Water from Ground to Sky

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Plant and atmosphere

• Water is critical for agricultural production
• Plants use water to maintain their structural integrity, to move nutrients, photosynthate and hormones from places where they are produced to places where they are consumed.
• Water loss by plants is inevitable: water leaves through the same stomata that CO2 enters.
• Plant roots take water from the soil, move it osmotically through the plant, lose it through stomata on the leaves through diffusion.
Soil Water Balance

- Challenge: Water is a finite resource: it is in increasingly short supply for agricultural use.
- There are ways to optimize its usage: too much water can be wasteful or even detrimental to the crop; too little creates a variety of problems: lower yields, greater susceptibility to diseases, etc.
- Principled methods of optimizing irrigation usage involve some kind of water balance calculation.
- Managing the water balance components for optimality: Scientific Irrigation Scheduling
SIS vs Non-SIS Methods Used

From the last six Farm And Ranch Irrigation Surveys

- SIS (total reporting)
- Non-SIS (total reporting)
The Interoperability Problem

• Scientific irrigation scheduling is infrequently used by growers.
• Reason: Integrating the necessary data sources is very complex and time-consuming.
• Northwestern Energy Efficiency Alliance (NEEA) concluded that a common data format for irrigation decision-making inputs and outputs would be a major first step toward greater interoperability.
AgGateway

• Nonprofit consortium of 240+ members
• Mission: Promote, enable and expand eAgriculture.
  • Strong emphasis on implementing existing standards
  • Strong emphasis on collaboration
• Membership
  • Open; members are primarily businesses.
  • Other organizations typically join as Associate members
  • There is a category for individual memberships.
• Transparent funding, governance, anti-trust and IP framework.
• Authority: De facto (Implementation by stakeholders)
  • Output often handed off to ISO, other de jure organizations.
• Expertise: Supply chain and field operations business processes
• Field operations interoperability initiatives: SPADE, PAIL, ADAPT.
PAIL Goal & Objective

• **Goal**: promote use of irrigation management technology by facilitating integration of disparate management systems

• **Objective**: provide an industry-wide format that will enable the exchange and use of data from irrigation management systems.
Scope

Observations

Operations
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"
Core Documents and their Relationships

- Observations and Measurements
- Plan
- Recommendation
- Reference, Setup and Configuration Data
- Work Record
- Work Order

- Scope of ISO 11783-10

Field operation

Motivates
Informs

Provides context for

Informs

Provides context for

Provides context for

Provides context for

Provides context for

Provides context for
<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>What</td>
<td>The products or services being applied, or the data being reported.</td>
<td>ISO 11783 + SPADE semantics</td>
</tr>
<tr>
<td>Where</td>
<td>Grower / Farms / Fields / Cropzones / GPS locations</td>
<td>ISO 11783 + SPADE + ISO 19112</td>
</tr>
<tr>
<td>Who</td>
<td>People involved and their roles: grower, operator, agronomist, trucker, customer, etc.</td>
<td>SPADE + Semantics</td>
</tr>
<tr>
<td>When</td>
<td>When should / did the operation happen?</td>
<td>ISO 6709 + SPADE semantics</td>
</tr>
<tr>
<td>How</td>
<td>Product rates, equipment settings, etc.</td>
<td>ISO 11783, 19115, 19156, 19157 + SPADE</td>
</tr>
<tr>
<td>With What</td>
<td>What equipment is involved?</td>
<td>ISO 11783, 19115, 19156, 19157 + Deere + ADAPT</td>
</tr>
<tr>
<td>Why</td>
<td>What was the reason for performing the operation?</td>
<td>SPADE semantics</td>
</tr>
<tr>
<td>Local data</td>
<td><strong>Context items</strong>: A generic system to encode geopolitical-context-dependent information such as (for the US) FSA, EPA, DOT numbers, and so forth.</td>
<td>SPADE / ADAPT</td>
</tr>
<tr>
<td>Semantics</td>
<td>Infrastructure of variable-type registries</td>
<td>ISO 19135, 25964</td>
</tr>
</tbody>
</table>
Standards we are using or considering

• Using
  • ISO 11783 (TC23/SC19): Farm machine control, data generation
  • ISO 19112 (TC211): Lists of identified locations
  • ISO 19156 (TC211): Observations and Measurements

• In Progress / learning
  • ISO 19135 (TC211): Managing controlled vocabulary registries
  • ISO 29564 (TC46/SC9/WG8): Thesauri

• Considering / need starting point
  • ISO 19115 (TC211): Metadata
  • ISO 19157 (TC211): Data Quality
  • Sensor Observation Service
  • SensorThings
PAIL Status

- Field Trail / Beta Test concluded this year and last
- Beta Test validated scope and depth of schema
- Submit draft standard in next few months
ASABE X632 Project

• ASABE Standards project
  • Parent committee is NRES-24

• Deliverable: US National Standard

• Coordinated with NRES-03/2 US TAG ISO TC23/SC18

• New, ad-hoc committee formed to guide movement through standards process

• Will be submitted to ISO TC23 / SC18 for consideration as a new standard after adoption by ASABE

• First standard in NRES-24 that contains an XML Schema

• Multipart standard similar to other ISO
  • Part 1: Common Elements
  • Part 2: Observations
  • Part 3: Operations

• Future Parts
  • Pumping & Flow Control
  • Drip/Micro Irrigation
  • Compliance testing
  • Chemigation / Fertigation
AgGateway / PAIL Stakeholders

AgGateway: About 240 companies

Precision Ag Council: About 120 companies

PAIL Project: 20+ companies (See below)

Logos of various companies related to precision agriculture and technology.
Questions?
(Including how you can participate)

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In-Season Management BPMN