Why this research is important:
Transplant of unrooted plant cuttings to produce rooted liner trays is a manufacturing process that requires considerable labor, especially during the peak season. Greenhouse companies must have the necessary workforce (full time and seasonal) to meet production targets. However, with a shortage of labor, it has become difficult for greenhouse businesses to find available workers to transplant plant cuttings. Transplanting robots have recently been developed that allow automation of the cutting transplant process.

Objective:
- To analyze the profitability and return on investment of a transplanting robot
- To identify key factors that businesses would consider when purchasing a transplanting robot

Approach:
- 4 companies are being surveyed that are using between one and five ISO transplant robots. Each company transplanted between 800,000 to 3M cuttings in their peak week of 2016.
- Participants had collaborated in previous studies by the Floriculture Research Alliance and were willing to share sensitive financial data (IRB approved).
- Data were collected on the number and labor cost of cuttings transplanted manually and with the robots in 2016.
- A spreadsheet return on investment model was developed to analyze costs and productivity of the robots.

Preliminary results
- Capital cost of a transplant robot was approx. $125,000, including additional costs for conveyor belts, scanners, etc.
- 1 to 1.25 workers were required to operate each robot.
- The robots transplanted an average 2000 cuttings per hour, including down time.
- Initial analysis indicates the cost per cutting for the transplant robot was $0.04 to $0.07 (average $0.055), compared with $0.007 to $0.033 per cutting (average $0.016) from our earlier survey of the cost of manual sticking.
- Cost per cutting could be reduced by (a) increasing the number of robots per location and improving efficiency of operator labor (b) having multiple shifts to increase capacity during the peak (c) long runs of a single cultivar to reduce change-over time (d) automated sanitation of equipment between cultivars, and automated labelling of trays (added at one location) (e) spreading sticking over many weeks of the year rather than in a sharp peak
- The main benefit appears to be in reducing labor requirement, rather than reduced cost per cutting.
- Some cuttings (e.g. small or poorly-defined stem) were not suitable for the transplant robot and required manual sticking.
• Each business requires a customized analysis to evaluate return on investment and impact on labor and costs.

• For example, the scenario below is based on the average number of cuttings transplanted per week at five grower locations. In this scenario, we assume the grower has purchased two robots for a total cost of $250,000, each of which can stick 2000 cuttings per hour compared with 878 cuttings per hour for manual sticking. The robot is assumed to work for up to two shifts of 76 hours, with a maximum capacity of 304,000 cuttings per week. A robot operator would be paid $17.40 per hour, and a manual transplanting worker would receive $11.84 per hour.

• With these assumptions, the cost per cutting (labor and capital costs) for automated sticking would be $0.039, compared with $0.013 with manual sticking.

• The robots would work at maximum capacity (304,000 cuttings per week) for more than half of the year, with less use during the summer off-season. During the peak from week 1 to 10, this would mean between 11 and 21% of the cuttings would be transplanted by the robot, with the remaining transplanted manually.

• Although this would reduce the number of worker FTEs (full-time equivalents) required to manually stick cuttings, more robots would be needed to have a major impact on labor requirement during the peak.

• The results of our analysis are dependent on the assumptions in the model. Therefore, we are taking a modeling approach where we will be able to calibrate these assumptions to be valid for specific grower locations. Additional data are being collected during 2017 from growers using transplant robots to improve our model.

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