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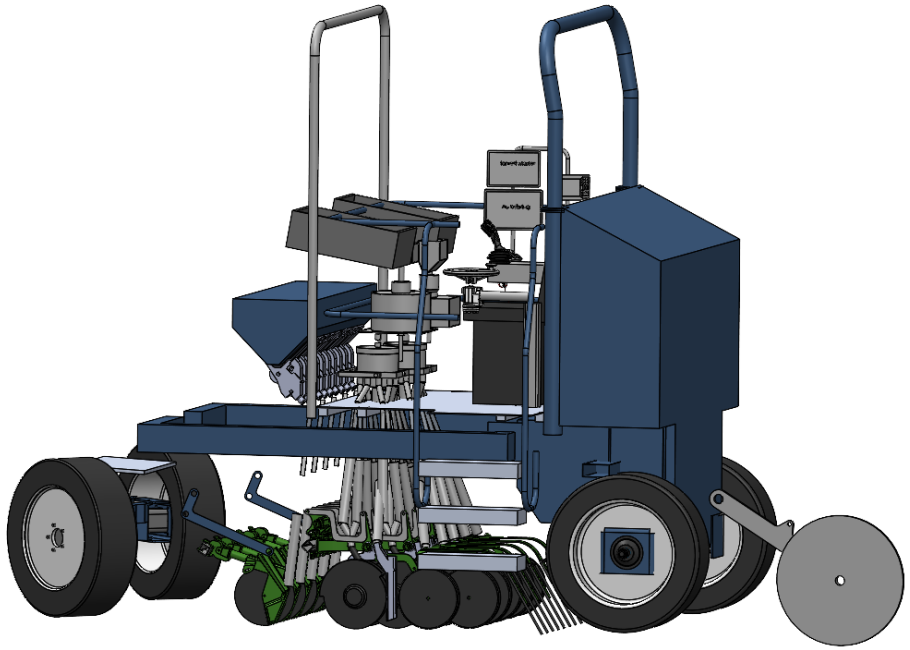
Phidan® Engineering

Value creation - cross border in field applied science

A Plot Seeder Development between HS Klostergården and TSAgro



Key question in VC and objectives for the project - SAPS

- For any Contract Research Organization, CRO
  - How to meet costumer needs – In this case the Breeding industry?
  - How to secure being an attractive CRO in Europe for field scientist?
  - How to document key elements in variety testing?
  - How to be agile and efficient in field applied operations?
  - How to remove static work and heavy lifting in plot seeding operations?
- These are key objectives for the project – Sensor based Autonomous Plot Seeder, SAPS
- Stakeholder in the project are HS Klostergården and we are looking for more – if you want to impact/influence – come forward
- Within the project we are looking for implementation of automated assessment by sensors/cameras on the go
- We have engaged Phidan Engendering, HS Sweden, AgTech Sweden, DTI and the breeding industry so far

Starting point - the self-propelled Plot Seeder – AU Flakkebjerg in 2023

- Self propelled, 4X4, Tool carrier, 2.5-meter plot width; drills fertilizer, cereals, grass for seed and liquid fertilizer

- Fertilizer application, solid/granules/liquid
- Plot drilling – cereals etc
- Plot drilling – grass for seed
- All in one operation

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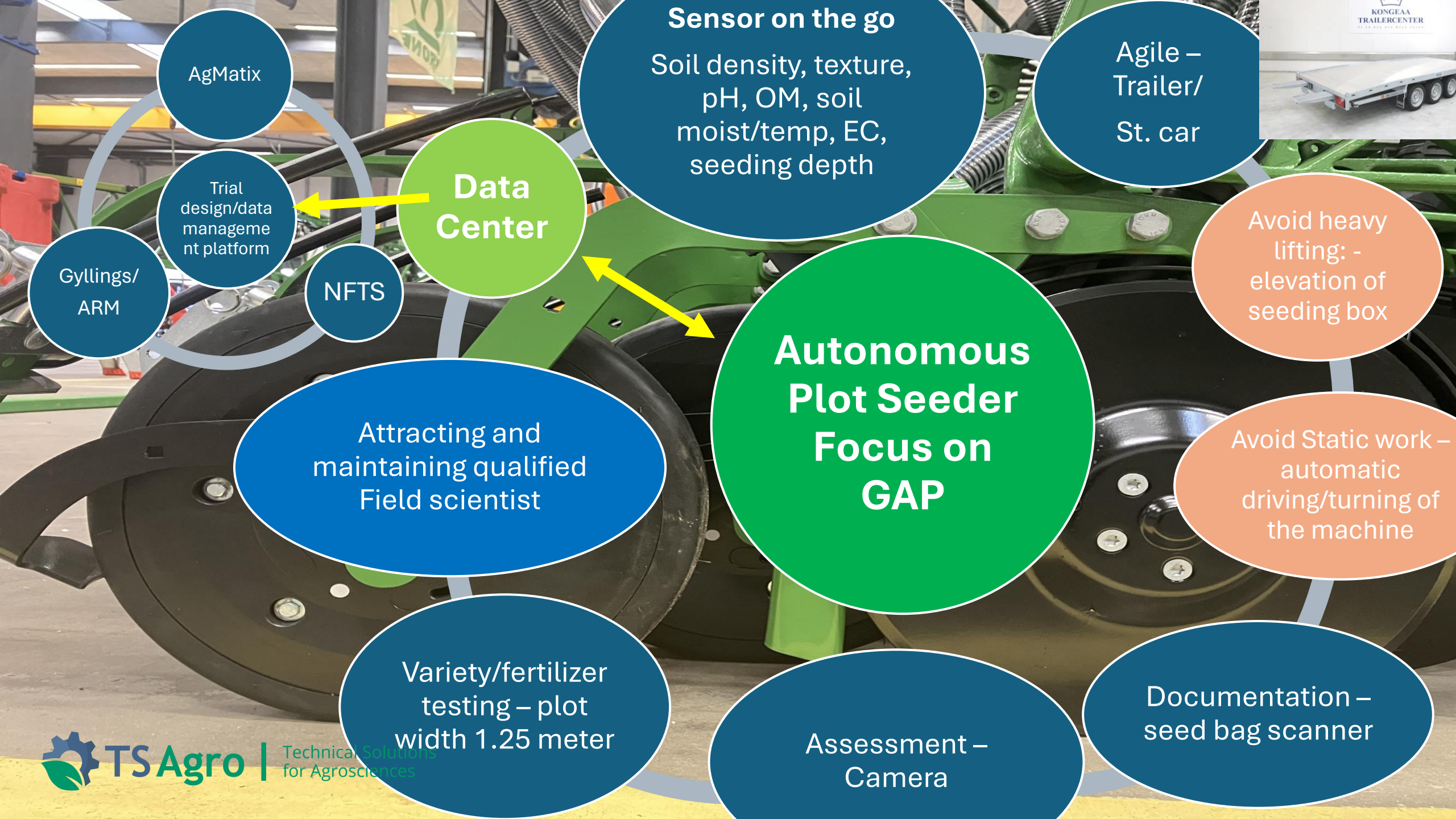
AgMatix
Trial design/data management platform
Gyllings/ ARM
NFTS
Data Center
Sensor on the go
Soil density, texture, pH, OM, soil moist/temp, EC, seeding depth
Agile – Trailer/ St. car
Avoid heavy lifting: - elevation of seeding box
Autonomous Plot Seeder Focus on GAP
Attracting and maintaining qualified Field scientist
Avoid Static work – automatic driving/turning of the machine
Variety/fertilizer testing – plot width 1.25 meter
Assessment – Camera
Documentation – seed bag scanner
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Key activities in the task solution and background for the project

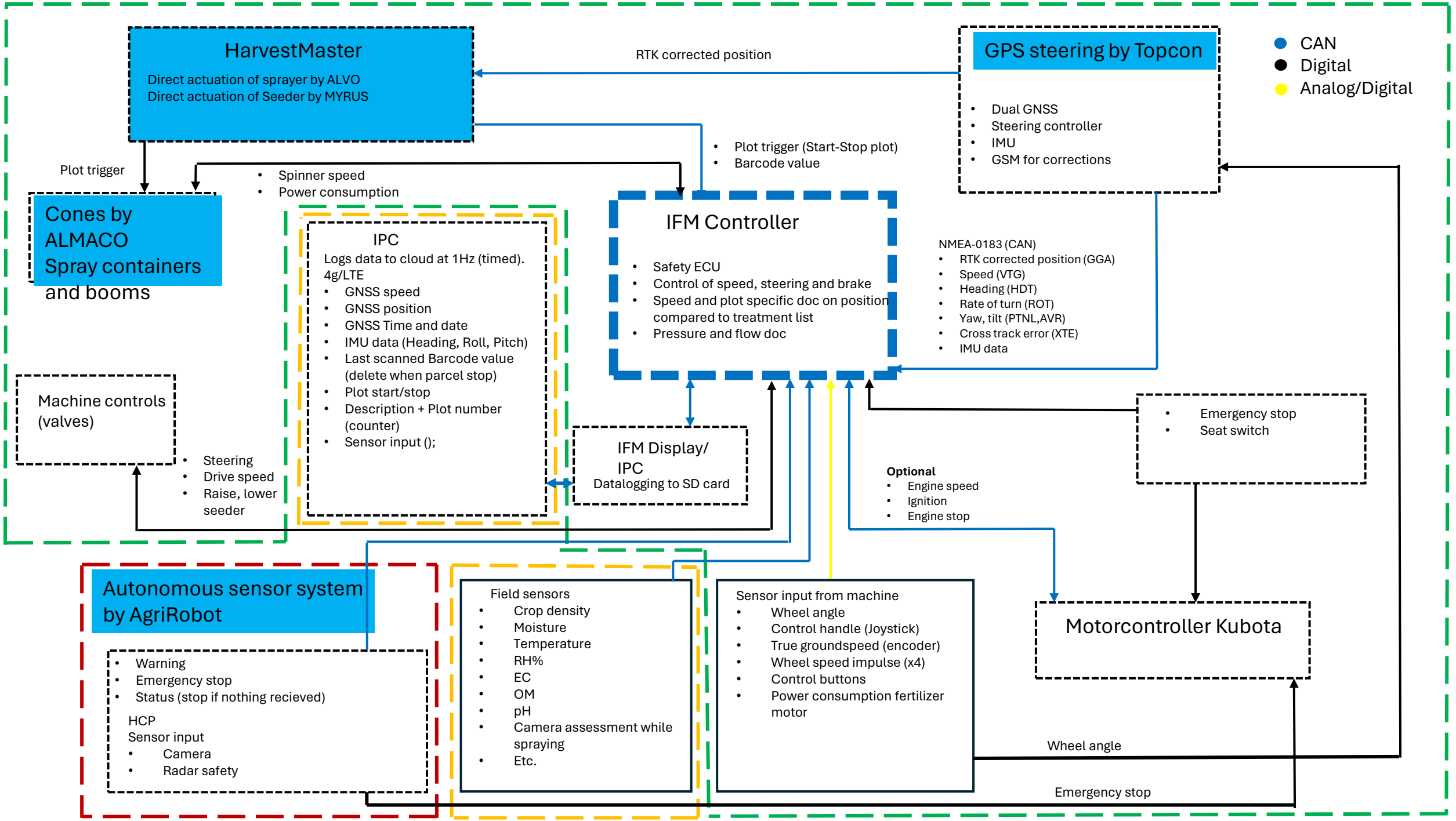
- **Attracting and maintaining qualified field scientist** in the experimental field applied arena is severely challenged in a Nordic/European labor market and a solution to this, among other things, is a **reduction of workers from 2 to 1 test technician** in the process of sowing e.g., variety testing/plant breeding.

- **Static work** is a clear challenge for the working environment and making the machine autonomous solves a significantly static task and generates effectiveness – humans cannot turn precise every time – the machine can

- **Heavy lifting** is characterized by seeding in the experimental system and the implementation of elevation options from ground level to platform solves this

Plot specific data – not only location specific data:

- Key implementation on the platform will be the ability to apply sensor and camera technologies "on the go".
  - The platform is described as any field applied equipment e.g. plot seeder/sprayer
- “On the go” requires automation in data collection as well as structuring and data processing.
- “On the go” will significantly increase the amount of data by applying sensor and camera technologies on field trial equipment to the benefit of extended use of collected data.
- This is solved through the implementation of a collection platform (HPC and iCloud) which stores the data collection for further analysis in any data management platform.


HarvestMaster
Direct actuation of sprayer by ALVO
Direct actuation of Seeder by MYRUS
RTK corrected position
GPS steering by Topcon
Dual GNSS
Steering controller
IMU
GSM for corrections
CAN
Digital
Analog/Digital
Plot trigger
Spinner speed
Power consumption
Plot trigger (Start-Stop plot)
Barcode value
Cones by ALMACO Spray containers and booms
IPC
Logs data to cloud at 1Hz (timed). 4g/LTE
GNSS speed
GNSS position
GNSS Time and date
IMU data (Heading, Roll, Pitch)
Last scanned Barcode value (delete when parcel stop)
Plot start/stop
Description + Plot number (counter)
Sensor input ();
IFM Controller
Safety ECU
Control of speed, steering and brake
Speed and plot specific doc on position compared to treatment list
Pressure and flow doc
NMEA-0183 (CAN)
RTK corrected position (GGA)
Speed (VTG)
Heading (HDT)
Rate of turn (ROT)
Yaw, tilt (PTNL,AVR)
Cross track error (XTE)
IMU data
Machine controls (valves)
Steering
Drive speed
Raise, lower seeder
IFM Display/ IPC
Datalogging to SD card
Emergency stop
Seat switch
Optional
Engine speed
Ignition
Engine stop
Autonomous sensor system by AgriRobot
Warning
Emergency stop
Status (stop if nothing recieved)
HCP
Sensor input
Camera
Radar safety
Field sensors
Crop density
Moisture
Temperature
RH%
EC
OM
pH
Camera assessment while spraying
Etc.
Sensor input from machine
Wheel angle
Control handle (Joystick)
True groundspeed (encoder)
Wheel speed impulse (x4)
Control buttons
Power consumption fertilizer motor
Motorcontroller Kubota
Wheel angle
Emergency stop

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SAPS - Configuration and timelines

Sensor based Autonomous Plot Seeder, SAPS

- Drills fertilizer from a seeding box or from cones in bagged fertilizer
- Drills the crop from a seeding box or from cones in bagged seed in one and the same machine
- Bagged seed or fertilizer from two cones, belt and cell cone
- Crop defined as: Cereals, Peas, Beans, Canola, Cumin, Grass, corn, beets etc
- Construction start 1st of October 2024, first testing late December 2024, field test february 2025 – Delivery expected by March 2025

Illustration of SAPSeeder By TSAgro

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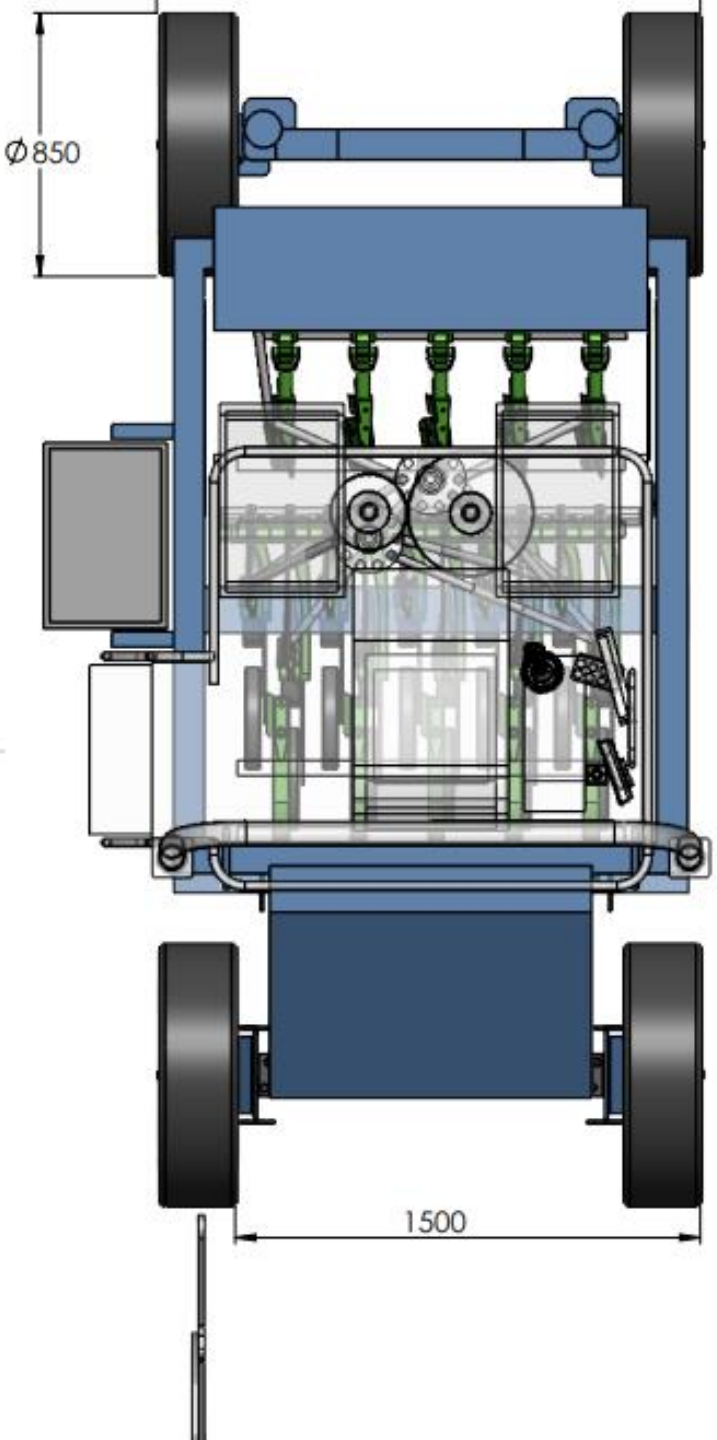
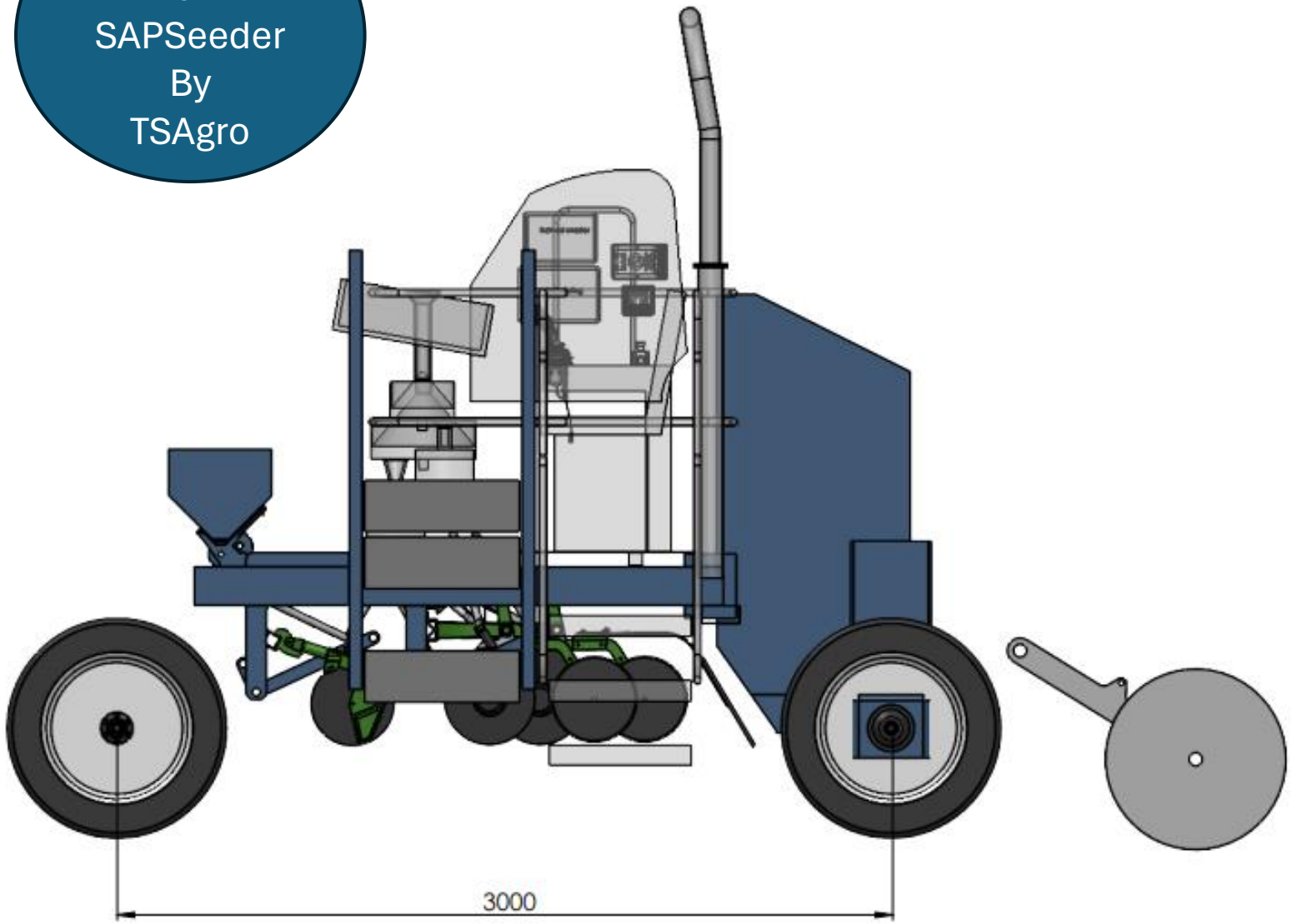
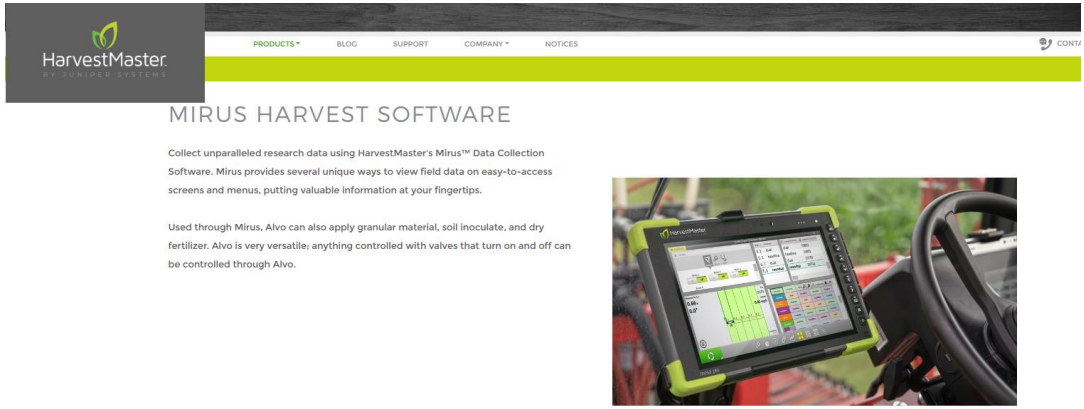
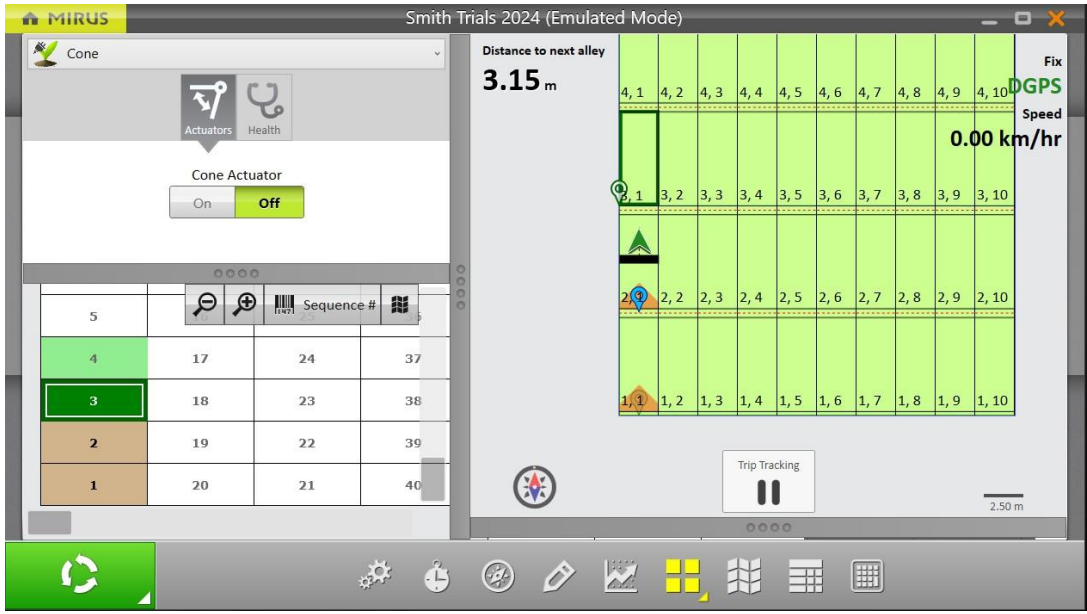




Design and data management

- NFTS/ARM or any planning tool
- Design push direct to MIRUS Planter by HM
  - Bar code scanning of seed bag linked to GPS position of single plots
- The project aim are to collect:
  - Texture and density messurement
  - Seeding depth and soil moisture on the go
  - Nutrient including cadmium messurement
  - EM 38
  - EC at 0-60 cm
  - PH
  - OM
  - RH%
  - Assessment of bio derversity is a goal
  - ETC





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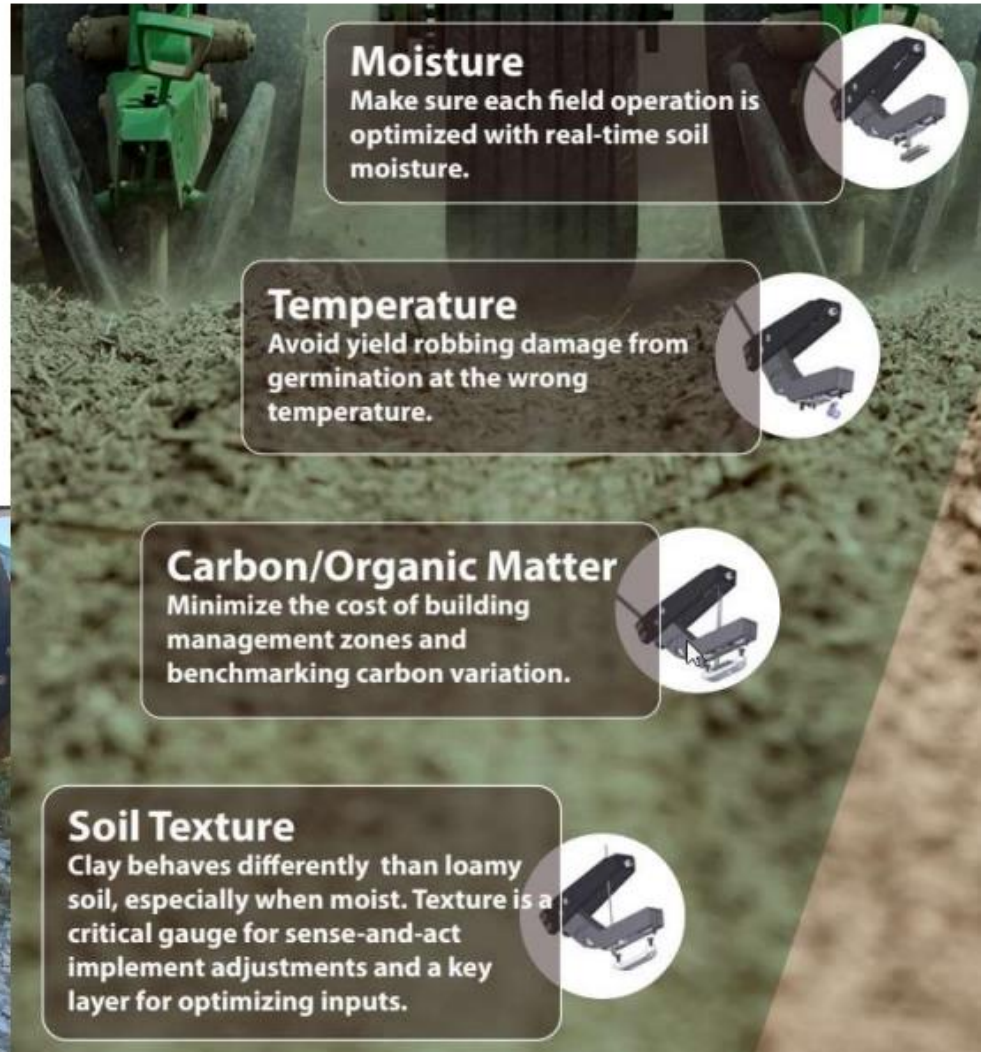
Sensor implements

FurrowScan



Answer to Key questions

- How to meet costumer needs – In this case the Breeding industry? Plot size and documentation
- How to secure being an attractive CRO in Europe for field scientist and How to remove static work and heavy lifting in plot seeding operations? Effective modern equipment with a high focus on working environment and safety implementing elevation of seeding boxes from ground to platform
- How to document key elements in variety testing? Implementing direct export of trial design from data management platform to application technology, scan a barcode and store it together with GPS coordinates and include automated sensor-based assessment on plot level
- How to be agile and efficient in field applied operations? Design a plot seeder which can be mounted on a trailer designed for standard cars and incorporate automated technology for machine operations

Sensor “On the go” - SAPSeeder

- The Plot Seeder platform – in development
  - Interest partners: HS in Sweden, Breeding companies and Breeding CRO, SLU (Agtech Sweden)
- Control unit (Harvestmaster), storage, GPS (Topcon) and autonomy (AgriRobot) are being assembled for implementation
- Sensor units (e.g. Veris) – in scooping phase together with SLU and AgTech Sweden
- Camera mounting on Seeder/Sprayer and or any devise – development area where we need inputs

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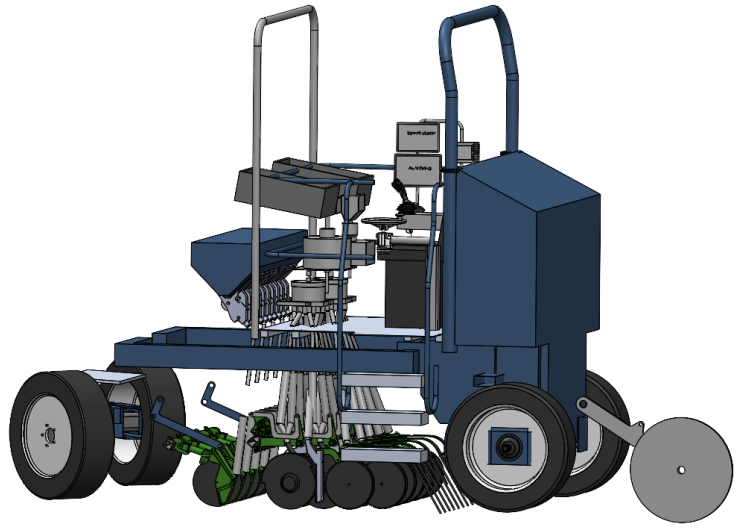
Thank you for your attention and looking forward to the co work with you



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