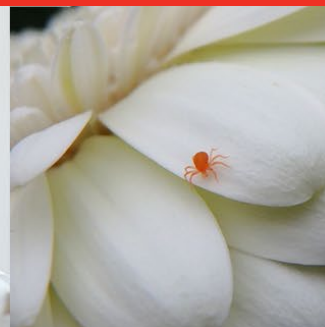




# vineland

RESEARCH & INNOVATION CENTRE



# **Automation Showcase**

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**Challenges & Future Opportunities**

**March 2023**

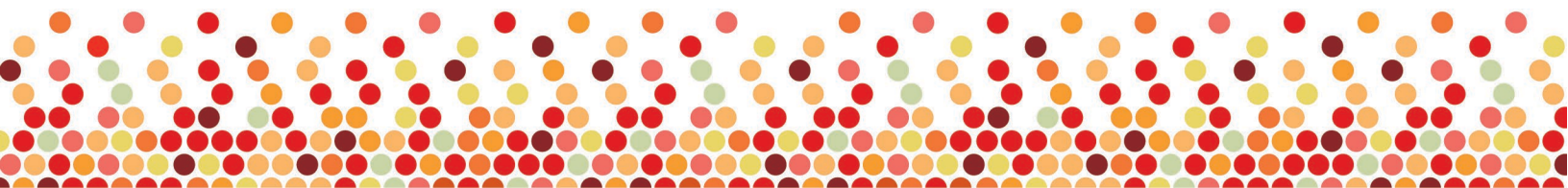
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## Overview

In February 2023, Vineland Research and Innovation Centre (Vineland) hosted an event to bring together a variety of horticulture stakeholders including Canadian scientists, engineers, companies and end-users. The goals were to communicate the outcomes of the Horticultural Automation Cluster funded by Agriculture and Agri-Food Canada (AAFC), to hear from leading international experts on the state of horticultural automation, to create connections and develop opportunities for future research collaboration and to create awareness for the advancement of Canadian automation R&D.

As part of this event, Vineland conducted stakeholder interviews with 26 different companies and organizations involved in horticultural automation in early 2023. These interviews comprised 22 automation companies, three consultants or government representatives and one individual from academia with worldwide representation from Canada (10), the Netherlands (9), the United States (3), Japan, Singapore and Israel. Twenty-two of these companies were directly involved with horticulture for both indoor (12) and outdoor production (4) or working in both environments (6).

These interviews provided a great overview to understand how the companies work in the space, where they see the best opportunities and how they can be connected to enhance impact for the sector. The interviews also highlighted many challenges faced by this emerging sector and the growth and key learnings gained over the past five years. Addressing these challenges will be key to establishing a path forward and areas for future collaboration, research and investment in the sector. Vineland provided a presentation on the main themes that emerged from these sector interviews. Following the presentation, an in-person conversation with event participants took place to address these challenges and create opportunities for future collaboration and growth of the horticultural automation sector.

## Challenges

Stakeholder interviews of the automation sector identified six main challenges facing horticultural automation development. A full description of these challenges is found in the presentation *[State of the horticulture automation sector: challenges and opportunities](#)* and has been summarized as follow:

1. Highly variable and harsh environments are a unique challenge within horticulture:
  - a. Variability in crop type and variety, production practices, infrastructure and variability over time require more sophisticated equipment.
  - b. It can be difficult to define an average operation, which leads to the constant need to customize.
2. Balancing the high cost of development with ROI:
  - a. High variability means large data sets and extensive data collection times are required.
  - b. Horticulture is a niche industry with each crop and/or growing operation design having unique requirements.

- c. There is an underestimated development time due to variability and need for customization. Extensive development time adds to cost.
  - d. Expensive, robust electronics are needed for harsh environments.
3. Developing connections with growers during the development phase:
  - a. Many growers are not willing to participate in trials due to potential liabilities, high financial cost and time commitment.
  - b. Word of mouth and personal relationships are key to developing horticultural connections, making it difficult for new entrants in the market to build trust.
  - c. Balancing the timing of going to trials to demonstrate efficacy versus commercial readiness.
4. Grower buy-in at commercialization:
  - a. Cash flow is limited, so technology needs to demonstrate an ROI.
  - b. Technology is not seen as necessary or doesn't fit existing infrastructure.
  - c. There is a lack of access to technical support if technology should fail.
5. Lack of collaboration:
  - a. There is a limited horticultural knowledge sharing and a lack of public data sets.
  - b. Established companies may not be willing to share horticultural connections with new entrants thereby blocking market access.
  - c. There is a lack of inter-operability and modular systems.
  - d. Grower fatigue due to lack of streamlining trials across different companies.
6. Safety and logistics:
  - a. Biosecurity
  - b. Employee security
  - c. Compliance with industry and government regulations

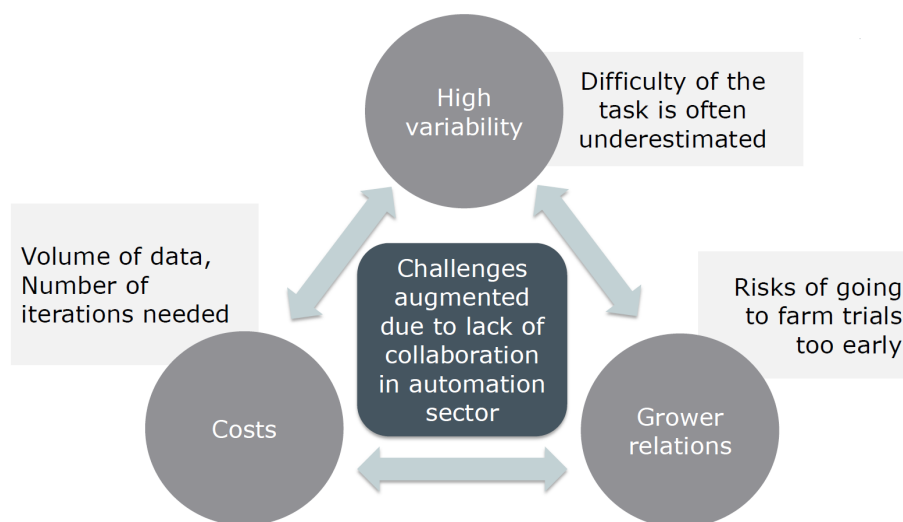


Figure 1: Summary of the main challenges facing horticultural automation based on interviews with 26 industry stakeholders.

Identifying challenges is an important first step. In fact, looking at them from a different perspective, they can be viewed as opportunities and areas for future research. There will be a continued need for automation in horticulture to address labour gaps and environmental sustainability.

## Opportunities

Looking ahead, it will be important to increase collaboration, create pre-commercial trialing spaces and address the identified challenges. When asked about research needs, the automation industry interview participants indicated they foresee vision systems and artificial intelligence (AI) to be adopted universally in the short term and robotics in the long term to meet the needs of the horticultural farm of the future. However, there are barriers preventing these technologies from being universally adopted at the present time, as described below.

### Current barriers to universal adoption

1. Cost: the cost of supplies and components is decreasing creating opportunities for the future.
2. Technical challenges: technology is just emerging and not yet reliable enough to for universal adoption.
3. Lack of collaboration: leading to system incompatibility and repetition of time-consuming data collection.

In order to help overcome these barriers, a number of research needs were expressed.

### Research needs

Identified by the automation industry in ranked order:

1. Technology validation and product demonstrations
2. Horticulture adaptation to fit automation
3. Sector scans of available technologies and top needs for different crops
4. Specific applications such as automated de-leafing, automated crop-lowering
5. System integration
6. Sustainability
7. Data availability and management
8. Social science (ethical, legal, business, commercialization support)

Overall, the feedback was clear in demonstrating that many industry professionals did not feel the development of new technology was required from research institutions. Instead, research institutions should focus on technology optimization, the development of tools (e.g. data management software, public data sets) to facilitate improved technology development by the automation industry and initiatives enhancing industry collaboration in an effort to streamline efforts.

### How to increase collaboration

As collaboration was continually raised as a key component to advance the horticultural automation sector, this became the focus of the interactive discussion session held with in-person participants at the Automation Cluster Event.

Participants were asked the question "How do we increase collaboration in horticultural automation?" and their answers were recorded live using menti.com word cloud generator.

Many themes were repeated but described using different words. The words were filtered and grouped under similar themes and a new word cloud was generated to provide a focused perspective.



Figure 2: Word cloud filtered by theme from the words generated by the automation industry participants when asked "How do we increase collaboration within horticultural automation".

Key words identified by participants to increase collaboration related to:

1. Validation
2. Funding
3. Leadership, sharing, networking
4. Events

Further discussion on the terms generated by the audience identified some key areas of interest that could facilitate increased collaboration.

### **Validation**

Validation is about building trust for your technology, demonstrating not only its functionality but also its usefulness and reliability while providing a return on investment. Technological validity is supported by conducting trials at a commercial facility or via workshops and product demonstrations. This highlights the importance of having access to facilities for technology validation. Growers can then see it for themselves to ensure it meets their expectations before investing financially and operationally. The concept of building collaborative pre-commercial testing sites across different regions/countries was strongly supported by participants and leads into the importance of resource and knowledge sharing to increase collaboration.



## **Funding**

Business models that allow for scalability of investment are required to reduce risk and facilitate trust building during technology development for smaller start-ups entering the sector. The funding requirements to bring an automation technology to market are often underestimated and difficult for start-up companies to secure.

There is also a need to generate more interest and investment from the technology sector in horticultural automation including talent development and recruitment of skill sets required for technology development and validation. A lack of skilled labour being attracted to the horticulture sector is another barrier to technology adoption.

Similarly, Brock University's recent study [\*Building Competitive Agri-Food Production Systems\*](#) identified funding access as an area requiring attention.

## **Leadership, sharing and networking**

Increased collaboration will require researchers, growers and companies to be open to sharing both their data and their ideas, creating partnerships and working towards a common goal. This can be achieved by looking within their sector or other sectors, for types of partnerships that work to create collaborative research models to support impact-driven results. A few examples include Vineland's Greening the Landscape Consortium, the Ocean Tracking Network headquartered at Dalhousie University and the Automated Weeding working group run by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA). Other possible models to investigate include those used for broad-acre agricultural crops.

A need exists to better communicate the value of sharing data since the industry generally employs a degree of protectionism. This is relevant to industry and researchers, as well as growers. If growers are willing to share their data, they can access customized solutions. Identifying types of data sets that can be shared or determining how to re-code data for effective sharing can better support product development and validation without having to re-create data sets. One solution is to develop models publicly available after a defined black out period.

Thought leaders or connector organizations also need to take a leadership role in data management and sharing. By determining the types of data that can be shared and the best platforms for sharing, such efforts will create buy-in by the automation industry to better collaborate. This directs to a consortium type approach for horticultural automation focused on the creation of collaborative technology and validation related to specific tasks or specific crops.

Standardization also arose through discussions as an important factor for improved industry collaboration. Developing a common set of tools used sector-wide is also essential to support horticultural automation. The sector has to define a common set of terms, standards, connectors and parts to support the integration of systems from different companies. The compatibility of technology will be an important factor in the acceptance by the horticultural sector due to the cost and lifespan of the technology. Using established systems such as ISO or ASTM to develop terms sheets, specifications and protocols for the sector will be necessary for technologies developed independently in order to be easily integrated in the future.



## Events

Events and workshops were other tools viewed by the industry as important in increasing engagement and trust but also in supporting the adoption of horticultural automation. Networking with industry professionals creates a word-of-mouth pipeline that can increase collaboration, develop new partnerships and also enhance grower participation. Finding growers with a long-term vision to adapt their businesses using technological advancements to make them more environmentally-friendly, operationally sustainable or profitable is an important step for technology validation and implementation. Events and workshops are great for growers to learn about emerging technologies.

## Final thoughts

It is important to remember the horticultural automation sector is still in its infancy and has grown significantly over the past five years. Many of the companies interviewed were not in business five years ago. As the sector matures, an opportunity exists to understand and address challenges and make a strategic and coordinated effort for the next five years and beyond. The time is ideal to increase collaboration, data sharing and identify business and partnership models for successful validation and implementation of automation technologies in supporting the horticultural sector.

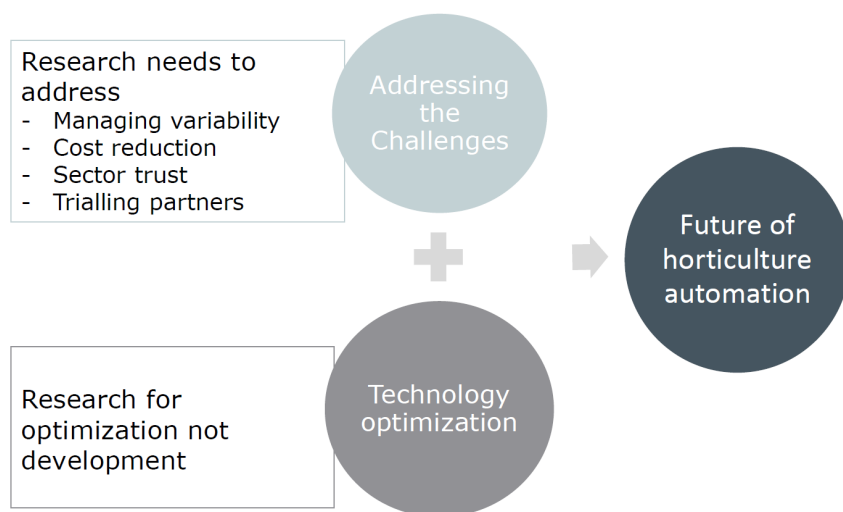


Figure 3: The future of horticulture automation.

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