SMART FOOD CHAIN
MINIMIZE WASTE IN FOOD SUPPLY

Developing and implementing effective smart packaging technologies to restructure conventional food supply chains.

Food supply chains have come under increased scrutiny in recent years. Food safety, food security and waste reduction in food as well as in packaging are now central issues which have to be addressed at every stage. New smart packaging technologies can offer vital data all along the value chain, to ensure stakeholders make the right decisions at the right time. AIPIA and its partners will bring together a group of experts from **every stakeholder in the chain** in order to develop a complete new supply chain.

- Generate and better use of **data** generated by smart packaging
- Use of (active) and sustainable packaging to increase **shelf life**
- Integrating of **sensors** for better quality control

A cooperation of

PACKZ®   AIPIA   Berenschot

Status & Goal of today

Status

We've been in contact with a lot of companies and thought out the project on a high level

Goal of today

We need to make the next step by going into more detail. Therefore, we <u>need</u> your input:

What would <u>you</u> like to develop in this project?

Agenda

01 — Envisioned Project

- Project Scope & Goals
- Project Working Plan
- Project Structure

02 — Summary of acquired information

- Sensors & Condition Indication
- Smart Packaging & Materials
- Data Systems & Smart Cloud
- Data Analytics & Supply Chain Management
- Recycling & Sustainability

03 — Gathering your input

- What Food/Beverage supply chain do we pick for demonstrating the Smart Food Chain?
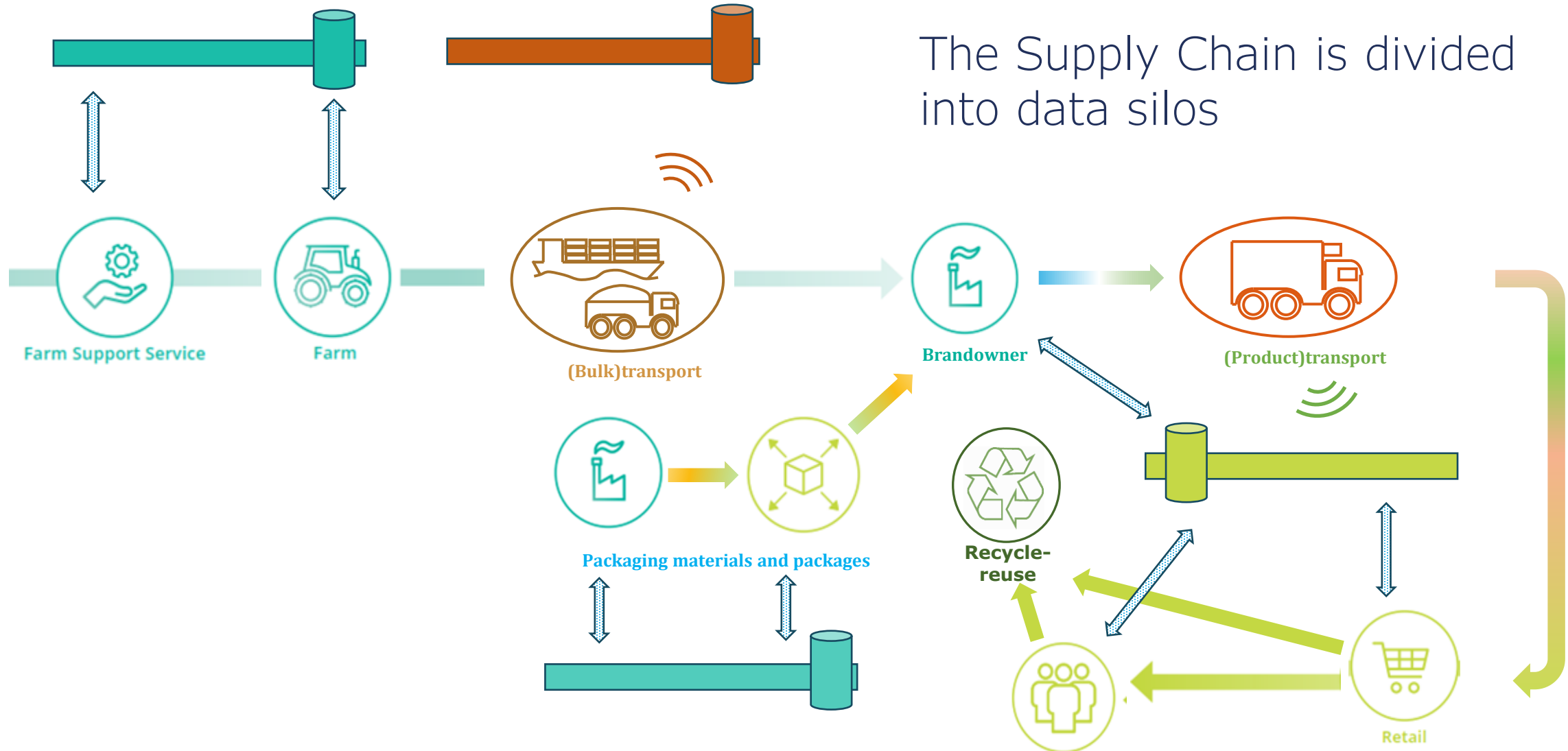- What would you like to develop?

04 — Next steps
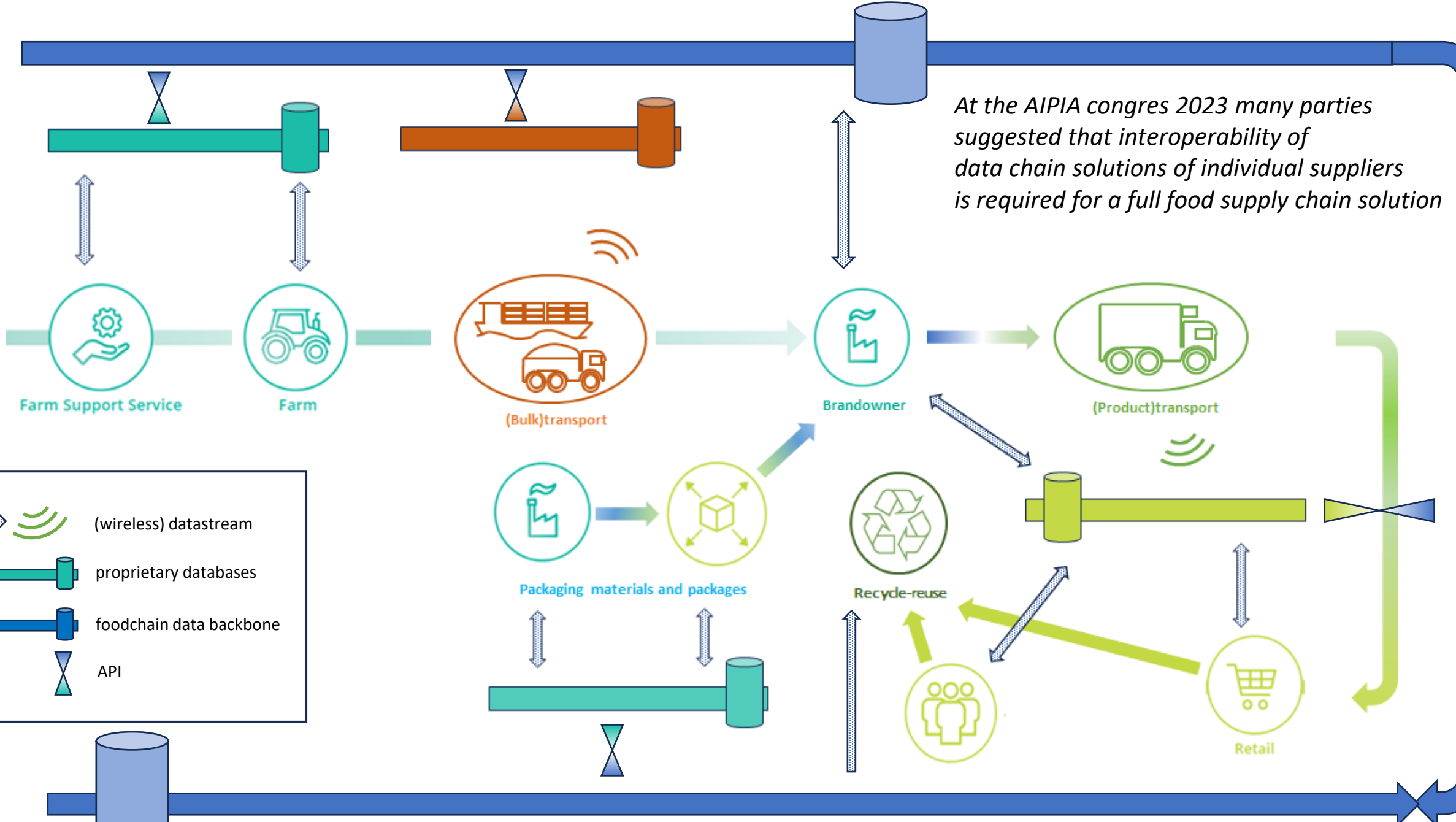
- Planning
- Next sessions

The problem we want to solve

The Supply Chain is divided into data silos

Farm Support Service

Farm

(Bulk)transport

Packaging materials and packages

Brandowner

(Product)transport

Recycle-reuse

Retail

At the AIPIA congres 2023 many parties suggested that interoperability of data chain solutions of individual suppliers is required for a full food supply chain solution

Legend:
- (wireless) datastream
- proprietary databases
- foodchain data backbone
- API

Farm Support Service

Farm

(Bulk)transport

Packaging materials and packages

Brandowner

(Product)transport

Recycle-reuse

Retail

Characteristics of
- Seeds
- Fertilizers
- Pesticides
- Feedstock, ……….

Characteristics of
- Growth conditions
- Time of sowing, harvesting
- …….

Transport conditions
- Time
- Temperature
- Location
- …….

Product properties
- Ingredients
- Processing charact…
- Batch number
- Shelf life, …..

Transportconditions
- Time
- Temperature
- Locations
- …….

Use and freshness
- Best before
- Temperature
- Origin
- Recipies, …..

Entry and storage
- Time
- Temperature
- Freshness/Best before
- …...

Packaging properties
- Material compositions
- Recyclability
- …..

- Re-use properties
- Recyclability

An interconnected data architecture enables the collection of all relevant data of produce and food items across the entire supply chain Apart from a data architecture we also envision to develop new sensor, packaging materials and techniques, and data analysis tools

Farm Support Service

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15-11-2023   6

Project Scope

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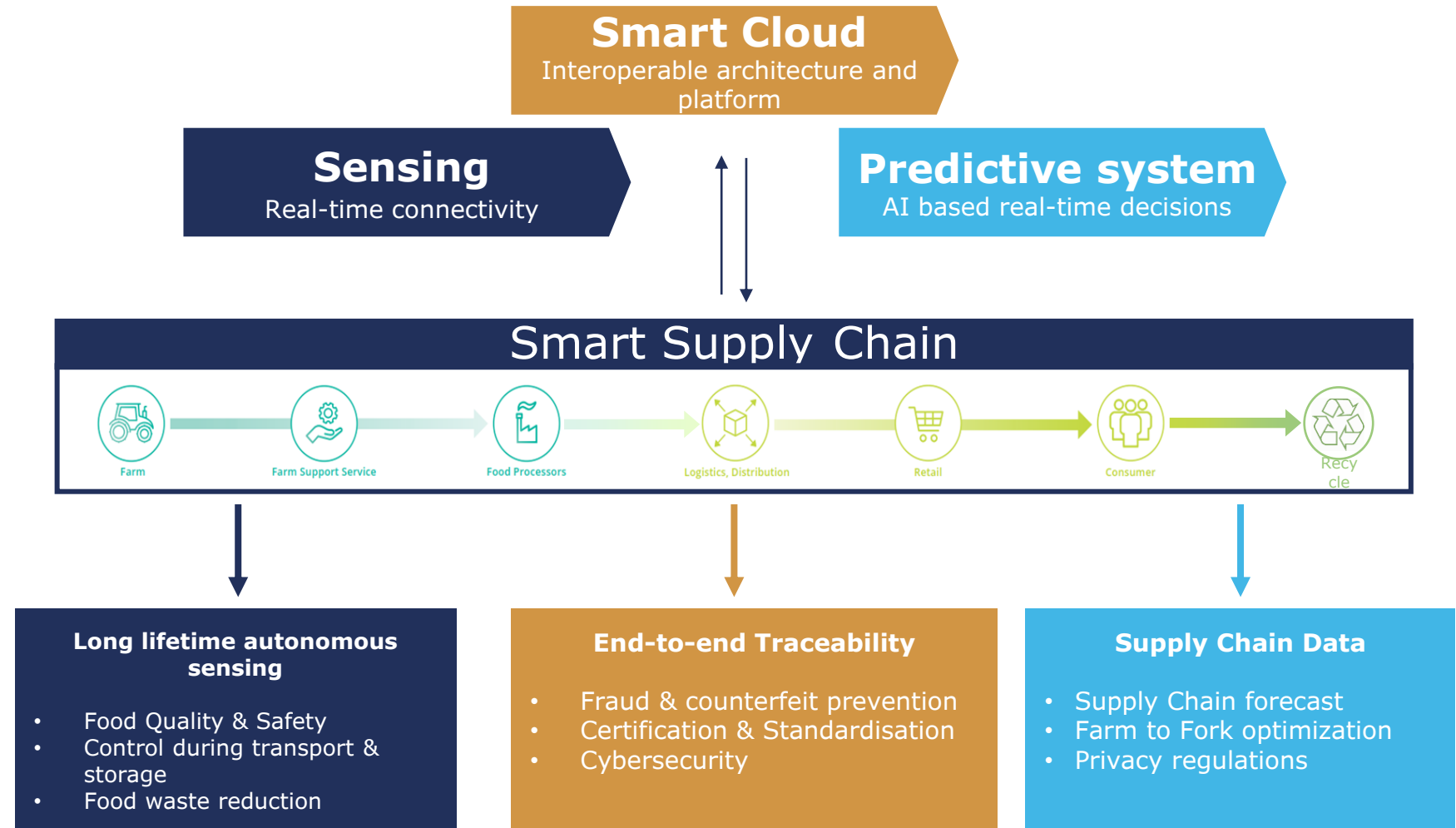
The envisioned project exactly matches the requirements for EU / National Authorities funded projects under the Key Digital Technologies Joint Undertaking funding scheme (KDT-JU, in 2024 to be renamed to Chips-JU) (https://www.kdt-ju.europa.eu/)

Also see page 417 and following of the Strategic Research and Innovation Agenda (SRIA) 2023
https://www.kdt-ju.europa.eu/sites/default/files/2023-02/ECS-SRIA%202023.pdf

Smart Cloud
Interoperable architecture and platform

Sensing
Real-time connectivity

Predictive system
AI based real-time decisions

Smart Supply Chain

Farm → Farm Support Service → Food Processors → Logistics, Distribution → Retail → Consumer → Recycle

Long lifetime autonomous sensing

- Food Quality & Safety
- Control during transport & storage
- Food waste reduction

End-to-end Traceability

- Fraud & counterfeit prevention
- Certification & Standardisation
- Cybersecurity

Supply Chain Data

- Supply Chain forecast
- Farm to Fork optimization
- Privacy regulations

Envisioned Work packages

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Smart Food Supply Chain

Farm → Farm Support Service → Food Processors → Logistics, Distribution → Retail → Consumer → Recycle

Food & Beverage Product supply chain demo's

- Product Type & Value & Quantity
- Logistic system (Transport container, DC's, last mile, Robotics, Smart retail)
- Product & Package Circularity

Sensors & Condition Indication

- Location
- Temperature
- Moisture
- Ethylene

Connectivity
- Smart Labels
- IoT

Smart Packaging & Materials

- Product level 1
- Package level 2
- Shipping level 3

Industrialisation
- Materials
- Assembly
- Integration

Data Systems & Smart Cloud

- Blockchain
- Communication devices (IoT)
- Standardisation

Data Analytics & Supply Chain Management

- Cloud analytics
- AI based decisions
- Production-consumption alignment
- Digital Twin
- VR
- AR
- Recycling/re-use

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Sensors & Condition Indication

What sensors are desired?

Who uses which data and with what purpose?

- Food producers -> Information on raw materials used
- Supply Chain -> Real time monitoring for improving real-time decision making
- Retail -> Act upon customer
- Customer -> Detailed information about the product

Sensor Connectivity

- Data rate & available after what time?
- Depending on application, preferably real-time (IoT)
- GS1 standards should be used -> EPCIS
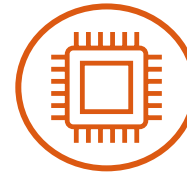
Types of sensors

- Temperature and food freshness sensing:
  - Cold supply chain monitoring
  - 'Best before' date labelling and monitoring
- Every type of food has different indicators (indirect & direct parameters)
  - Red meat -> Temperature
  - Seafood -> Snif (gas?) sensor

Costs

- Retailers and manufacturers are not scared of the technology, they are scared about the costs.
- Few cents per sensor means 10's of cents for retailers

Sensors & Condition Indication / Types of tags

Data exchange

Functionality

€€€

- Active RFID

Condition
(temp, freshness sensor)
Properties
Instantaneous location

- Passive RFID

Product condition (temp, freshness sensor)
Location

- Active visual

Product condition (temp, freshness sensor)

€   **- Printed label**

Product data / history

Smart Packaging & Materials

Smart Materials

- 3-phase polymer for prevention of bacterial growth (Aptar)
- Functionality added directly to package, reacting to
  - Moisture
  - Oxygen
  - Chemical product state indicators
    - Odor
    - Color

- Edible sensors
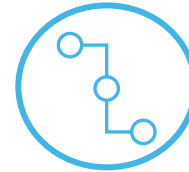
Connectivity

- RFID integration
- Watermarking

Application & Integration

- What technologies are necessary?
  - Printing
  - In-Mold electronics
  - Labels & Stickers

Data Systems & Smart Cloud

Smart Cloud requirements

- Extension of functionality
  - Product and packaging information
  - Include logistic information streams
  - Include information for consumers
  - Information for 'waste' stream/re-use & recycling
- Need for integral supply chain information and management systems

Solutions to be developed

- Highly efficient and easy to use system
- Privacy techniques / digital certificates
- ???

Data Sharing

- Creation of an interoperable 'neutral ground' for data sharing
- Finding truly open solutions in which parties can safely share information. The data backbone cannot be owned by a single party

Architecture

- Block chain 'data backbone' or federation of services?
- Different approaches possible:
  - Distributed ledger
  - Off-distributed ledger
  - Existing solutions: Catena X, IOTA

Data Analytics & Supply Chain Management
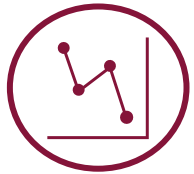
Data Processing & Analytics

- Data loading from Smart Cloud
  - Filter relevant data
- Data Analysis
  - AI algorithms
  - Decision making
    - Real time
    - Constant time intervals
    - Inconsistent time intervals
- Actionable data

Supply Chain Management

- Where can data be used in the Supply Chain?
  - Returnable assets
  - Extended Producer Responsibility (EPR) legislation / Digital product passport
- Insight in supply chain
  - Supply chain patterns
    - Correlation with quality
  - Knowing where, when, what
- Quality control
- Retail Inventory
- Connect to consumer

Recycling & Sustainability

Recycling

- Returnable assets
- Extended Producer Responsibility (EPR) legislation
- Using sensors for package identification
    - RFID
    - Watermarking

International system

- Recyclables vary in different countries
    - Use location data

Existing effort

- R-Cycle project
    - Open, globally applicable and accepted traceability standard for plastic products. Driven by a cross-industry community. Data infrastructure for the operation of digital product passports.

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Next steps

Towards the pre-proposal

Step 01
In depth meetings with individual companies

Coming weeks

Step 02
Online working session, task division and

13-12-2023

Step 03
Go-No go, commitment from partners & writing

Beginning 2024

Step 04
Submitting pre-proposal

May 2024

What developments are needed and what companies will take action?

Thoughts on first detailed draft & creating working groups

Multiple iterations of writing and reviewing

Detailed project working plan, deliverables and planning

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