Assessment of a semi-automated system for counting, measuring and tracking of export logs

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C3 Ltd
Global industrial roundwood production = 1.874 billion m\(^3\)
Global trade in industrial roundwood = 122 million m\(^3\)  ~7%

New Zealand: world’s largest softwood log exporter every year since 2013.
Who are C3?

- NZ’s largest on-wharf logistics company
  - stevedoring
  - marshalling
  - warehousing
  - wharf cartage

- Handle wide range of products
  - Break bulk, e.g. fertiliser
  - Steel
  - General cargo
  - Logs and forest products

- Operate in 15 ports in NZ and Australia
How important are logs to C3?

- Logs are C3’s largest cargo by volume
- In the last 8 years have tagged, measured, handled, and tracked over
  - 100 million tonnes of logs
  - 260 million individual logs
Current System – Scaling Shed

- Length from truck docket
- Bar code tags applied
- Log count checked
- Small end UB diameters measured
- Log volumes calculated
- Truck sent to storage row
Current System – To Shipside
Current System – To Shipside
Current System – On Ship

• Right volume
• Right supplier
• Right destination

☑ Every log accounted for
☑ Where stowed
☑ Every log ID’d
C3’s Challenge

- Improve customer service via:
  - Increased and time efficient truck throughput;
  - Increased vessel loading productivity;
  - Increased data integrity; and
  - Improved safety hazard environment.

- Provide innovative solution and services to international marketplace

**COM3TS**

**COunt, MEasure, Track SIMultaneously**
2013 Vision

Diagram showing the integration of a sensor head, operator interface, portable computer (Intel NUC), wireless access point, compressed images, and a workstation (GPGPU) forforest engineering applications.
Improved Counting – Shipside
Operational Trial: Goals

- To assess the accuracy (precision and bias) of the latest version of COM3TS in an operational trial and compare these with manual scaling.
- To assess the efficiency gains resulting from the use of COM3TS compared with manual scaling.
- To build up a large operational dataset for “machine learning” and testing of future software improvements.
Operational Trial: Accuracy

- 30,000 logs were ticketed and measured over 4 month period

- Each log scaled using current manual system and using COM³TS

- A random subset of 898 logs check-scaled by an expert scaler ("the gold standard")
Operational Trial: Results

- Maximum bias allowed for logs scaled on truck or on rail wagon is +/- 3% of volume.
- Compared with check-scaler, manual scaling over-scaled volume by 0.88%
- Compared with check-scaler, COM3TS under-scaled volume by 0.04%
Operational Trial: Results

Precision of JAS Diameter Measurements (Compared with Check-Scalars Measurements)

C3 Target
95% +/- 2cm

62.5% Same
Operational Trial: Efficiency

- Time studies based on video footage and real-time site visits were used to measure ticketing and scaling times (nearest 1/100th minute).

- Normal scaling of 42 rail wagon loads and 54 truckloads were timed.

- \textbf{COM3TS} scaling of 40 rail wagon loads and 26 truckloads were timed.

- Times were compared on minutes per log and minutes per JAS m³ criteria.
Operational Trial: Results

Scaling Time versus Log Length

<table>
<thead>
<tr>
<th></th>
<th>5.8 m</th>
<th>8.0 m</th>
<th>12.0 m</th>
<th>5.8 m</th>
<th>8.0 m</th>
<th>12.0 m</th>
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<td>0.12</td>
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<td>0.08</td>
<td>0.16</td>
<td>0.18</td>
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<td>Rail COM3TS</td>
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<td>0.13</td>
<td>0.07</td>
<td>0.15</td>
<td>0.17</td>
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<tr>
<td>Truck Manual Scaling</td>
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<td>0.12</td>
<td>0.06</td>
<td>0.14</td>
<td>0.16</td>
<td>0.12</td>
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<tr>
<td>Truck COM3TS</td>
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<td>0.11</td>
<td>0.05</td>
<td>0.13</td>
<td>0.15</td>
<td>0.11</td>
</tr>
</tbody>
</table>
Concluding Comments from Trial

- **COM3TS** was less biased and more precise than the current manual scaling system.

- **COM3TS** scaling was 14 to 46% faster (= more efficient) than the current manual scaling system.*

* Excludes ticketing and delays
Where to Next

- Increase range of log grades and move to make the system more portable.

- Integrate COM3TS with redefined business processes across NZ ports and internationally.

- Continuous improvement

- Automated scaling