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Background on the Organization (Vineland Research & Innovation Centre)

With a highly-skilled research team, oversight from an independent Board of Directors, engagement from an international Science Advisory Council and collaboration with more than 160 global partners including a Stakeholder Advisory Council, Vineland’s goal is to enhance Canadian growers’ commercial success through results-oriented innovation. We are an independent, not-for-profit organization funded in part by the Canadian Agricultural Partnership, a federal-provincial-territorial initiative.

Vineland’s vision: A vibrant, prosperous and sustainable horticulture industry working with innovation to fill our world with fruits, vegetables, flowers and plants.

Vineland’s mission: Enriching people’s lives through science and discovery in horticulture.

Vineland’s Robotics and Automation program was initiated in response to industry cost of production data that shows labour as the number one expense for grower operations. The main objective of the program is to design automation technology for use in an indoor environment to enhance commercial success of the horticultural sector.

Introduction to the Mushroom Harvesting Program

Mushroom harvesting is one of the most dynamic and difficult crop harvesting operations, where product quality and yield are highly dependent on smart harvesting decisions. With four to six harvesting rounds taking place every day, seven days a week, parameters to maximize yield are constantly changing and difficult to control. Without touching the mushrooms, harvesters must make several judgments based on the physical appearance of the mushroom to determine whether it should be picked. Considerations include avoiding physical damage and selecting mushrooms at various stages of maturity to optimize growth and meet market demand.

A significant portion of a mushroom farm’s operational costs are associated with labor, mainly around harvesting. Vineland has engaged and progressed in the development of automated harvesting technologies designed to ease the pressures around labour that are experienced by typical mushroom farms.

Robotic System for Mushroom Harvesting

Scope
The ultimate goal of the Automated Mushroom Harvesting program at Vineland is the commercialization of a fully automated system. There are several milestones to accomplish along the path to commercialization, one of which is the subject of this RFP. Vineland is currently ready to commence the design and build of a prototype of a fully automated in-shelf robotic mushroom harvesting system, to be installed and tested at a commercial farm. The intent of the prototype is to provide a platform for enhanced testing and continued
development of technologies, while demonstrating a technically/financially feasible migration path and scalability up to a commercially deployable, multi-robot solution. The proposed prototype will utilize two technologies already developed and tested by Vineland: a harvesting Decision Support System (DSS) and a computer vision system. The most important design consideration/requirement for the system is that it must operate within the physical constraints of the typical metal shelving structure (Dutch shelves) used in the majority of mushroom farms (see Figure 1).

Figure 1 - Mushrooms growing in a typical Dutch Shelf Environment

**Progress to Date**
Vineland has generated a number of novel technologies around automated mushroom harvesting, with numerous patents granted and pending. Trials of these technologies for harvesting mushrooms in both stationary lab scenarios and commercial in-shelf setups have been conducted and have demonstrated the economic value of the core technologies developed so far. At this time Vineland is seeking a capable systems integrator to construct a prototype robotic harvesting system that professionally integrates the technologies developed by Vineland with currently available robotic and automation technologies.

**Request for Proposal**

**Scope of Work**
Vineland is open to and seeking innovative solutions that optimize capability, price and exhibit a migration path to commercial deployment.

The following is a high level description of the main components to be developed and integrated in the prototype:

**Module 1: Harvesting arm**
This is the core component of the fully automated harvesting system. This module involves the design/selection of the harvesting arm that will pick the mushrooms from the growing beds within the Dutch shelving, and move the picked mushrooms outside the shelving area for further processing and packaging. Both robotic arm and Cartesian/gantry type setups
are technically feasible and it is up to the applicant to analyze the requirement and select the best option.

EOAT development is not required at this time as Vineland is pursuing a parallel development which will be installed at a later time. A suction cup is sufficient for testing.

**Module 2: Conveyance platform for the harvesting arm(s)**
The shelves where mushrooms are grown and harvested are typically more than 30 meters long and more than 4 meters high, with multiple layers. The robotic arm requires a conveyance platform to provide some mobility (horizontally and vertically), otherwise, tens of stationary harvesting arms would be required to cover one row of shelves. The prototype does not have to be mobile for the entire length of a typical shelving installation, but mobility over a subset of the typical commercial distance with obvious practical (physical and economic) scalability up to the entire commercial distance is required.

**Module 3: Cutting and packaging**
The harvesting system must trim the stems of the picked mushrooms, and place the mushrooms into small trays (punnets), which are filled to weight.

**Module 4: Punnet conveyance**
The final subsystem required is one to accumulate and convey the filled punnets. Multiple options for this are conceivable, potentially utilizing space on the harvesting platform itself and/or ancillary systems. Ultimately the filled punnets must reach the packing area at the end of the process where they receive shrink wrap and boxing. Vineland is open to discussing innovative approaches for dealing with accumulation and conveyance of the punnets from the growing rooms to the packing area.

**Technical Specs & Requirements**

See attached Technical specs PDF file.

(Vineland_RFP-Automated Mushroom Harvesting System_Tech Specs_Rev0)

**Project Phases**
Vineland would like to split the Project work into **three phases, occurring sequentially:**

- **First Phase:** Design of modules 1 to 4, construct and integrate an automation solution encompassing modules 1 & 2, the harvesting arm(s) with the conveyance platform for the harvesting arm(s).
- **Second Phase:** construct and integrate the system to trim stems and place the mushrooms in punnets (module 3).
- **Third phase:** construct and integrate the mushroom tray conveyance system (module 4).

Timelines to be discussed based on vendor capacity and Vineland’s deadlines.

To ensure compatibility of all subsystems, the initial system design should be done to include all modules/phases, while construction/integration will be phased over time as per above. For purposes of this RFP, a detailed quotation is required for phase 1 only. Budgetary pricing is sufficient for phases 2 and 3.
Overall System Performance Targets
Performance targets for the prototype growing area (one length of Dutch shelving with five layers, see specifications PDF for additional details):

<table>
<thead>
<tr>
<th>Table Subheading</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall system harvest throughput rate (Mushrooms/Day)</td>
<td>4000*</td>
</tr>
<tr>
<td>[in a 22 hrs/day operation]</td>
<td></td>
</tr>
<tr>
<td>Scalable to the full-system with min. overall harvesting throughput (Mushroom/day)</td>
<td>250,000**</td>
</tr>
<tr>
<td>Harvesting arm min. pick &amp; place speed (pick/min)</td>
<td>20</td>
</tr>
</tbody>
</table>

* For the prototype half-shelf growing rack area (check attached Technical spes Pdf file)
** For the 4 X Racks per Room (check attached Technical spes Pdf file)

General Operational Requirements
- The system needs to start-up and shutdown with minimal operator intervention
- The system needs to have an industrial grade HMI for control and monitoring the harvesting process and machine faults
- All off-the-shelf and custom system components need to be corrosion resistant whenever possible and not prone to rust in a humid environment
- The system should utilize a minimum of two harvesting arms. This is required to test a multi-arm scenario and its scalability to a commercial system
- It is desirable that while the system is deployed, there remains space in the aisles for the free movement of personnel
- The system should be self-powered and not tethered by cords/cables
- The system should be able to operate in the typical conditions of the mushroom growing rooms, which are humid and have growing trays filled with compost

Safety
The prototype should be built to meet the electrical safety requirements of the ESA, and integrate components that are CSA (or equivalent) approved as applicable.

It should be noted that the setup will ultimately be mobile and operational in a manned environment, so pertinent safety measures such as collaborative arms, safety light curtains, sensors, guarding, etc. must be considered up-front. To ensure a practical migration path to a commercially deployable product, the prototype should be designed to meet OSHA standards and pass a PSHSR. It is anticipated that the commercial product will have a global market. The needs in other jurisdictions such as the EU should be considered such that the proposed solution does not have any limiting safety issues in international markets, however the prototype will not need to formally pass any international testing.

Deliverables
The following are Phase 1 deliverables. Deliverables for subsequent phases will be determined prior to ordering.
1. All phase 1 hardware per specifications, factory acceptance testing complete
2. Design documentation including mechanical, schematics (electrical, pneumatic, etc.), source files, bills of materials
3. General documentation: specifications, operation manuals, maintenance manuals, system scalability plan
4. Installation and commissioning at Vineland, site acceptance testing complete

**Items to be supplied by Vineland**
The following will be provided for Phase 1, subsequent phases TBD.

1. Computer vision system hardware and Decision Support System. This system will provide mushroom coordinates to the harvesting setup using a wireless link. Communication protocol and physical layer options to be discussed
2. Optional: 1 x Precise Automation PF3400 SCARA collaborative robot. Vineland has evaluated and used this robot for previous proofs of concept. If the vendor’s solution can make use of this robot, it will be free-issued for integration.

**User Accepting Testing (UAT)**
Factory (FAT) and site acceptance testing are required milestones in the project. Test parameters to be defined by the vendor and approved by Vineland. Detailed test procedures are not required for this RFP, but a general outline should be provided.

**Timeline**
The following dates are estimated:

- Start of RFP process: **July 03, 2019**
- Close of RFP process: **August 04, 2019**
- Successful Proposal(s) selection: **August 07, 2019**
- Final Quotations deadline of successful proposal(s): **August 12, 2019**
- Decision on successful applicant: **August 15, 2019**
- Target Project start date: **August 19, 2019**
- Target Phase 1 delivery: **March 31, 2020**

**Evaluation criteria**
- Ability to manage the activities required for the successful completion of the project, either directly or in combination with other sub-contractors
- Technical ability, capacity and related prior experience to design and manufacture the required equipment
- Manufacturing facilities capable of producing the technology in Ontario
- Management, key personnel and skill sets
- Technical staff, resources and bandwidth to complete the project on schedule
- References and sample past projects
- Historical customer service performance
• Quality of the RFP response and level of technical detail
• Price
• Technical feasibility and level of innovation of the solution
• Terms of after-sales support and warranty
• The solution’s visible path towards a practical commercial product that can be manufactured and deployed at scale
• Manufacturing capacity and ability and willingness to scale up. As the technology progresses towards commercialization, Vineland will be seeking a partner capable of designing and building the pilot version of the product, as well as the final commercial version in volume. The exercise of building this prototype will be considered a benchmark for a future potential partnership

Budget

Vineland has budget allocated and wishes to engage in this project as a fee-for-service to the selected vendor.

Vineland will submit payment for the project on a milestone basis. Milestones are to be mutually agreed upon between Vineland and the vendor and may include, but are not limited to:

- Review and approval of design and BOM
- Progress milestones and in-factory demonstrations
- Completion of Factory Acceptance Testing
- Completion of Site Acceptance Testing
- Etc.

Proposal Guidelines and Requirements

a) Vineland is seeking a systems integrator to construct and deliver a prototype automated mushroom harvesting system as described herein. This is an open and competitive process

b) Any assumptions in the proposed solutions should be clearly highlighted in the proposal/quotation document under a separate section

c) Any exclusions either from the proposed solution or the quoted prices should be clearly highlighted in the proposal/quotation document under a separate section

d) Pricing should be itemised, not in lump-sum, including any equipment, man hours, materials, installation, delivery, or shipping rates. (for any required equipment, the possibility of a leasing option should be stated with the estimated rate)

e) Requests to visit Vineland to view the mushroom growing rack, previous POC’s, etc. should be made at least two days in advance of the requested day of the visit

f) Submissions received after the date and time of closing will not be considered

g) Payment terms and quoted prices should be clearly written in Canadian Dollars with the applicable taxes rates

h) Warranty terms and conditions should be clearly stated in a separate section

i) The proposal must contain the signature of a duly authorized officer or agent of the company submitting the proposal
j) Manufacturing of the system must take place in Ontario.

k) Once a vendor has been identified, Vineland will work with that vendor to finalize specifications, pricing and delivery. If agreement on any of these items cannot be reached between the parties within 30 days, Vineland may seek an alternate vendor.

**Submission and Further Information**

This and other referenced/attached documents are meant as an overview to engage interested systems integrators who may wish to bid on this project. For more information applicants should contact Vineland, and more detailed technical, commercial and mushroom growing/harvesting information will be provided at Vineland’s discretion. A sample of the Dutch shelving system as well as other development efforts to date are located at Vineland’s facility and are available for viewing at Vineland’s discretion and upon the execution of a non-disclosure agreement.

Vineland understands that parties interesting in bidding on this project may not have experience in mushroom or horticultural practices and automation. Vineland aims to bridge this knowledge gap through a collaborative process with the selected vendor, providing advice, information and technical evaluation/approval throughout the lifecycle of the project.

Questions and submissions should be directed to:

Vineland Research and Innovation Centre  
Attn: Omar Abdelzaher, Systems Integration Project Manager  
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PO Box 4000  
Vineland Station, Ontario L0R 2E0  
Phone: 905.562.0320 x306  
Email: omar.abdelzaher@vinelandresearch.com

A submission template is not provided with this RFP. Vineland invites applicants to submit proposals using their own format.

If a decision is made by Vineland to release more information than is currently included in this package, the information will be sent to all potential applicants.

**Disclaimer**

All data or information provided in this package is confidential, and will be protected under a Non-Disclosure Agreement during the RFP/RFQ process.

All information provided is accurate at the time the RFP is distributed but may be subject to change.

Responses will be evaluated based on all relevant factors, as determined by Vineland. Vineland may request, from any responding party, additional information and/or clarification in regard to the submitted quotation. Vineland reserves the right to enter into negotiations subsequent to this RFP which may result in changes to any of the terms initially proposed in
the RFP. Any responses, materials, correspondence, or documents provided to Vineland will be kept confidential.
Revision History

Rev 0    July 03, 2019    Initial release