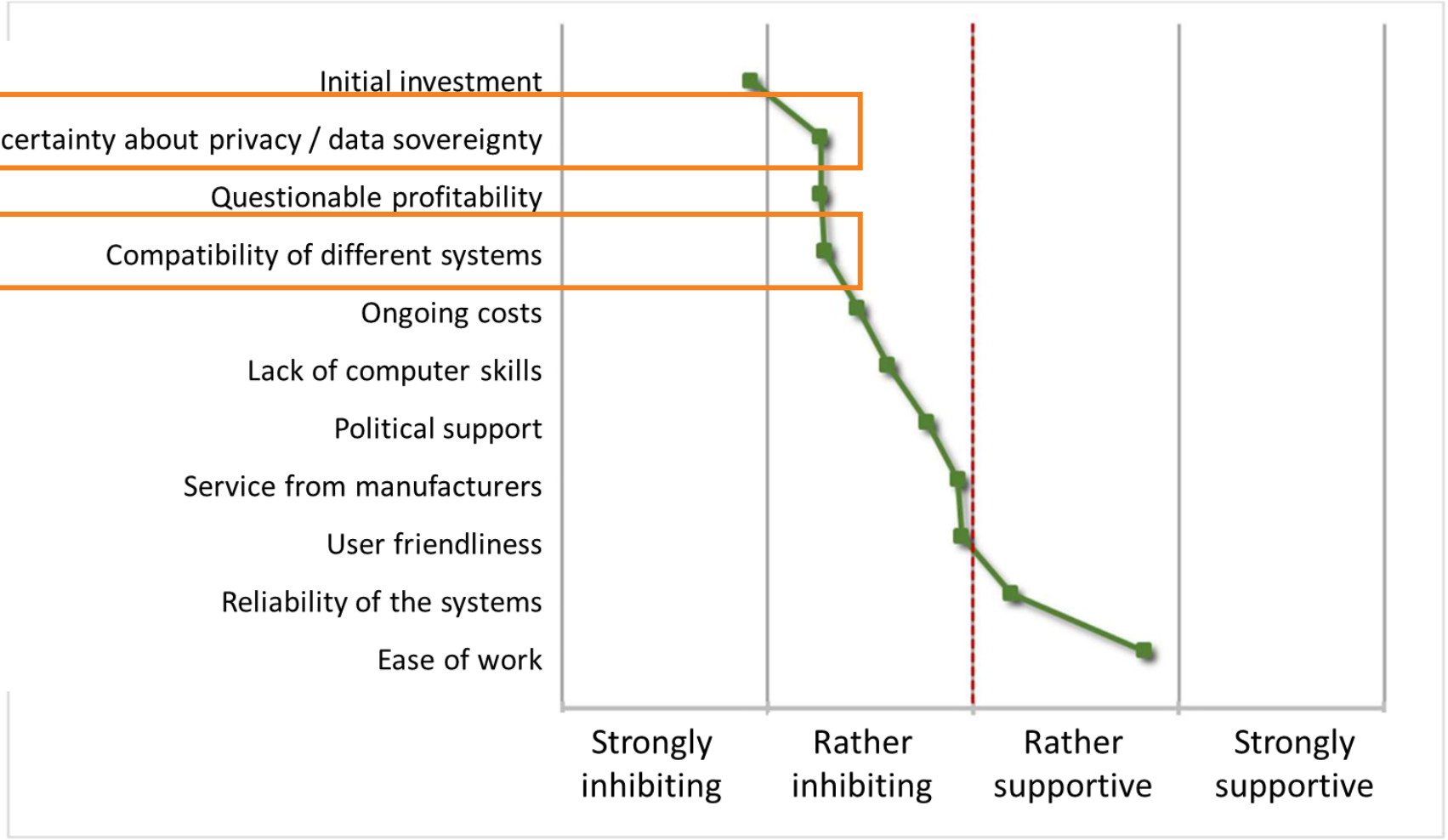

Figure : Inhibiting and supporting aspects of DFT from the farmers' perspective (n=591)

Source: Translated from Gabriel, A., Gandorfer, M., & Spykman, O. (2021). Nutzung und Hemmnisse digitaler Technologien in der Landwirtschaft: Sichtweisen aus der Praxis und in den Fachmedien. *Berichte über Landwirtschaft-Zeitschrift für Agrarpolitik und Landwirtschaft*.

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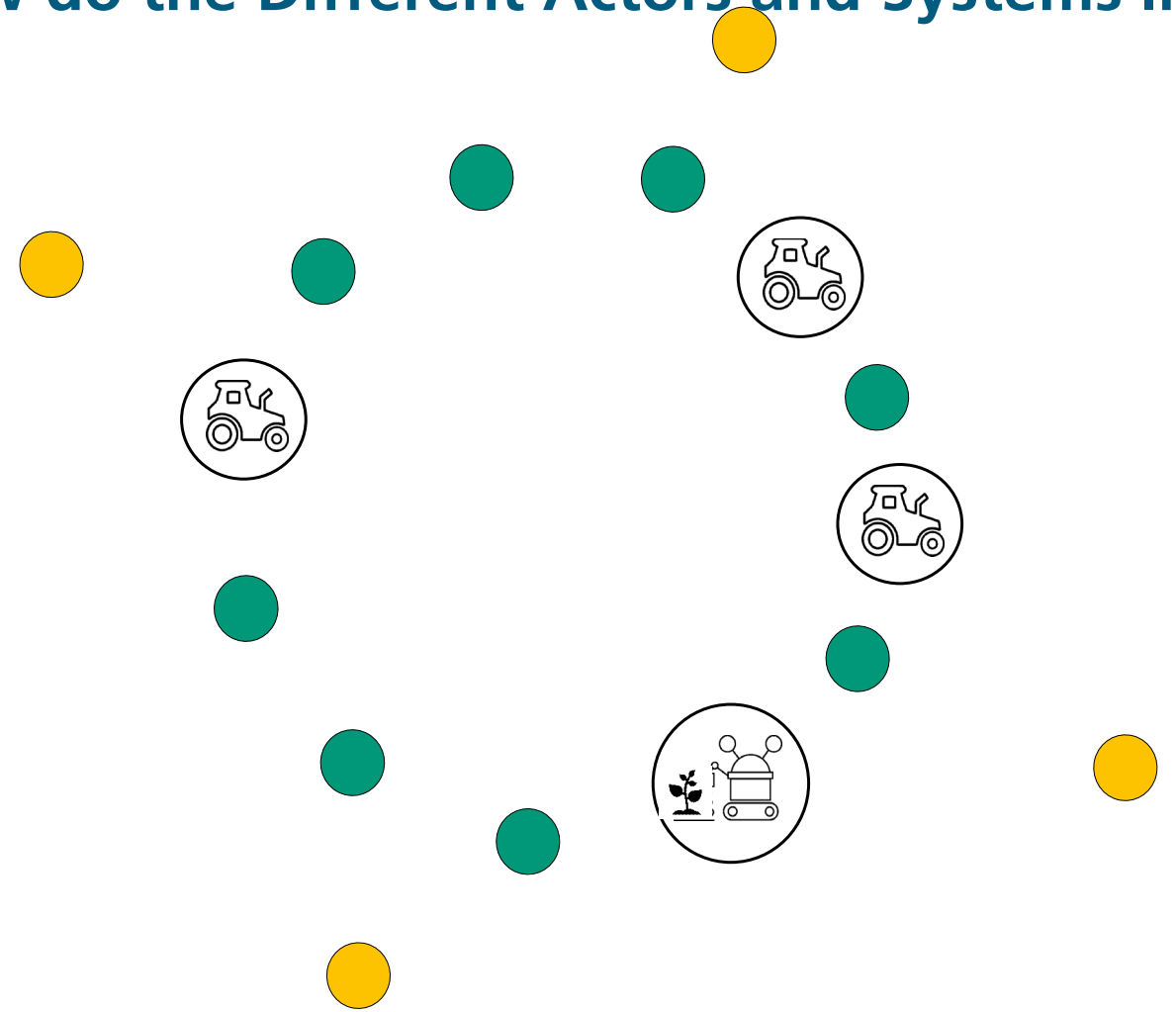
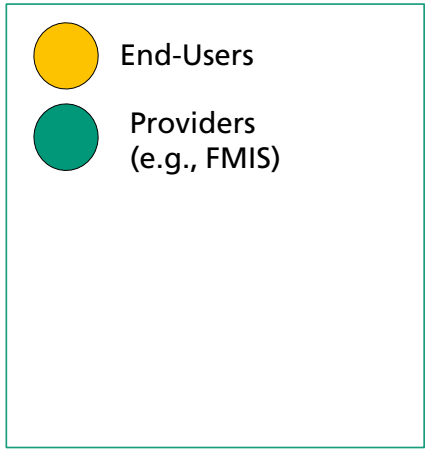
Different Actors in the Ecosystem – Challenge: How do the Different Actors and Systems Interact?





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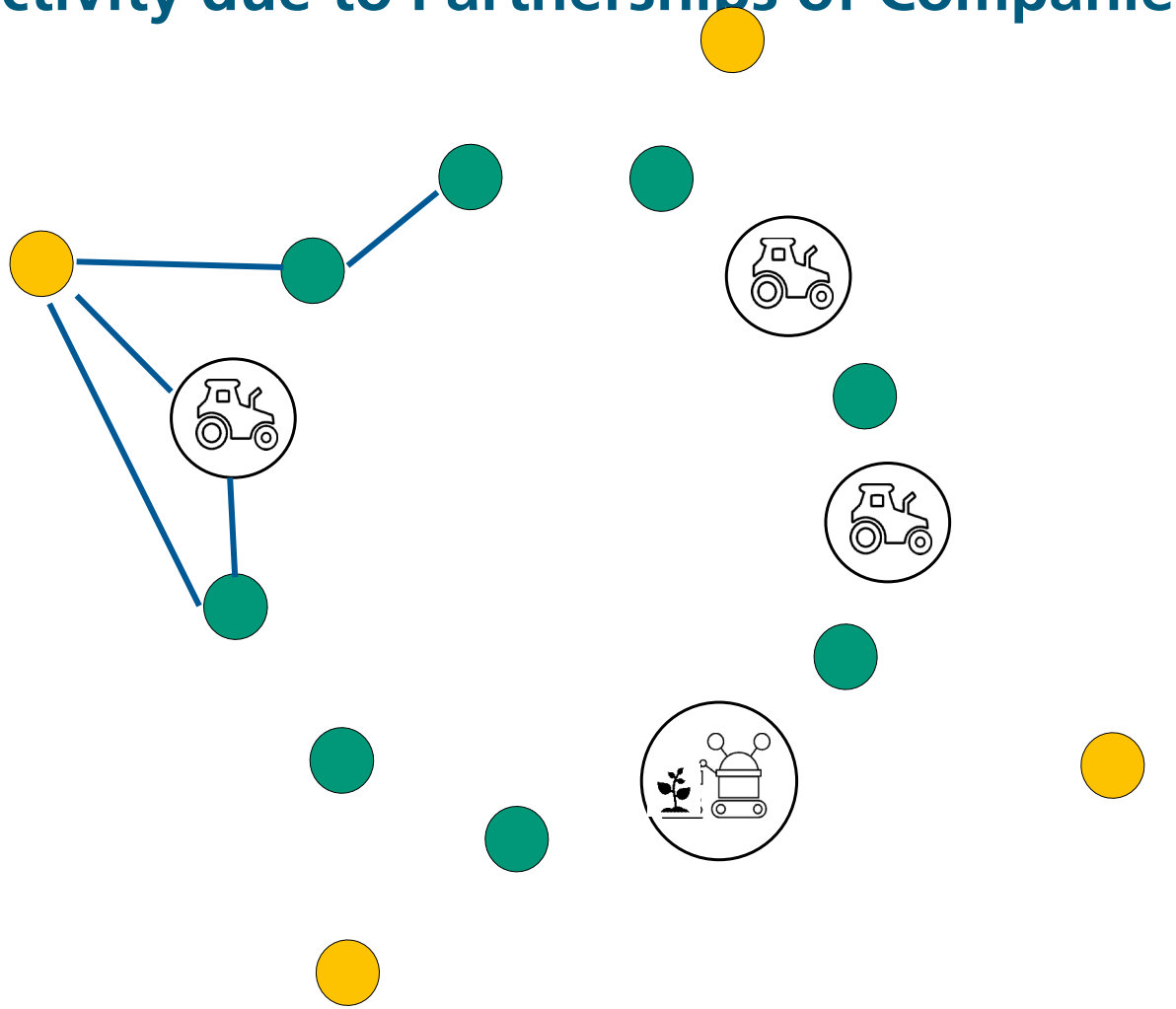
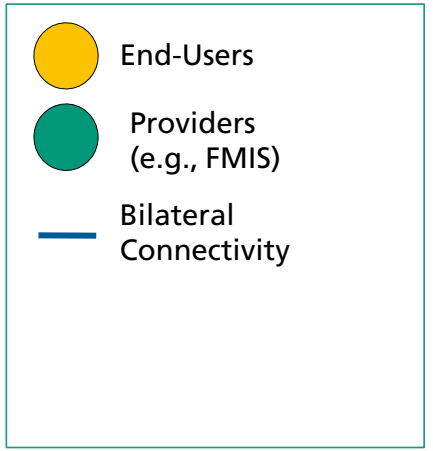
Different Actors in the Ecosystem – Bilateral Connectivity due to Partnerships of Companies





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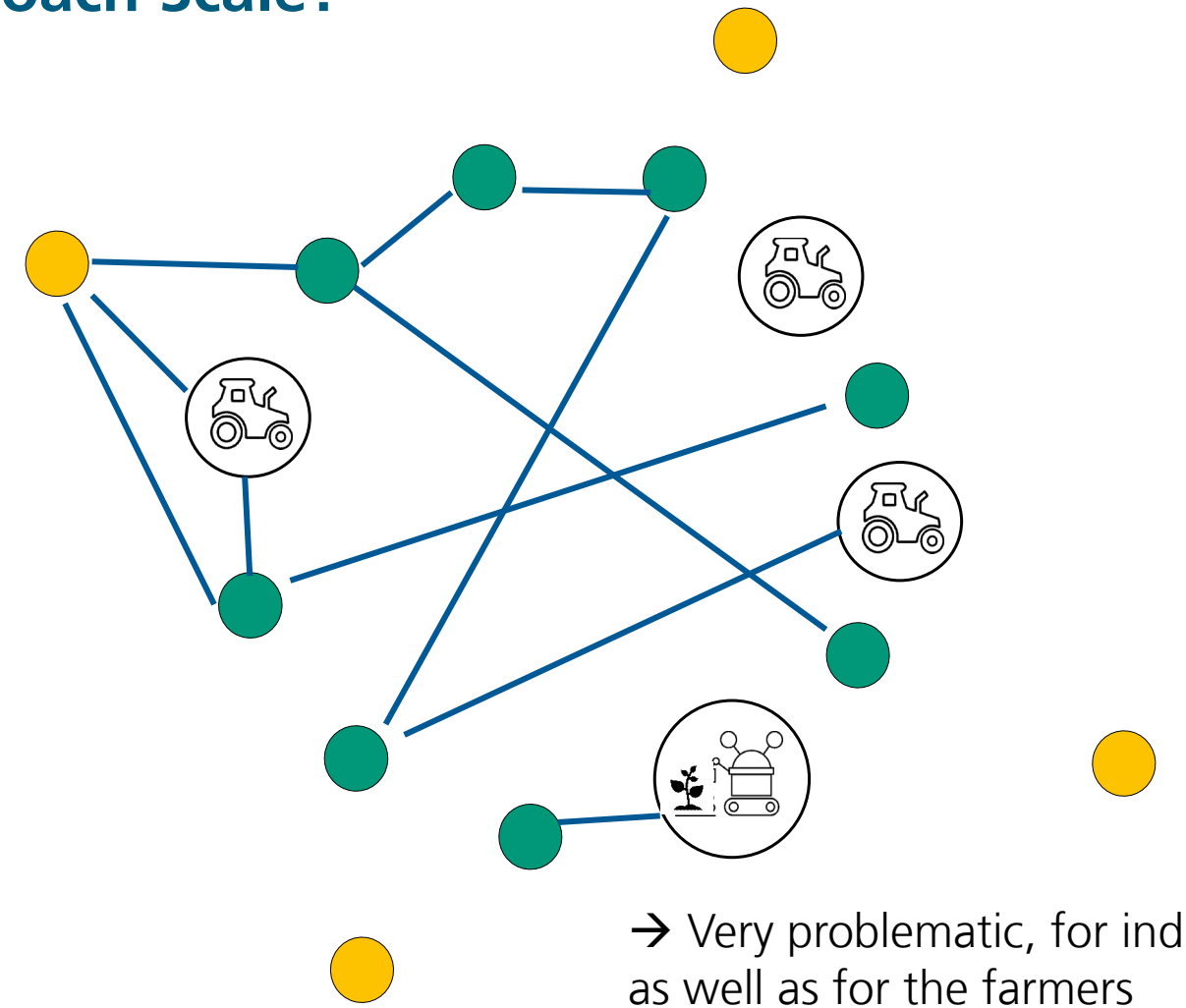
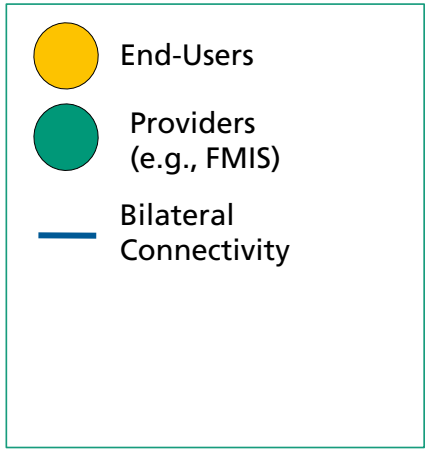
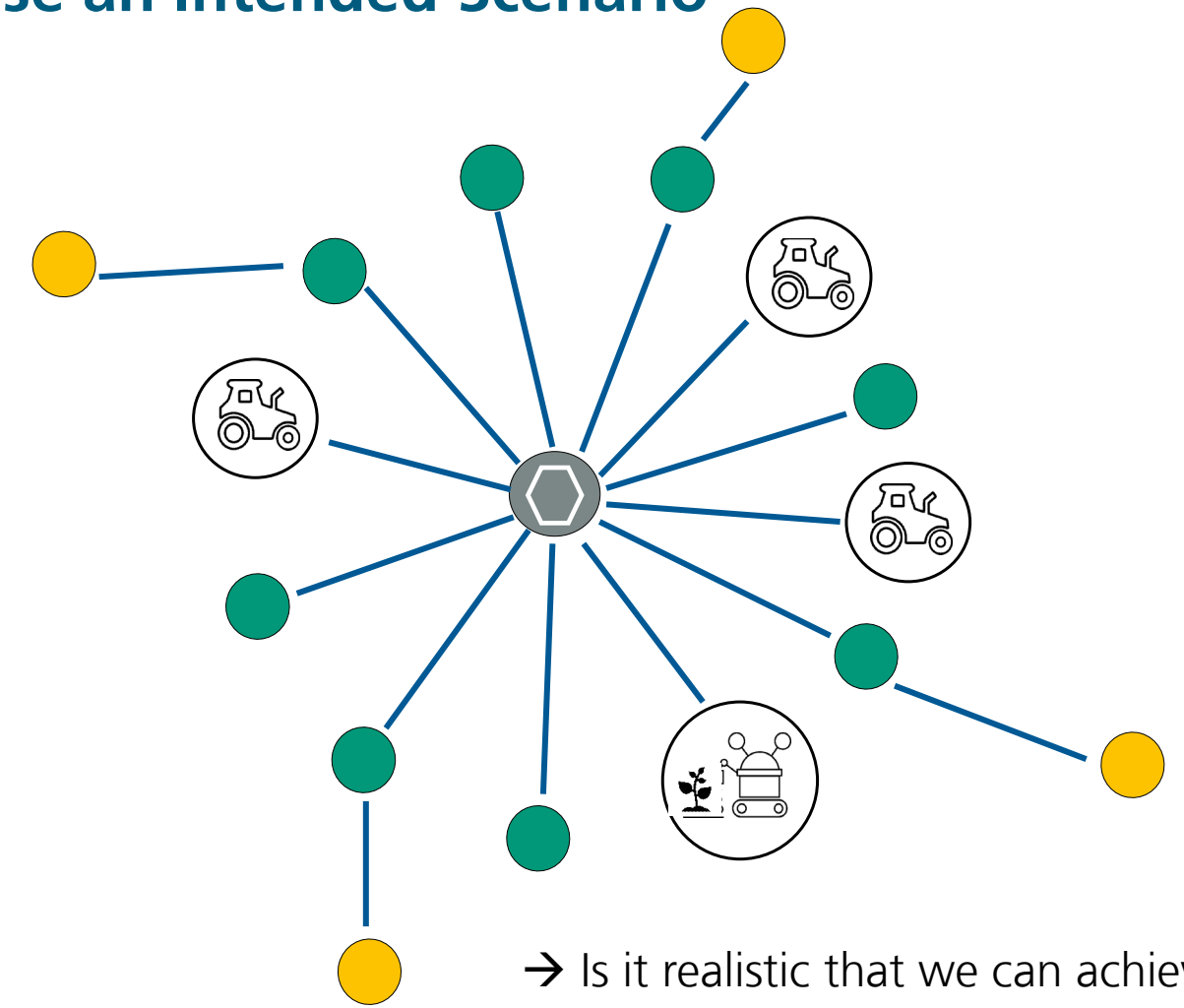
Different Actors in the Ecosystem – Does this Approach Scale?



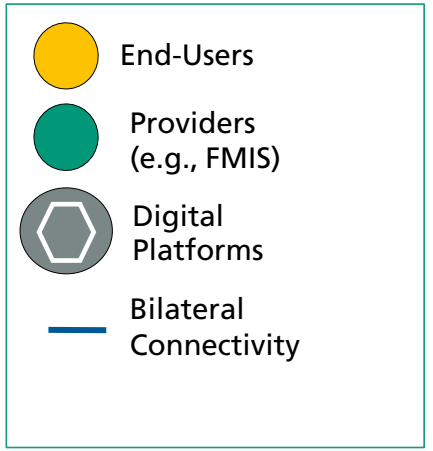
→ Very problematic, for industry as well as for the farmers



Different Actors in the Ecosystem – Technology-wise an Intended Scenario

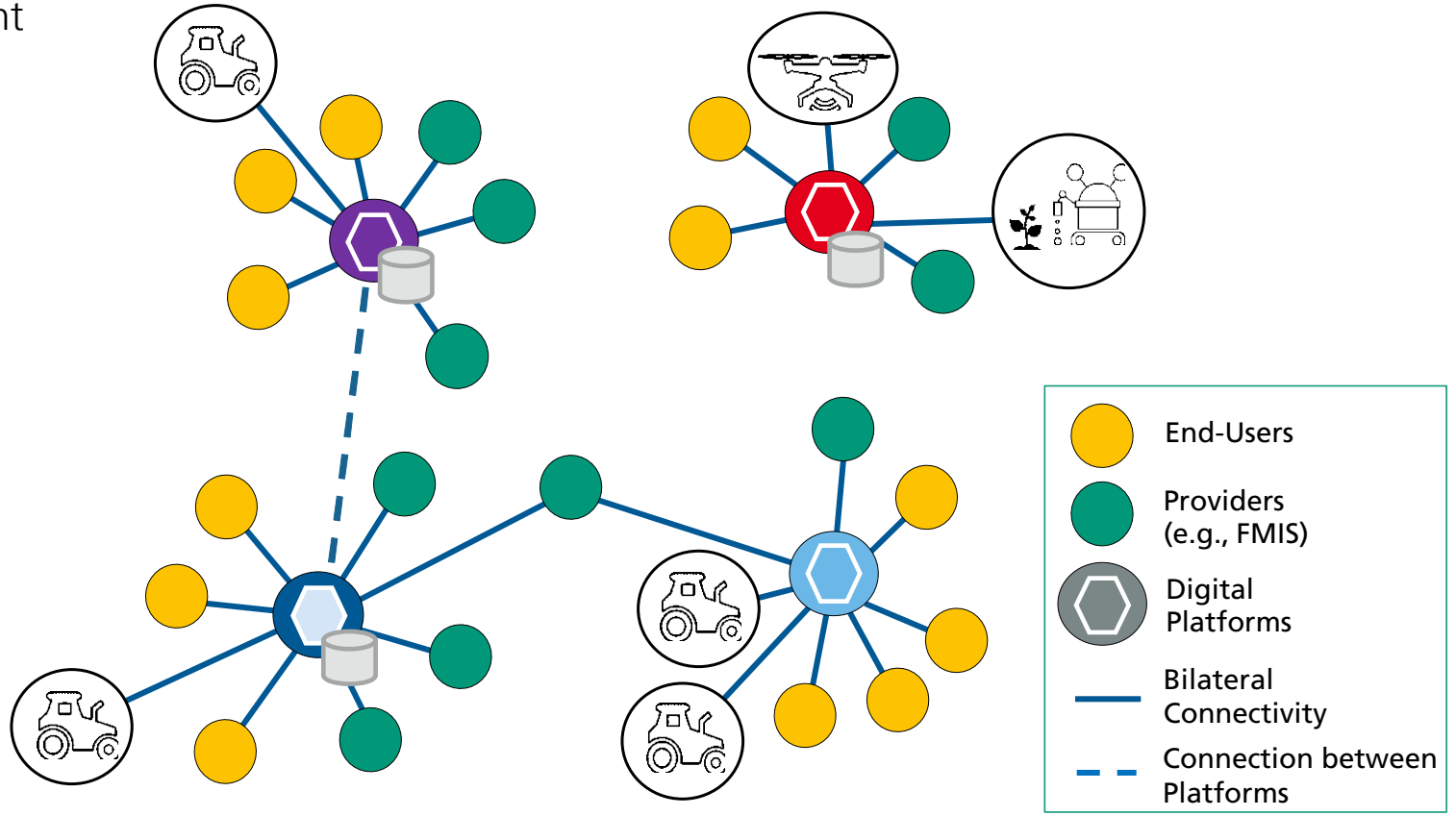


→ Is it realistic that we can achieve this?



Observed Challenges in the Context of Data Management / Data Spaces

- It is **hard to interconnect** entities from different digital ecosystems (islands)
- Data from specific assets like fields, animals, farms, or machinery is often **stored and distributed across multiple software solutions** and digital ecosystems
- Data is often stored in a **proprietary manner**, and interfaces for data access are not available
- **Data sovereignty** across ecosystems, is **rarely addressed** or if it is, then mostly within ecosystem boundaries
- The **complexity of agricultural processes**, as well as the multitude of entities and actors are **overwhelming challenges**



Source: Doerr, J.; Kalmar, R; Rauch, B; Stiene, S. (2022): Data Spaces in Agriculture, VDI International Conference on Agricultural Engineering, 2022

Data Spaces Technologies can bring several advantages into this situation

What are data spaces?

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What are data spaces?

- A data space is another word for a data center → **No**
- A data space is a platform → **No**
- A data space (e.g. for agriculture) exists only once → **No**
- A data space is a computing infrastructure similar to AWS, ... → **No**
- I store my data in a data space → **No**
- Data space initiatives are purely technical constructs → **No**

What are data spaces?

- A data space is an **infrastructure** that enables **data transactions between different parties** in the data ecosystem **based on the governance framework of** that data space. A data space should be generic enough to support the **implementation of different use cases.**

- Industrial data spaces, for example, can support various levels of **trusted and secure sharing and trading of commercial data assets** with automated and robust regulatory compliance and remuneration controls. Data spaces ensure **compliance with personal data regulations; data subjects** and data owners **can control their data and its subsequent use**.

Source: Parts translated from https://dssc.eu/ **Public**

EU Data Spaces Support Center DSSC

- **Goal**: The DSSC will **explore the needs of data space initiatives, define common requirements,** and **establish best practices to** accelerate the formation of sovereign data spaces as a critical element of digital transformation across all sectors.

- **Origin**: Consortium of different project partners (see figure) funded by the **EU**

Consortium members

BDV BIG DATA VALUE ASSOCIATION
Capgemini invent
FIWARE FOUNDATION
Fraunhofer
gaia-x
INTERNATIONAL DATA SPACES ASSOCIATION
KU LEUVEN
MyData
Ollscoil na Gaillimhe University of Galway
SITRA
TNO innovation for life
VTT

Source: https://dssc.eu/

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Business and organisational building blocks

Business	Governance	Legal
Business model	Organisational form and governance authority	Regulatory compliance
Use case development	Participation management	Contractual framework
Data product		
Intermediaries & Operators		

https://dssc.eu/

Technical building blocks

Foundational Standards	Control & Data Plane	Data Space Services
Data interoperability	Data sovereignty and trust	Data value creation enablers
Data models	Identity & attestation management	Data services & offerings descriptions
Data exchange	Trust framework	Publication & discovery
Provenance & traceability	Access & usage policies enforcement	Value Creation Services

https://dssc.eu/

Data Spaces for Agriculture – commonalities and differences…

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Project AgriDataSpace: Main Objective

Funded by the European Union

- Pave the way for a **European Agriculture Data Space** that facilitates data sharing, processing and analysis in a secured, trusted, transparent and responsible manner to create new opportunities for monitoring and optimizing natural resource use stimulating data-driven innovations.

Gaia-X Projects in the Ag-Domain (Germany):

X-KIT: Gaia-X and AI projects: Transfer & Networking

Gefördert durch
Bundesministerium für Ernährung und Landwirtschaft
aufgrund eines Beschlusses des Deutschen Bundestages

Projektträger
Bundesanstalt für Landwirtschaft und Ernährung

Objective of the Project

- The overall goal of the X-KIT project is to **promote networking and interoperability of systems in the AI projects funded by the BMEL** from the very beginning and to achieve **networking also with GAIA-X infrastructures** and further developments in adjacent projects.

Subproject 1 - Networking of the BMEL-funded AI projects

Subproject 2 - Support and development of Gaia-X projects in the agricultural sector.

- The goal of the second subproject is to **advance the further development of the agricultural domain in Gaia-X** by **analyzing requirements of the agricultural sector** and, if necessary, support their conceptualization and implementation into Gaia-X developments.

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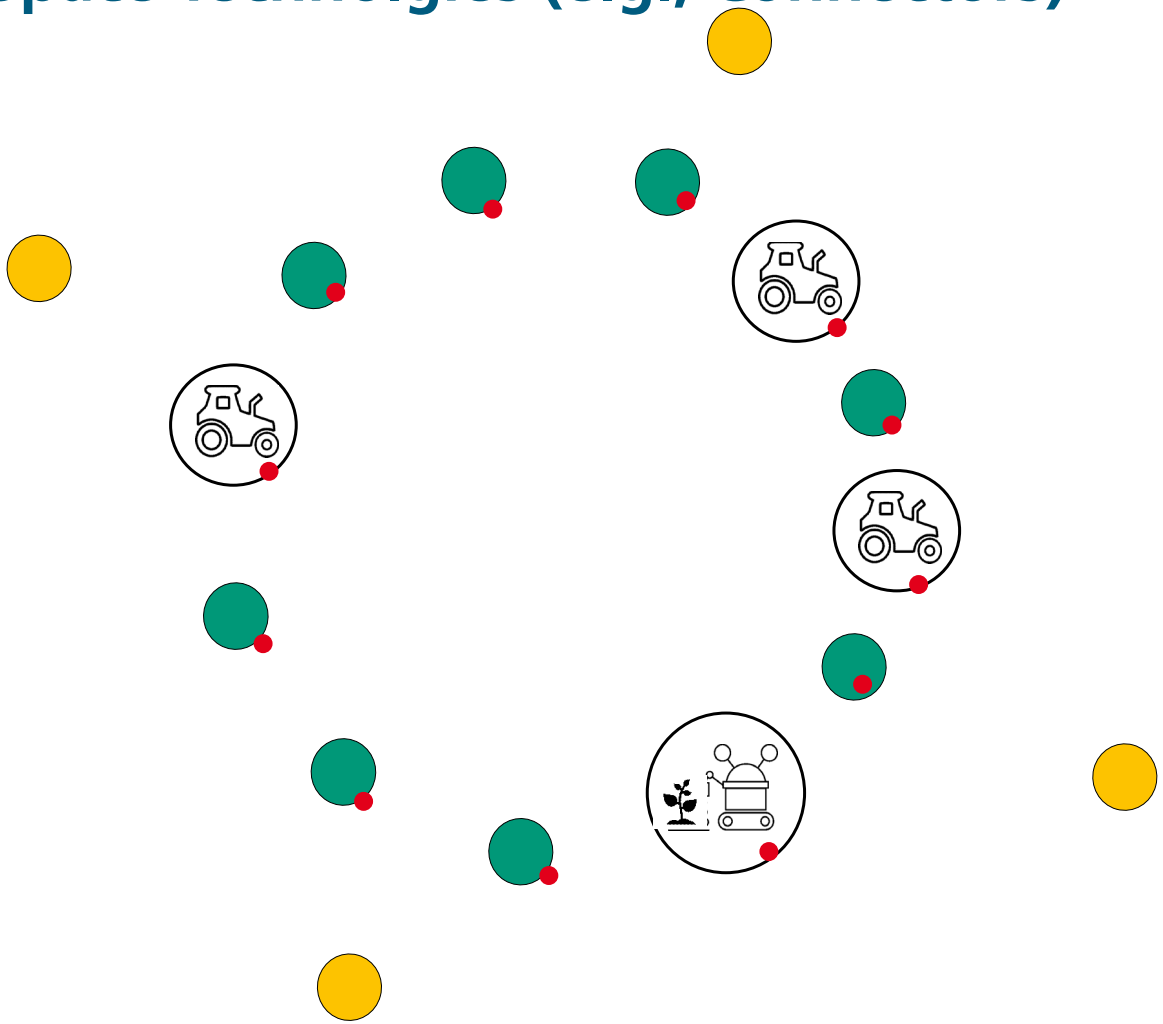
Different Actors in the Ecosystem – Usage of Data Space Technolgies (e.g., Connectors)



End-Users

Providers (e.g., FMIS)

Data Space Technology (Connectors)

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Agricultural Data spaces from the Perspective of Manufacturers and the Public Sector

Data spaces from the perspective of manufacturers and the public sector

Typical role in the area of data spaces:

- Manufacturers or authorities can **connect** their systems **to existing data spaces**
- Manufacturers or authorities must **(semantically) describe** their **data offerings** for this purpose

Potential benefit:

- Manufacturers or authorities can make their data available to many partners (in the ecosystem) (free of charge or at a cost) **without having** to **deal with individual partner interfaces**
- A **wide range of data** is available to manufacturers or authorities
- Manufacturers or authorities can obtain data from partners **without further programming effort**

Typical questions:

- How much effort is required to connect technically? Which data space technology should I use?
- How much effort does it take to (semantically) describe your data offerings?

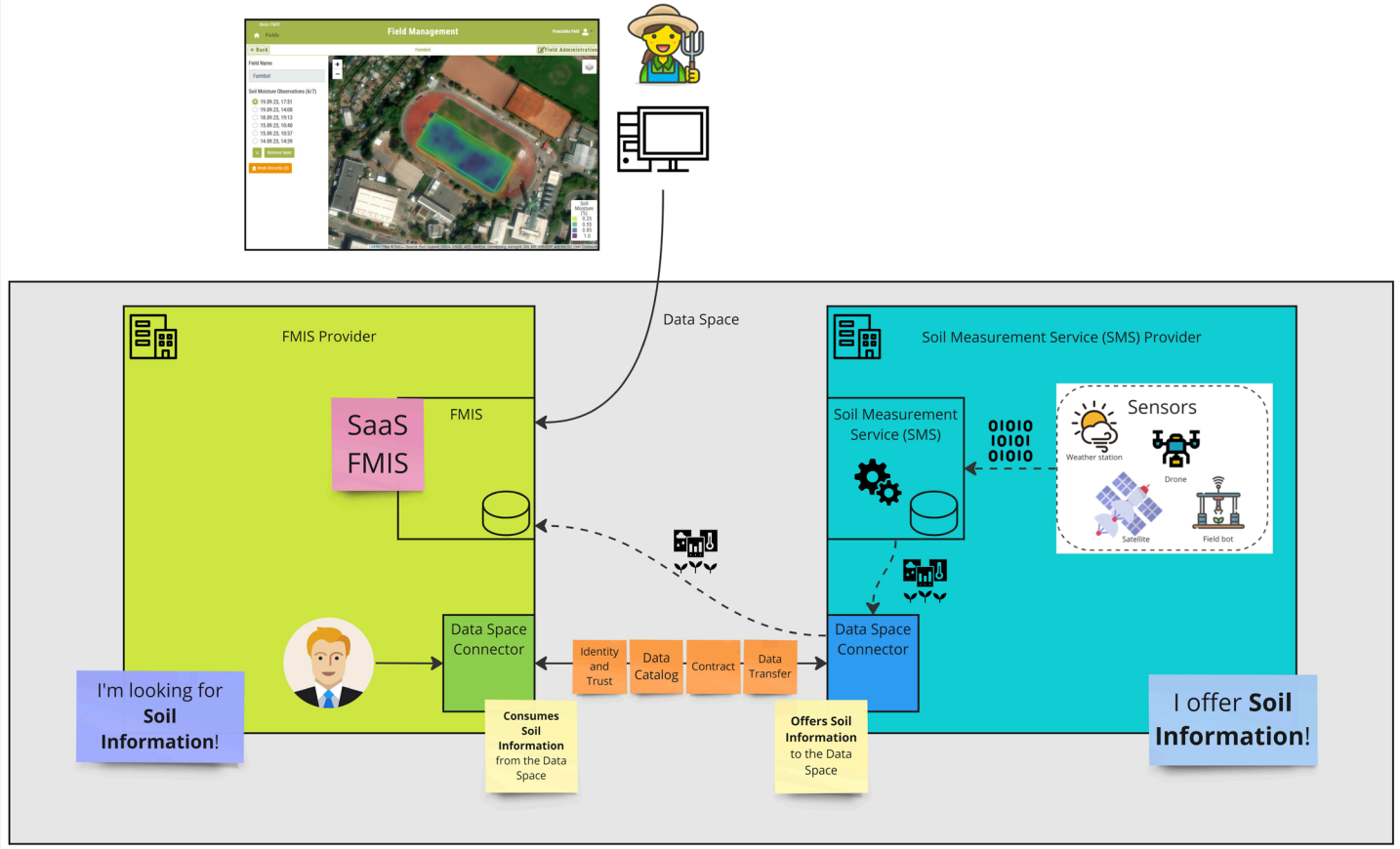
Demo video for data access with data space technology

X-KIT
GAIA-X + KI-PROJEKTE
Transfer & Vernetzung

Gefördert durch
Bundesministerium für Ernährung und Landwirtschaft
aufgrund eines Beschlusses des Deutschen Bundestages

Projektträger
Bundesanstalt für Landwirtschaft und Ernährung

- Situation.
  - SMS offers soil moisture data in a data space
  - FMIS wants to use soil moisture data
- Focus is on finding and retrieving soil moisture data
  - Precondition: SMS already offers the data
- Step 1: Discover the offer
- Step 2: Contract negotiation
- Step 3: Starting the transfer on the basis of the contract
  - Request data transfer
  - Provision of details for the data sink (Endpoint @ FMIS + login data)
- Step 4: User (farmer) can see new data in FMIS



Demo video available at https://www.iese.fraunhofer.de/de/projekt/x-kit/fachbeitrag/eclipse-dataspace.html

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Agricultural Data spaces from the Farmers‘ Perspective

Data spaces from the farmers' perspective

Typical role in the area of data spaces:

- Farmers **do not** have to **connect to data spaces themselves**
- Farmers **use systems that have been connected by the manufacturers or authorities**

Potential benefit:

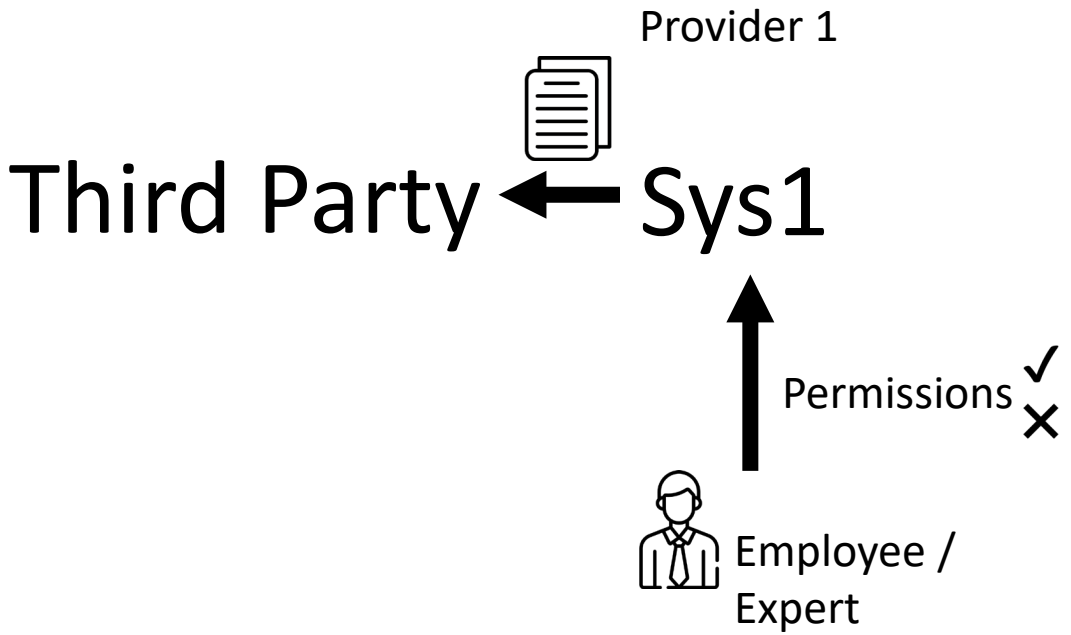
- Farmers have **less manual data entry work** as they benefit from the **improved data flow (interoperability) between the systems connected to the data space**
- Farmers receive **higher quality services**
- (Farmers can benefit monetarily from the provision of their data)

Typical questions:

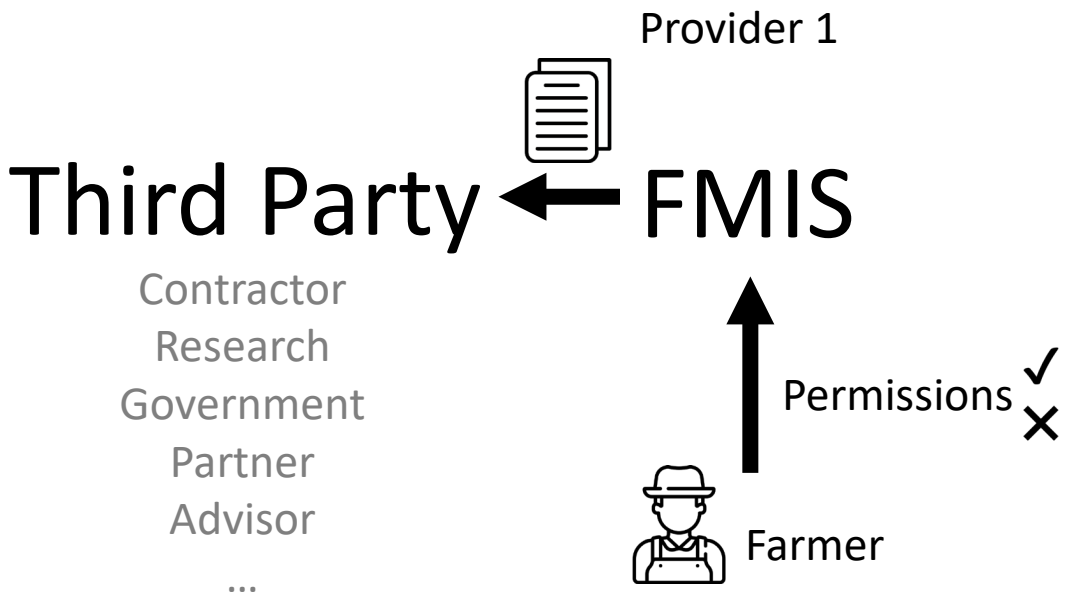
- How can I **control** the **flow of my data**?
- How can I recognize which systems are **currently best positioned**?
- How can I recognize which systems are **future-proof**?

On the Role of Consent and Permission Management…

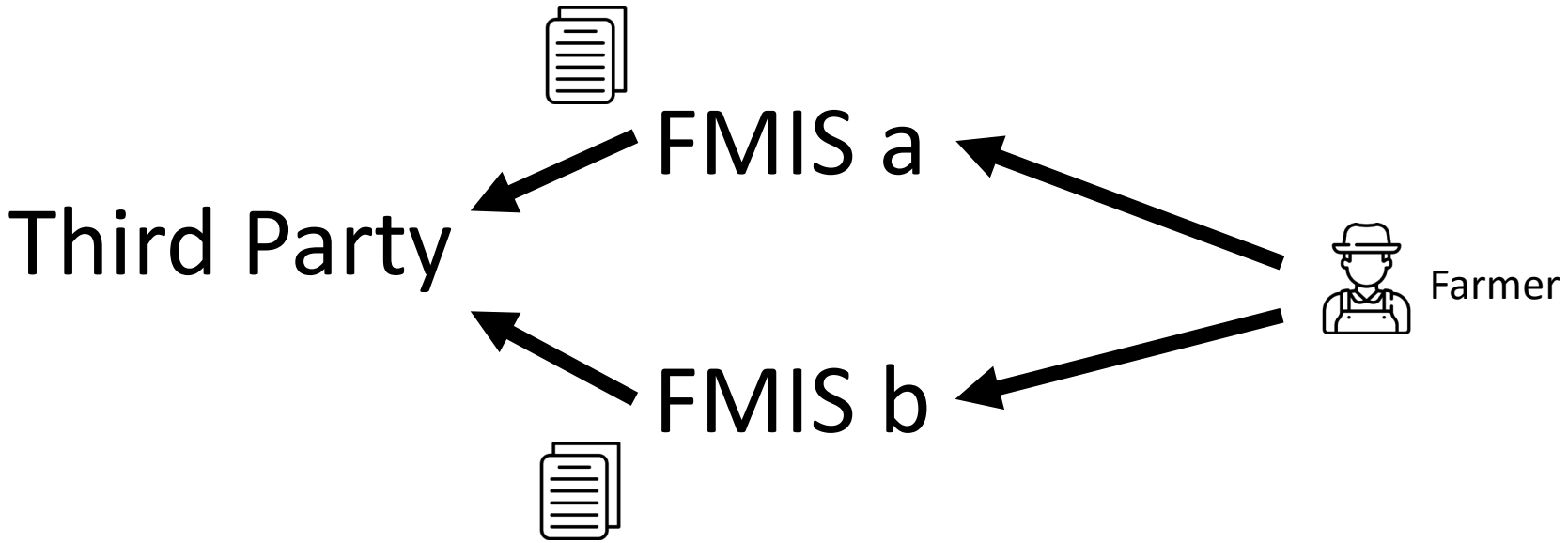
Typical situation for one data space (domain independent)



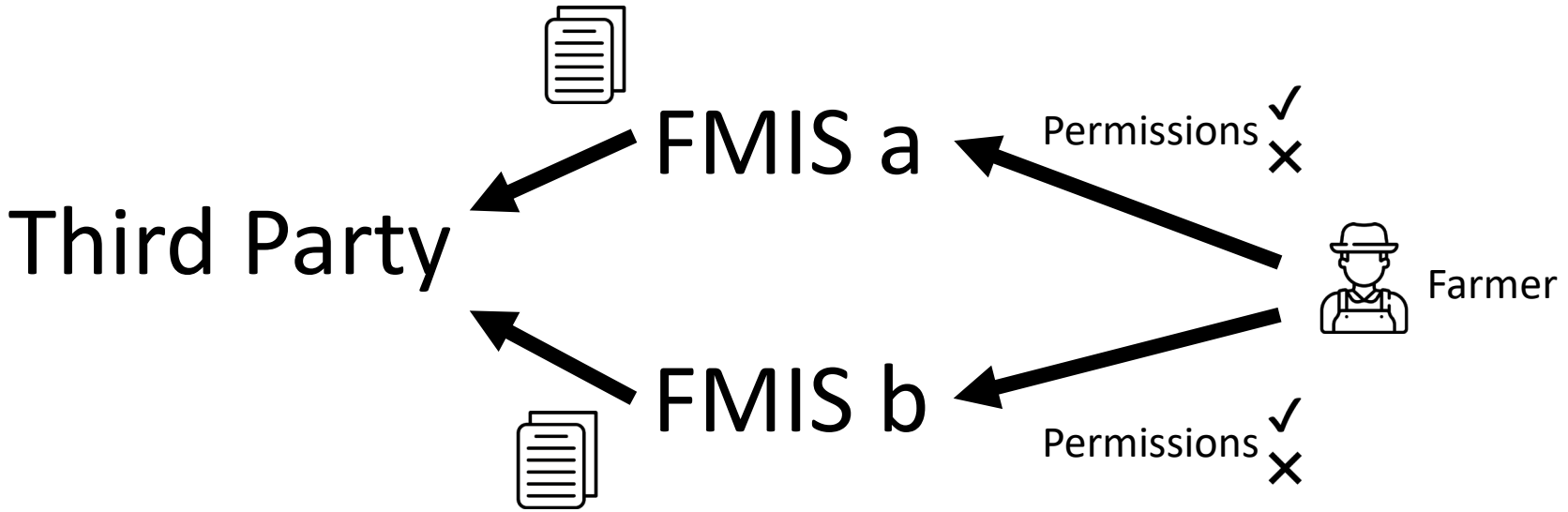
Simple situation with end users in smart farming



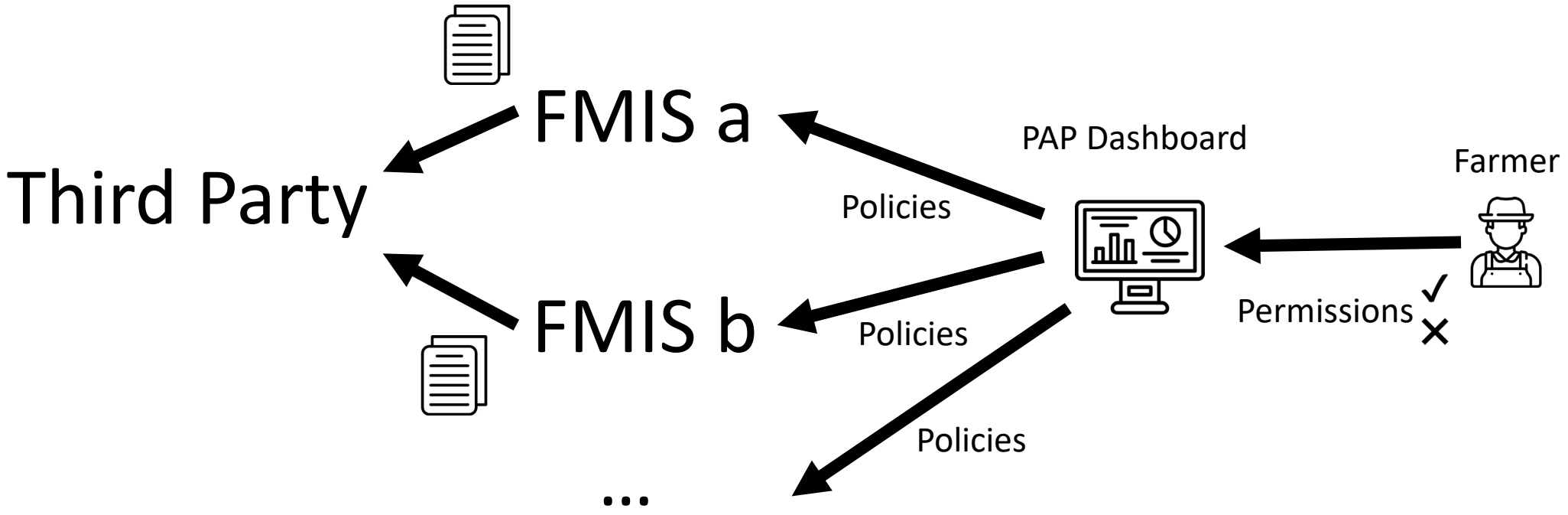
Typical situation in smart farming: multiple FMIS / DSI



Unintended situation with end-users
+ usage of multiple systems with the same (type of) data



Desired situation with end-users
+ Usage of a separate dashboard as Policy Access Point PAP



Summary

- ***Interoperability is (also technology-wise) a big challenge*** in agriculture; the topic gets ***more and more attention***
- Data Space technologies can be ***beneficial for the agricultural data exchange***
- The agricultural sector has several specific demands; e.g., ***consent and permission management needs to be handled differently*** from other sectors
- Esp. the ***farmer's perspective*** (use of dashboards) must be taken into account

Contact

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