PA and the Three I’s principle:

Interoperable
Interactive
Interpretable

Nathan Robinson, Andrew MacLeod, Peter Dahlhaus, Megan Wong, Helen Thompson, Heath Gillett, Ben Fleay, Meera Cameron
Key philosophies

- Ensuring end-user tools and applications are fast, intuitive and easy-to-use.
- Making sure that applications work seamlessly across a variety of platforms, operating systems and browsers to the extent possible.
- Use of open-source and standards compliant software and technologies, wherever possible.
- Building upon existing collaborative software initiatives and contributing enhancements/tools back to the community.
- Ensuring the flexibility of the developed system to consume data from a variety of sources so as not to interfere with existing provider work practices.
- Use of software based in the cloud: no end-user requirement for software, updates, computation power or plug-ins.
Logical linkages in next generation decision support systems

Shared vision

• Co-creating innovative precision agriculture …. in response to farmer and farm adviser needs
• Real-world projects focused on advancing agribusiness decision making through data, insight and action
• Increased farm productivity and sustainability through the practical application of spatial technologies
• Integrating agricultural data from disparate sources using international standards for the interoperable exchange of data
Challenge:
Farmers understanding the value proposition for adopting and using Precision Agriculture
Interoperable

Solution
Interoperability between software platforms and machinery is an ongoing challenge.

More data collected now through sensors – the ‘data deluge’

Make data standardised – using protocols and agreed terminology (vocabularies)

Examples include: ANZSoilML, FarmML, PAML
For example – did you know:

- There are 32 different soil phosphorus test methods recognised in Australia (Rayment & Lyons, 2011)

- Terms used to describe methods: *extractable*, *total*, *available*, *index*, *saturation*, *ratio*

- Units of measure: %, mg P/kg, µg P/kg, X/C, PBI, colour

- Common soil P assays include: Colwell, Olsen, DGT

Enabling interoperability - spatial infrastructure

**Use-cases:**
Co-creation using real-world examples,

"A farmer uses her iPad to view the yield maps for a selected paddock over the past ten years and compares that to the fertiliser, soil moisture and waterlogging histories over the same period."
Interoperable – examples

1. Looking at the data – a simple workflow (as easy as it gets?)
   (e.g. laboratory data $\rightarrow$ ANZSoilML $\rightarrow$ map view $\rightarrow$ analysis tools $\rightarrow$ end use)

2. Public and private data – combining for new insights
<table>
<thead>
<tr>
<th>Test</th>
<th>Test Result</th>
<th>STATUS COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available Phosphorus-Celewell</td>
<td>13 mg/kg</td>
<td></td>
</tr>
<tr>
<td>Phosphorus Olsen equivalent</td>
<td>6 mg/kg</td>
<td></td>
</tr>
<tr>
<td>Available Potassium</td>
<td>157 mg/kg</td>
<td></td>
</tr>
<tr>
<td>Available Sulphur-AlCl</td>
<td>9 mg/kg</td>
<td></td>
</tr>
<tr>
<td>Electrical Conductivity (EC)</td>
<td>0.10 dS/m</td>
<td></td>
</tr>
<tr>
<td>Organic Carbon</td>
<td>2.4 %</td>
<td></td>
</tr>
<tr>
<td>pH Calcium Chloride</td>
<td>4.6</td>
<td></td>
</tr>
<tr>
<td>pH (water)</td>
<td>5.3</td>
<td></td>
</tr>
<tr>
<td>Exchangeable Aluminium</td>
<td>0.3 meq/100gm</td>
<td>4%</td>
</tr>
<tr>
<td>Exchangeable cations</td>
<td></td>
<td>Highly acidic</td>
</tr>
<tr>
<td>Calcium</td>
<td>4.3 meq/100gm</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>Magnesium</td>
<td>1.4 meq/100gm</td>
<td>21%</td>
</tr>
<tr>
<td>Sodium</td>
<td>0.2 meq/100gm</td>
<td>3%</td>
</tr>
<tr>
<td>Potassium</td>
<td>0.3 meq/100gm</td>
<td>3%</td>
</tr>
<tr>
<td>Total Cation Exchange Capacity</td>
<td>6.5 meq/100gm</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Legend**

- **farm_pdfs_test**
  - Col P
    - 9 - 10
    - 11 - 19
    - 20 - 25
    - 26 - 50

**Finding the Colwell P test critical value**

- **Critical Colwell P (mg/kg)**
  - Target Colwell P
  - Current Colwell P

**Target Colwell P**

- **Critical Colwell P**
  - 0
  - 10
  - 20
  - 30
  - 40

**Current Colwell P**

- **Critical Colwell P**
  - 50
  - 60

**Critical Colwell P**

- 0
- 10
- 20
- 30
- 40
- 50
- 60

**Critical Colwell P**

- Target Colwell P
- Current Colwell P

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21st Precision Agriculture Symposium in Australasia, 10-11th September 2018.
Soil test data

Soil types

Digital soil maps

Land cover
Other contextual data and information

**Soil Profile Characteristics:**

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Horizon Depth (cm)</th>
<th>pH (H2O)</th>
<th>pH (CaCl2)</th>
<th>EC (dS/m)</th>
<th>Sulphate (ppm)</th>
<th>Exchangeable Ca (cmol/kg)</th>
<th>Exchangeable Mg (cmol/kg)</th>
<th>Exchangeable K (cmol/kg)</th>
<th>Exchangeable Na (cmol/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>0-12</td>
<td>5.5</td>
<td>6.4</td>
<td>0.17</td>
<td>7</td>
<td>29</td>
<td>0.36</td>
<td>0.73</td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>12-40</td>
<td>5.1</td>
<td>5.0</td>
<td>0.07</td>
<td>2.3</td>
<td>14</td>
<td>0.11</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>40-80</td>
<td>5.0</td>
<td>5.0</td>
<td>0.22</td>
<td>6.0</td>
<td>9.0</td>
<td>0.41</td>
<td>0.53</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>80-150</td>
<td>7.5</td>
<td>6.7</td>
<td>0.32</td>
<td>4.6</td>
<td>10</td>
<td>0.32</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td>150-400</td>
<td>6.5</td>
<td>6.5</td>
<td>0.3</td>
<td>7.9</td>
<td>14</td>
<td>0.37</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

**Surface Soil:**
- Dark greyish brown (10YR3/2), hardsetting and cracking in the surface, fine sandy clay loam; moderate surface, low to medium bulk density, fine peds.
- pH: 5.5; Electrical Conductivity: 0.17 dS/m; ECe: 0.07 dS/m.

**Subsoil:**
- Dark greyish brown (10YR4/6), with stringy brown (7.5YR5/4) mottles, heavy clay, coarse clay, structure: weak columnar peds; pH: 7.5.
- pH: 6.7; Electrical Conductivity: 0.22 dS/m; ECe: 0.07 dS/m.

**Soil Profile Morphology:**
- A1: 0-12 cm
- A2: 12-40 cm
- B1: 40-80 cm
- B2: 80-150 cm
- B3: 150-400 cm

**Soil Profile Characteristics:**
- Weak columnar structure, weakly developed; pH: 5.5.

**Other contextual data and information:**
- Australian Soil Classification: Vertoskeletal, Yellow. 50033GCL
- General Landscape Description: Dairy farming
- Site Description: Raised bed (2 m wide) cropping paddock. Giga micro-void present.
- Geology: Quaternary clay loam
Interactive

- Often data and information is only useful to the domain expert.
- Online services such as Web Feature Service (WFS), Web Coverage Service (WCS) or Web Processing Service (WPS).
- Ability to bring data together from a variety of different sources.
- Data that is private and publicly managed.
- By bringing data together – develop new understandings via the ability to query and interrogate with little effort (for the user)
- Data visualisation – trends in data (e.g. yield zone performance, inputs, discount cash flows)
Bringing this data together

- Soil test data
- Digital Soil Maps
- Experimental data – e.g. farm trials
- Climate data
- Soil moisture
- In-season biomass and groundcover
Digital Soil Map (pH)

Trials

Soil moisture data

Biomass estimates

Climate data

Other data?
Interpretable

- Coupling data with tools and systems – translation into meaningful (actionable) information
- User interface easy and intuitive
- Use and contribute to tools/DSS in existence, or being developed, e.g. benefit cost analysis for variable rate liming – in development by AgVic.
Soil test results (phosphorus) with target range values (green lines)
Other data ... treatments/experiments

Linked reports
Yield comparison

Max. wheat yield (7 yrs wheat yield data)
Key lessons learnt

- Co-creating/development/implementation
- Understanding needs – use cases
- Harnessing the benefits of private and public data
- Interoperability – making things compatible and usable
- Interactive – enabling users to have control
- Interpretable – delivering the right information at the right time
- Small changes – big outcomes: Tuning management to maximise returns
THANK YOU

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