How Robotics Will Fuel the Future of Agriculture

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Lux Research | The Deciding Factor

Agenda

1 **The landscape of robotics use-cases**

2 Drivers of the advancement of robotics in agriculture

3 Identifying platforms capable of driving impact

4 Will robotics rise up to agriculture’s challenges?

Overview

1. Use-case versatility is paramount.
2. Software development will change the game.
3. Don’t get stuck on obvious solutions to obvious problems.

A basic robotics framework is divided into hardware and software

Sensor

A sensor is a hardware component of any robot, which could be in the form of a camera or vision sensors.

Actuator

An actuator is hardware that performs actions like reaching, gripping, or cutting.

Sense

Sense is a part of required software for a robot that determines the tasks like ripe fruits, weeds and all.

Plan

As part of a software platform, plan creates a decision-making template for whether to pick a fruit or laser a weed or not.

ACT

This is part of the software that tells the bot to act on the plan, such as pick fruits/vegetable, move on to the next row, or use spray.

Startups look to disrupt physical industry with novel robotics innovations

Mining & Construction

Industrial & Manufacturing

READY ROBOTICS

ABB

SARCOS

SANCTUARY

Energy

AMPbotics

ENERGY ROBOTICS

OCRobotics
A GE Aviation company

E-commerce, logistics, & AVs*

LOCUS ROBOTICS

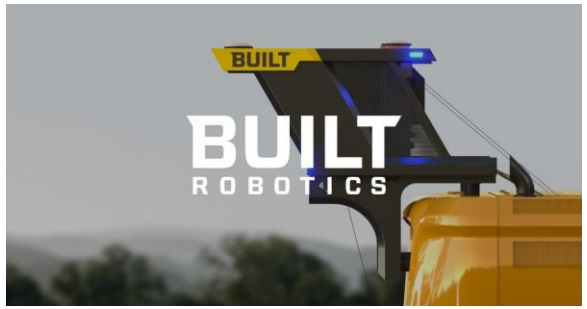
B GARAGE

AVs, autonomous vehicles

Technology impact is magnified when the use-case hits key sector drivers and challenges

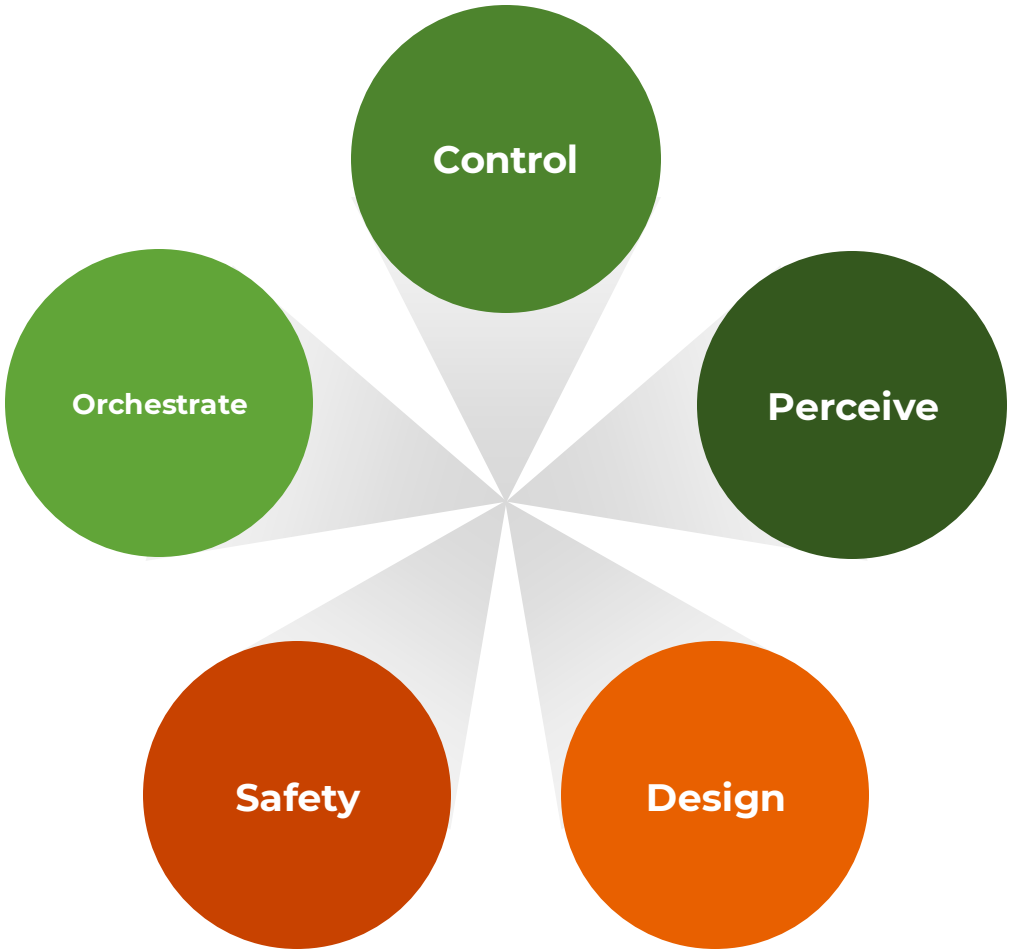
Ready Robotics uses generative AI and large language model (LLM) interest in developing an operating system.

Energy Robotics orchestrates fleets of robotics, thereby enabling a breadth of use-cases.



Built Robotics retrofits mining and construction equipment with autonomy.

5 noteworthy areas of underlying robotics technology innovation



Sensing, including AI-powered computer vision

Autonomy requires real-time, general sensing capabilities. Significant materials and software-level innovations have been achieved in the past eight years. Much of this has been repurposed from advancements driven by AVs, such as lidar and connected vehicles.

Control software

Vendors are expediting deployment with general-purpose robotics operating systems and LLMs to produce machine commands.

Fleet orchestration

Orchestrating disparate robots is seen as a more viable alternative to a general-purpose robot in broadening use-cases and, hence, commercial viability.

Labor safety and efficiency

Covid and e-commerce reignited the “lights-out” warehouse vision. Cobots, drones, and autonomous mobile robots providers aspire to human-robotic collaboration.

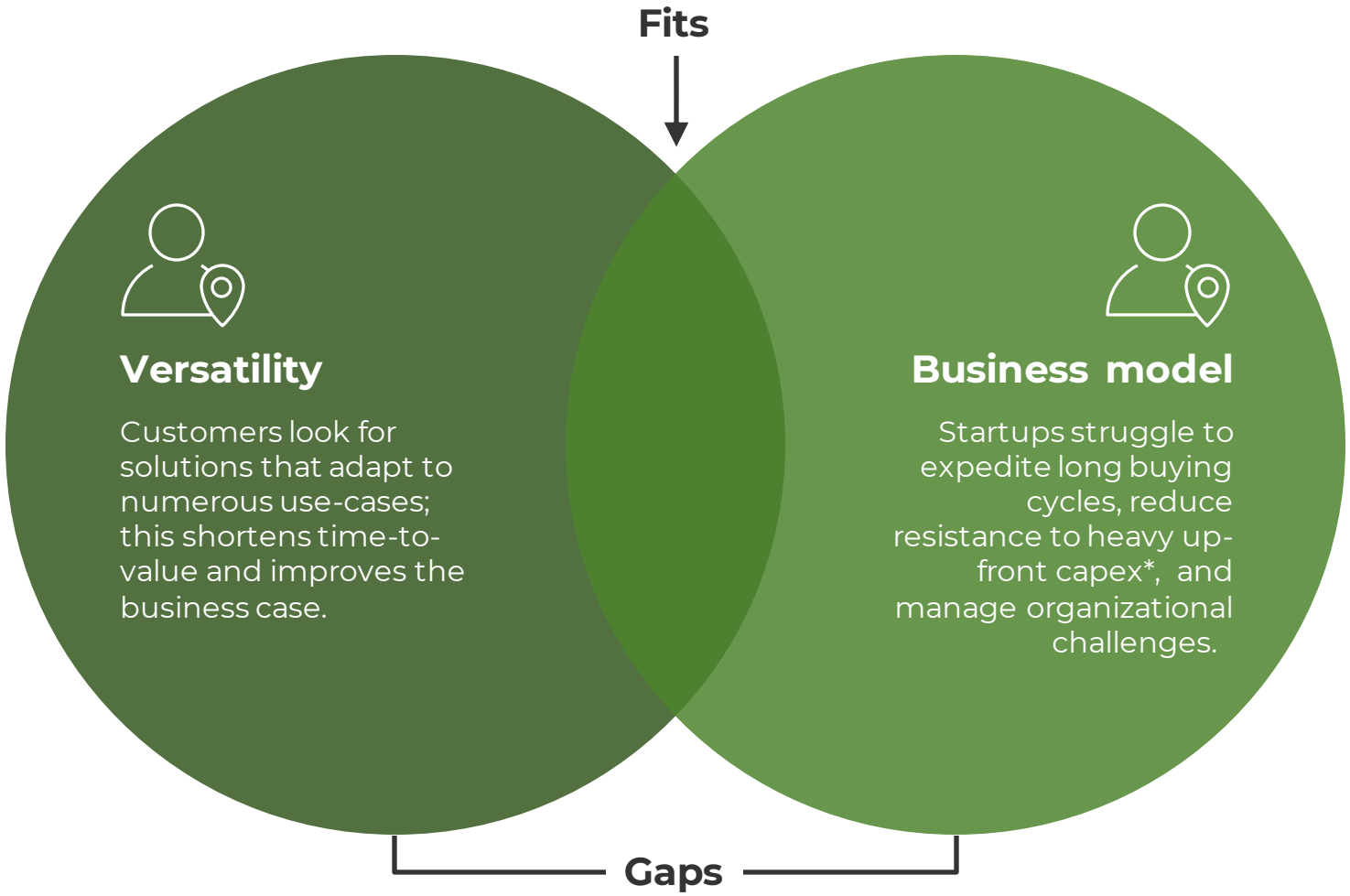
Form factor and locomotion

Turtles, worms, and dogs are a few design models for the novel polymorphic, bioinspired robotics that research groups hope to deploy to navigate rough environments like pipeline interiors and offshore rigs.

Successful solutions align to 5 key capabilities

Precision and Accuracy	**Can the robot repeat the same action in an expected way?**
Autonomy and Safety	**Can the robot perform without human intervention? Can it operate in new and unpredictable environments? Can the robot safely operate near humans?**
User Interface	**How simple is it to set up the robot and reconfigure it?**
Scalability	**How easy is it to deploy many instances of the same robot?**
Versatility	**Can the robot perform more than one operation?**

Startups need to strike harmony between enabling compelling use-cases and value proposition for customers



*capex, capital expenditures

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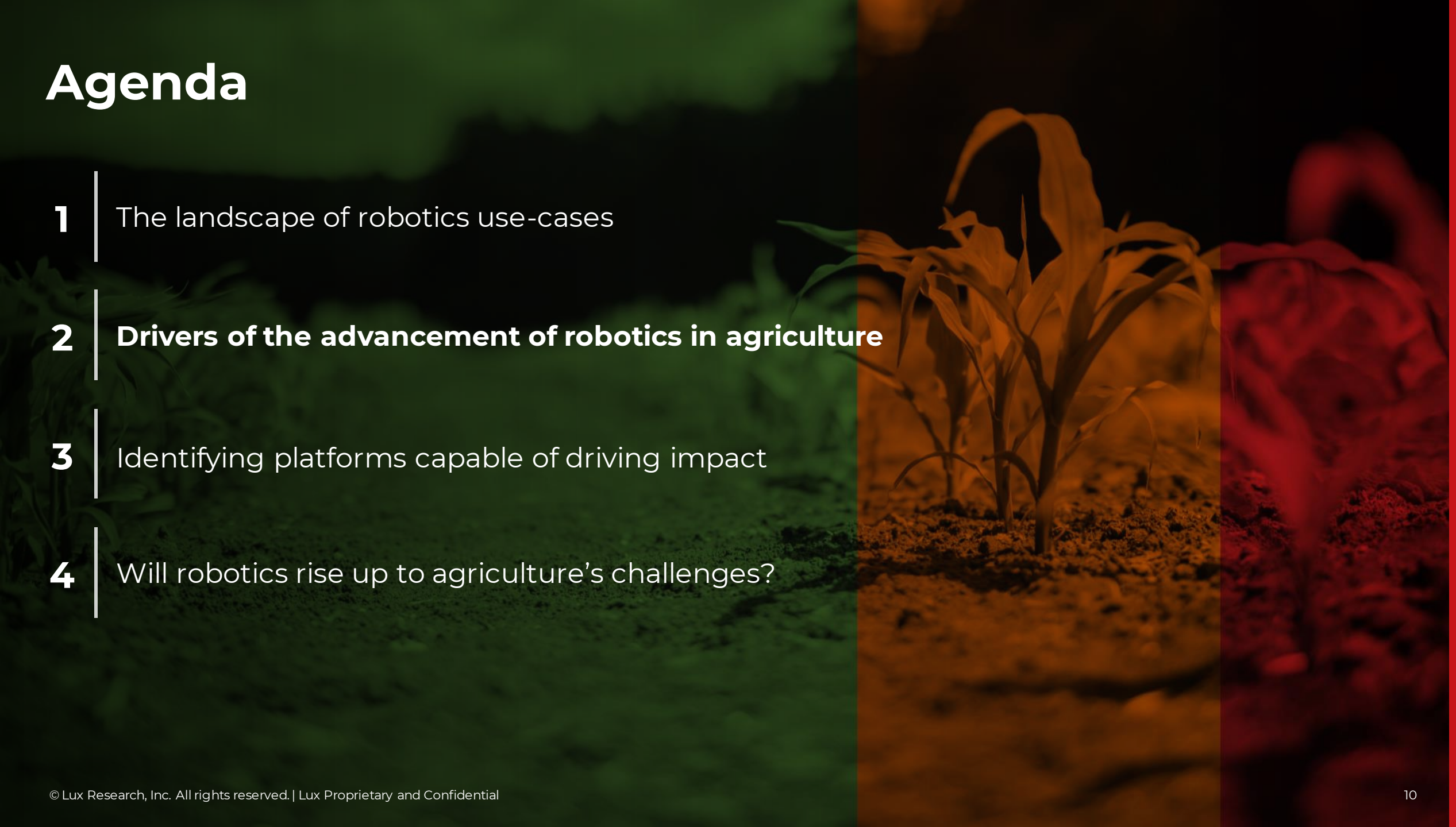


Robotics builds on established mechanization momentum

- **Most solutions are hyperspecific to a task, offering a high-cost, highly specialized alternative to a labor-intensive agriculture task.**
- **Developers target differentiation based on the hardware and software that are particularly well suited to a single task, like grasping and pulling a weed or identifying and picking a ripe strawberry.**

Asia drives mechanization but is joined by others on the path toward a new era of agriculture equipment

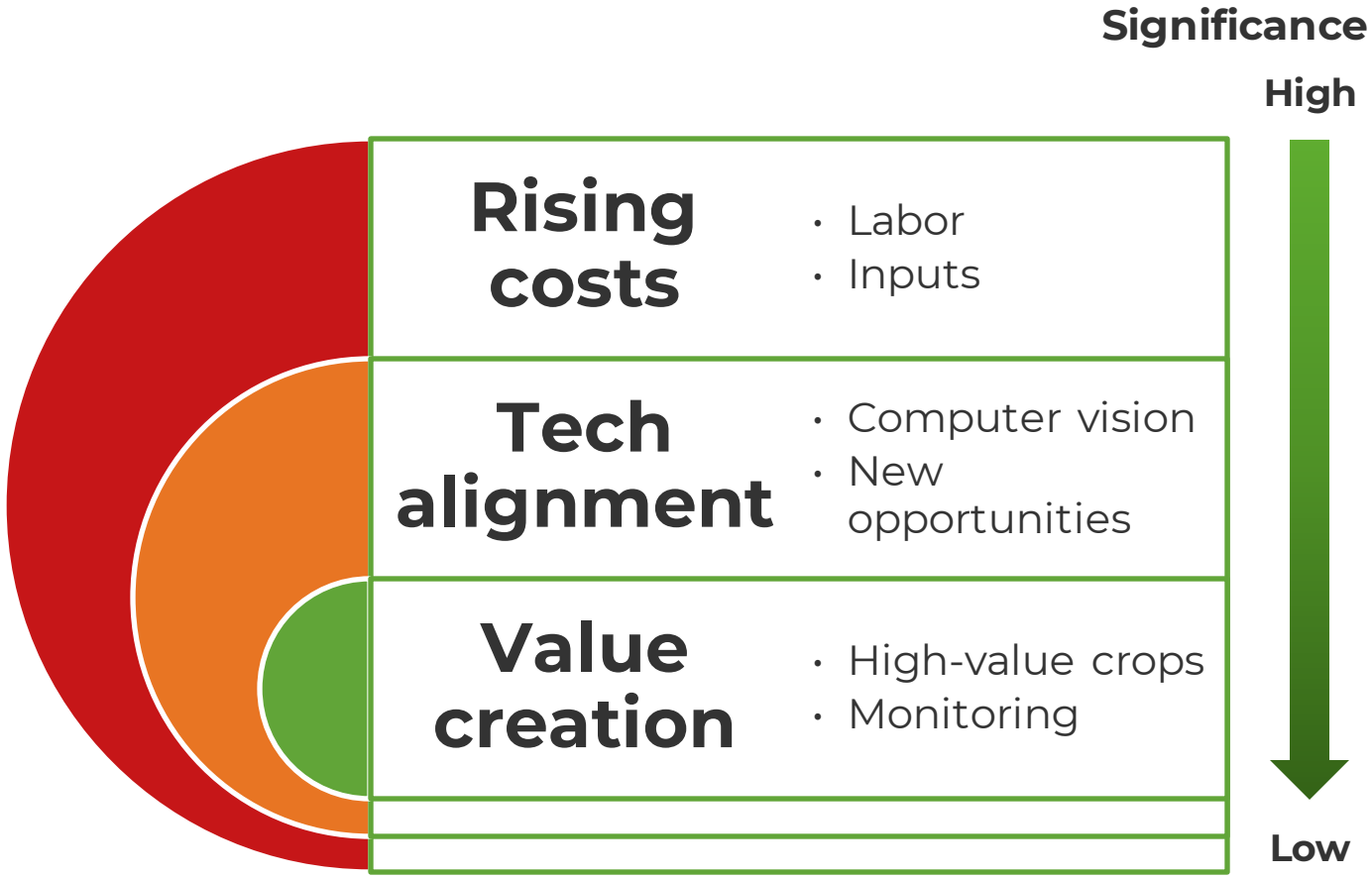
https://members.luxresearchinc.com/research/report/37715

Innovation Force is a composite score of 10 agricultural machinery technologies: advanced harvesting, advanced weed control, agriculture drones, agriculture robotics, farm management, indoor/vertical farming, irrigation sensors and analytics, precision agriculture, precision planting, tractor/machinery automation. The Innovation Force is designed to take into consideration the total patent applications and rate of acceleration at which innovation activity is occurring. The Innovation Force does not measure quality or disruptiveness of any patents, instead is designed to capture the amount of effort instead.

3 factors drive ag robotics acceleration

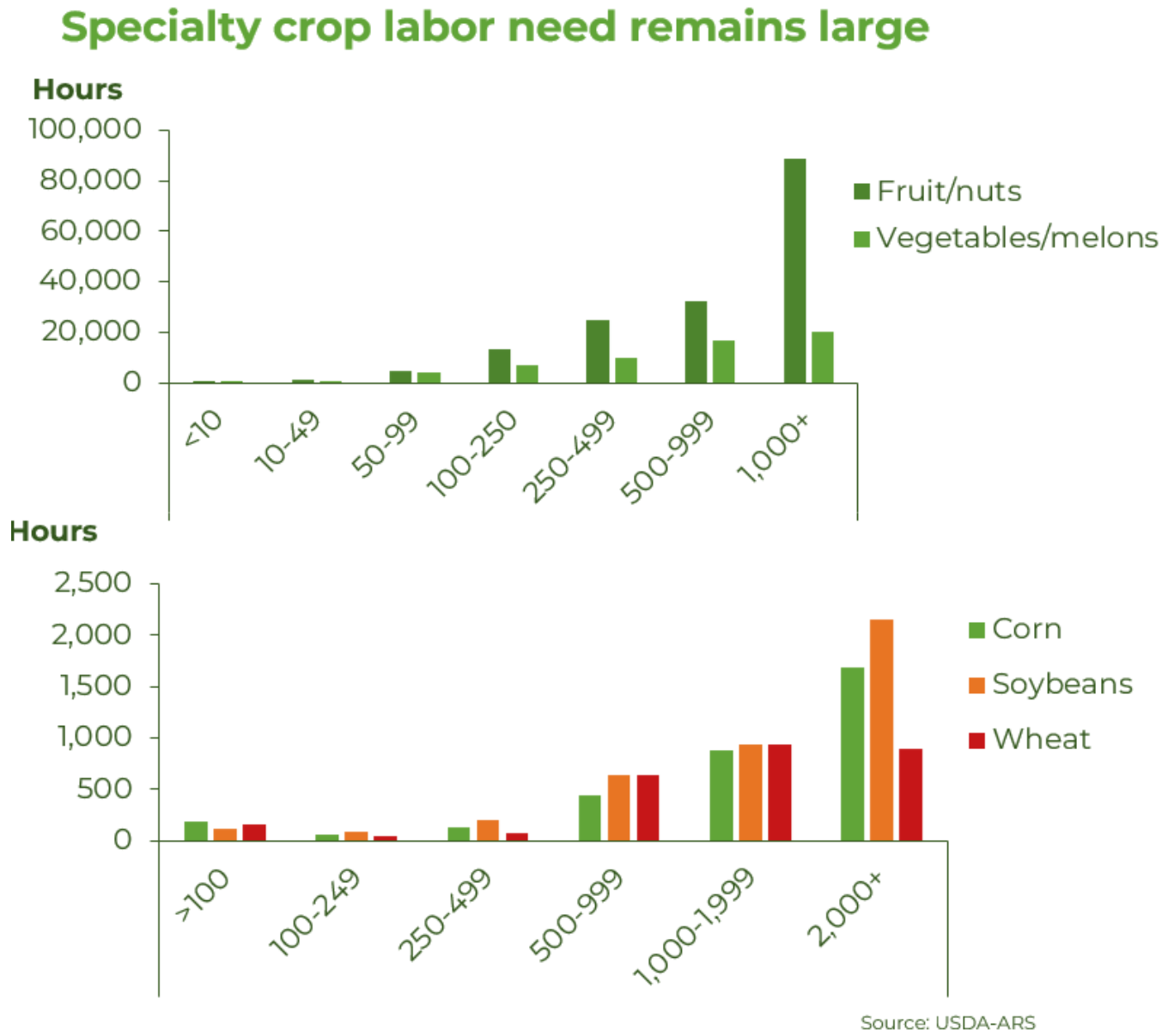
- **Increase in input cost and shortage.**
- **Advancement in technology, such as computer vision, machine learning, and AI.**
- **The use of robotics in high-value crops like vineyards, orchards, and vegetable fields is increasing.**

Drivers for acceleration of ag robotics



Labor shortages built on numerous fronts

- In the past 70 years, ag sector saw a staggering 73% decline in family farmworkers and 52% in hired farmworkers.
- Broad-acre crops require reduced hours, and perennial crops and tasks are already equipment dependent.

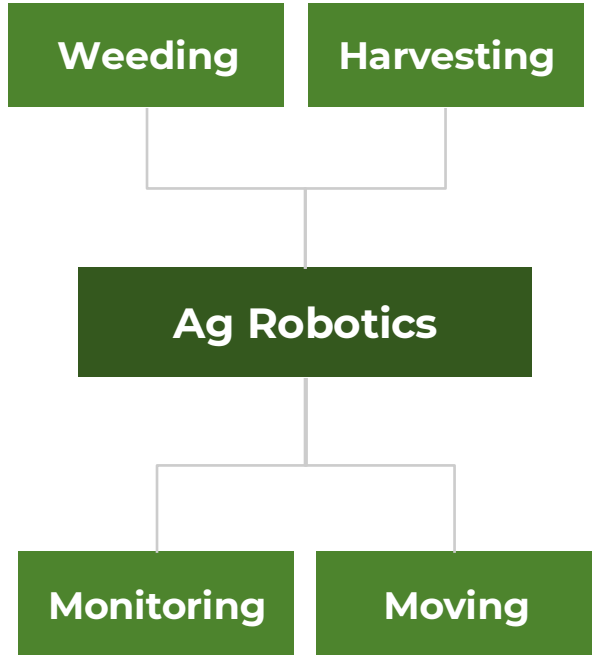


Unique offerings emerge for each use-case due to the task-based nature of grower needs

One size doesn't fit all for ag robotics

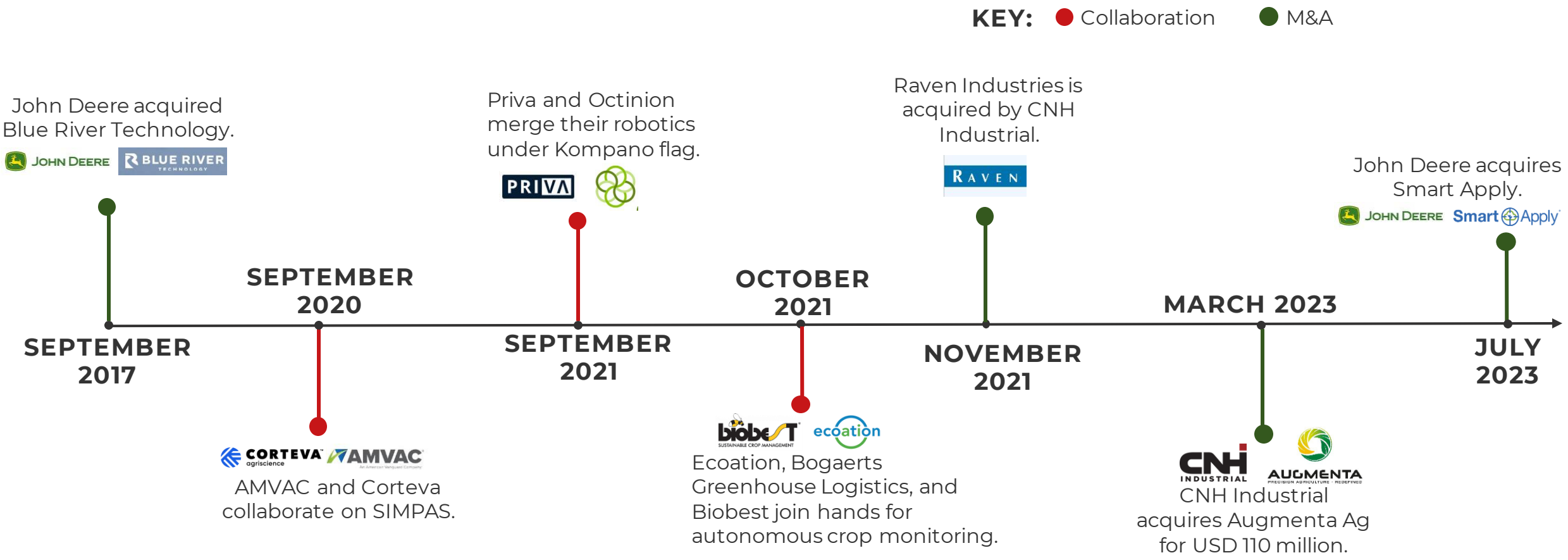
- **Equipment helps in weeding, harvesting, monitoring, and moving.**
- **In the past decade, robotics has seen frequent mergers and acquisitions (M&As) and collaboration from both big and smaller players that is turning into a robust, generalizable business model.**

Landscape of ag robotics



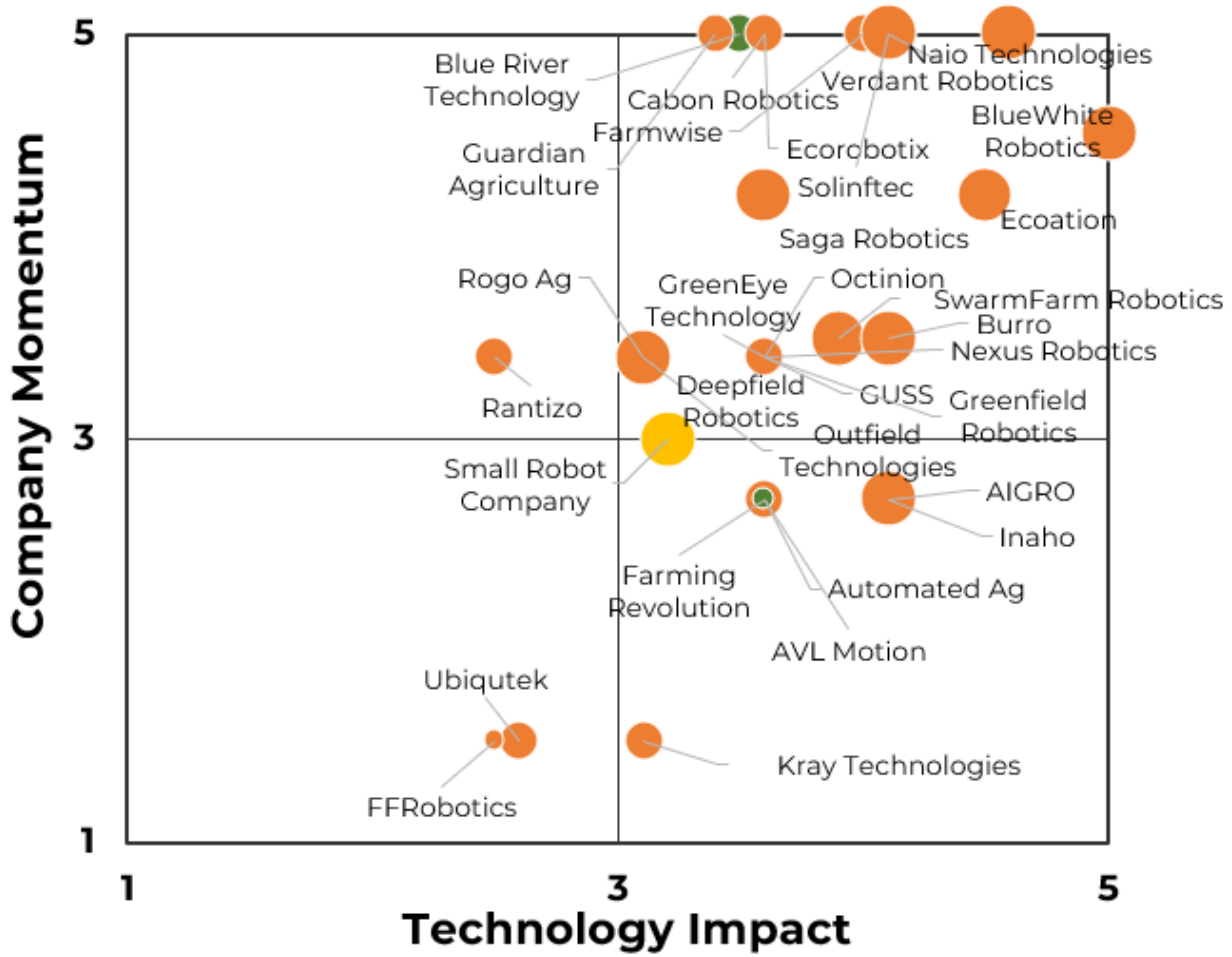
The need for shared expertise is supported by diverse collaborations

Robotics platforms aimed at weeding and disease control have gained commercial momentum, driven by M&As



The current focus in ag robotics is on a weeding solution

- **Agricultural robotics is an emerging sector that supports many farm activities, including weeding, harvesting, monitoring, and moving.**
- **Currently, technologies that address the weeding use-case are the focal point of momentum.**
- **Companies with multiple use-cases have high company momentum and technology impact.**



SIZE KEY: Multiple Weeding Harvesting

COLOR KEY: Sell or Service | Not Sure | Sell and Service

CASE STUDY

Solinftec launched Solix platform

Solar power, autonomy, and sensor technology to optimize the field

- **Solar-powered unit Solix can scout the farm, can spray at mm-level accuracy and also can control pests during the night with collection of various field data.**
- **While Solinftec continues to be innovative, its recent partnership with Growmark might also help these robots be adopted more for North American agriculture, given their cost parity.**

LUX TAKE

Robotic platforms have gained momentum, and with customers in 11 countries and over 12 million acres across various crops, Solinftec could see scaled adoption as its platform is versatile and farmers see justification for the cost.

Image source: Soinftec

CASE STUDY

A dual-threat robot from Verdant Robotics is ready to scale

Verdant Robotics' dual-threat robot can kill weeds and fertilize plants simultaneously and differentially.

- **The company claims its robot can identify and treat 500,000 plants/h, which is synonymous with 4.2 acres/h, using 95% less chemicals.**
- **Its bot is equipped with 50 spray nozzles with submillimeter accuracy along with laser technology (to kill weeds).**

LUX TAKE

Innovations targeting growers' pain points will likely see more success than others. For startups like Verdant, the RaaS* model allows farmers to try the platform before they buy. It gives them time to understand problems and identify new challenges to solve, making it a win-win situation for both parties.

VERDANT ROBOTICS

*RaaS, robotics as a service

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Will robotics rise up to agriculture's challenges?

- Business model and leveraging recurring revenue
- Choosing the right problems — is herbicide the right one?
- Generalizable use-cases
- Long buying cycles
- Supporting infrastructure
- Regulatory drivers both in favor and against
- Who benefits the most?

Key Takeaways

1. Robotics innovators are building solutions to disrupt targeted industry problems, such as labor safety and shortages, regulation, and input costs. Robotics solutions are highly customized for each use-case, but vendors need to build out into broader uses to make a compelling business case.

2. Agriculture robotics technology is catching up to the capabilities developed to serve other sectors and uses, and this transfer is facilitated in large part by developments in edge and AI computing. The trend in software development can enable new business models centered on recurring revenue and stickiness.

3. While the cost of inputs like herbicide motivates many robotics solutions, there are a number of considerations when pairing robotics solutions to farming problems, including supporting infrastructure and time-to-ROI.

Thank you

A link of the webinar recording will be emailed within 24–48 hours.

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