Applications of AgGateway Connectivity Tools
Grain Traceability Use Case

Jeremy Wilson
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Topics

• Introduction – Jeremy Wilson
• The AgGateway Org. – Jeremy Wilson
• 2014 POC – Jeremy Wilson
  • Value to Grower
• 2017 POC – Tevis
  • General Description & Capabilities
  • Use of adapt
• Management Guidelines - Wilson
• Opportunities for Innovation - Tevis
• Closing Remarks - Wilson
AgGateway North America Key Facts

• Non-Profit
• Established 10 years ago
• Steady growth to what is currently over 200+ member companies
• Non-competitive, transparent environment for collaboration
• Scope of standards is international
• Does not touch any transactional data, ever!
8 April: Industry Issues Identified

→ Need Face-to-Face Meeting

Review the ADAPT Data Model, including:

- **Product. Specializations thereof. Review of use**
- **Containers. Load / ContainerUse / ProductAllocation**
- **Equipment / Machine / Configuration model: Check that we can convert to/from ISO. Can we document how to process a DDOP?**
- **How are we representing LoggedData? / PAIL Operations data and how it can be inserted.**
- **Grower / Farm / Field / Cropzone / Location / Facility and ISO 15000-5 Core Components compatibility.**
- **Person / PersonRole / ContactInfo ISO 15000-5 Core Components compatibility.**
- **ContextItem. Places we can use it and problems it solves. Review of discussions with AEF.**
- **List of actors: check compatibility with / opportunity of integrating with UN/CEFACT list of economic agents. Check out pp 20-21 here:**
  

- **TimeScopes and DateContexts**
- **Guidance: are we capturing all necessary use cases? Are there best practices to promote (e.g., “avoid guidance LINES”)?**

Real-World Issues
18 April: Industry Issues Addressed

Not Pictured:
Other ADAPT contributors who could not attend the meeting, but who trust that this collection of contributors will fairly address industry needs.
## Project Scope

<table>
<thead>
<tr>
<th>Reference data APIs</th>
<th>Requirements</th>
<th>Process definitions</th>
<th>Data requirements</th>
<th>Standards</th>
<th>Gap-Checking</th>
<th>Infrastructure</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>S2</td>
<td>S2</td>
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<td>S3</td>
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<td>Seeding operations</td>
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<td>A</td>
<td>S3</td>
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<tr>
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<td>S2</td>
<td>S2</td>
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<td>A</td>
<td>S3</td>
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<tr>
<td>Crop protection operations</td>
<td>S2</td>
<td>S2</td>
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<td>A</td>
<td>S3</td>
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<tr>
<td>Crop nutrition operations</td>
<td>S3</td>
<td>S3</td>
<td>S3</td>
<td>S3</td>
<td>A</td>
<td>S3</td>
<td>S3</td>
</tr>
<tr>
<td>Grain handling (CART)</td>
<td>S3</td>
<td>S3</td>
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<tr>
<td>Crop scouting operations</td>
<td>S3</td>
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<td>S3</td>
<td>A</td>
<td>S3</td>
<td>S3</td>
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<tr>
<td>Telematics (WAVE)</td>
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<td>S3</td>
<td></td>
<td>S3</td>
<td>S3</td>
</tr>
<tr>
<td>Sensor and weather data</td>
<td>P1</td>
<td>P1</td>
<td>P1</td>
<td>P1</td>
<td>P2</td>
<td>P2</td>
<td>P2</td>
</tr>
<tr>
<td>Irrigation Operations</td>
<td>P1</td>
<td>P1</td>
<td>P1</td>
<td>P1</td>
<td>P2</td>
<td>P2</td>
<td>P2</td>
</tr>
</tbody>
</table>

**KEY** - S1: SPADE1; S2: SPADE2; S3: SPADE3; A: ADAPT; P1: PAIL1; P2: PAIL2.
The Core Documents (to date)

- **Plan**
  - "This is how we are going to grow this crop this season"

- **Observations and Measurements:**
  - “This is happening out in the field"

- **Recommendation**
  - "This is what I recommend we do about it"

- **Work Order**
  - "This is what we are going to do“

- **Work Record**
  - "This is what we actually did"
The Core Documents (to date)

• Plan
  • "This is how we are going to grow this crop this season"

• Observations and Measurements:
  • “This is happening out in the field"

• Recommendation
  • "This is what I recommend we do about it"

• Work Order
  • "This is what we are going to do “

• Work Record
  • "This is what we actually did"
High Technology Work Record

Work Record

Grower: Wode Wilson
Farm: Jeremy Wilson
Field: J1 South Field And Patches
Crop: Corn
Acres: 15.21
Hybrid: 6622
Rate: 33500 Seeds/Acre
Actual Rate: 33972 Seeds/Acre
GPS Accuracy: RTK
Crop Nutrition: Pop-up Fertilizer
Rate: 3 Gals/Acre
Actual Rate: 2.78 Gals/Acre

05/19/2016

Map of field with color-coded areas.
Low Technology Work Record

Work Record

Grower: Wade Wilson
Farm: Jeremy Wilson
Field: J1 South Field And Patches
Crop: Corn
Acres: 15.21

05/19/2016
Supply Chain / Traceability Value Chain

Diagram showing the supply chain from Technology Providers to Consumer, with Traceability highlighted from the seed to the consumer.
2014 POC Objectives

- Establish data standards which:
  - Link combine unloading events with grain-cart loading events
    - Mass
    - Transport vehicles
  - Standards impacted:
    - ISO 11783
    - SPADE2?
    - AgXML?
Harvesting
Harvesting
Soybean Harvest
Harvest Load ID

Customer: Harvest Unloading
Task Area: N/A
Start Date: 10/21/2014 11:41:01 AM
End Date: 10/22/2014 1:01:10 PM

val
L44 3.88
L45 4.67
L47 4.37
L49 5.33
L50 3.38
L52 3.76
L54 8.70
L55 4.75
L57 5.10
L59 5.37

ac
L60 3.19
L62 2.18
L63 5.04
L65 3.64
L67 3.91
L68 3.80
L70 4.68
L71 1.94

Event Boundary

0 388 776 1164 1651 ft
Harvested Grain Traceability
2017 POC

• Extend the 2014 POC to On Farm Storage
• Goal is to use AgGateway Core Documents
• Planning to engage with local elevators to AgXML standards to prepopulate information for scale tickets that leads to settlement
• Use Bluetooth and RFID devices to share load, truck, weight and destination information
Harvested Grain Traceability

ISO 11783 - 10 → SPADE → CART/AgXML

1st Transport Vehicle → Secondary Transport Vehicle(s) → Storage Facilities

Grain Processors

AgGateway

Midwest Grain Processors

ADM

The InfoAg Conference 2017
DAP Application

2017 DAP Application

Rate (Mass) (lb/ac)
- 224.00 - 240.92 (8.61 ac)
- 208.08 - 224.00 (15.05 ac)
- 194.76 - 208.08 (16.13 ac)
- 182.10 - 194.76 (16.26 ac)
- 167.40 - 182.10 (15.03 ac)
- 149.03 - 167.40 (13.35 ac)
- 104.60 - 149.03 (11.04 ac)

Grower: Wade Wilson
Farm: George dicro
Field: WGD16 West of Shed
Year: 2017
Operation: Fertilizing
Crop/Product: 18-46-0 DAP
Op. Instance: Fertilizing - 1
Area: 99.56 ac
Est. Amount: 18.683 lb
Avg. Rate: 107.65 lb/ac
Start Date: 4/14/17
End Date: 4/14/17
Working Time: 0.841 h
Avg. Productivity: 118.33 ac/h
GPS Count: 3209
Nitrogen Application

Rate (Mass) (lb/ac)
- 165.16 - 226.10 (12.74 ac)
- 160.23 - 165.16 (14.00 ac)
- 156.90 - 160.23 (13.42 ac)
- 153.36 - 156.90 (17.84 ac)
- 150.09 - 153.36 (13.52 ac)
- 146.39 - 150.09 (16.89 ac)
- 131.11 - 146.39 (10.74 ac)

Grower: Wade Wilson
Farm: George dcrio
Field: WGD16 West of Shed
Year: 2017
Operation: Fertilizing
Crop / Product: NH3
Op. Instance: Fertilizing - 1
Area: 100.19 ac
Est. Amount: 15,569 lb
Avg. Rate: 155.39 lb/ac
Start Date: 4/13/17
End Date: 4/13/17
Working Time: 4.447 h
Avg. Productivity: 22.53 ac/h
GPS Count: 16008
Nitrogen Stabilizer Application

Nitrogen Stabilizer

Rate (Volume)
(gal(US)/ac)
- 0.27 - 0.79 (12.33 ac)
- 0.26 - 0.27 (14.53 ac)
- 0.26 - 0.26 (17.55 ac)
- 0.26 - 0.26 (16.05 ac)
- 0.26 - 0.26 (13.26 ac)
- 0.25 - 0.26 (14.16 ac)
- 0.22 - 0.25 (11.59 ac)

Grower: Wade Wilson
Farm: George dico
Field: WGD16 West of Shed
Year: 2017
Operation: Fertilizing (Liquid)
Crop/Product: Nutrisphere-N
Op. Instance: Fertilizing - 1
Area: 99.53 ac
Start Date: 4/13/17
End Date: 4/13/17
Working Time: 4.446 h
Avg. Productivity: 22.38 ac/h
GPS Count: 16007
2017 Planting Data

2017 Planting

Rate (Count) (kds/ac)
- 30.16 - 675.85 (13.38 ac)
- 30.06 - 30.18 (14.04 ac)
- 29.98 - 30.06 (14.10 ac)
- 29.40 - 29.90 (14.16 ac)
- 29.31 - 29.89 (14.16 ac)
- 29.68 - 28.81 (14.10 ac)
- 1.61 - 29.68 (13.45 ac)

Grower: Wade Wilson
Farm: George dicro
Field: WGD16 West of Shed
Year: 2017
Operation: Planting
Crop/Product: 6365-AM
Area: 97.38 ac
Est. Amount: 2,915,564 sds
Avg. Rate: 29.94 kds/ac
Start Date: 5/17/17
End Date: 5/18/17
Working Time: 8.163 h
Avg. Productivity: 11.93 ac/h
GPS Count: 29388
Harvest Work Order

Work Order

Grower: Wade Wilson
Farm: George DiCiro
Field: WGD16 West of Shed
Task: Harvest
Crop: Corn
Hybrid: 6365-AM
Start Date: Sept. 15 2017
End Date: Oct. 30 2017
Value to our Farm

• Today we are required to use paper to track harvested grain to the bin and elevator. Through this POC we will show that we can automate this process

• Our local elevator uses RFID and paper bill of lading to deliver grain which has caused errors in the past. This POC will also eliminate the need for paper bill of lading

• Reduce time I spend in the fall completing production reports for each farm

• Traceability is a growing concern in our operation and value to this new automation is real
Grain Traceability

POC DATA STANDARDS
## ISO 11783

<table>
<thead>
<tr>
<th>Primary Objectives</th>
<th>Enable interoperability of equipment to perform field operations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tasks which define instructions to complete field operations</td>
</tr>
<tr>
<td></td>
<td>Document the execution of the task</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Administration</th>
<th>ISO - Phase Gate process used to change/enhance the standard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AEF – Promotion and manages committee work and conformance testing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Access</th>
<th>Requires AEF membership to participate in committees and working groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standards documents are available for purchase to the public</td>
</tr>
</tbody>
</table>
AEF Load/Unload Working Group

- Initial work ~2012
- Added load & unload event DDI elements to ISO 11783
  - Harvest - Grain mass transferred from combine to cart
  - Planting – Seed count transferred from tender to planter
  - Crop Protection – Chemical mass/vol transferred from mixing station to sprayer
- Transfer partner IDs
# AgXML

## Primary Objectives

- Track the movement of commodity grain from destination A to destination B (Field to elevator, Field to processor, etc.)
- Document grain quality certificates
- Document the fulfillment of grain contracts

## Administration

- Managed and promoted by AgGateway
- Process controlled by AgGateway Staff

## Access

- Requires AgGateway membership to participate in committees and governance
- Standard is available for free download to the public
AgGateway CART Project

Commodity Automation for Rail and Truck

• Jan 2017 CART Face to Face meeting at SSI offices, Shellbyville IL
• Identified “touch points” between ISO 11783 and AgXML
• Identified grain transfer use cases beyond ISO/AEF
  • Semi to on-farm storage
  • Cart to on-farm storage
  • Semi to elevator
  • Semi to food processor
  • Elevator to food processor
• Defined enhancements to AgXML
# ADAPT

<table>
<thead>
<tr>
<th>Primary Objectives</th>
<th>Enable interoperability between OEM tractor-implement control systems (MICS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FMIS to FMIS data transfers</td>
</tr>
<tr>
<td></td>
<td>Provide a standard for field operations not covered by ISO 11783 such as irrigation</td>
</tr>
<tr>
<td>Administration</td>
<td>Promotion and governance provided by AgGateway</td>
</tr>
<tr>
<td></td>
<td>Cooperation with AEF</td>
</tr>
<tr>
<td>Access</td>
<td>AgGateway membership required to participate in governance</td>
</tr>
<tr>
<td></td>
<td>Code contribution is open to the public</td>
</tr>
<tr>
<td></td>
<td>All code available for download free to the public @ <a href="http://www.adaptframework.org">www.adaptframework.org</a></td>
</tr>
</tbody>
</table>
ADAPT Traceability Data Elements

Entity Diagram
Traceability Building Blocks

- Opportunity for Innovation
- Back Office Design
  - Plug-ins Translate ISO & AgXML to ADAPT Data Elements
- Modify Existing Standards
- Define ADAPT Traceability Data Elements

- ISO 11783
- AgXML
2017 PROOF OF CONCEPT
## Industry Groups

2.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Relevant Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 AgGateway</td>
<td>1. ADAPT</td>
</tr>
<tr>
<td></td>
<td>2. AgXML</td>
</tr>
<tr>
<td>2 Agricultural Industry Electronics Foundation (AEF)</td>
<td>ISO 11783</td>
</tr>
<tr>
<td>3 National Institute of Standards and Technology (NIST)</td>
<td></td>
</tr>
</tbody>
</table>
2014 POC In Scope – Use Case 1

ISO 11783 - 10

Harvest

1st Transport Vehicle(s)

Grain Cart 1
Load 1
Load 2

Grain Cart 2
Load 1
Load 2

Semi Trailer 1
Load 1
Load 2

2nd Transport Vehicle(s)
2017 POC In Scope – Use Case 1

ISO 11783 - 10

Harvest

1st Transport Vehicle(s)

Grain Cart 1
Load 1
Load 2

Grain Cart 2
Load 1
Load 2

Semi Trailer 1
Load 1

2nd Transport Vehicle(s)

Grain Storage 1
Load 1

On-farm Storage

AgXML
2017 POC In Scope – Use Case 2

ISO 11783 - 10

Grain Cart 1
Load 1
Load 2

Grain Cart 2
Load 1
Load 2

Semi Trailer 1
Load 1
Load 2

2nd InBound Transport Vehicle(s)

1st InBound Transport Vehicle(s)

Harvest

Grain Elevator

AgXML
2017 POC In Scope – Use Case 3

ISO 11783 - 10 → AgXML

Harvest → 1st Inbound Transport Vehicle(s)

Grain Cart 1
Load 1
Load 2

Semi Trailer 1
Load 1
Load 2

2nd Inbound Transport Vehicle(s)

Grain Elevator

1st Outbound Transport

Semi Trailer 1
Load 1

Food Processor

AgXML → AgXML
2017 POC Out of Scope

• Grain Movement in the Elevator
  • Transfers from dump site to first bin
  • “Blending” operations for fulfillment
  • Drying
  • Flow of grain in “mega” storage units
2017 POC Scope Summary

• In Scope
  • Test and validate ISO 11783 "Load/Unload" DDI for traceability
  • Test and validate AgXML enhancements from SSI F2F for traceability
  • Validate proposed ADAPT traceability data elements

• Out of Scope
  • Transaction encryption and security methods (block chain, provenance, etc.)
  • Electronic messaging involving grower and/or in-field equipment.
  • Considerations of data privacy
  • Development of required business relationships
  • Tracking and modeling of grain transfers and flow with a grain elevator or terminal
## Use Unique Identifiers (UI)

### What You Should Know

<table>
<thead>
<tr>
<th>What it is:</th>
<th>Why it's important:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Every entity or resource collected or used in any precision ag process should be associated with a managed unique identifier.</td>
<td>• Probably the single most important management practice that can be implemented to improve data quality as well as data management (sharing..transfer) efficiency.</td>
</tr>
</tbody>
</table>

### Points of Emphasis

- UI should be associated with the source of the identifier
- UI should support multiple identifiers for each entity
- Carefully consider the required scope for each UI

Programmers references:
- • ISO 11783 – Annex E
- • ADAPT – compound identifier
## Document all Material Transfers

### What You Should Know

<table>
<thead>
<tr>
<th>What it is:</th>
<th>Why it's important:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating planned tasks including crops/varieties and crop inputs is a good first step but these plans are often over-ridden in the field.</td>
<td>Documenting every unload event (harvest) and load event (crop input) is the best way to accurately document what was harvested from a field and what was applied to a field. It also creates data elements key to traceability.</td>
</tr>
</tbody>
</table>

### Points of Emphasis

- Record the UI for each product of crop input including mixtures in spraying and seeding applications
- Record vehicle/container ID of each involved in the transfer
- Record a timestamp of the event
## Use Planned Tasks

### What You Should Know

<table>
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<th>Why it’s important:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each field operation, especially data critical field operations, should start in the office with a planned task or a task setup file containing all required entities with identifiers.</td>
<td>This will simplify field operations for unskilled labor and improve data quality by eliminating the need for “hand entry” of important entities such as crop and input products.</td>
</tr>
</tbody>
</table>

### Points of Emphasis

- When creating the planned task or setup file, export only those entities and UI’s appropriate for the field operations.
- Make sure that the terminals (MICS) being used support the use of UI’s.
Maintain Record of Vehicle/Container ID

What You Should Know

This is primarily for **traceability systems** but can also help in creating **accurate as-applied records**.

Points of Emphasis

- The maintained vehicle/container ID matches those used in documenting material transfers
- Record including a description, and picture, of the vehicle/container
- Consistency maintained from year to year
INNOVATION OPPORTUNITIES
# Vehicle Detection and Identification

## What You Should Know

<table>
<thead>
<tr>
<th>What it is:</th>
<th>Why its important:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• One of the key elements of material transfer documentation is an identifier of each vehicle or container participating in the transfer.</td>
<td>• Every transfer event requires at least one of the containers being equipped with a “smart” version. (see below)</td>
</tr>
</tbody>
</table>

### Key Design Requirements

- **Inexpensive with little or no required maintenance**
- **Programmable to allow assignment of container ID**
- **Available in a “smart” version**
  - • A method to log both container IDs involved in a transfer, a timestamp and geo-location
  - • A method to forward all logged data to a FMIS or “back office”
- **Available in a “dumb” version:**
  - • For retrofit to older vehicles
  - • Internal power
## Messaging Platform

<table>
<thead>
<tr>
<th>What You Should Know</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What it is:</strong></td>
</tr>
<tr>
<td>• Digital data is currently being handled by systems which support either ISO 11783 (field operations) or AgXML (Commodity Movement).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Design Requirements</th>
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<tbody>
<tr>
<td>Supports pre-defined messages (TBD)</td>
</tr>
<tr>
<td>Supports customizable dropped down lists (destinations, grain contracts, etc.)</td>
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<tr>
<td>Creates a message log</td>
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<tr>
<td>Supports “free form” text messages</td>
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<tr>
<td>Adaptable to PC and mobile operating systems</td>
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<tr>
<td>Integrates with and share controlled vocabularies with existing business systems</td>
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</table>
# Data Normalization Software

## What You Should Know

<table>
<thead>
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<tbody>
<tr>
<td>Converts the raw data collected in ISOXML and AgXML to a standard set of ADAPT data elements</td>
<td>This approach requires minimal changes to either the ISO or AgXML standard and processes</td>
</tr>
</tbody>
</table>

## Key Design Requirements

- References a common database of containers and vehicles
- Requires no manual modifications or edits of the raw data
- Flexible to adapt to non-standards/proprietary data sets.
## Traceability Platform/System

<table>
<thead>
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<tbody>
<tr>
<td><strong>What it is:</strong></td>
</tr>
<tr>
<td>• A Web based platform to allow the traceability stakeholders display user defined traceability search and queries</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Key Design Requirements</th>
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<tr>
<td>Trace from destination to source</td>
</tr>
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</tr>
<tr>
<td>Includes all display of all material properties measured along the way,</td>
</tr>
</tbody>
</table>
Grain Flow Modeling – Storage

What You Should Know

Once grain is delivered from the harvested field to the typical elevator, the ability to track grain back to the field(s) or origin is essentially lost. Innovations are needed to reduce the risk of delivering out of spec grain to a food processor.

Key Design Requirements

- Tracks grain from the dump site to the final bin before exiting the elevator,
- Documents the blending process,
- Documents both inbound and outbound grain
- Provides risk reduction estimate
- Models grain flow through gravity driven bins.
THANK YOU