The Internet of Machines: Ag Equipment as IOT

Jason Ward
Equipment Has A Story to Tell
“Machine Data”

• How well is my equipment running?
• How well is my equipment doing its job?
AgGateway Data Model

Diagram showing the relationships between different data elements in the AgGateway Data Model.
Enabling Technologies: CAN Bus
Everything is Connected
THE INTERNET OF THINGS
AN EXPLOSION OF CONNECTED POSSIBILITY

1992: 1,000,000
First computers sell for $1,000.

2002: 0.5 BILLION
First billion connected devices on Earth (see also 2014)

2003: 10.2 BILLION
Increased segment of 10 billion connected devices.

2008: 8.7 BILLION
8.7 billion connected devices worldwide.

2010: 11.2 BILLION
11.2 billion connected devices by 2010.

2014: 14.4 BILLION
Trend shows the Internet of Things is no longer a niche but rather a way of life.

2016: 22.9 BILLION
More connected devices than people.

2019: 34.6 BILLION
The number of connected devices will reach 34.6 billion in 2019.

2020: 42.1 BILLION
The number of connected devices will reach 42.1 billion in 2020.

2025: 50.1 BILLION
The number of connected devices will reach 50.1 billion by 2025.

Jim Harris Twitter: @JimHarris
Data Points ➔ Data Ecosystems
Data in the Cloud

- OEM, Aftermarket, Service Provider
- Fixes the “data on terminal” issue
- Creates other problems
Dashboard Fatigue

YOU GET A DASHBOARD! YOU GET A DASHBOARD!

Everybody gets a dashboard!
CAN Loggers

• Avoid inherent file format issues
• Mixed Fleet Management
• Only access to public data streams
Beware the Switcheroo

• Data in aggregate has more value than data on its own
• Digital data has perfect fidelity
• Secondary data markets often “discovered”
Data is now part of the problem

• There has been a race to
  – Connect
  – Collect
  – Utilize
  – Monetize

• Data is NOT decision
http://www.agdatatransparent.com/

The Ag Data Seal of Approval
Use Cases

• Core Business Functions
Its’s not who you are, but what you are

• If I told you
  – Planting Date
  – Target Population
It's not who you are, but what you are

- If I told you
  - Planting Date
  - Target Population
  - Row Spacing
  - Fertilization Rates / Timing
  - Protectant Rates / Timing
  - Harvest Date
  - Yield
PEOPLE IN THE SIXTIES:

I BETTER NOT SAY THAT OR THE GOVERNMENT WILL WIRETAP MY HOUSE

PEOPLE TODAY:

HEY WIRETAP, DO YOU HAVE A RECIPE FOR PANCAKES?
Data as a Natural Resource
All Data is Agronomic
Why do you buy a tractor?
Technology Drives Equipment Value

• Precision Ag in not just a technology.

• Transparent Technology
  – Air Conditioning
  – Air-Ride

• Data & Telematics are not options.
Precision Agriculture First Principles

• Precision is added to agriculture.
• Precision Agriculture = Data Relationships
Relationships = Local Dealer

• Biggest challenge is delivering the decision to the field
• Making the recommendation actionable
• Making the recommendation reasonable

• Machine X Agronomic Interaction
Equipment Efficiency

• Do your work.
• Know how you did.

<table>
<thead>
<tr>
<th>Time</th>
<th>Fuel Used</th>
<th>Rate</th>
<th>Efficiency</th>
<th>Work Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>02:39:11</td>
<td>20.2 gal</td>
<td>7.6 gal/h</td>
<td>16.4%</td>
<td>64.0%</td>
</tr>
<tr>
<td>00:28:04</td>
<td>—</td>
<td>—</td>
<td>17.6%</td>
<td>1.6 gal</td>
</tr>
<tr>
<td>00:46:35</td>
<td>16.5 mi</td>
<td>29.3%</td>
<td>16.9 gal</td>
<td></td>
</tr>
<tr>
<td>00:10:04</td>
<td>0.8 mi</td>
<td>6.3%</td>
<td>6.9 gal</td>
<td></td>
</tr>
<tr>
<td>01:14:28</td>
<td>162.5 ac</td>
<td>46.8%</td>
<td>10.6 gal</td>
<td></td>
</tr>
</tbody>
</table>

100% Spraying
- Worked Area: 162.5 ac
- Fuel Use: 10.6 gal
- Avg Speed: 10.8 mph
- Avg Engine Load: 77.3%
Fuel Consumption

GIS analysis of fuel consumption while baling corn stover at two rates in a single field. Green indicates high fuel consumption, and red indicates low fuel consumption.
Operator Training and Rewards

• Bonus for operator with lowest idle time
  – Fuel Consumption
  – Most Consistent Spray Rate

• Identify Problem Operators
Draft Load

- Identify compaction zones
- Poor drainage
- Likely only heavy compaction
Engine Load

• Faster Planting + Larger Planters = Higher Engine Load

• Continuously Maxing Engine Load = Faster Wear
## Equipment Coverage VS DSFW

<table>
<thead>
<tr>
<th>State</th>
<th>Min</th>
<th>15th</th>
<th>50th</th>
<th>85th</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>9.2</td>
<td>19.7</td>
<td>22.2</td>
<td>24.4</td>
<td>27.1</td>
</tr>
<tr>
<td>Arkansas</td>
<td>24.0</td>
<td>28.5</td>
<td>34.0</td>
<td>37.6</td>
<td>46.0</td>
</tr>
<tr>
<td>Florida</td>
<td>24.4</td>
<td>24.7</td>
<td>25.2</td>
<td>25.5</td>
<td>25.7</td>
</tr>
<tr>
<td>Georgia</td>
<td>18.0</td>
<td>21.1</td>
<td>23.0</td>
<td>24.7</td>
<td>26.2</td>
</tr>
<tr>
<td>Mississippi</td>
<td>17.2</td>
<td>19.6</td>
<td>24.6</td>
<td>28.8</td>
<td>31.0</td>
</tr>
<tr>
<td>New Mexico</td>
<td>25.2</td>
<td>30.8</td>
<td>33.5</td>
<td>34.1</td>
<td>34.9</td>
</tr>
<tr>
<td>North Carolina</td>
<td>10.4</td>
<td>13.7</td>
<td>16.4</td>
<td>18.2</td>
<td>19.0</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>11.2</td>
<td>17.9</td>
<td>24.8</td>
<td>28.5</td>
<td>30.2</td>
</tr>
<tr>
<td>South Carolina</td>
<td>19.8</td>
<td>21.2</td>
<td>23.6</td>
<td>24.4</td>
<td>25.3</td>
</tr>
<tr>
<td>Texas</td>
<td>11.3</td>
<td>15.0</td>
<td>20.8</td>
<td>22.8</td>
<td>23.3</td>
</tr>
<tr>
<td>Virginia</td>
<td>12.2</td>
<td>16.0</td>
<td>20.3</td>
<td>22.9</td>
<td>25.1</td>
</tr>
</tbody>
</table>
What’s next?
Predictive Analytics

- What happened?
- Why did it happen?
- What will happen?
- How can we make it happen?

Value vs. Difficulty

- Descriptive Analytics
- Diagnostic Analytics
- Predictive Analytics
- Prescriptive Analytics

Optimization

Information

Hindsight

Insight

Foresight
Uptime As A Service

• Buy an up-time package, not a service package

• Share machine info with dealer / service
  – Knows your machine status
  – Knows your machine location
Implements Talking to Machines

- Current proprietary implementations
- AEF Compliance Testing
Machines Talking to Each Other

- Typically in Harvest
  - Ground Speed / Heading
  - %Full
  - Shared Settings
Single connections

Agricultural Machine Manufacturers

External Service Provider

Seed / Fertilizer / Plant Protection

Dealer & Machine Service

Contractor

Farmer

FMIS supplier

Advisor / Agronomist

Weigh Bridges

Food Processing
How am I using it?
Cotton Quality Mapping

Harvest Identification, Cotton – Module traceability in the field

RFID Bridge

Gin Yard

RFID Reader on feed floor
Peanut Field Efficiency and Logistics
Final Thoughts
Ag Equipment as IOT

- Machines have a story to tell
- Everything is Connected
- All Data is Agronomic

- Technology Unlocks Iron Value
- How Well is my Equipment doing its job?
Advanced Ag Lab
Technology + Farming

Jason Ward // jason.ward@ncsu.edu