Welcome to...
Thank You – Sponsors

Platinum

Gold

Silver
Thank You – IPNI Member Companies and Industry Associations

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<th>Company Name</th>
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Thank You – InfoAg Partners
2017 InfoAg Attendance

~1300 attendees from 22 countries
FIGURE 1: Precision Services Offered By Dealers

- Soil sampling with GPS
- Field mapping with GPS
- Yield monitor data analysis
- Satellite imagery
- Soil electrical conductivity mapping
- UAVs

Note: Survey administered every other year starting in 2011. 2017 Base: 209
Anticipated Growth in Precision Ag Services in the USA
FIGURE 5: Profitability of Services Offered

- **Profit/costmapping**: 20% making a profit, 44% breaking even, 16% not breaking even, 26% do not know.
- **Telematics equip sales**: 21% making a profit, 29% breaking even, 13% not breaking even, 37% do not know.
- **Precision planter equip sales**: 43% making a profit, 20% breaking even, 7% not breaking even, 30% do not know.
- **Chlorophyll/greenness sensors**: 26% making a profit, 37% breaking even, 37% do not know.
- **Soil EC mapping**: 40% making a profit, 29% breaking even, 4% not breaking even, 27% do not know.
- **Grid or zone soil sampling**: 44% making a profit, 64% breaking even, 8% not breaking even, 2% do not know.
- **Guidance/autosteer sales and support**: 42% making a profit, 26% breaking even, 3% not breaking even, 26% do not know.
- **UAV or Drone Imagery**: 20% making a profit, 27% breaking even, 25% not breaking even, 27% do not know.
- **Satellite/aerial imagery**: 25% making a profit, 41% breaking even, 14% not breaking even, 20% do not know.
- **Yield monitor and other data analysis**: 38% making a profit, 35% breaking even, 14% not breaking even, 12% do not know.
- **Yield monitor sales/support**: 39% making a profit, 30% breaking even, 31% not breaking even, 20% do not know.
- **VRT Seeding Prescriptions**: 43% making a profit, 29% breaking even, 8% not breaking even, 20% do not know.
- **VRT Pesticide App**: 58% making a profit, 22% breaking even, 3% not breaking even, 32% do not know.
- **VRT Lime App**: 38% making a profit, 73% breaking even, 2% not breaking even, 7% do not know.
- **VRT Fertilizer App**: 43% making a profit, 83% breaking even, 10% not breaking even, 5% do not know.
- **VRT Fertilizer on Lime Prescriptions**: 38% making a profit, 73% breaking even, 20% not breaking even, 6% do not know.
- **Field mapping (with GIS)**: 35% making a profit, 43% breaking even, 7% not breaking even, 15% do not know.

**Note**: includes only dealers offering each service, not all survey respondents.
Ag Technology Adoption Trends - KS

Proportion of farms

[Bar chart showing adoption trends from 1995 to 2016 for different technologies: YM+VRF+PSS, YM+VRF, VRF+PSS, YM+PSS, YM, VRF, PSS, None.]

n=538 Farms
### Transition Probability

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<th>VRF</th>
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Conclusions – T. Griffin

• Farms persist with current state of adoption
  – Strongest persistence with “None” and “Complete Bundle”

• Forecasted demand for technology substantial
  – VR expected to have highest adoption demand in 2017
  – PSS second highest adoption demand in 2017
AWARD OF EXCELLENCE
About the award
2017 Educator/Researcher Award

Dr. Harold van Es
Cornell University
2017 Crop Adviser/Entrepreneur Award

Wade Barnes
Farmers Edge
2017 Educator/Researcher Award

Dr. Joe Luck
University Of Nebraska - Lincoln
2017 Legacy Award
Dr. Paul Fixen
International Plant Nutrition Institute
Award Of Excellence

2017 Winners
Beyond Big Data --
Digital Agriculture

Steve Sonka
July 25, 2017
Agenda

- Reframing our perspective
  - Beyond Big Data
  - To digital agriculture
- Explore
  - The likely evolution of
  - Planning & action to fit its dynamics

**WE** can reduce
the potential to be surprised
AND
enhance potential
for gaining advantage
Semantics – but semantics can matter

Lean, finely textured beef

OR

Pink Slime
Big Data x Digital Ag

Semantics – but semantics can matter

Genetically Modified Organisms

Genetically Enhanced Crops

SAY NO TO GMOs
14 October 2016

The Australian Red Meat Industry’s Digital Strategy Forum was an opportunity for every participant in the value chain to hear about new digital opportunities and participate in the development of a digital strategy for the red meat and livestock industry. The forum was part of the next phase in the development of MLA’s Digital Value Chain Strategy.
Ag Data – About 1952

1. Farmers have wanted to manage w/ data
2. Measurement:
   • An economic activity
   • Conditioned by technology
The Term of Today

BIG DATA
Dimensions of Big Data: 3 Vs and an A

Volume
Velocity
Variety

Analytics

Let’s Consider—What is BIG really? A positive A concern

Beyond Precision Ag
Amazon.com – millions of back-end operations every day, as well as queries from more than half a million third-party sellers.

Walmart – more than 1 million customer transactions every hour
– databases w/ more than 2.5 petabytes (2560 terabytes) of data
– 167 times the information contained in all the books in the US Library of Congress.

Facebook handles 50 billion photos from its user base.
500,000 data points every 15 seconds

POTENTIAL: 1% efficiency gain = + 3 years of global supply
The Game of Go

- Originated in China more than 2,500 years ago.
- Played by more than 40 million people.
- Players take turns to place black or white stones on a board, trying to capture the opponent's stones or surround empty space to make points of territory.
- Go is a game of profound complexity.
- There are more than the number of atoms in the universe possible positions.
- More than the number of atoms in the universe.
A Positive:
GIGO is Now GI nn GO

GIGO
Garbage In, Garbage Out

Garbage In
not necessarily
Garbage Out

Beyond Precision Ag
Identification of Free Parking Lots

Goal: Find Free Parking Lots on UIUC Campus

Y: Free Parking lot : no charge after 5pm
N: Not free parking lot
Free Parking Lot Identification

Experiment setup:
106 parking lots of interests, 46 indeed free
30 participants, 901 marks collected

Table I. Accuracy of Finding Free Parking Lots on Campus

<table>
<thead>
<tr>
<th>Schemes</th>
<th>False Positives</th>
<th>False Negatives</th>
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</thead>
<tbody>
<tr>
<td>Voting</td>
<td>21.67%</td>
<td>23.91%</td>
</tr>
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</table>

Actually; this is a “lots of data” example
Maximize log-likelihood by appropriate selection of truth values for claims:

Log-likelihood Function of EM Scheme:

\[
l_{em}(x; \theta) = \sum_{j=1}^{N} \left\{ z_j \times \left( \sum_{i=1}^{M} (S_i C_j \log a_i + (1 - S_i C_j) \log(1 - a_i) + \log d) \right) \right\} + (1 - z_j) \times \left( \sum_{i=1}^{M} (S_i C_j \log b_i + (1 - S_i C_j) \log(1 - b_i) + \log(1 - d)) \right)\]

where \( z_j = 1 \) when measured variable \( j \) is true and 0 otherwise.
Expectation Maximization

\[
L(\theta; X, Z) = p(X, Z | \theta)
\]

\[
= \prod_{j=1}^{N} \left\{ \prod_{i=1}^{M} a_i^{S_i C_j} (1 - a_i)^{(1 - S_i C_j)} \times d \times z_j + \prod_{i=1}^{M} b_i^{S_i C_j} (1 - b_i)^{(1 - S_i C_j)} \times (1 - d) \times (1 - z_j) \right\}
\]

**Expectation Step (E-Step)**

\[
Q(\theta | \theta^{(t)}) = E_{Z|X,\theta^{(t)}}[\log L(\theta; X, Z)]
\]

\[
= \sum_{j=1}^{N} \left\{ p(z_j = 1|X_j, \theta^{(t)}) \times \left[ \sum_{i=1}^{M} (S_i C_j \log a_i + (1 - S_i C_j) \log (1 - a_i) + \log d) \right] 
\right. \\
\quad + \left. p(z_j = 0|X_j, \theta^{(t)}) \times \left[ \sum_{i=1}^{M} (S_i C_j \log b_i + (1 - S_i C_j) \log (1 - b_i) + \log (1 - d)) \right] \right\}
\]

**Maximization Step (M-Step)**

\[
a_i^{(t+1)} = a_i^{*} = \frac{\sum_{j \in S_i} Z(t, j)}{\sum_{j=1}^{N} Z(k, j)}
\]

\[
b_i^{(t+1)} = b_i^{*} = \frac{K_i - \sum_{j \in S_i} Z(t, j)}{N - \sum_{j=1}^{N} Z(t, j)}
\]

\[
d_i^{(t+1)} = d_i^{*} = \frac{\sum_{j=1}^{N} Z(t, j)}{N}
\]

Iterate
A Concern:
Big Data is About Knowing **What**;
Society will need to shed some of its obsession for causality in exchange for simple correlations:

\textit{not knowing why but only what}.
The Truth about Nutrition

- The Japanese eat very little fat
  - suffer fewer heart attacks than do the British or Americans
- The French eat a lot of fat
  - suffer fewer heart attacks than do the British or Americans
- The Italians drink excessive amounts of red wine
  - suffer fewer heart attacks than do the British or Americans
- The Japanese drink very little red wine
  - suffer fewer heart attacks than do the British or Americans
- The Germans drink a lot of beer and eat lots of sausages
  - suffer fewer heart attacks than do the British or Americans
SO.............

EAT what you want,
Apparently it’s
SPEAKING ENGLISH
that kills you!

Over fitting
The Term of Today

BIG DATA

The key to digital ag
What Do I Mean by Digital Ag?

- Employing sensors and technologies to capture data in digital form

**AND**

- Using tools and techniques to
  - Summarize/Analyze/Synthesize
  - Communicate
digital and other information
to improve decision making
Dimensions of Digital Data: 3 Vs and an A

- Variety
- Velocity
- Volume
- Analytics
### Data Sources – Today!

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<th>Type</th>
<th>Source</th>
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<tr>
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</tr>
</tbody>
</table>
Data Sources

This is THE change factor in Digital agriculture

Low-Cost Data Sensors
My Digital Ag “Vision”

??Opportunity??

Lots of Data

Precision Ag

Internet of Things

Big Data

Big Data IS a big deal
BUT;
Is only PART of the opportunity
Agenda

- Reframing our perspective
  Beyond Big Data
  To digital agriculture

- Explore
  - The likely evolution of digital agriculture
  - The planning/action processes which fit its dynamics

**WE** can reduce the potential to be surprised AND enhance potential for gaining advantage.
I didn’t realize it would be so mammoth!

I didn’t realize it would be so woolly!
Lessons from Technology Innovation

- WHAT WE CAN EXPECT !!!

Over-enthusiastic excitement

Disappointment

Can’t live without it
Lessons from Technology Innovation

- Initial technology works but is weak

- Initial use misses eventual success

- Defending competitors

Thomas Watson: World only needs FIVE computers
Digital ag

- Economics of data
- Data becomes “free”
Digital ag

- Economics of data
- Data becomes "free"
- Novel entrants
- Economics of data
- Data becomes “free”
- Novel entrants
- Innovation in developing countries

Geo-Spatial in Rwanda

Limited soil maps

National soil maps just completed

Using Remote sensing

Agrilift has been accepted as a member of the Clinton Global Initiative
Strategy -- SWOT

- **S** — Strength: things you do well
- **W** — Weakness: things you don’t do well
- **O** — Opportunities: Innovations that can provide gain
- **T** — Threats: Innovations that offer challenge

The Strategic Plan

Surprise !!!

Surprise !!!

Surprise !!!
Strategy -- SWOT

- **S** — Strength: things you do well
- **W** — Weakness: things you don’t do well
- **O** — Opportunities: Innovations that can provide gain
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Assumptions about technology
Digital Ag Strategy – 9 Months Later

**Impact**
- Customer trust
- Optimal value chain efficiency
- Increased market access

**Mission**
By 2025, value chain stakeholders
- Utilize world’s best digital technology
- Connect through shared industry data

**Investment Pillars**
- Digitally enabled value chain
- Digital building blocks
- Linked value chain data
Digital Building Blocks

People, skills and stimulating innovation

Global scouting network

Pilot projects

Producer demonstration sites
Who in the US is responsible for our Digital Building Blocks?

InfoAg!

Others?
Wrapping UP

- Reframing our perspective
  - Beyond Big Data
  - To digital agriculture
- Explore
  - The likely evolution of
  - Planning & action to fit its dynamics

**WE** can reduce the potential to be surprised AND enhance potential for gaining advantage.
Thank You
What do I want to show—consistent pattern; highly uncertain

– Hype cycle; much more than hype—reality
– Goal is to aid in anticipating and understanding

Show historic examples

Move to on-line groceries

Failure – Concorde / Boom

fit to needs

– Vacuum tubess
– Defenders
Semantics – but semantics can matter

The 1960s
Lots of kids

Retirees

The Young Old

The “Yolders”
Capturing data
From 4,605 monitoring sites comprising
23,557,430 sampling events