Evaluation of Automation for Florida Citrus Packinghouses

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• Automation - controlled operation of an apparatus, process or system by mechanical or electronic devices taking the place of human organs of observation, effort or decision

Automation assessment
(Fruit grading example)

• Economic
• Better product
• Competitive advantage

Manual Grading Costs

\[ YCE = NG^*HR^*(RH+1.5*OH)+OC+PC^*NG^*1.5 \]

YCE - yearly cost estimate
NG - number of graders
HR - hourly wage rate, grader
RH, OH - regular and overtime hour(s)
OC - overhead charge, % of total wage
PC - processing cost per grader

Automatic Grading Costs

\[ YCE = CC + MC + OS - MS - PLS \]

YCE - yearly cost estimate
CC - capital costs
MC - maintenance costs, % of capital costs
OS - operator's salary, plus overhead
MS - materials savings; e.g. wax and fungicide
PLS - productivity labor savings; reduction % of hourly labor charge

Economic Assumptions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital</td>
<td>$400,000-800,000</td>
</tr>
<tr>
<td>Cost Projection Period</td>
<td>5 yr.</td>
</tr>
<tr>
<td>Overhead Charge</td>
<td>15 %</td>
</tr>
<tr>
<td>Hourly Wage Rate</td>
<td>$6.00</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>7 %</td>
</tr>
<tr>
<td>Maint. Charge, 2-5 yr.</td>
<td>4 % of capital costs</td>
</tr>
<tr>
<td>Materials Savings</td>
<td>2.5 – 7.5 %</td>
</tr>
</tbody>
</table>

Economic Assumptions (2)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grader Reduction</td>
<td>6 – 16 persons</td>
</tr>
<tr>
<td>Operator Salary</td>
<td>$20,500</td>
</tr>
<tr>
<td>Overtime Hours</td>
<td>300 hr</td>
</tr>
<tr>
<td>Packing Output</td>
<td>1.2 million cartons</td>
</tr>
<tr>
<td>Personnel Charge</td>
<td>$100</td>
</tr>
<tr>
<td>Productivity Labor Savings</td>
<td>5 – 10 %</td>
</tr>
<tr>
<td>Regular Hours</td>
<td>1100 hr</td>
</tr>
</tbody>
</table>
Low-Cost Projection

Medium-Cost Projection

High-Cost Projection

Opportunities for automation

- Packing (more standardization would be helpful)
- Data collection/documentation (traceability, JIT, HAACP, ISO9000 series, GAP, GMP)
- Enhancements (internal fruit quality, system integration [grove to consumer])

RSS-14 Stacked Omnidirectional
Each (or Bulk) Point of Sale Identification

PLU number remains on Sticker
- each or
- weighed
**RFID Technologies**

- Main processor chip, antenna, power source, reader (interrogator)
- Passive devices: range ~ 1 m
- Active devices: range ~ 30 m
- Integrate with other sensing: temperature, humidity, gas levels, GPS data, other tags

**RFID Tags**

**Automation a Benefit, not Burden to Packinghouse Management**

- Production Schedule (Fruit/Materials/People)
- Process (Application)
- Product (Internal/External Quality)
- Personnel
- Automation (An additional facet but should reduce workload of the 4 P’s above)

**Benefits of Automation**

- Reduced Labor
- Better Quality Control and Product Matching with Customer
- More Uniform and Enhanced Production
- Tracking Records
- Food Safety Requirements
- Packinghouse to Packinghouse Uniformity

**The Future**

- How much automation?
- What will the impetus for more automation? (labor availability/cost, product uniformity, food safety)
- How to manage competitive advantage through automation?