
Digital utveckling hos företagen
Mistra
Digital Forest


Erik Willén, Stora Enso
Mistra
Digital Forest

Precision Forestry

Bringing quantifiable change to the way we understand, value and manage forests

Erik Willén
Senior Manager Precision forestry

StoraEnso

Precision Forestry for accurate, sustainable forest management and wood supply

StoraEnso

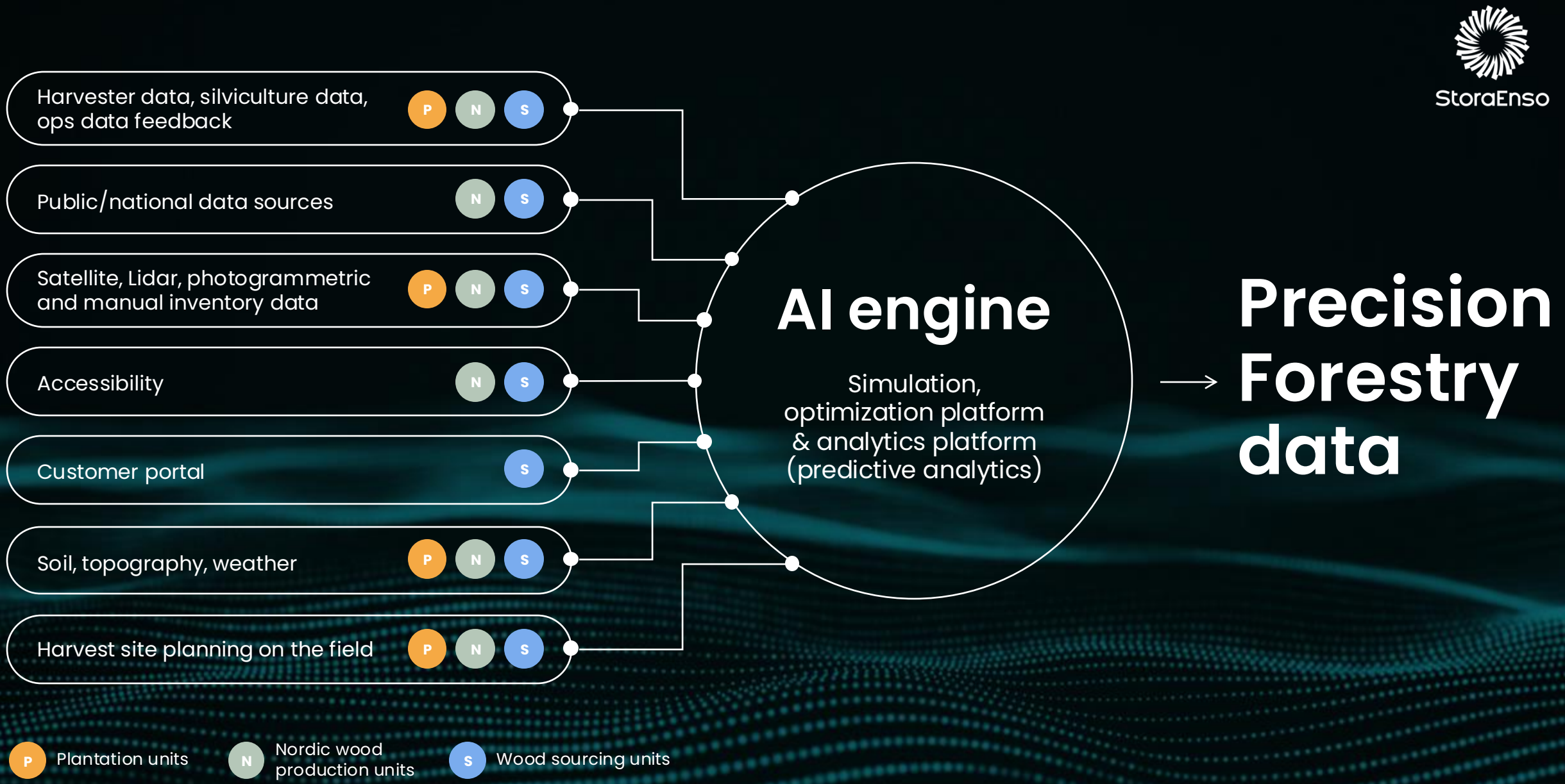
Est. 2022

Our vision is to utilize digital tools and technology for advanced **forest data acquisition, processing and utilization** of forest information. That builds up into an accurate and up-to-date **digital twin of the forest**.

With an easy access to **accurate and up-to-date forest data**, we work more efficiently. Precision Forestry enables more data-driven processes related to our own forest, wood supply and sustainability.

Better data supports **better decision making**, which leads to operational excellence.

This **competitive edge** enables us to take better advantage of business opportunities.


Harvester data, silviculture data, ops data feedback
P N S
Public/national data sources
N S
Satellite, Lidar, photogrammetric and manual inventory data
P N S
Accessibility
N S
Customer portal
S
Soil, topography, weather
P N S
Harvest site planning on the field
P N S
AI engine
Simulation, optimization platform & analytics platform (predictive analytics)
Precision Forestry data
P Plantation units
N Nordic wood production units
S Wood sourcing units

Measure, model and monitor forest assets with unmatched accuracy and reliability

StoraEnso

Precise measuring

Based on verified data sources and methodologies used to manage millions of hectares.

Accurate modelling

Prediction-based AI modelling of multiple layers of verified data.

Effective monitoring

Monitoring of forest ecosystem characteristics over time.

Case examples inspired by Mistra Digital Forest

PRECISION FORESTRY SOLUTION IN USE

Forest data updates with AI

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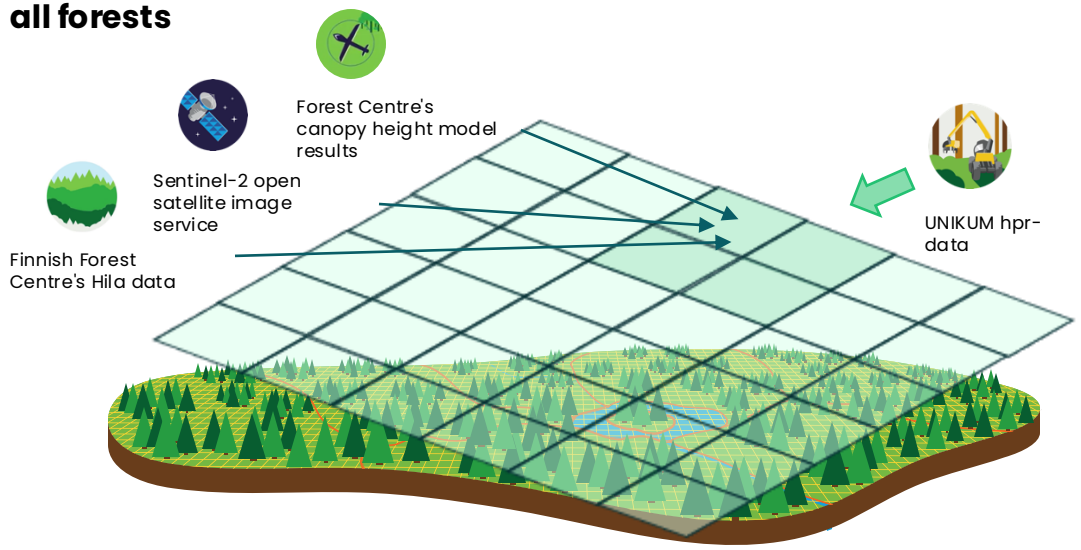
WHAT IS THE SOLUTION ALL ABOUT?

- Using several data sources, we can train a model that understands how a specific area appears in nature.
- AI-updated forest resource information is on average more accurate than open forest resource data.
- AI-updated forest resource information is compared to harvesting and other new available data, and we can continuously improve the model.

SOLUTION USAGE

- AI-updated forest data is already available for all users in Finland and own forest in Sweden

Open datasets in Finland covering all forests



PRECISION FORESTRY SOLUTION IN USE

Forwarder optimization

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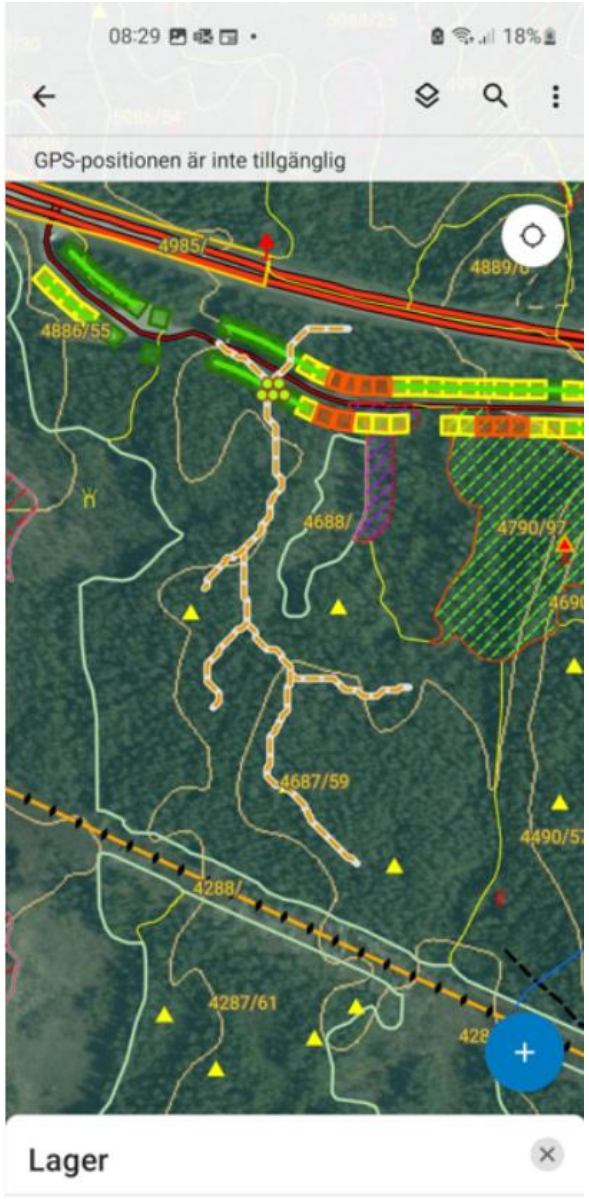
WHAT THE SOLUTION IS ALL ABOUT?

- For each forest cutting we also plan the landings and main forwarding extraction routes. Forwarder optimization tool in Timbetrail offers **optimized forwarding routes** for **forest planners and forest machine operators**.
- Optimized forwarding routes will e.g.,
  - reduce total forwarder distance in the forest (reducing CO2 emissions)
  - reduce driving damages in the forest (reduced risk of rutting and driving in NoGo Areas)
  - reduce efforts (time saving) for forestry planners and machine operators.

SOLUTION USAGE

- Solution available in **FieldMaps** for **planners**, since summer 2024.



Visual example of the solution

PRECISION FORESTRY SOLUTION IN USE

Decision support for thinning

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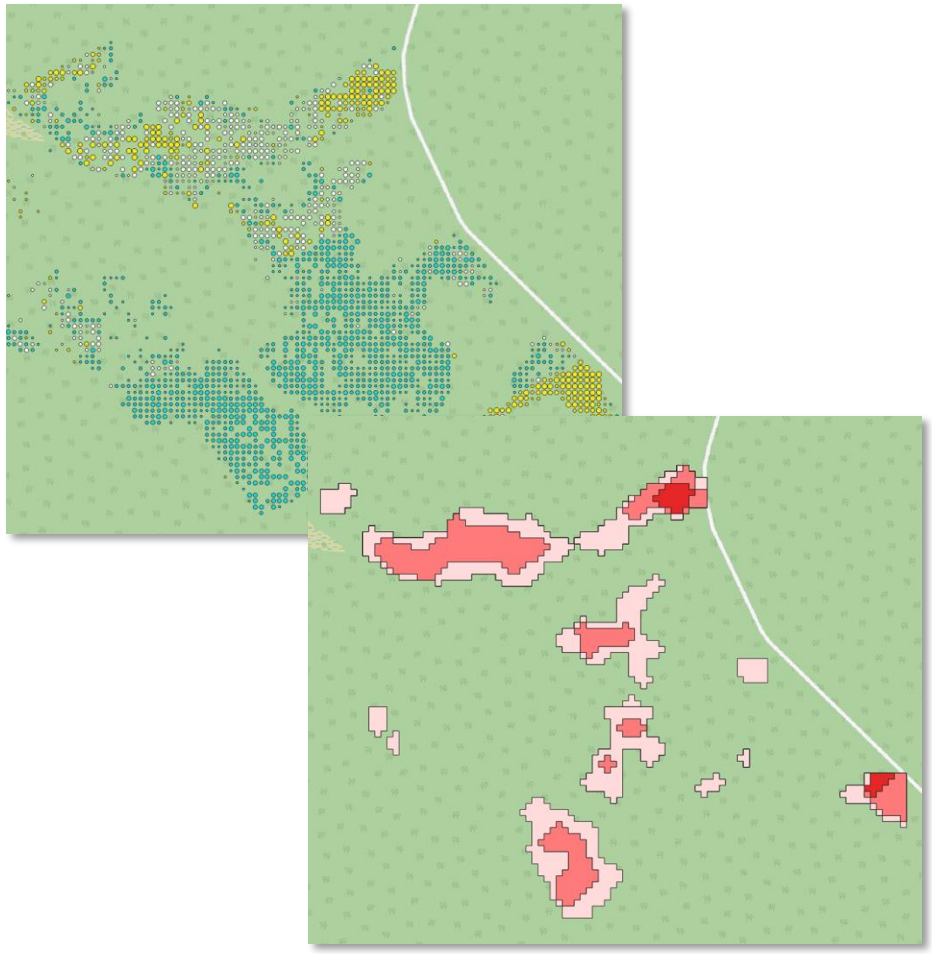
WHAT IS THE SOLUTION ALL ABOUT?

- The solution delivers forestry planners models that **automatically map detailed need for thinning**, both for own forest and private forest land
- The solution enables
  - More detailed instructions for more site adapted thinnings
  - Less errors and more efficient planning
  - Increased quality in thinning operations
  - Weekly updates
  - Risk mapping

SOLUTION USAGE

- Solution available **for planners** and wood purchasers
- Better service for our private forest owner customers

Visual example of the solution:



PRECISION FORESTRY SOLUTION IN USE

Mapping of standing deadwood

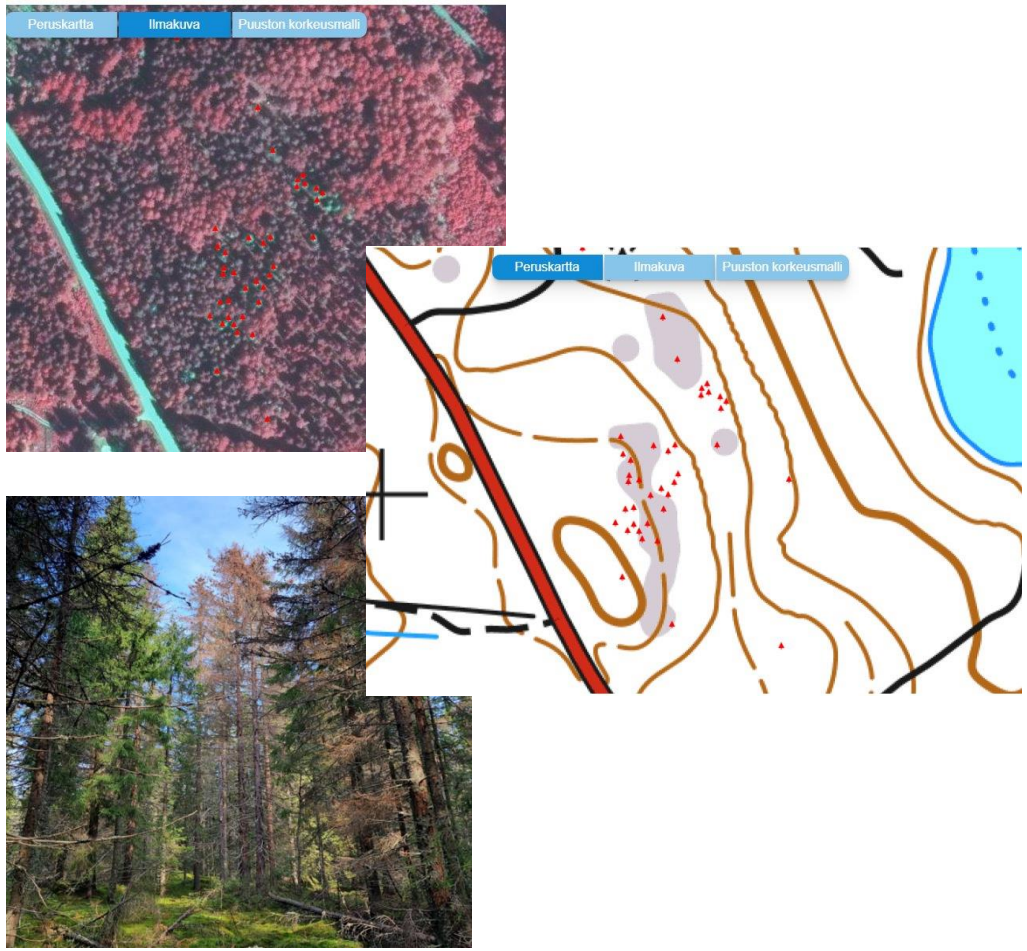
StoraEnso

WHAT IS THE SOLUTION ALL ABOUT?

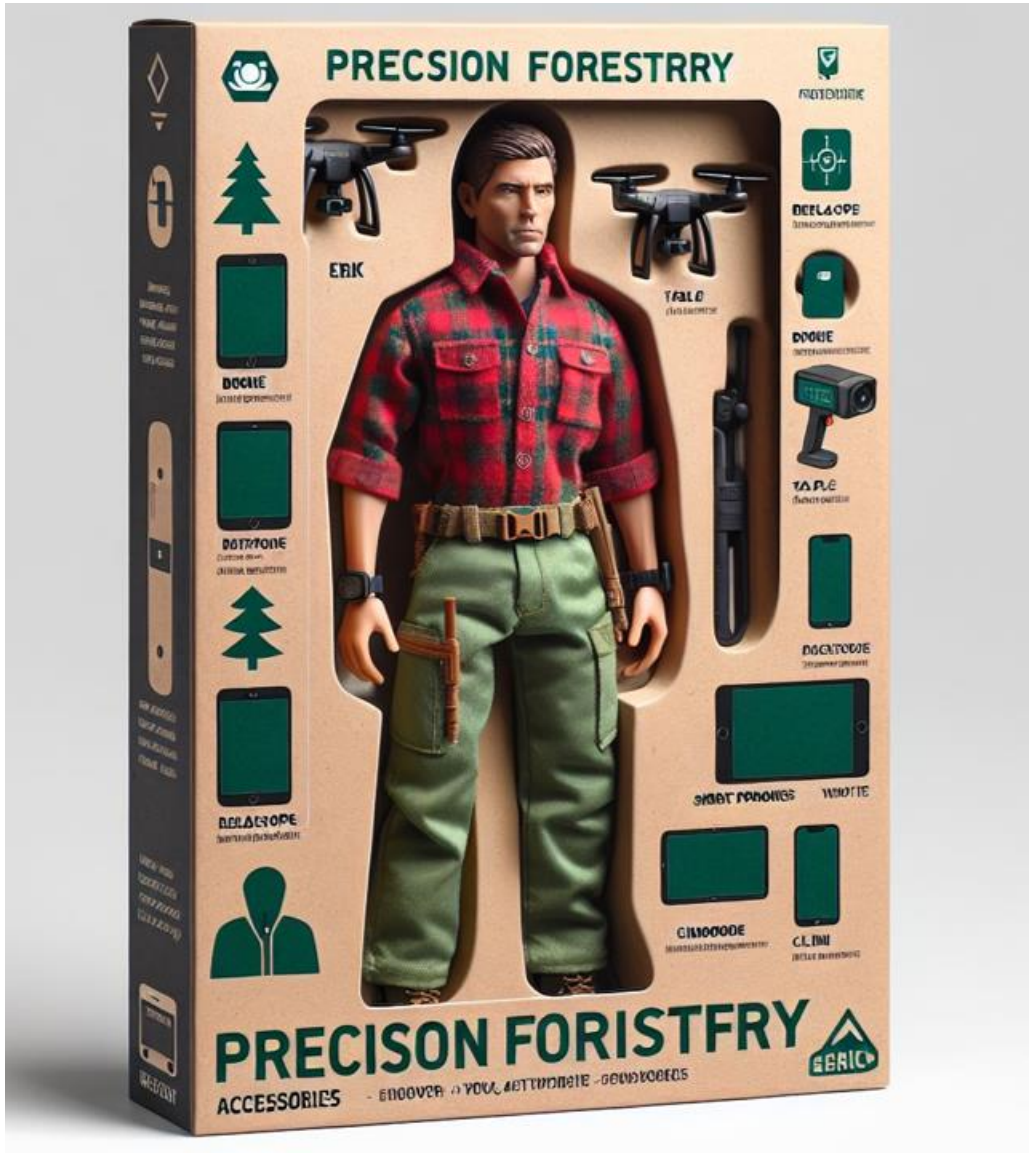
- Precision Forestry has developed the use of aerial imagery and artificial intelligence/machine learning to identify potential bark beetle damages
  - The AI model scans through areal image data and automatically detects dead trees
- More precise damage identification enables early damage control and thus, helps us to provide better service to forest owner customers

DEVELOPMENT STATUS

- Piloted in Sweden and Finland and developed in full scale in 2025
- Positive feedback has led to many new interactions with forest owners



Thank you!



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Erik.willen@storaenso.com


Framåt- och utåtblick
Mistra
Digital Forest


Anna Wallner, Södra
Mistra
Digital Forest

BraSatt - Från planering till plantering

2025-11-19

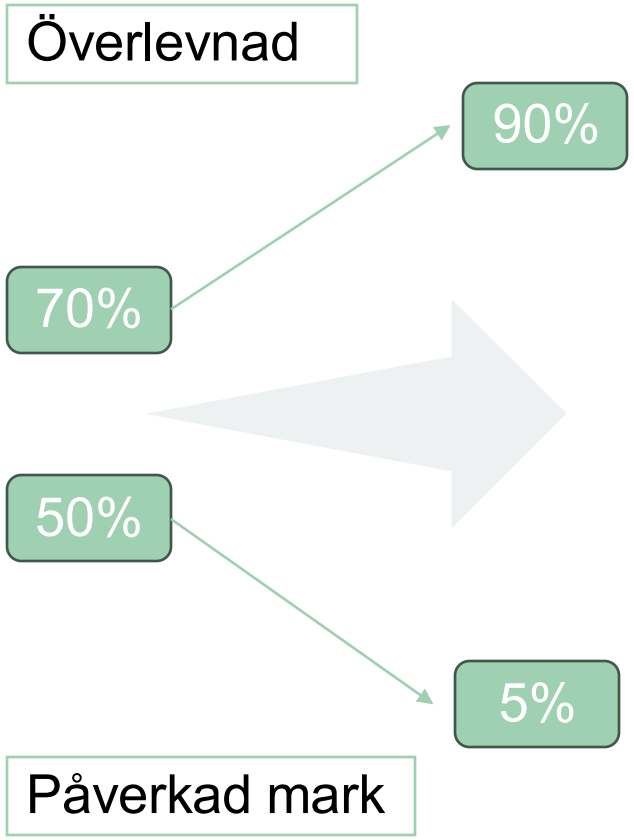
Anna Wallner
anna.wallner@sodra.com

Digital växtkraft från familjeskogsbruket

SÖDRA

Bakgrund

BraSatt - Önskad förflyttning



Proof of concept – plantans överlevnad högst på agendan

Ökad tillväxt

- Bättre plantöverlevnad
- Skonsam markberedning
- Arbetskraft

Plantöverlevnad

- Optimala planteringspunkter
- Inversmarkberedning

Markberedningsmetod

- Utvecklat aggregat för inversmarkberedning
- Markbereder och planterar i samma sekvens
- Valda punkter

Lönsamhet

- Kapacitet
- Hög automationsgrad

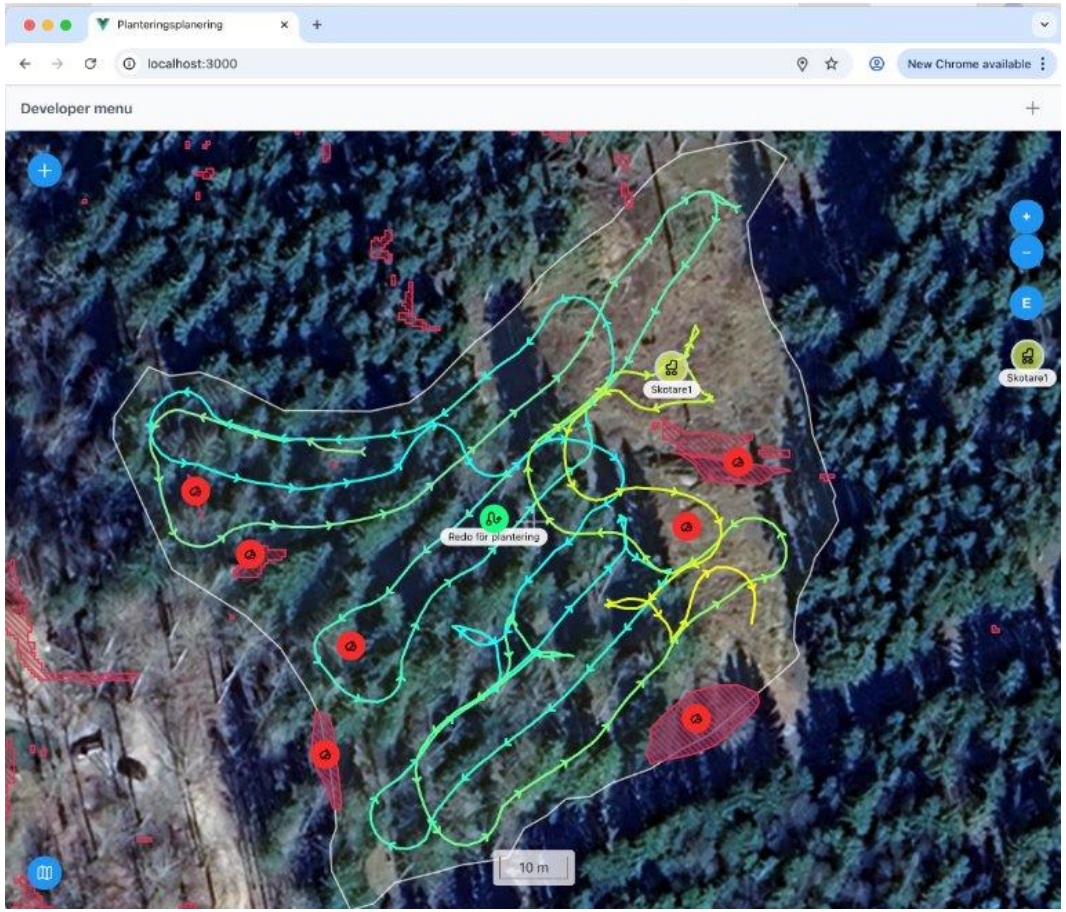
Team människa och maskin

- Maskininstruktion
- Förutsägbarhet
- Återkoppling

Datadriven föryngring

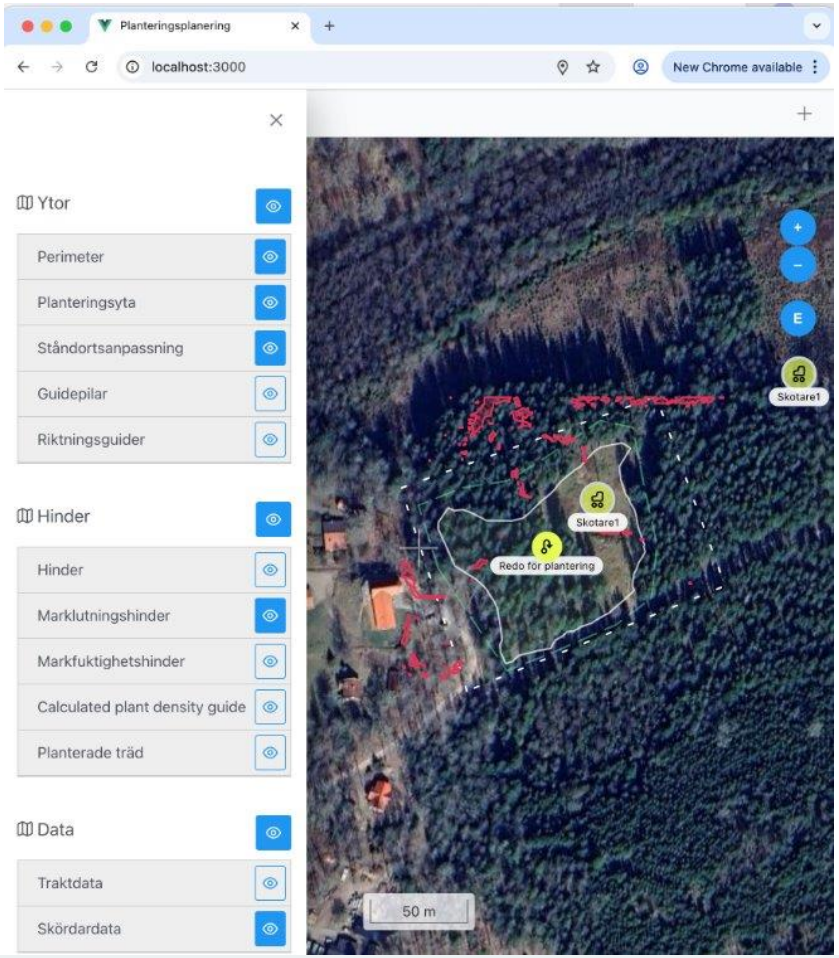
BraSatts Planeringsapp

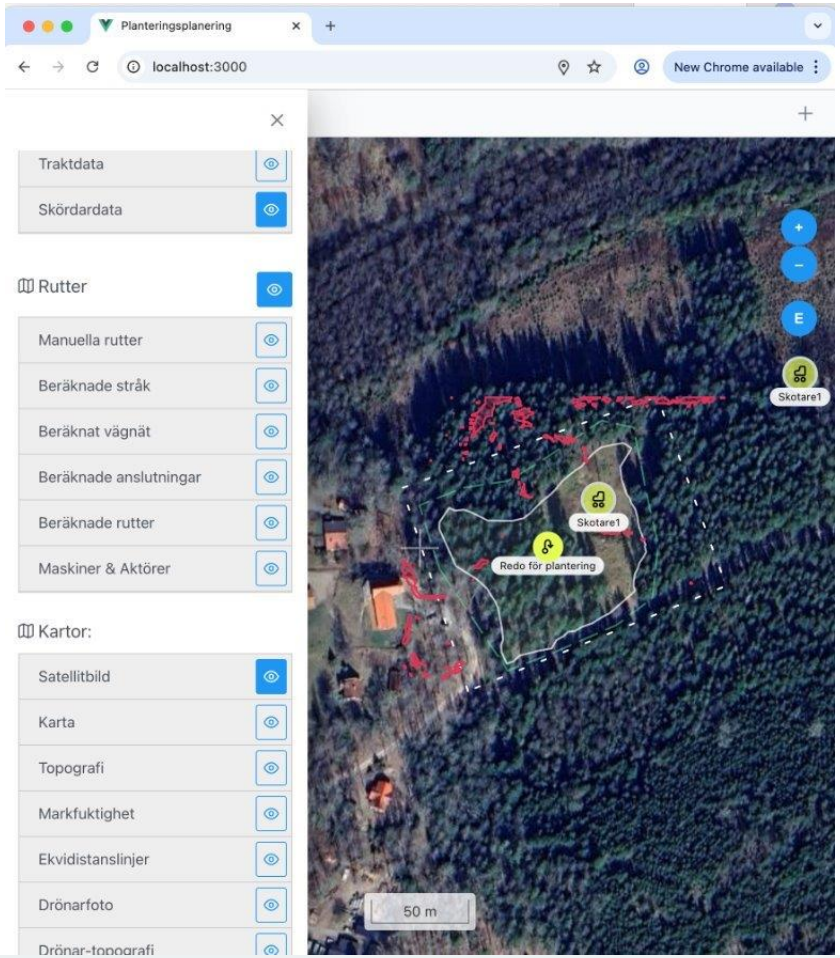
Planera vid skrivbordet



- Vilken information finns om trakten?
- Önskemål med föryngringen?
- Vilken metod är lämplig?
- Hur ska en maskin köra för att täcka hela ytan?
- Vilka plantor behövs? Antal plantor?

Planeringsappens kartlager

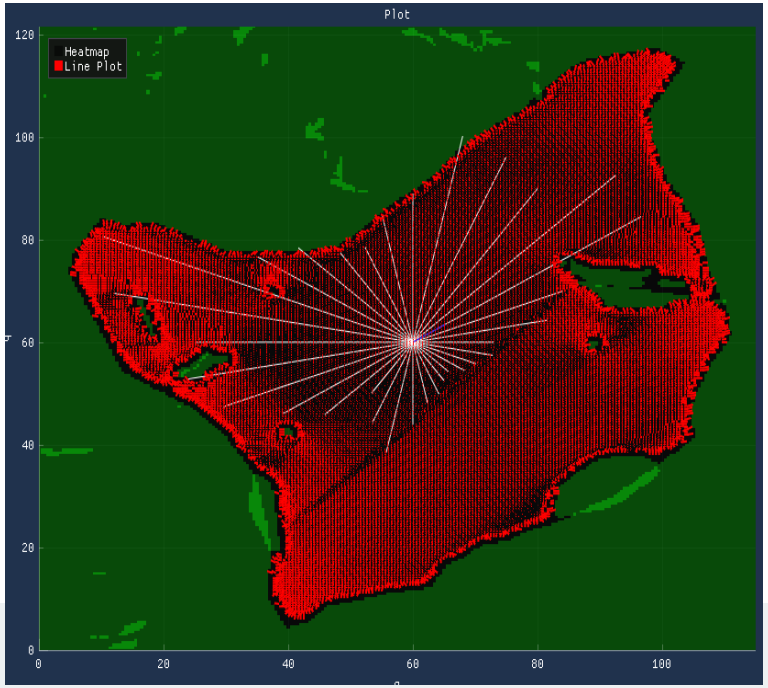


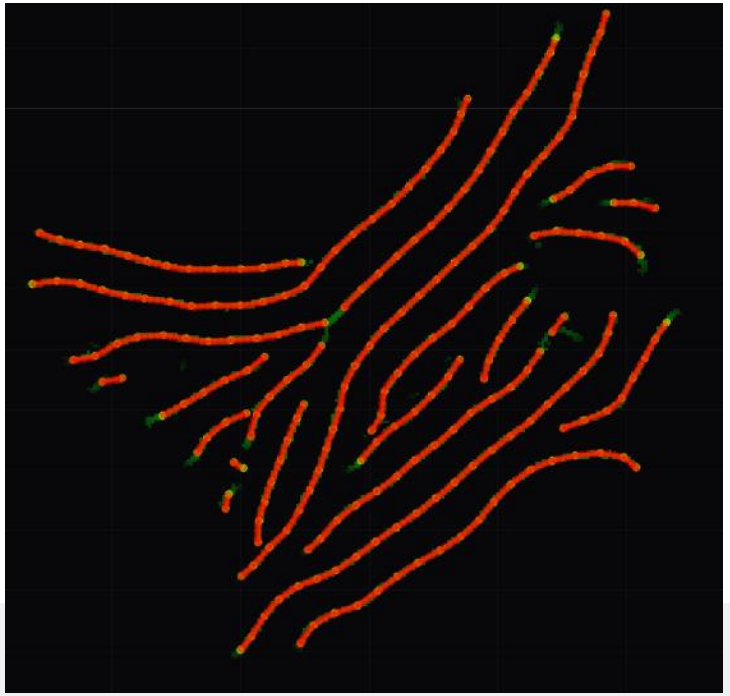


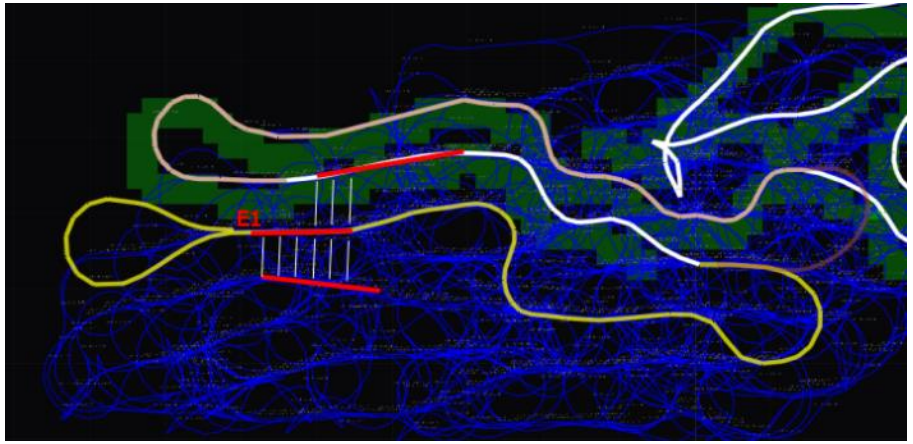
Körvägsberäkning

Effektiv körväg för att nå rimlig del av föryngringsytan

Perimeter → GIS-data → Huvudriktning → Stråkgenerering → Sammankoppla stråk → Skapa färdvägssekvens → Körinstruktion



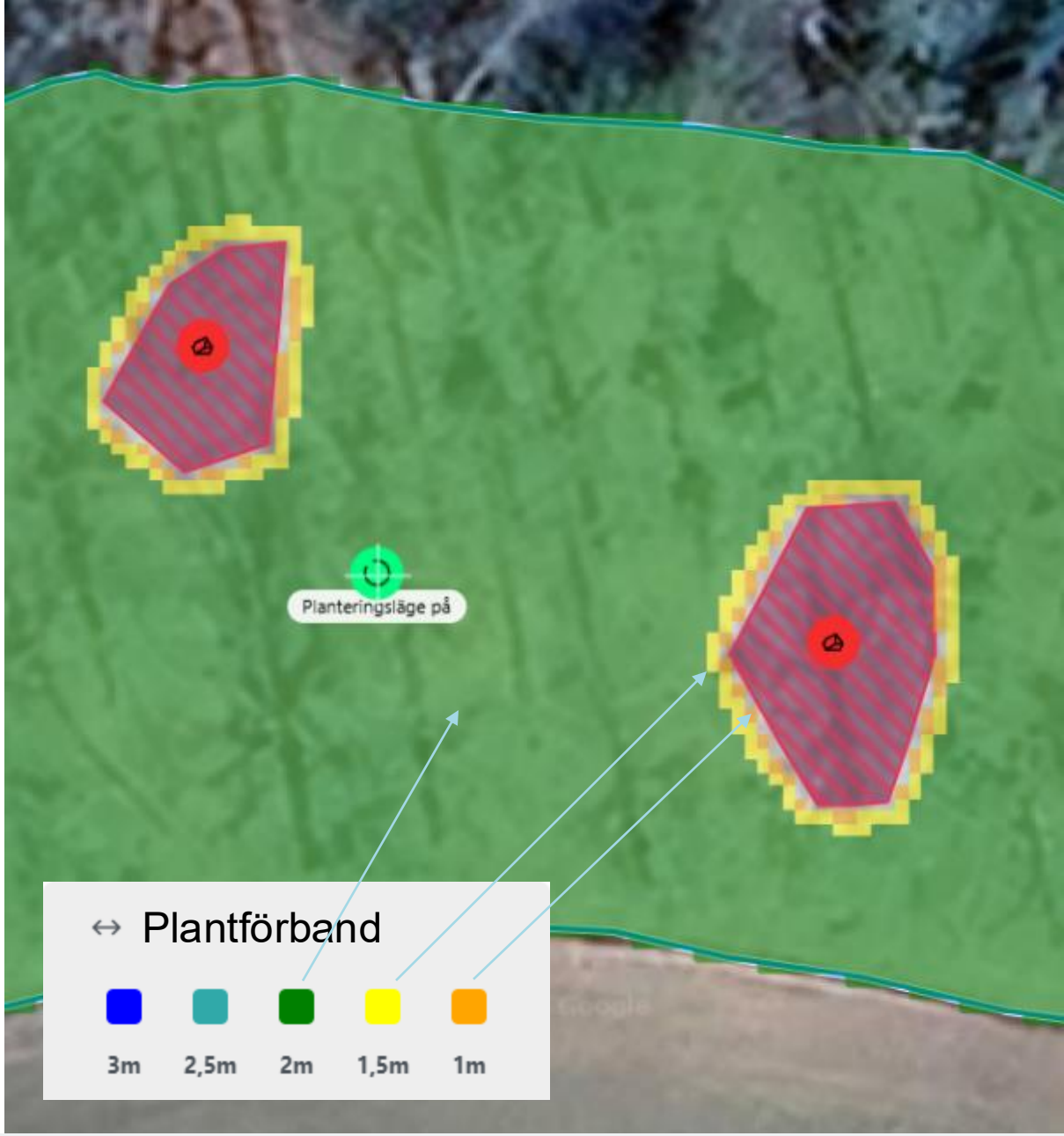




Nyttja markens produktionsförmåga

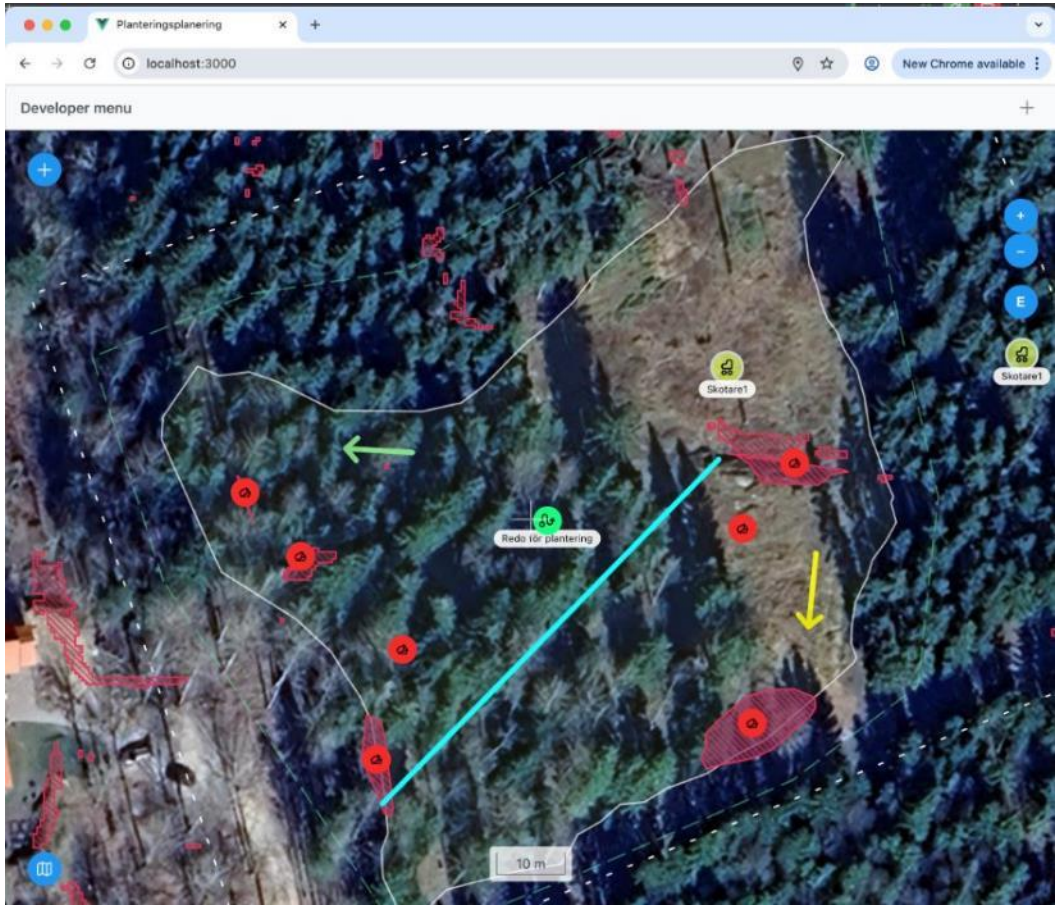
- Träden tillgodogör sig vatten, näring och ljus från ej planterbara ytor
- Planteringslogik – en guide för plantförband

- Exempel:
  - Målförband 2400 pl/ha, 2 rishögar (bilden)
  - Guide:
    - närmast rishögarna plantera med 1m-förband (gult)
    - sen 1,5m-förband (orange)
    - eftersträva 2m-förband på resten (grönt)



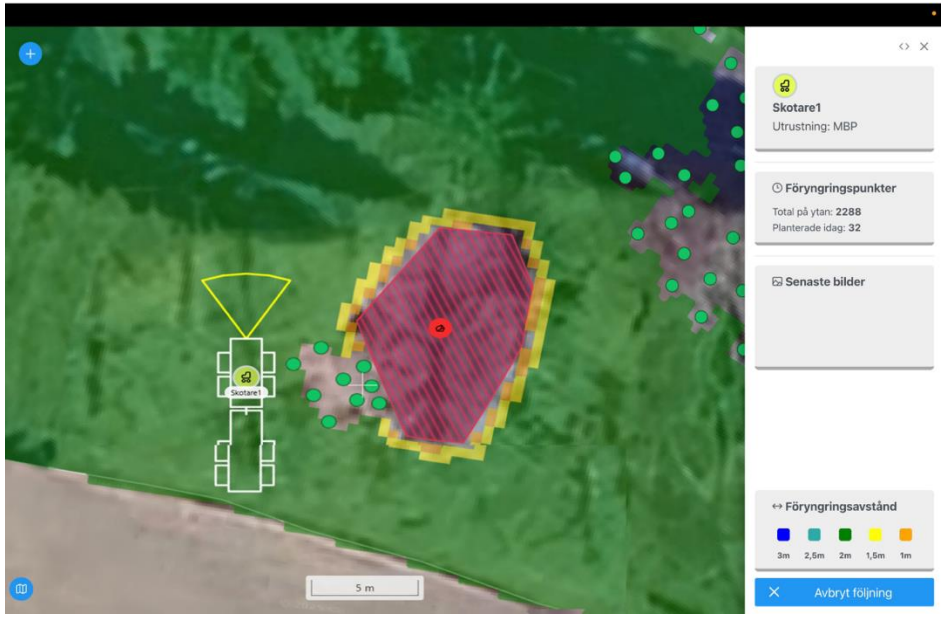
Framme vid föryngringsytan - uppdatera planeringen

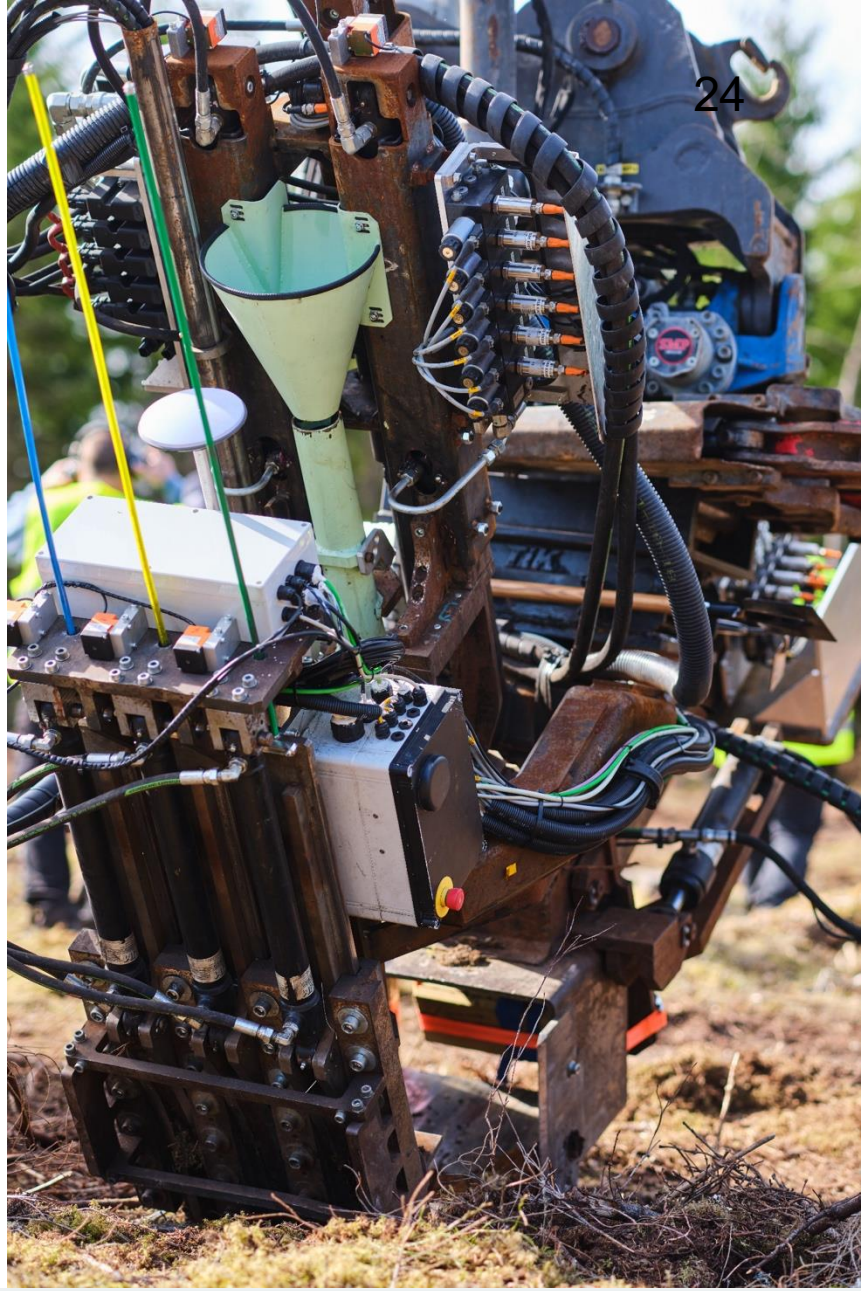
- Reality check
- Vattenläge
- Vindfällen
- Start-yta
- Uppdatera beräkningen – skicka till maskinen



Starta planteringsmaskinen

- Följ framdriften
- Maskinstatus
- Plantstatus





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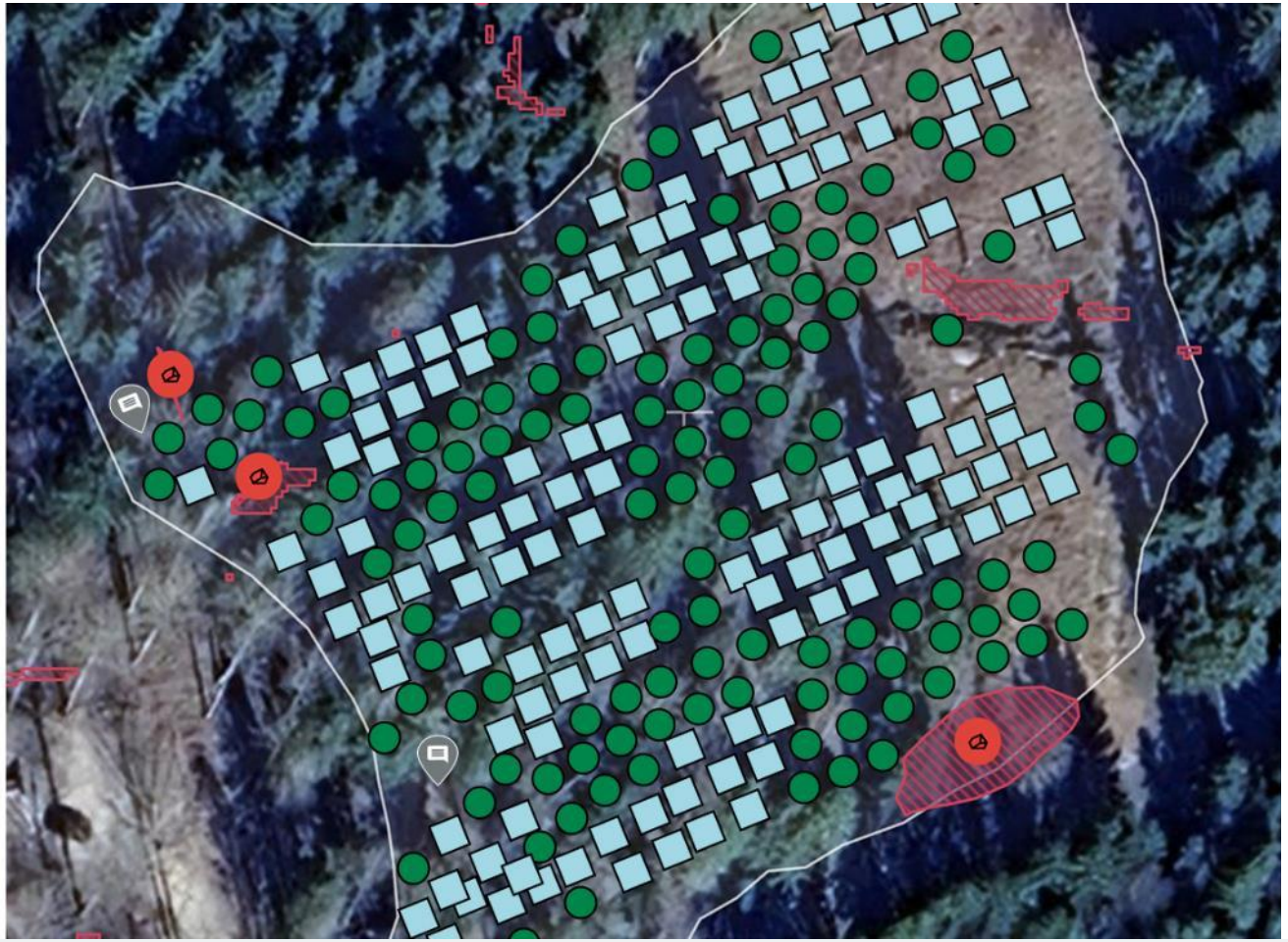
Återrapport – detaljerat kvitto



Automation – en nyckel till effektivitet

Antag:
200 pl/h/aggregat

200 pl/h

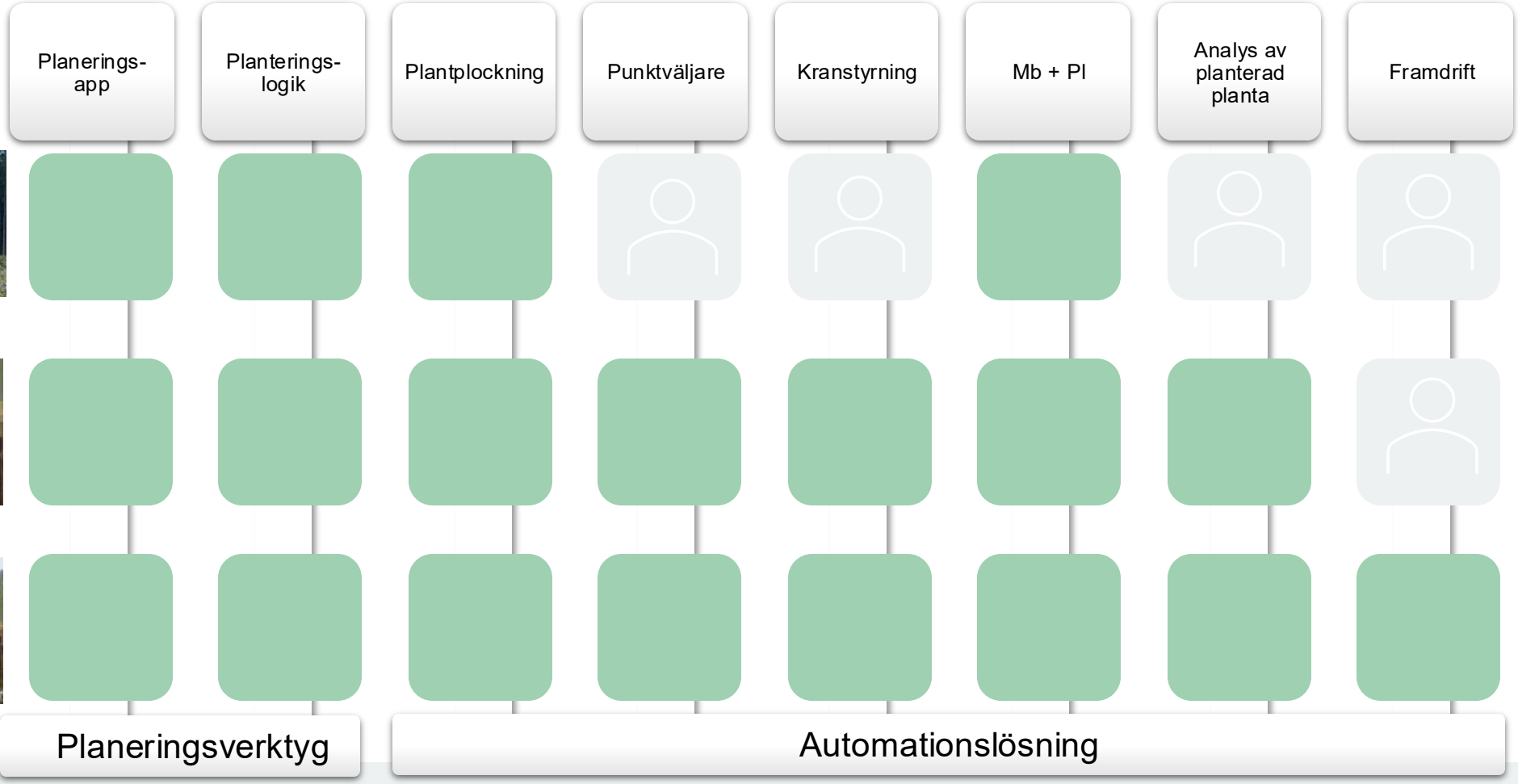
- 1 operatör
- 1 maskin
- 1 aggregat

600 pl/h

- 1 operatör
- 1 maskin
- 3 aggregat

1200 pl/h

- 1 operatör
- 2 maskiner
- 6 aggregat



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En vanlig syn i framtiden?

Vi är öppna för samarbeten och partnerskap!


Digital växtkraft från familjeskogsbruket
sodra.com
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Linnea Hansson, Skogforsk
Mistra
Digital Forest

AutoPlant

Autonom skogsföryngring för en hållbar bioekonomi

VINNOVA
Sveriges innovationsmyndighet

Samhällsutmaningar

Klimatutmaningen

Ny skog snabbt och bättre!
(bättre planteringspunkter, högre överlevnad)

Energieffektivisering
(energisnålare markberedning, mer precision)

Miljöutmaningen

Mindre markstörningar:
bra för miljö- och kulturvård
friluftsliv, bärplockning, rennäring

Arbetsmiljöutmaningen

Inga helkroppsvibrationer

Arbetskraft- och jämställdhetsutmaningen

Lättare att kombinera med familjeliv, nya grupper attraheras av arbetsuppgifterna

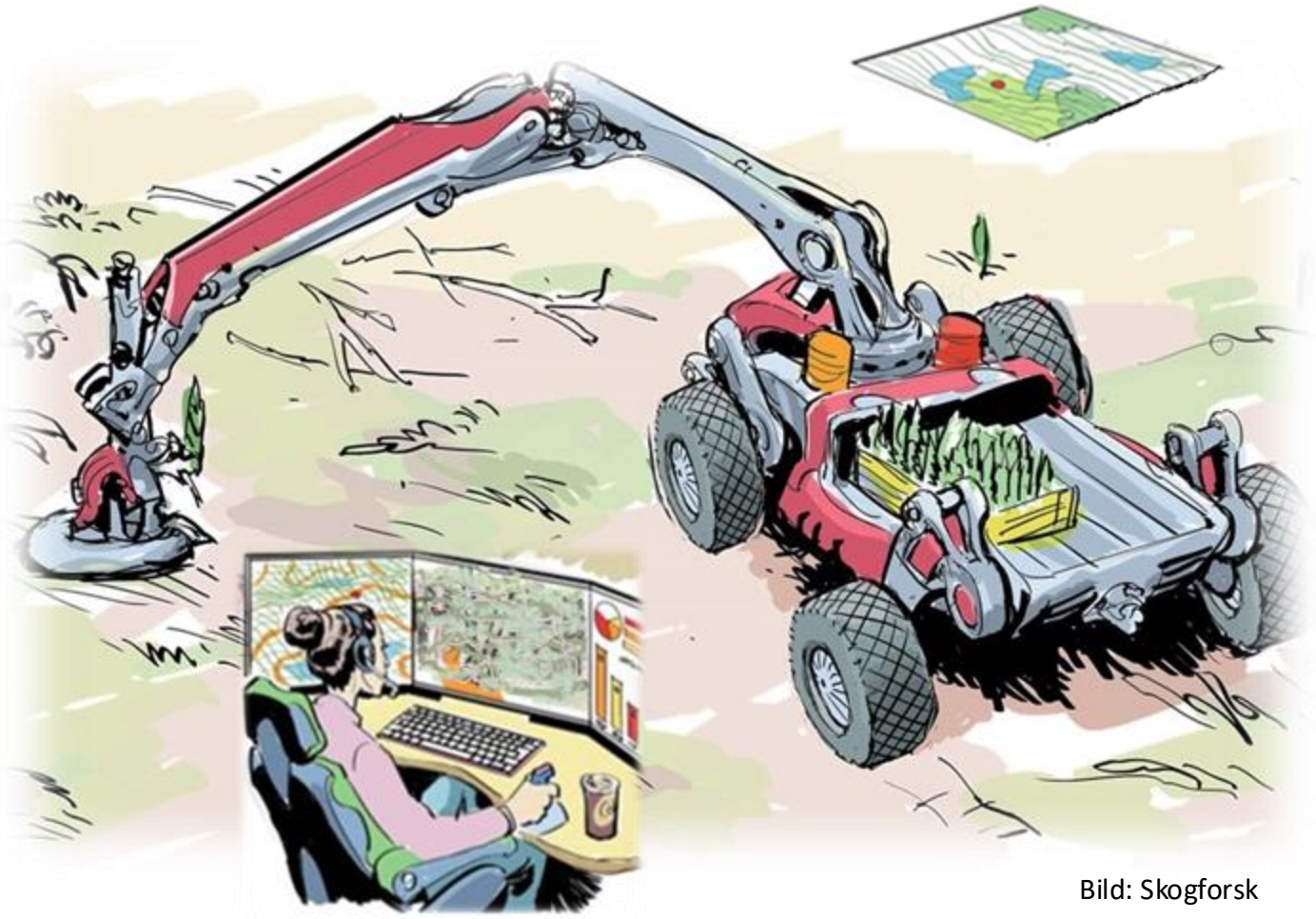


Bild: Skogforsk

Autoplant Steg 3

(2024-2026)

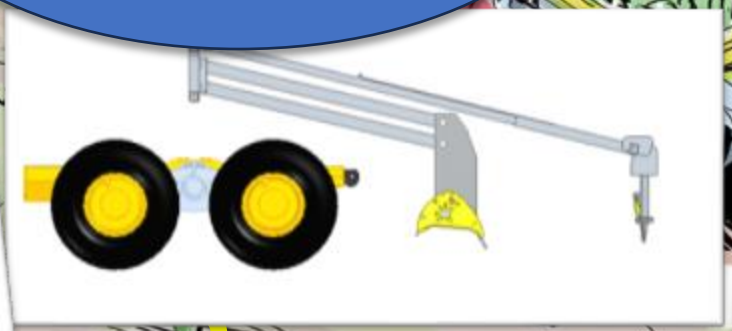
Perception, detektion och kvalitetsmätning

Skonsam terrängkörning

Autonom markberedning och plantering

Arbetsmiljö och människa-maskininteraktion

Lagar, regler och lobbyarbete



Ny skog snabbt och bättre med minskad markpåverkan

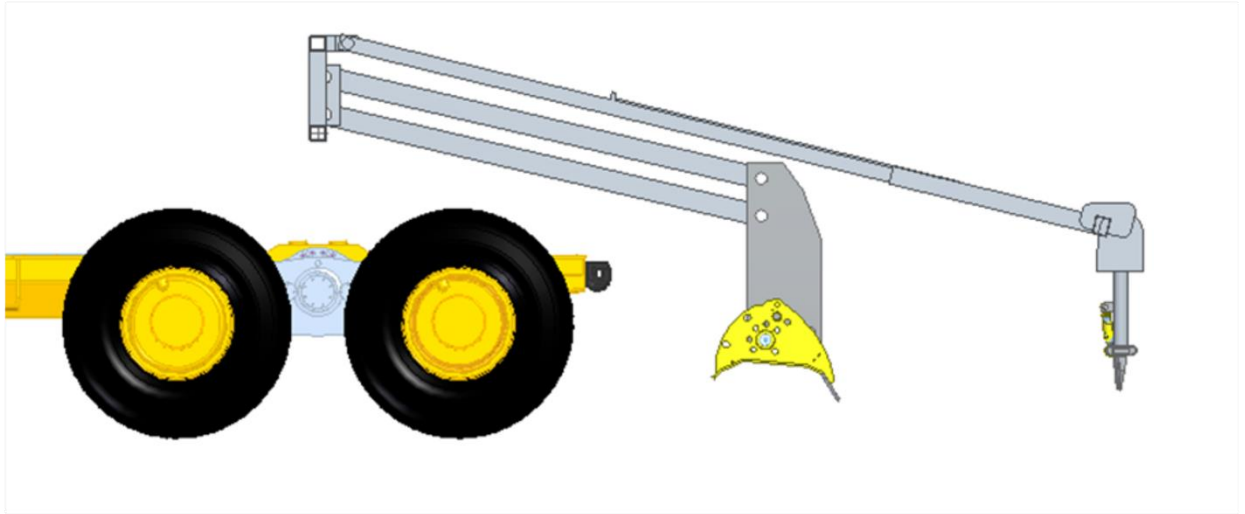
Autonom markberedning och plantering

Bracke utvecklar nytt aggregat - kan mata plantor, markbereda och plantera autonomt

- Nytt styrsystem och manöverdon
- Aggregatet är skalbart och kan dras av terrängfordon i olika storlekar
- Kontinuerlig framdrift

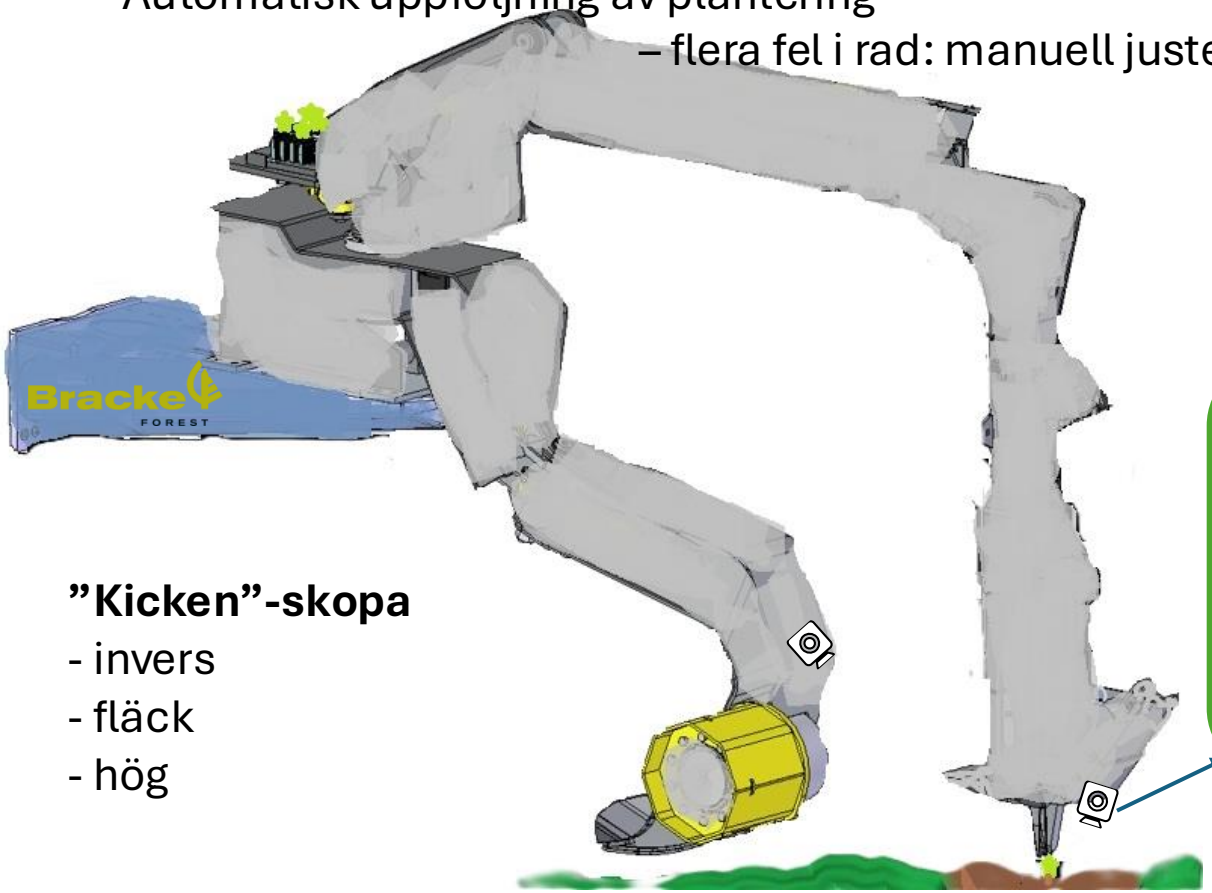
Mål

- Energieffektivare system
- mindre markstörning
- olika typer av planteringspunkter



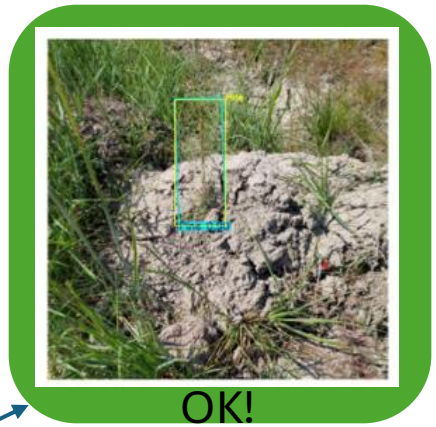
Autoplantsystemet

- 1 förare som enbart kör maskinen framåt (autonom på sikt)
- Markberedning och plantering autonomt
- Hinderdetektering/justering möjlig
- Automatisk uppföljning av plantering
  – flera fel i rad: manuell justering kan behövas

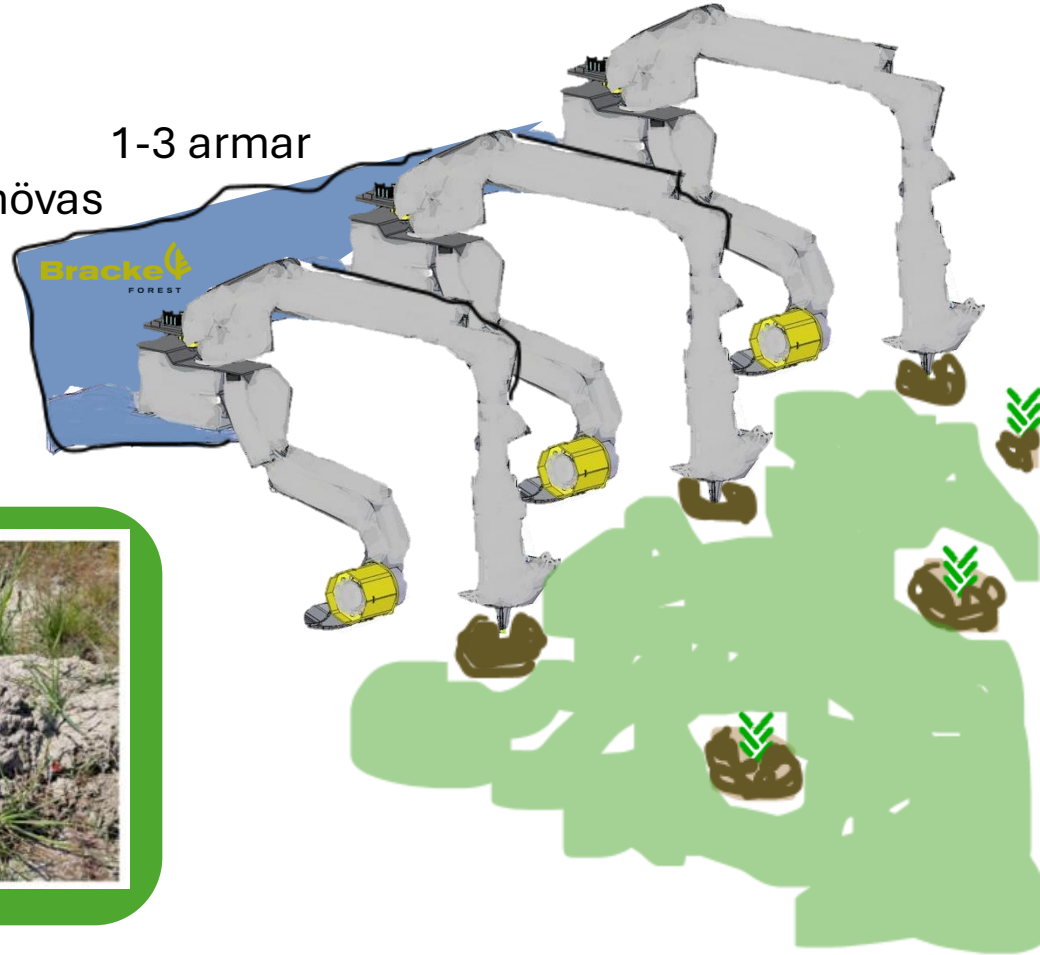


”Kicken”-skopa
- invers
- fläck
- hög

- Bild
- Trädslag
- Koordinat



1-3 armar



Premiär utanför verkstaden…

- Färdigställande och trimmande av planteringscykel under vintern. Testande i fält till våren.
- Plantmatning har tagits fram i separat projekt men integreras inte till vårens tester

Ny skog snabbt och bättre med minskad markpåverkan

Överlevnad, tillväxt och markstörning i ungskog markberedd med dragen invers (**Kicken**) och harv 5-10 år efter markberedning

- Två exjobbare från SLU (jägmästare)
- 15 invershyggen + 15 harvade
- Mest Västerbotten
- Holmen, SCA, Sveaskog

Syfte och forskningsfrågor

Det övergripande syftet är att följa upp om inversmarkberedning är så bra i praktiken som tidigare kontrollerade forskningsförsök med manuell inversmarkberedning visat.

- Är överlevnad och tillväxt bättre eller lika bra som vid harvning?
- Syns skillnader i markstörningar efter 10 år?
- Skiljer röjningsbehovet åt mellan harvning och invers?

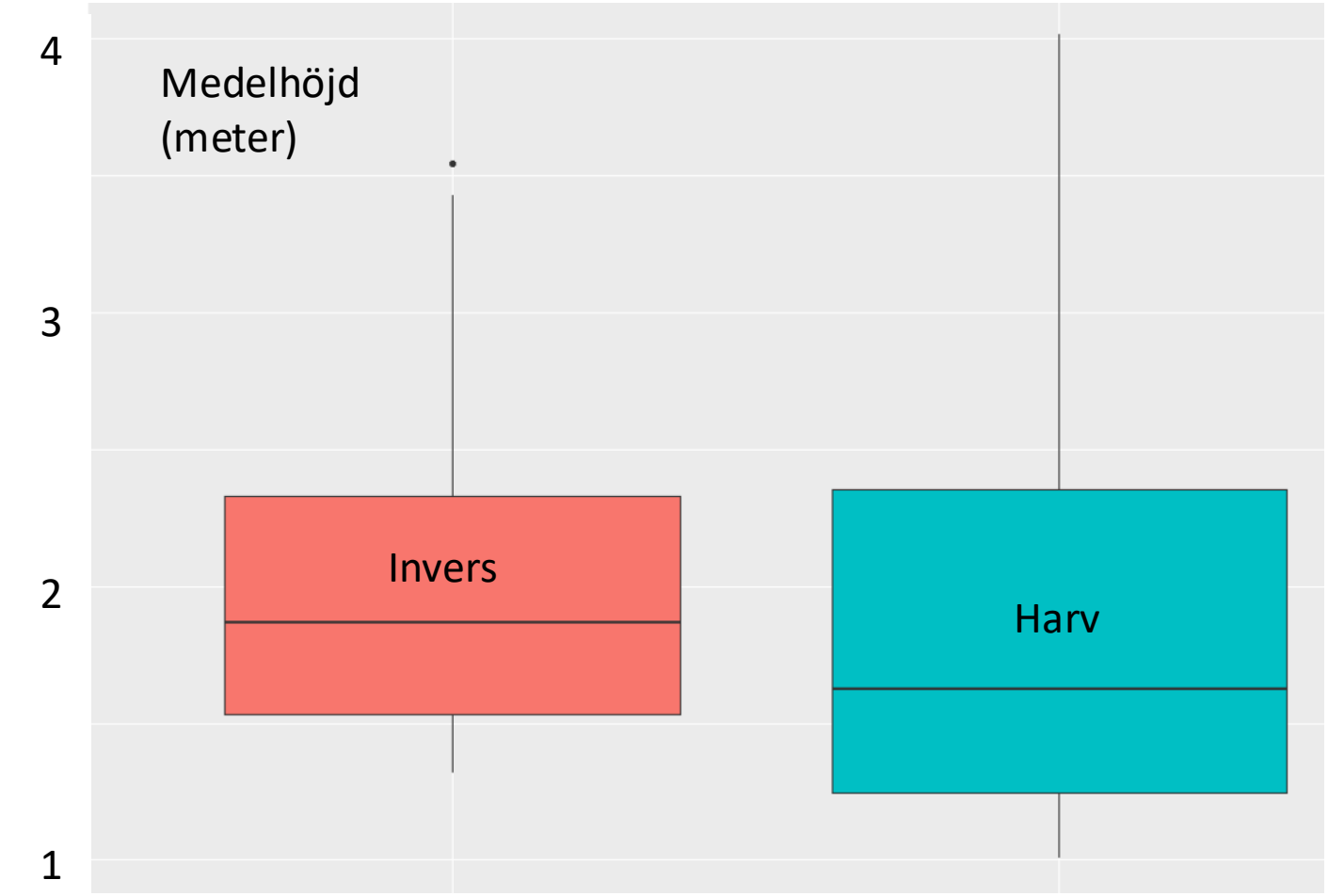
Markstörningar (Johannes Turesson)

Preliminära resultat för Kicken jämfört med harv

- 72 % minskad påverkan på markvegetation
- 67 % minskad påverkad mark
- 58 % minskad blottad mineraljord

Tillväxt + röjningsbehov (Anton Granström)

Ingen signifikant skillnad i höjd och antalet barrstammar men mer löv i det harvade



Fortsättning följer…

AutoPlant

skogforsk

LULEÅ UNIVERSITY OF TECHNOLOGY

KTH VETENSKAP OCH KONST

Bracke FOREST

SKOGS-TEKNISKA KLUSTRET

SCA

SÖDRA

SVEASKOG

HOLMEN

StoraEnso

VINNOVA
Sveriges innovationsmyndighet

Martin Servin, Umeå universitet

Mistra Digital Forest

Machines of the future

Martin Servin – 2025-11-17 – Programkonferens Mistra Digital Forest
Umeå University – martin.servin@umu.se

What is the single most important factor for R&D of intelligent autonomous heavy machinery?

1. It's the people!
2. Compute and AI-models
3. Physical testbeds
4. Mobilise investments

The forestry autonomy stack

Sensor data: Camera, GPS+RTK, fuel consumption, IMU, joint encoder, lidar, pressure sensor, radar, ...

Perception

3D reconstruction, detection, ext. Kalman filter, localization, mapping, parameter identification, segmentation, system identification, tracking, ...

World models: Digital elevation map, discrete elements, multibody system, occupancy grid, process model, polygonal 3D model, ...

infrastructure

Planning

A*, sample-based planning, motion planning, policy, task planning, trajectory planning, ...

Plans: high-level decisions, behaviour tree, mission plan, motion plan, objective, policy, task sequence, trajectory, ...

Control

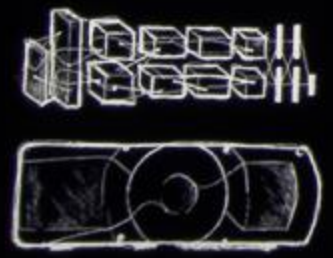
Distributed control, LQ regulator, MPC, optimal control, PLC, PID, reinforcement learning control, shared control, ...

Actuator signals: current, streering command, PLC signal, set value, throttle, ...

Worldwide, around $3tn will be spent on data centres that support AI between now and 2029.

Morgan Stanley investment bank
https://www.bbc.com/news/articles/ckg2ldpl9leo

2012 ALEXNET



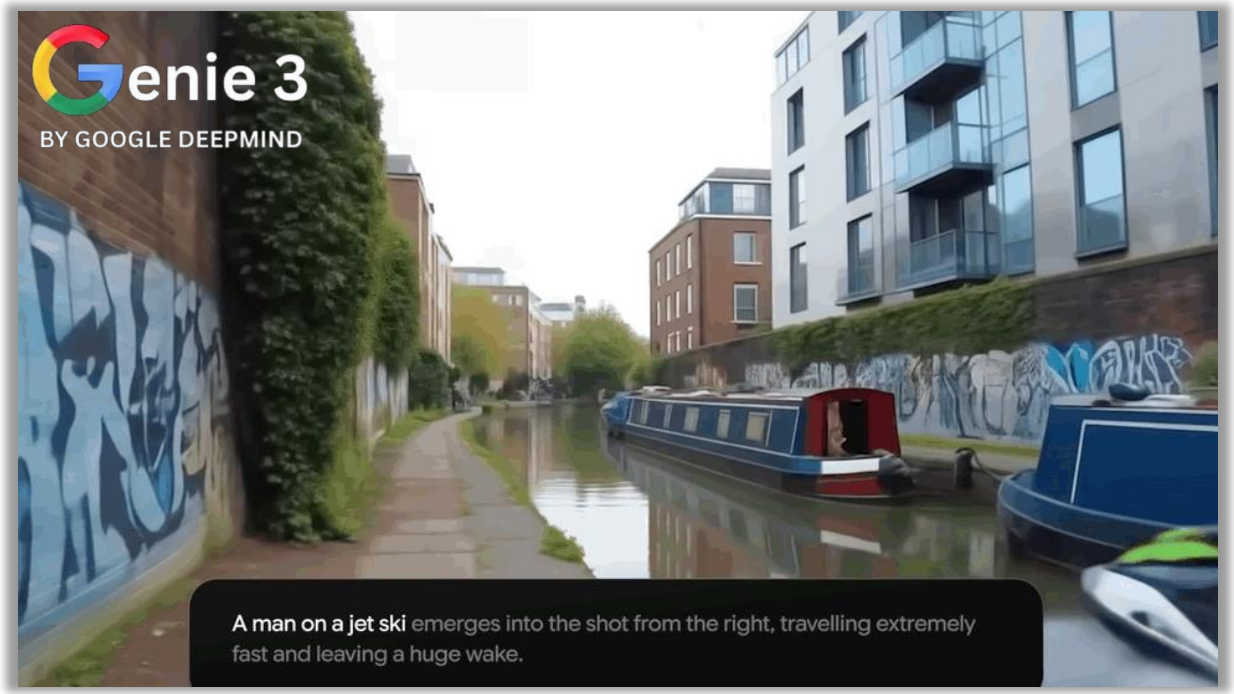
PERCEPTION AI
SPEECH RECOGNITION
DEEP RECSYS
MEDICAL IMAGING
2012 – 2019

GENERATIVE AI
DIGITAL MARKETING
CONTENT CREATION
2019 – 2024

AGENTIC AI
CODING ASSISTANT
CUSTOMER SERVICE
PATIENT CARE
2025 – 2027?

PHYSICAL AI
AUTONOMOUS VEHICLES
GENERAL ROBOTICS
2027 – 2035?

Jensen Huang
CEO NVIDIA, GTC 2025

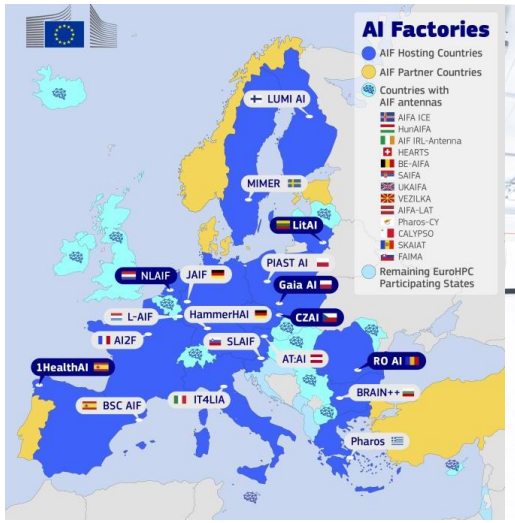

Genie 3
BY GOOGLE DEEPMIND
A man on a jet ski emerges into the shot from the right, travelling extremely fast and leaving a huge wake.


FIGURE

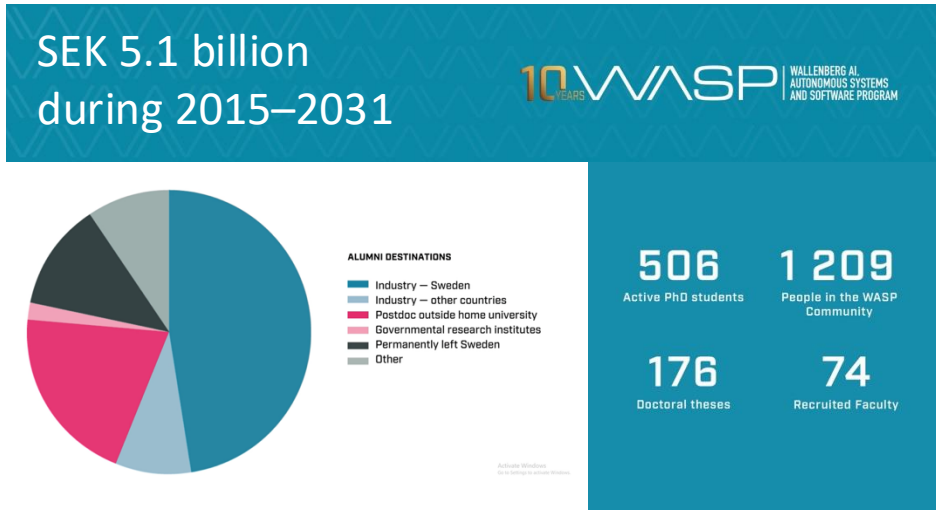

WAYMO


DEEP Robotics
云深处科技

19 AI Factories and 13 antennas launched through European Commission's AI Innovation Package (July 2024)



InvestAI, a public–private initiative aimed at mobilising EUR200 billion for AI development across the EU, including EUR20 billion for four AI gigafactories



Strategic areas: AI, Autonomous systems, Software
Arenas: Operational data, Robotics, Media & Language, Medicine, Public safety

European & Swedish AI tech growth

Mistral AI

AXELERA ARTIFICIAL INTELLIGENCE

Lovable

LEGORA

Svensk basindustri, maskintillverkare & systemleverantör

Epiroc, Komatsu Forest, Scania, Volvo CE, …
ABB, Ericsson, …

Mistra Digital Forest

Two initiatives

Centre for Machines of the Future

Excellence Cluster in Autonomous Field Robotics

Centre for Machines of the Future

Ongoing pilot study!

Planned centre at Umeå University

Pilot study lead by Martin Servin, June 2025 — Mars 2026

fundamental science

- **computational physics & math**
- **AI, data analysis & optimization**
- **design & robotics**
- **green energy systems**

applied science

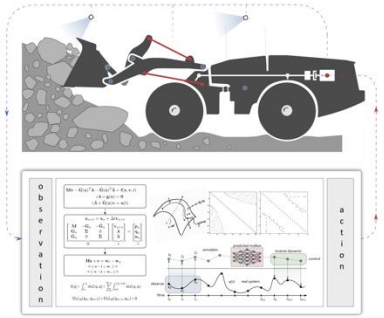
infrastructure

- Modeling & simulation - Digital physics
- Computational design optimization
- Advanced materials & green energy systems
- Safe & trustworthy AI

advanced courses

Mission: computational tools and knowledge for answering how should future machine systems be designed and controlled for achieving the sustainability goals?

Future Machines
unmanned, smart, & sustainable



Ambition: 50 scientists, recruiting two new groups, competitive fundamental & applied research, industry doctoral students, advanced courses specialists in R&D industry

Partners in forestry, mining & construction, space, automation & computational software

Komatsu, SCA, Södra, Holmen, Cranab, Indexator, Olofsfors, Vimek, Skogsindustrierna, Skogforsk, SLU – Boliden, Brokk, Epiroc, Komatsu, LKAB, Rototilt, Volvo, Ltu – Airbus, MDA, iSpace, JAXA, JAMSS, Kajima, NASA, ESA, DLR, IRF, Ltu, Rymdstyrelsen – ABB, AMD, Afry, Algoryx, Combitech, Ericsson, Oryx – BAE, HIAB, Macgregor, JOST (Ålö) – Wallenberg Foundation, Formas, Swedish Research Foundation, Kempe Foundation, Mistra, ESA & Rymdstyrelsen, VINNOVA, Vetenskapsrådet

Centre for Machines of the Future

Example research questions and activities

Fundamental research

- *Agentic AI researching machine autonomy / design*

Applied research

- *Finetuning of robotic foundation models for planning & control of forest machines*

Education

- *Master program in Physical AI and Simulation*

Testing

- *Teleoperation – with safety-filters and physics-informed interfaces*

Excellence Cluster in Autonomous Field Robotics

Regeringsuppdrag till VINNOVA & VR: satsning på excellenskluster för banbrytande och strategisk teknik

Plan: fem excellenskluster med vardera ca 50 mkr/år i 10 år

- Artificiell Intelligens (AI) och autonoma system
- Avancerad digital teknik, inklusive halvledare
- Kvantteknik
- Energiteknik
- Material- och produktionsteknik
- Bioteknik

Strategiska tekniker för Sverige - Ett underlag för nationella prioriteringar, VINNOVA (2024)

Vinnovas uppdrag att genomföra insatser för samverkansbaserad forskning och innovation inom excellenskluster för banbrytande och strategisk teknik, Regeringsbeslut KN2025/01161

45 klusterinitiativ är beviljade planeringsbidrag (Nov 2025 – Mars 2026)

Excellence Cluster in Autonomous Field Robotics

Initiators: KTH, LiU, Ltu, Skogforsk, UMU, ÖRU

To be completed during planning phase!

Stakeholders	Cluster representation	Target	Outreach channels
Academia and research institutes	**LiU**, **LTU**, **KTH**, **ORU**, **UMU**, **Skogforsk**, RISE	Swedish universities with excellent track record in field robotics. Institutes with testing capacity.	Cluster PIs' network outreach, WASP Winter Conference, WASP research arenas in Public Safety and Robotics
Heavy Equipment Manufacturers	**Epiroc**, Brokk, **Husqvarna**, **Komatsu Forest**, **Volvo CE**	Major manufacturers of heavy machines in Sweden	PIs' industrial networks from previous projects, Science parks at academic partners, Industrial partners networks
Automation end-users	**Boliden**, LKAB, **Holmen**, **SCA**, **Skanska**	Mining, forestry, construction, logistics	
ICT & tech startups	ABB, **Algoryx**, Ericsson, Hexagon, **NFA**	Suppliers of digital platforms and solutions	PIs' industrial network, WASP Academia and Industry Days
Innovation support system	AI Sweden, **KTH innovation**, **Skogtekniska klustret**, Tunga fordon	Incubators, Science Parks and Innovation Offices	Direct contact

	Perception	Navigation	Manipulation	Interaction	Adaptivity	Integration
Forestry	tree health assessment	locomotion in terrain	log grasping, planting	shared control	uncertain and changing environment	multi-vehicle sensor reconciliation
Agriculture	yield mapping	low-compaction traversal	precision picking, pruning, weeding	shared control	seasonal modelling	weather-resistant operation
Construction	air flow mapping	mm-tolerance localisation	granular material handling	gesture-based interfaces	contiunal structure changes	interoperability
Logistics and Transport	out-of-distribution detection	scalable fleet coordination	human–robot co-manipulation	trust in self-optimising fleets	human-aware navigation	edge–cloud integration
Public Safety	low-visibility perception	highly dynamic environments	precision delivery	high-stress interfaces	resource-bounded reasoning	unreliable communications
Mining	ore/waste differentiation	tight manoeuvers	loading fragmented rock	mixed human/autonomous traffic	adaptive drilling	underground communication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Polina Kurtser, UMU


Martin Magnusson. ÖRU Project lead


George Nikolakopoulos. LiU


Martin Servin, UMU


Johannes Stork. ÖRU


Todor Stoyanovn. ÖRU


Mattias Tiger. LiU


Mariusz Wzorek. LiU

+ industrial advisory board + international scientific advisory board

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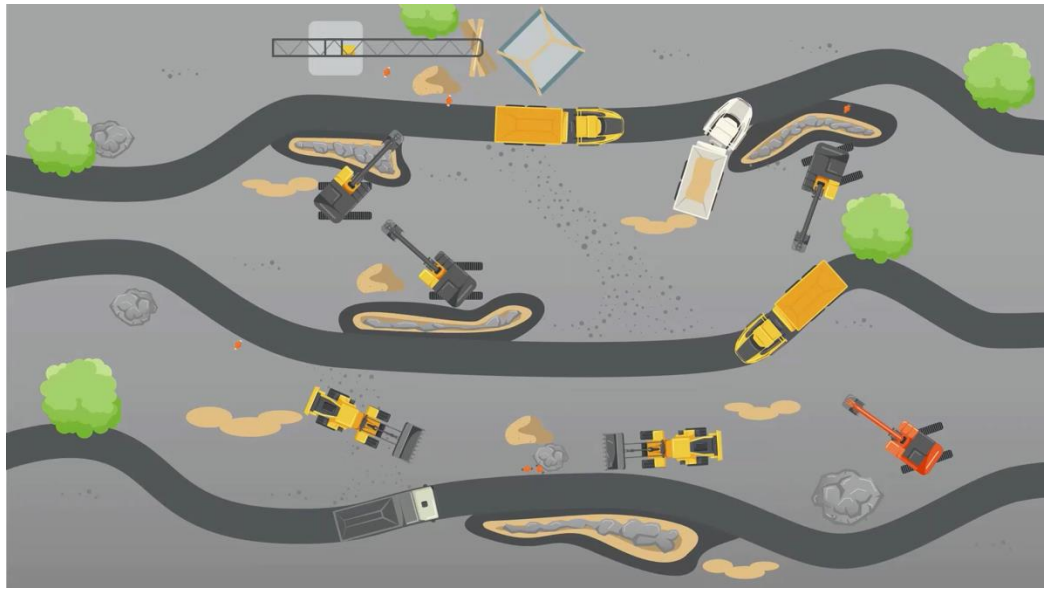
Initiators: KTH, LiU, Ltu, Skogforsk, UMU, ÖRU



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The excellence cluster will **facilitate a future where autonomous systems, underpinned by cutting-edge AI, operate seamlessly in unstructured, dynamic environments**, addressing critical challenges posed by a shrinking workforce and the imperative for resource independence.

The challenges are substantial: creating adaptable and trustworthy systems that work reliably in complex conditions.

Research addressing these directly, advancing **AI-driven perception, decision-making, control, and human–robot collaboration,** while pioneering **technologies for resilient, large-scale mobile autonomy**.

Academic and industry partners **will develop, validate, and transfer groundbreaking automation technologies – from lab and supercomputers to the field and to industry – cementing Sweden's role as a global leader in real-world and field-tested autonomous systems by 2035.**

Excellence Cluster in Autonomous Field Robotics

Timeline

- information meeting VINNOVA and Vetenskapsrådet – Nov 25
- preparatory phase (2025-2026)
- establishment phase (2026 - 2027)
- accumulation phase (2027-2030)
- exploitation and diversification (2030-2035)

Excellence Cluster in Autonomous Field Robotics

What happens next?

- Workshops – per application area
- Needs and requirements
- Strategy for research, education, & innovation
- Funding and investments

Contact

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Input

- Contact person
- Type of interest and contribution
- Other people & organisations

Syntesarbete
– vad har vi åstadkommit under de här åren?

Mistra
Digital Forest

Digital Forestry Value Chain

STAGE	DIGITAL COMPONENT	BENEFIT
Forest Data Collection	Remote sensing, IoT sensors	Accurate and timely data
Digital Models	GIS, simulation tools	Predictive analysis and planning
Decision Support	AI algorithms	Optimized resource use
Operations	Autonomous machinery	Efficiency and safety
Industry Integration	Data platforms	Transparency and traceability