Macro-Trends and the Implications on the Agricultural Equipment Sector – Final Report

October 23, 2018
Objective, Scope, and Methodology
Project Objective and Scope

OBJECTIVE

The objective of this project is to provide insights to AEM members on the impact that three to five big, global, societal trends may have across the agricultural equipment industry. Context will explore customer expectations, channel requirements, product development, manufacturing, human resources, capital sourcing, supply chain, as well as sales & marketing.

SCOPE

The scope of this project includes the agriculture marketplace and the macro trends impacting its future. The timeframe scope of this project is generally ten to twenty-five years into the future.
Methodology

**PHASE 1**
5-6 Weeks
- Review prior work
- Desk research
- Thought-leader interviews
- Synthesis and prioritization

**PHASE 2**
5-6 Weeks
- Trend analysis
- Add’l thought-leader interviews
- Internal Context panel
- Work session with AEM

**PHASE 3**
3-4 Weeks
- Refinements from Phase 2
- Socialize the report with key AEM members
- Final presentation to Board

**Proposed timeline**

- **10/26/2017** Kick-off meeting
- **12/19/2017** Phase 1 Interim Report
- **2/20/2018** Work Session
- **3/14/2018** Final Presentation

**EXPECTED TIME ~ 3-4 MONTHS**

*Timeline accounts for Thanksgiving, Christmas, and New Years Holidays*
Phase 1: Information Gathering

PHASE 1a

6 Weeks

**SECONDARY Research**
- Open source literature review
- Key themes from futures work
- Synthesis of findings

**INTERNAL Review**
- Past Context non-proprietary work
- AEM construction industry report and other past work

**INTERVIEWS with Experts**
- Ag Equipment Execs
- University Experts
- Other Context Associates

Body of Work
Phase 1: Organize & Prioritize

PHASE 1b
6 Weeks

10-15 Macro Trends

- Trend #1
- Trend #2
- Trend #3
- Trend #4
- Trend #5
- Trend #6
- Trend #7
- Trend #8
- Trend #9
- Trend #10
- Trend #11
- Trend #12
- Trend #13

Organize

Impact on Ag Equip Industry

Prioritize

Live

- Trend #1
- Trend #2
- Trend #3
- Trend #4
- Trend #5

New Emerging Economies

Civil Society

Food and Natural Resources

Eco-Systems

Amplifying the Individual
Phase 2: Macro Trend Analysis

PHASE 2
6 Weeks

FURTHER ANALYSIS

EXPERT PANEL

ADDED DEPTH TOP 5 MACRO TRENDS

• Topic
• Viewpoint
• Supporting Reasons
• Examples

RECOMMENDED POSITION STATEMENT

MEETING WITH AEM
Phase 3: Sharing and Socialization

**PHASE 3**

4 Weeks

- **Incorporate Suggestions and Feedback**
- **Share and Socialize with Ag Sector Board members**
- **Back-brief AEM Sponsors on feedback**
- **Final Presentation**

Delivered Live
Phase 3: Update for Canada

**PHASE 4**

4 Weeks

- Conduct Experts Interviews
- Collect Canadian Data
- Synthesize data and develop insights
- Final Presentation
Phase 1 Results
13 Major Trends Identified

1. Population Growth
2. Changing Demographics
3. Urbanization
4. Global Security
5. Food Prices and Global GDP
6. Changing Investment Landscape
7. Climate Change
8. Structural Change Across Industry
9. Workforce Population & Automation
10. Education
11. Consumer Awareness
12. Service-Based Economy
13. Technology and Artificial Intelligence
Four Trends were advanced to Phase 2 (#8, #11, #12, #13). We’ll also look at #6, but with specific regard to #13.

At the conclusion of the project, AEM wants to have the option of forming task forces or committees with its member companies to address a few of the trends. Some of the trends were simply too big for AEM to tackle, such as population growth (#1), changing demographics (#2), and global security (#4). Other trends were already being addressed within AEM, such as workforce population (#9) and education (#10). The four selected were considered most actionable to AEM members.
Four Major Trends
Four major trends were identified and selected for further analysis.

- Technology and Artificial Intelligence
- Service-Based Economy
- Consumer Awareness, Sustainability, Transparency
- Farm Structure Change
FOUR MAJOR TRENDS

Farm Structure Change

Consumer Awareness, Sustainability, Transparency

Technology

Service-Based Economy

FOUR MAJOR TRENDS
In the next 10 years, the current farmland owning/renting model is dying, but not dead….

Changing Farm Structure

No major shifts in farm structure. Large farms continue to get larger, primarily through cash rent. Operators get older, but there is not a mass exodus due to retirement. Most land remains in families; corporate land ownership continues to grow, but remains minor compared to family ownership.

Average age of a farmer reach age 60+, but they continue to farm. No significant changes in the owner/operator of land.

Most land transfers remain in the family and the amount of land owned by absentee or retired land owners increases. Succession planning intensifies and plans are implemented.
Driven by competition and aided by technology, the number of Canadian agricultural operations is decreasing and the agricultural operations that remain are larger and more capital intensive.

Farm operations will continue to make rational decisions based on economics and regulations.

Leasing of new equipment will continue into the foreseeable future as a way to manage ownership costs.
In the next 25 years, the farmland owning/renting model of 2018 is fundamentally different, due to land transfers and technology. Look for the convergence of precision agriculture technology with less farmland restriction policies. This leads to more corporate-type land ownership and tech-savvy, data-driven farm operators who report to non-family shareholders.

Advances in automation enable operators to farm significantly more acres with less labor.

Increased volatility and scrutiny as well as complexity of data and technology require a different set of operator competencies to lead a large farming operation.

Source: https://www.ruralmarketing.in/industry/technology/click-and-change-the-future-of-farming-mobitech
More land eventually becomes available to large operators and other entities.

Farmland ownership restriction policies do not work. Most land transactions will not include family, but instead large operators, corporations, and pension fund investors, and potentially foreign investors.

Provinces with anti-corporate farming laws will likely modify those statutes, enabling corporate ownership.

Source: https://www.ruralmarketing.in/industry/technology/click-and-change-the-future-of-farming-mobiletech
Most Canadian farmland is owned and/or worked by an aging population of operators

Land in farms
(159 million acres, 2016)

- Area Owned: 60%
- Area leased from governments: 13%
- Area rented or leased from others: 24%
- Area crop-shared from others: 1%
- Land area used through other arrangements: 3%

Farmland ownership trends
(193,492 farm operations, 2016)

- Other Operating Arrangements: 0%
- Non-Family Corporations: 3%
- Family Corporations: 23%
- Partnerships: 23%
- Sole Proprietorship: 52%

Of agricultural operations where all operators were under the age of 35, 50.6% rented land from others, compared with 35.1% of all agricultural operations.

On agricultural operations that used only rented land, the average operator age was 46.0 years, 9 years younger than the national average.

Source: Statistics Canada
Operators on farms in Canada continue to get older.

Average Age of All Farm Operators

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>55</td>
</tr>
<tr>
<td>2011</td>
<td>54</td>
</tr>
<tr>
<td>2006</td>
<td>52</td>
</tr>
<tr>
<td>2001</td>
<td>50</td>
</tr>
<tr>
<td>1996</td>
<td>49</td>
</tr>
<tr>
<td>1991</td>
<td>47.5</td>
</tr>
</tbody>
</table>

Average Age of Farm Operators with One or Two Plus Operators

- **55 Years and Over**
  - Farms with two or more operators: 82,435
  - Farms with one operator: 65,815
- **35 to 54 Years**
  - Farms with two or more operators: 60,055
  - Farms with one operator: 38,785
- **Under 35 Years**
  - Farms with two or more operators: 15,715
  - Farms with one operator: 9,135

Operators on All Farms

<table>
<thead>
<tr>
<th>Age Range</th>
<th>2011 Census</th>
<th>2016 Census</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 25 years</td>
<td>8,365</td>
<td>8,655</td>
</tr>
<tr>
<td>25 to 29 years</td>
<td>7,655</td>
<td>7,570</td>
</tr>
<tr>
<td>30 to 34 years</td>
<td>12,970</td>
<td>13,295</td>
</tr>
<tr>
<td>35 to 39 years</td>
<td>17,000</td>
<td>17,195</td>
</tr>
<tr>
<td>40 to 44 years</td>
<td>18,970</td>
<td>18,900</td>
</tr>
<tr>
<td>45 to 49 years</td>
<td>24,115</td>
<td>24,460</td>
</tr>
<tr>
<td>50 to 54 years</td>
<td>24,460</td>
<td>24,005</td>
</tr>
<tr>
<td>55 to 59 years</td>
<td>38,410</td>
<td>44,585</td>
</tr>
<tr>
<td>60 to 64 years</td>
<td>44,585</td>
<td>44,655</td>
</tr>
<tr>
<td>65 to 69 years</td>
<td>37,435</td>
<td>38,570</td>
</tr>
<tr>
<td>70 to 74 years</td>
<td>27,375</td>
<td>25,930</td>
</tr>
<tr>
<td>75 years and older</td>
<td>18,685</td>
<td>18,960</td>
</tr>
</tbody>
</table>

Principal Operator Land Owners in Canada:

- 6 farmers over 65 for every 1 farmer under 35
- 5 male operators for every 2 female operators

<table>
<thead>
<tr>
<th>Category</th>
<th>Average Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Farms</td>
<td>Avg age = 55</td>
</tr>
<tr>
<td>Farms with One Operator</td>
<td>Avg age = 56</td>
</tr>
<tr>
<td>Farms with Two or More Operators</td>
<td>Avg age = 54</td>
</tr>
<tr>
<td>1 in 4 farms were incorporated in 2016</td>
<td></td>
</tr>
</tbody>
</table>
Limited supply of farmland, coupled with lack of succession planning, indicates transitioning ownership over the next 10-20 years in Canada.

In 2016, 8.4% of all farm operations had Succession Plans

Of those 8.4%, about half were Sole Proprietorship Operations and half were Family & Non-Family Corporations

Of the approximately 95,000 Sole Proprietorship Operations, 5% had written Succession Plans

Of the approximately 46,000 Family & Non-Family Corporations, 16% had written Succession Plans

Access to land and capital required for land will continue to be a challenge; Significant barrier to entry for new farmers and the next generation

An increase in commodity prices has also led to an increase in farmers’ incomes. These increased incomes, coupled with relatively low interest rates, have created relatively high demand for farmland among farmers in order to remain competitive by benefiting from economies of scale.

Source: Statistics Canada
Non-ag interests are competing for land in Canada, including foreign investors

<table>
<thead>
<tr>
<th>Province</th>
<th>Restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Columbia</td>
<td><strong>No restriction</strong> on foreign ownership. Uses of land in the Agricultural Land Reserve are regulated by the Agricultural Land Commission.</td>
</tr>
<tr>
<td>Alberta</td>
<td>Subject to certain exceptions for commercial ventures (including limited natural resource extraction or processing and residential development), non-residents and foreign-controlled corporations can own up to 20 acres of agricultural land. <em>Foreign Ownership of Land Regulations, Alta Reg 160/1979</em></td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>Non-residents and foreign entities can own up to 10 acres of Saskatchewan farm land. Entities that are partially foreign-owned but controlled by Saskatchewan residents or their farming corporations can own up to 320 acres. <em>The Saskatchewan Farm Security Act, SS 1988-89, c S-17.1,</em> <em>The Saskatchewan Farm Security Regulations, RRS c S-17.1 Reg 1</em></td>
</tr>
<tr>
<td>Manitoba</td>
<td>Non-residents and foreign entities can own up to 40 acres of farm land. <em>The Farm Lands Ownership Act, CCSM c F-35</em></td>
</tr>
<tr>
<td>Ontario</td>
<td><strong>No restriction</strong> on foreign ownership. Uses of prime agricultural areas are regulated by planning authorities acting pursuant to the 2005 Provincial Policy Statement.</td>
</tr>
<tr>
<td>Québec</td>
<td>Non-residents and foreign-controlled entities must get permission to buy more than 4 hectares (or about 10 acres) of agricultural land from the Commission de la protection du territoire agricole du Québec. <em>An Act respecting the acquisition of farm land by non-residents, RSQ c A-4.1</em></td>
</tr>
</tbody>
</table>

Source: https://gowlingwlg.com/en/insights-resources/articles/2014/restrictions-on-foreign-ownership-of-agricultural/
The Central and Western Provinces of Saskatchewan, Alberta, and Manitoba make up 81% of Canadian Farmland. Between 2002 and 2014, the amount of Saskatchewan farmland owned by investors increased 16-fold. Holdings by investors increased from 51,957 acres in 2002, to 837,019 acres in 2014. In 2002 the largest holding was 24,296 by the Hutterian Brethren Church. By 2014, three investors each owned more than 100,000 acres, the largest at >160,000 acres. They include:
- Andielic Land Inc
- Canadian Pension Plan Investment Board
- HCI Ventures

Major shifts in landownership are occurring in the largest agricultural provinces.
FOUR MAJOR TRENDS

- Technology
- Farm Structure Change
- Consumer Awareness, Sustainability, Transparency
- Service-Based Economy

FOUR MAJOR TRENDS
In the next 10 years, Precision Ag (PAg) will replace CP/Traits as the center of gravity for crop production. Who will own this?

Clear platform leadership in the precision ag space is still undetermined; equipment providers have a significant opportunity in this space in a relevant and powerful way if they can own the platform.

Frustrated by multiple sources of disparate data and information, operators look for a single enterprise platform to collect, organize and manage their operation. Who will own this platform is yet to be determined.

The general trend is that all categories of PAg tools and technology are moving toward full adoption – the basic feature is not optional; as technology and artificial intelligence continue to improve along with farm size increasing – these tools will permeate crop production.

Look for new entrants with no value chain equities (start-ups, and/or a Google/Amazon/Elon Musk) to enter agriculture with a platform or new hardware solutions.

Who the grower shares their data with is the “Trusted Advisor” – historically a difficult area for ag equipment to play in now opens up.

The Big 4 (CP/Traits) companies attempt to enter PAg to “own the platform”, but are encumbered by the disruption of their core businesses.

There is a greater reliance on the IoT to operate a farm and inform the decision-making of the grower.

Due to the continuous improvement in technologies, operators are increasingly comfortable constantly re-learning how to use them (think constant updates to OS and apps.)

If the ag equipment sector is not engaged in this transition, they will lose the grower relationship and ability to capture value on tech implementation.

Source: http://www.precisionag.com/service-providers/tools-smart-equipment/autonomous-tractors-could-work-in-wetter-conditions-than-traditional-tractors/#Tinsel/60558/1
In 25 years, agriculture will be managed on a level of granularity unrecognizable today and will rely heavily on autonomous systems.

The “trusted advisor” role shifts from a person to the platform itself. Whoever owns the platform has the greatest level of influence over the grower.

Imagery and in-field monitoring empowered by AI assesses field conditions 24/7, makes instant economically-rational CP decisions, and deploys drones to treat (chemically, biologically, physically, etc.) a weed or crop.

There is a focus on purpose-grown (and identity-preserved) field crops. The end-use is predetermined before the field is planted. The system will be a hybrid between specialty and commodity crops.

Pag evolves to a level of granularity where it is possible to manage a farm on a plant-by-plant basis.

As PAg and AI evolve, ag equipment transitions to being fully autonomous and decreases in size (HP) to give the grower more flexibility in their operation.

These massive disruptions create opportunities for equipment manufacturers to increase market share and monetize new technology, thus strengthening their relationship with the grower.
Agriculture has lagged other industries in digitization, but the current environment makes it ripe for transformation.

Canada is one of the few countries where climate change may create some opportunities for growing crops in northern latitudes; the amount of arable land could rise between 26 and 40 percent by 2040.

The world’s food production needs to be increased 70% by 2050 to feed the expected population of 9b.

Projected changes in key climate variables affecting agricultural productivity

2016-2035 projections

2046-2065 projections

The rate of innovation has plateaued over the last 10-15 years

Growers and consumers are continuing to push back

A Looming Malthusian Doomsday?

Yield

Weather Patterns

World Population

Consumer Scrutiny and Governance

Source: Canadian Federation of Agriculture, Agriculture and Agri-Food Canada
There is work to be done to overcome the challenges to introducing AI in agriculture.

<table>
<thead>
<tr>
<th>Lack of connectivity on many farms</th>
<th>Lack of data for algorithms due to seasonal nature of growing season</th>
<th>Lack of familiarity of AI advances and potential application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerging agtech companies are building decision automation tools while there still exist large gaps in data collection and benchmarking capabilities.</td>
<td>Poor transparency around data use and ownership</td>
<td>Lack of standards and difficulty of gathering/sharing data</td>
</tr>
<tr>
<td>Farms lack the information technology infrastructure and data warehousing systems that Silicon Valley tech firms have relied on to develop and implement AI applications</td>
<td>Emerging agtech companies have tended to avoid using scientifically validated, statistically controlled field trials to quantify the benefits of their products (instead relying on a small subset of customers).</td>
<td>Competition for AI talent is fierce and a challenge to retain these individuals after they join a company. (A machine learning specialist was recently recruited away by a tech giant for over $700k in annual compensation.)</td>
</tr>
</tbody>
</table>

Source: https://www.forbes.com/sites/themixingbowl/2017/09/05/can-artificial-intelligence-help-feed-the-world/#ccfc8bc46dbb
From farm to fork, ag technology funding is driving a new age of technology.

2017 investment reached an estimated $2 billion with over 250 deals involving 600-700 unique investors.

The United States tends to dominate the investment landscape; Unsurprisingly, California had far and away the most deals. Non-US activity in India, Canada, UK, Israel, France, and China.

Much of the investment in agriculture is coming from outside of agriculture to include Google Ventures, other generalists, VCs (US and non-US).

Corporates are also playing a role with many setting up their own arms to invest in startups (Monsanto and Syngenta were the most active).

While there are headwinds, there are reasons to believe AI’s success and large-scale adoption in Canadian agriculture are on the horizon.

Advanced technologies are using data to automating more than vehicle steering and input on/off control.

Farmers are using sensors and soil sampling to gather data on soil moisture and nutrient levels across their fields.

Ag information management systems, that make analyzing operational and financial data easy.

Farmers today have access to software tools to assist in in-field scouting.

Source: https://www.forbes.com/sites/themixingbowl/2017/09/05/can-artificial-intelligence-help-feed-the-world/#cfc8bc46dbb
Agriculture technology financing and investing is heating up.

Ag tech started gaining significant attention after the acquisition of The Climate Corporation by Monsanto for $1B+ in 2013. In 2017, more than 230 unique investors made at least one ag tech investment. The biggest increase has been in VC interest, with 118 unique VCs invested in ag tech.

See Appendix to compare with other sectors, industries, and categories.

Gaining momentum in 2014, ag tech startups have raised over $550 million in the last 5 years.

### Analyzing Satellite Images
- Descartes Labs
- farmshots
- Orbital Insight
- OmniEarth

### In-Field Monitoring
- Honeycomb
- SkySquirrel
- AgriEye
- SkyCision
- DJI
- GeoVisual Analytics
- Airwood
- SenseLion
- Precision Ag
- Resson

### Assessing Crop/Soil Health
- Trace Genomics
- indigo
- Peat
- Benson Hill
- Snap Dragon

### Agricultural Robots
- Clearpath Robotics
- FarmBot
- Harvest Croo Robotics
- Blue River Technology
- Abundant Robotics

### Predictive Analytics
- ec2ce
- aWhere
- Optimal Applied Reinforcement Learning

Source: https://www.cbinsights.com/research/ai-robotics-agriculture-tech-startups-future/
Excluding Indigo and DJI Innovations, over 60% of investment is targeted toward ag robots and satellite imagery analysis.

VCs like Bessemer Venture Partners, Accel Partners, Khosla Ventures, Lux Capital, and Data Collective have invested in general-purpose drone and computer vision companies with a focus on agricultural applications such as DJI, Orbital Insight, Blue River Technology. Monsanto and Syngenta have backed companies like Resson and Blue River Technology.

### Category

<table>
<thead>
<tr>
<th>Category</th>
<th>Total Funding</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural robots</td>
<td>$83.95</td>
<td>29%</td>
</tr>
<tr>
<td>Crop/soil health analysis*</td>
<td>$38.39</td>
<td>13%</td>
</tr>
<tr>
<td>In-field monitoring**</td>
<td>$60.07</td>
<td>21%</td>
</tr>
<tr>
<td>Predictive analytics</td>
<td>$14.79</td>
<td>5%</td>
</tr>
<tr>
<td>Satellite image analysis</td>
<td>$94.01</td>
<td>32%</td>
</tr>
<tr>
<td>TOTAL (without Indigo and DJI Innovations)</td>
<td>$291.21</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>$559.71 M</td>
<td></td>
</tr>
</tbody>
</table>

* Does not include Indigo Ag ($163.5M)
** Does not include DJI Innovations ($105.0M)

### Top 12 Companies

<table>
<thead>
<tr>
<th>Category</th>
<th>Category</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigo Agriculture</td>
<td>Crop/soil health analysis</td>
<td>$163.50</td>
</tr>
<tr>
<td>DJI Innovations</td>
<td>In-field monitoring</td>
<td>$105.00</td>
</tr>
<tr>
<td>Orbital Insight</td>
<td>Satellite image analysis</td>
<td>$78.70</td>
</tr>
<tr>
<td>Clearpath Robotics</td>
<td>Agricultural robots</td>
<td>$40.79</td>
</tr>
<tr>
<td>Benson Hill Biosystems</td>
<td>Crop/soil health analysis</td>
<td>$34.21</td>
</tr>
<tr>
<td>Blue River Technology</td>
<td>Agricultural robots</td>
<td>$30.75</td>
</tr>
<tr>
<td>PrecisionHawk</td>
<td>In-field monitoring</td>
<td>$29.00</td>
</tr>
<tr>
<td>Resson</td>
<td>In-field monitoring</td>
<td>$14.00</td>
</tr>
<tr>
<td>aWhere</td>
<td>Predictive analytics</td>
<td>$12.45</td>
</tr>
<tr>
<td>Abundant Robotics</td>
<td>Agricultural robots</td>
<td>$10.00</td>
</tr>
<tr>
<td>Descartes Labs</td>
<td>Satellite image analysis</td>
<td>$8.38</td>
</tr>
<tr>
<td>Prospera</td>
<td>In-field monitoring</td>
<td>$7.00</td>
</tr>
<tr>
<td>All Others (17)</td>
<td></td>
<td>$25.93</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>$559.71M</td>
</tr>
</tbody>
</table>

* Does not include Indigo Ag ($163.5M)
** Does not include DJI Innovations ($105.0M)

Source: [https://www.cbinsights.com/research/ai-robotics-agriculture-tech-startups-future/](https://www.cbinsights.com/research/ai-robotics-agriculture-tech-startups-future/)
Analyzing satellite imagery provides a macro-level understanding of agricultural practices.

Geo-spatial data can provide information on crop distribution patterns across the globe and the impact of weather changes on agriculture, among other applications. Startups here are using machine learning and computer vision algorithms to classify data and extract meaningful information from millions of such satellite images.

Orbital Insight has raised $78.7M in total funding, including a $50M Series C round in Q1’17 backed by investors including Lux Capital, Sequoia Capital, and Google Ventures. Their solutions for agriculture include a model for predicting crop yield.

<table>
<thead>
<tr>
<th>Category</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbital Insight</td>
<td>$78.70</td>
</tr>
<tr>
<td>Descartes Labs</td>
<td>$8.38</td>
</tr>
<tr>
<td>OmniEarth</td>
<td>$5.16</td>
</tr>
<tr>
<td>FarmShots</td>
<td>$1.77</td>
</tr>
<tr>
<td></td>
<td>$94.01 M</td>
</tr>
</tbody>
</table>

Source: https://www.cbinsights.com/research/ai-robotics-agriculture-tech-startups-future/
In-field monitoring includes drone manufacturers and startups working on computer vision algorithms to process data.

Drone manufacturing startups, focused on tasks like site inspection and surveying for industries like agriculture and construction, saw 41 deals last year – the largest number of deals among the enterprise robotics categories in 2016 — up from 22 in 2015. This includes drone manufacturers with a focus on agriculture, as well as startups working on computer vision algorithms to process the data captured by drones and other on-field cameras. On the software side, companies like Prospera use deep learning-based computer vision technology for monitoring crops in real time.

<table>
<thead>
<tr>
<th>Category</th>
<th>Funding</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>DJI Innovations</td>
<td>$105.00</td>
<td>Accel Partners, Sequoia Capital China</td>
</tr>
<tr>
<td>PrecisionHawk</td>
<td>$29.00</td>
<td>Bob Young, DuPont, Innovate Indiana Fund, Intel Capital, Millennium Technology Value Partners, NTT DoCoMo Ventures, USAA, Verizon Ventures, Yamaha Motor Ventures</td>
</tr>
<tr>
<td>Resson</td>
<td>$14.00</td>
<td>BDC Capital, BDC Venture Capital, Build Ventures, East Valley Ventures, Monsanto Growth Ventures, New Brunswick Innovation Foundation, Rho Canada</td>
</tr>
<tr>
<td>Prospera</td>
<td>$7.00</td>
<td>Bessemer Venture Partners</td>
</tr>
<tr>
<td>Gamaya</td>
<td>$3.72</td>
<td>Foundation for Technological Innovation, Seed4Equity, VI Partners</td>
</tr>
<tr>
<td>Sensurion</td>
<td>$2.00</td>
<td>NA</td>
</tr>
<tr>
<td>HUVRData</td>
<td>$2.00</td>
<td>Central Texas Angel Network, Houston Angel Network</td>
</tr>
<tr>
<td>SkySquirrel Technologies</td>
<td>$1.02</td>
<td>Innovacorp, The Pearse Lyons Accelerator – Alltech</td>
</tr>
<tr>
<td>Raptor Maps</td>
<td>$0.72</td>
<td>Commercial Drone Fund, Y Combinator</td>
</tr>
<tr>
<td>HoneyComb Corp.</td>
<td>$0.46</td>
<td>Oregon BEST, Portland Seed Fund, Prosper Portland</td>
</tr>
<tr>
<td>Agri Eye</td>
<td>$0.15</td>
<td>1991 Open Data Incubator</td>
</tr>
<tr>
<td>Airwood Aerostructures</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$165.07 M

Source: https://www.cbinsights.com/research/ai-robotics-agriculture-tech-startups-future/
Startups in the crop and soil health analysis are using machine learning to predict the effects of microbes and identify pathogens.

Startups here are using machine learning to predict the effect of various microbes on plant health and identify genetic mutations in pathogens that may be harmful for the plant, among other things. Benson Hill Biosystems uses a cognitive engine, CropOS, to identify genetic pathways in plants that can improve photosynthesis.

<table>
<thead>
<tr>
<th>Company</th>
<th>Funding</th>
<th>Investors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigo Agriculture</td>
<td>$163.50</td>
<td>Alaska Permanent Fund, Flagship Pioneering</td>
</tr>
<tr>
<td>Benson Hill Biosystems</td>
<td>$34.21</td>
<td>Alexandria Venture Investments, BioGenerator, Cultivation Capital, Fall Line Capital, iSelect Fund, Lewis &amp; Clark Ventures, Mercury Fund, Middleland Capital, Missouri Technology Corporation, National Corn Growers Association, Prelude Ventures, Prolog Ventures, S2G Ventures, Technology Acceleration Partners</td>
</tr>
<tr>
<td>Trace Genomics</td>
<td>$4.12</td>
<td>Fall Line Capital, Illumina Accelerator, Illumina Ventures, Refactor Capital, Terra, THRIVE Accelerator, Viking Global Investors</td>
</tr>
<tr>
<td>PEAT</td>
<td>$0.06</td>
<td>Atlantic Labs, Merck Accelerator</td>
</tr>
</tbody>
</table>

$201.89 M

Source: https://www.cbinsights.com/research/ai-robotics-agriculture-tech-startups-future/
Agricultural Robots, including ground robots, will perform many field tasks, to include the use of computer vision to “see and spray”.

Blue River Technology is developing robots that use computer vision to “see and spray” at weeds on cotton plants. The National Science Foundation grantee is backed by smart money VCs, Data Collective and Khosla Ventures. Another startup, Abundant Robotics, which spun out of SRI International last year, raised $10M from investors like Google Ventures and Yamaha Motor Ventures to develop apple-picking robots.

**Company** | **Funding**
---|---
Clearpath Robotics | $40.79 Caterpillar Ventures, Eclipse Ventures, GE Ventures, iNovia Capital, Public Works and Government Services Canada, RRE Ventures, Silicon Valley Bank
Blue River Technology* | $30.75 Data Collective, Innovation Endeavors, Khosla Ventures, Monsanto Growth Ventures, National Science Foundation, Pontifax, Stanford Angels & Entrepreneurs, Steve Blank, Syngenta Ventures, Ulu Venture
Abundant Robotics | $10.00 Comet Labs, Google Ventures, KPCB Edge, SRI International, Tellus Partners, Yamaha Motor Ventures
Harvest CROO | $1.71 NA
Farbot | $0.70 muru-D, SYD Ventures

*$83.95 M

* Prior to acquisition by John Deere for $305 million in September 2017

Source: [https://www.cbinsights.com/research/ai-robotics-agriculture-tech-startups-future/](https://www.cbinsights.com/research/ai-robotics-agriculture-tech-startups-future/)
Predictive analytics startups are using machine learning models for agricultural R&D, seasonal analysis, and other applications.

<table>
<thead>
<tr>
<th>Category</th>
<th>Funding</th>
<th>Investors</th>
</tr>
</thead>
<tbody>
<tr>
<td>aWhere</td>
<td>$12.45</td>
<td>AgFunder, Aravaipa Ventures, Elixir Capital</td>
</tr>
<tr>
<td>GeoVisual Analytics</td>
<td>$1.27</td>
<td>AI Capital, Colorado Office of Economic Development and International Trade, NASA, SVG Ventures, Taylor Farms, THRIVE Accelerator</td>
</tr>
<tr>
<td>ec2ec</td>
<td>$1.06</td>
<td>NA</td>
</tr>
<tr>
<td>Optimal</td>
<td>$0.01</td>
<td>Entrepreneur First</td>
</tr>
</tbody>
</table>

$14.79 M

Source: https://www.cbinsights.com/research/ai-robotics-agriculture-tech-startups-future/
Who will own the platforms in the digitization of agriculture? TBD. Which sector? Is it a company that doesn’t exist today?

Platform-oriented companies represent the largest and fastest growing companies in the world.

<table>
<thead>
<tr>
<th>Company*</th>
<th>World’s largest…</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alibaba</td>
<td>Retailer</td>
<td>Stores/warehouses owned = 0</td>
</tr>
<tr>
<td>Airbnb</td>
<td>Accommodation provider</td>
<td>Hotels/rooms owned = 0</td>
</tr>
<tr>
<td>Uber</td>
<td>Taxi company</td>
<td>Cars owned = 0</td>
</tr>
</tbody>
</table>

* None existed 10 years ago!!

MARCH 8, 2017 MARKET CAPITALIZATION, $ BILLION

<table>
<thead>
<tr>
<th>Company</th>
<th>Market Capitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>$732.0</td>
</tr>
<tr>
<td>Alphabet (Google)</td>
<td>$581.8</td>
</tr>
<tr>
<td>Amazon</td>
<td>$403.7</td>
</tr>
<tr>
<td>Facebook</td>
<td>$396.8</td>
</tr>
<tr>
<td>Berkshire Hathaway</td>
<td>$431.1</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>$342.2</td>
</tr>
<tr>
<td>JPMorgan Chase</td>
<td>$326.5</td>
</tr>
<tr>
<td>Wells Fargo</td>
<td>$291.7</td>
</tr>
<tr>
<td>Microsoft</td>
<td>$497.7</td>
</tr>
<tr>
<td>Johnson &amp; Johnson</td>
<td>$336.8</td>
</tr>
</tbody>
</table>

Growth Venture of the Big 4

Ag Retail

Ag Equipment

Ag Tech Startup

Somebody Else

The adoption and success of Precision Ag is a leading indicator that AI and associated technologies will eventually be deployed in ag.

### Market Definition

**Precision Agriculture (PAg)** is the **technology-enabled utilization of data collection and analysis** to inform and enable **site-specific** agricultural activities, inclusive of the **hardware, software**, and **human capital** required to successfully perform these actions.

<table>
<thead>
<tr>
<th>Definition of Space</th>
<th>Ag Equip Position</th>
<th>PAg Tools &amp; Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Precision Ag Hardware</strong></td>
<td><strong>Collection</strong></td>
<td><strong>• Yield Monitor Controllers</strong></td>
</tr>
<tr>
<td>Hardware-enabled <strong>data collection</strong> of agronomic information including soil, water, crop growth, and harvest data.</td>
<td><strong>conducted via partnerships with hardware and other data collection tools</strong></td>
<td><strong>• UAS</strong></td>
</tr>
<tr>
<td><strong>Decision Ag</strong></td>
<td><strong>Analysis, Insight, and Application</strong></td>
<td><strong>• Planter Sprayer</strong></td>
</tr>
<tr>
<td>Organization, management, and <strong>analysis</strong> of multiple layers of site-specific data to provide agronomic and financial <strong>insight</strong>, then acted upon through variable rate prescriptions and ultimately <strong>application</strong>.</td>
<td><strong>are collaborative efforts between the retailer agronomists/analysts and their customers; including benchmarking of performance data such as FBN and FarmLink offer.</strong></td>
<td><strong>• Soil Tests</strong></td>
</tr>
</tbody>
</table>

Source: The Context Network 2016 Precision Ag Multi Client Project
The Precision Ag market remains a highly fragmented space with offerings from software, hardware and integrated solutions providers.

- As the hardware and integrated service providers acquire independent solution providers, the precision market will become less fragmented
- Lack of compatibility between competing and partnering platforms creates a barrier for retailers and growers alike

Source: The Context Network 2016 Precision Ag Multi Client Project
There are many potential beneficiaries and potential methods of additional profit generation through PAg technology across the agricultural landscape.

<table>
<thead>
<tr>
<th>Value Chain Participant</th>
<th>Profit Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision Ag Companies</td>
<td>Organic potential, but equipment GP is likely to become marginalized over time</td>
</tr>
<tr>
<td>OEMs</td>
<td>Primarily maintain or grow market share, some “up sell” potential</td>
</tr>
<tr>
<td>Retail / Distribution</td>
<td>Improved internal operations, increased customer service potential, ability to sell more inputs; higher grower “switching” costs</td>
</tr>
<tr>
<td>Input Suppliers (Seed / Chem / Fert)</td>
<td>Maintain or grow market share and increase sales of their products through use of integrated performance programs</td>
</tr>
<tr>
<td>Farmers / Producers</td>
<td>ROI, increased yields, earlier detection and management decisions, risk management strategy</td>
</tr>
<tr>
<td>Regulators / Lenders / Insurance Programs</td>
<td>Risk and volatility management, more representative aggregated data</td>
</tr>
<tr>
<td>Food Companies</td>
<td>Traceability ease, value added creation with additional data and insight</td>
</tr>
</tbody>
</table>

**Potential Beneficiaries**

- **Farmers / Producers**
- **The environment**
- **Regulators, insurance / lending institutions**
- **Government programs**
- **Technology and service providers**
- **Input suppliers**
- **Food companies**
- **Sustainability programs**

"Anyone who eats."
– one farmer’s view

"Field to Table"

---

Source: The Context Network 2016 Precision Ag Multi Client Project
The general trend is that all categories of PAg tools and technology are moving toward full adoption – basic feature not optional.

Producers continue to integrate technology, mechanization and improved processes to their operations. These allow farms to create efficiency, achieve scale and maximize profitability.

### Percentage of agricultural operations that reported using technology by type, Canada 2015

- Computers/laptops for farm management: 56.2%
- Smartphones/tablets for farm management: 42.9%
- GPS technology: 30.1%
- Automated steering: 20.5%
- GIS mapping: 8.2%
- Automated animal feeding: 4.9%
- Greenhouse automation: 4.5%
- Automated environmental controls for animal housing: 0.8%
- Other technology: 0.6%
- Robotic milking: 0.5%

### Percentage of agricultural operations reporting selected technologies by cropland acreage, Canada 2015

- **10,001 and over**
  - GPS Technology: 97%
  - Automated Steering: 94%
  - GIS Mapping: 94%
- **5,001 to 10,000**
  - GPS Technology: 53%
  - Automated Steering: 42%
  - GIS Mapping: 96%
- **1,001 to 5,000**
  - GPS Technology: 42%
  - Automated Steering: 21%
  - GIS Mapping: 78%
- **501 to 1,000**
  - GPS Technology: 42%
  - Automated Steering: 13%
  - GIS Mapping: 60%
- **1 to 500**
  - GPS Technology: 21%
  - Automated Steering: 11%
  - GIS Mapping: 5%

Larger farms are leveraging their size to invest in efficiency-generating technologies.

### Value of tractors (in 2016 constant dollars) by category, 2011 and 2016

- **Under 60 p.t.o hp**
  - 2011: $2
  - 2016: $2
- **60 to 149 p.t.o hp**
  - 2011: $8
  - 2016: $7
- **Over 149 p.t.o hp**
  - 2011: $6
  - 2016: $9

Farms are increasingly using larger and more advanced equipment to manage costs and improve efficiency. Larger equipment allows fieldwork to be completed faster, while advances in equipment and production practices allow more precise seeding and input application.

Source: Statistics Canada
Although the use of Precision Ag services is growing steadily, the recent period of mass adoption is winding down in many areas.

Causes of Less Rapid Growth

- Past the rapid adoption phase of the growth curve
- Low commodity prices
- Questions around who actually owns the data
- Lack of some precision ag tools going beyond data collection to data insights
- Land renters may not invest in PA since they may only be on the land for a few years

Location-Level Retailer Quote

“We have a lot of farmers that are stuck on spraying the same thing every year. Precision Ag tells them the same thing we have been telling them all along, but we can show them the actual data.”

KEY INSIGHTS

Once a grower is using precision ag, they tend to stick with it. Consensus among ag retailers is that precision ag is growing now and will continue to grow.

Precision Ag is affecting the buying patterns of growers; they follow the prescriptions provided to them.

Growers are disappointed by the lack of collaboration and compatibility between platforms and products.

Ag Equipment dealers could be in a unique position to help growers interpret and draw insights from their data generated by precision ag tools.

Expect Ag Retailers to compete to own the PRECISION AG RELATIONSHIP with Operators.

Is there an opportunity for Equipment Companies and Dealers along with Crop Science and Ag Retailers to work together?
FOUR MAJOR TRENDS

- Farm Structure Change
- Technology
- Consumer Awareness, Sustainability, Transparency
- Service-Based Economy
The nature of service to farm operators is immutable, but the character of service begins to change in the next 10 years.

Relationships remain a critical part of service; operators have multiple trusted advisors (equipment, inputs, insurance, accounting, etc.), but service related to PAg platforms becomes the center of gravity.

The most valued service providers are able to interpret information and provide recommendations with a total enterprise profitability perspective of the operation.

All suppliers (ag retailers, CP/biotech, equipment dealers) find it increasingly difficult to attract sufficient talent in rural America; some (esp. new entrants) use in-field monitoring, satellite imagery, etc. to provide virtual service through screening; early adaptors / early majority adoption.

Ag equipment suppliers (OEMs and dealers) are challenged to recruit and retain the type of talent required to maintain autonomous power units, drones, etc.; regardless, more maintenance will be conducted by dealers and less by operators.

The ability to print parts at dealer locations becomes practical as equipment becomes smaller and lighter and made from alternative materials.

New equipment rental arrangements will emerge; concept: operators pay a fee to have X amount of equipment operational for a specified window of time (i.e. planting).
In 25 years, operators will have a select few trusted advisors who have full enterprise breadth; virtual service will be acceptable.

| Relationships remain important, but not as dependent on any particular individual; service is very much centered on the PAg platform; operators have fewer trusted advisors. |
| Virtual service via screening, in-field monitoring, etc. is broadly adopted; operators accept competent advice, even if it’s coming from a call center in another country. |
| Smaller, lighter autonomous power units with clip-on implements made from alternative materials facilitates modular manufacturing with fewer major components, allowing simple (less skill required) in-field repair, thereby reducing downtime. |
| The most valued service providers interpret information and provide recommendations with a total enterprise profitability perspective of the operation and an appropriate sensitivity to owner/shareholder priorities. |
| Opportunity for ag equipment suppliers to transition from a primarily transactional relationship to a broader, enterprise-wide advisory relationship. |
Ag equipment and crop science each provide key tools in the PAg framework. Are there opportunities to converge?

Crop science has a firm grasp on all levels of the analysis and insight process for the grower. Ag equipment already owns the precision application for the grower. They could capture the decision making process by providing agronomic expertise as well.

Crop science and the Ag Retail network currently own the crop production relationship with operators.

As equipment and crop science converge, ag equipment is at risk of being out of position to fully capitalize on PAg as crop science continues to invest in technology.

This table reflects where we are today (2018)

<table>
<thead>
<tr>
<th></th>
<th>Hardware</th>
<th>Software</th>
<th>Human Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analysis</td>
<td>Not applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insight</td>
<td>Not applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PAg Tools and Outcomes

- Collection
  - Yield Monitor Controllers
  - UAS
  - Planter Sprayer
  - Sensors
  - Soil Tests
  - Weather
  - ISOBUS
  - GreenSeeker
  - Scouting
  - Satellite

- Analysis
  - Field Manager
  - Advanced Yield
  - Crop Modeling
  - Advanced Analytics

- Insight
  - Nitrogen Management
  - Crop Protection
  - Variable Rate
  - Fertility
  - Planting
  - Crop Specialist
  - Grower

- Application
  - Crop Science
  - Start-ups/New Entrants
  - Ag Equip.
  - Scouting
  - Satellite
  - Soil Tests
  - Weather
  - UAS
  - Planter Sprayer

As equipment and crop science converge, ag equipment is at risk of being out of position to fully capitalize on PAg as crop science continues to invest in technology.
The virtual retailer concept was attempted in the early 2000s and failed, but FBN now seems to be gaining some traction.

<table>
<thead>
<tr>
<th>KEY PLAYERS</th>
<th>PAST RETAILERS</th>
<th>2000’s</th>
<th>CURRENT RETAILERS</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fielder’s Choice (Acquired by Monsanto)</td>
<td>-</td>
<td>FBN was established in 2014. It is a data management organization that connects growers to share knowledge and gain trusted insights about their farms, inputs, and practices. FBN Direct combines manufacturer-direct pricing, direct-to-farm delivery, and an independent farmer service network to drive major savings on farm products. FBN sales $30M 2016, est. $80M 2017 and $300M in 2018</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XS Ag</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICorn</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the early 2000s, a wave of internet ag chem/seed retail companies attempted, unsuccessfully, to capitalize on internet-driven price transparency.

<table>
<thead>
<tr>
<th>PRODUCTS OFFERED</th>
<th>FAILURE</th>
<th>POTENTIAL SUCCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed, Seed Treatment, Herbicide, Fungicides, and possibly other CP products</td>
<td>- Simply a website to buy inputs at a good price (Price competitiveness decreased over time) - Few products offered - Ahead of its time - Not a reliable supplier - Poor customer return rate - Internet was still new - Retailers would match the price anyway (not enough incidence to matter)</td>
<td>- Market dynamics have created a perfect storm of opportunity for (FBN) and other direct and virtual retailers to carve out a growing piece in the US ag retail market: low commodity prices, generic chemistries, convenience of the internet, and willing participants at both the supplier &amp; grower levels - Free shipping, delivery, competitive prices - On the ground chemical reps that provide advice</td>
</tr>
</tbody>
</table>

The equipment market may not be ready for a virtual dealer today, but ag retail wasn’t ready ten years ago and it is rapidly disrupting the retail marketplace today.
FBN is currently disrupting the crop protection sector. Is the ag equipment sector at risk for a similar disruptor?

The equipment sector (particularly the distribution network) needs to be engaged in the ongoing transition or risk being easily substitutable by an FBN-type model and lose the ability to fully capture value on technology implementation in agriculture.

As ag equipment gets smaller and the individual price tags follow, there may be a day when operators would be willing to purchase their new equipment online.

Decision-makers in a corporate-type purchasing environment may be very comfortable making online purchases and hold trust with those online sellers.

As ag equipment becomes more interoperable (both digitally and mechanically), web based purchasing will make the purchasing process easier for the grower.

The demand for price first, service second is already present; it will only grow.

Source: The Context Network 2017 US Ag Retailer Multi Client Study

1) Majority of products are generic; 2) States that are shaded darker can ship products within 1-3 days
How should the ag equipment industry address volatile market conditions and continuous evolution of technology?

Technology replacement cycles may be out-of-synch with an operator’s equipment replacement cycle.

As farm operations become larger (corporate-like), they will need to provide their shareholders with more accurate earnings forecasts. They may demand more flexibility from all suppliers. They’ll be interested in the capability the equipment provides, not necessarily having an asset on their balance sheet.

What happens to the value of the secondary market when PAg technology built into equipment is incompatible or obsolete?
FOUR MAJOR TRENDS

- Technology
- Farm Structure Change
- Service-Based Economy
- Consumer Awareness, Sustainability, Transparency
In 10-15 years, Blockchain Technology (or a related technology) will be widely adopted by the food supply chain.

Consumer food companies like Wal-Mart, Nestle, and Unilever successfully implement blockchain and bring a substantial portion of the supply chain with them.

Transparency (with the use of blockchain and PAg) in the agrifood sector drives a higher level of accountability for safety, fairness, and sustainable farming practices.

Unknown whether traceability leads to higher food prices and if that value is passed back through the supply chain to farm owners and operators.

Influencers, to include consumer food companies, continue to confuse organic, GMO-free, vegan-friendly, etc. with healthy, sustainable food.

Highly-educated consumers continue to be influenced by various media forces on the evils of some agricultural practices (i.e. GMOs, animal confinement)
In 25 years, a very small number of North American consumers will have any connection to agriculture.

Most US consumers will be multiple generations removed from any direct exposure to agriculture. Their attitudes, perceptions, and beliefs about agriculture and farming are shaped entirely by external forces, which may or may not be science-based and balanced.

Gen Z, not Millennials and Gen X, drive trends in food; Gen Z (the digital natives) grow up expecting to know the origin of their food.

Next generation blockchain is fully implemented and the granularity of traceability continues to improve. **Traceability is now a way of life.**

The Uberization* of the agrifood sector not only provides transparency, but also creates opportunities for purpose-grown, identity-preserved crops leading to better profitability.

* In the context, Uberization refers to the idea that traceability enabled by blockchain provides the capability to very quickly match a customer who has a specific agrifood demand (i.e. a food company) with a supplier (i.e. a grower) who can meet that demand...much like a person orders an Uber ride.
North American consumers are becoming more health conscious and want to be more knowledgeable of food production practices.

2/3 of Americans report that they have given some thought to whether foods and beverages they purchase or consume are produced in a sustainable way.

Fresh, Natural, & Minimally Processed Foods ARE MOST IMPORTANT TO CONSUMERS GLOBALLY, when making their food purchase decisions.

GLOBAL RESPONDENTS prioritized:
- 43% All Natural Ingredients
- 42% Absence of Artificial Colors
- 41% Absence of Artificial Flavors
- 40% Foods Made From Vegetables / Fruits

Intentional purchasing decisions are driven by practices perceived to be sustainable:
- "Local" driven Purchases
- Farmers Market driven Purchases
- Purchases driven by recycled containers / packaging

Consumers stop buying products or brands due to concerns over food safety and inputs used during food production:
- Food Safety
- Bacteria
- Chemicals
- Pesticides
- Imported Food
- Animal Antibiotics
- Undeclared Allergens

However, the sources of information are often agenda-driven; lack balanced, scientific rigor; and sometimes border on ridiculous.

**Documentaries**

- DOCUMENTARIES FOCUSING ON FOOD AND AGRICULTURE HAVE BECOME MORE PREVALENT AND CONTINUE TO GENERATE ATTENTION.

**Books**

- BOOKS FOCUSING ON ANTI-GMO AND AGRICULTURE HAVE BECOME A COMMON TOPIC IN TODAY’S WORLD.

**Social Media Chatter**

- CONSUMER BRAND FOOD COMPANIES ARE STILL LEARNING THAT SOCIAL MEDIA IS A TWO-WAY CONVERSATION, NOT A PLATFORM TO PUSH MARKETING MESSAGES.

**Product Marketing**

- THE FOOD LABELING CRAZE COUPLED WITH BANNER HEADLINES ABOUT THE DANGERS OF GLUTEN, GMOS, AND HORMONES ARE LEADING TO INCREASINGLY ABSURD PRODUCT CLAIMS.

Source: 2012 Food & Health Survey: Consumer Attitudes toward Food Safety, Nutrition and Health
Organic food continues to be popular and consumers are willing to pay a premium for these items.

A growing number of consumers prefer organically produced food because of their concerns regarding health, the environment, and animal welfare, and they show a willingness to pay the price premiums established in the marketplace.

Fresh fruits and vegetables have been the top selling category of organically grown food since the organic food industry started retailing products over three decades ago.

Prices for organic products continue to be higher than for their conventional counterparts.

While organic demand is real, it’s still a small market and has obstacles to overcome.

Source: USDA-ERS Organic Market Overview, Kevin Kelly Extrapolations; Food, 2014
In thinking about the future, Gen Z, not Millennials or Gen X, provide insights into future food trends, and they will expect food traceability.

Look for greater discernment from Gen Z on the information that they receive from media, food marketers, and other influencers. They are growing up in a world of C2B and will expect companies to engage them in the food procurement process.

**Generation Z defined:**
Currently ages 8-22, they are the most diverse and multicultural of any N.A. generation. They are growing up online and they get their information from online influencers, but also friends and family.

They are driving less, respect the ‘natural’, and are getting greener. They are open-minded and adaptable, not known for fixed opinions or inflexibility. They respond to messaging that reflects reality, not perfection.

Although Gen Z is the smallest portion of food shoppers and lowest spenders, their preferences will be the wave of the future. They show a high awareness of, and desire for, “healthy food”, with more than a third of their grocery basket considered organic. They prefer smaller, but more frequent trips to the grocery store.

Unlike Millennials, they don’t anticipate hand-holding and constant success (a trophy). They are highly educated, technologically-savvy, innovative thinkers who look for solutions on their own.

For the purposes of this report, Context has focused on industry transparency and traceability as consumer concerns.

The global food chain is complex, bringing together farmers, warehousing, shipping companies, distributors, and grocers. Involving so many different parties also means involving many different types of record keeping methods, from Excel sheets to emails to paper printouts.

Not only is this system inefficient, it’s also imprecise. When you buy a vegetable at your local grocery store, the brand listed on the sticker may have no idea which farm the vegetable came from. Therefore, brands may not be sure how to react when something goes wrong.
Big food companies are investing in blockchain as a long-term solution to supply chain visibility and traceability in the food industry.

In August 2017, ten of the world’s biggest food companies partnered with IBM to integrate blockchain into their supply chains. These companies represent more than half a trillion dollars in aggregate annual global sales.

**WHAT IS BLOCKCHAIN?**
- a way of storing and sharing information across a network of users in an open virtual space.
- allows for users to look at all transactions simultaneously and in real-time.
- since transactions are not stored in any single location, it is almost impossible to hack the information.

**IN FOOD...**
- a retailer would know their supplier’s suppliers
- it allows specific products to be traced, which would help to reduce food waste.
- contaminated products can be easily and quickly traced, while safe foods would remain on the shelves and not be sent to landfills.

Prior to using blockchain, Walmart conducted a traceback test on **mangoes** in one of its stores.

It took **six days, 18 hours, and 26 minutes** to trace mangoes back to its original farm.

Using blockchain, Walmart did it in **2.2 seconds**.

The agrifood arena is filled with secrets and blockchain will be problematic for some food companies...considered a “solution looking for a problem”. However, that sentiment may be irrelevant. Companies, like Walmart, have more power and influence over other companies within the same supply chain. Look for **Blockchain Technology** to be deployed **broadly** in the food industry.

Source: https://app.cbinsights.com/research/blockchain-grocery-supply-chain
At least one company in the feed milling industry is getting on board with supply chain traceability.

DFS Animal Nutrition, a top 10 U.S. Feed Manufacturer, launched a traceability platform called FeedTrackur that provides their customers (livestock producers) in-transit visibility of their feed.

The intent is to ensure that there are no mistakes in the delivery and reception of inbound rations.

Eventually, batches of feed will be linked back to the specific feed ingredients used to make them.

For some livestock operations, this will be mandated once the FDA Food Safety Modernization Act is fully implemented.

Source: http://www.feedtrackur.com
Safe Food for Canadians Regulations

The Safe Food for Canadians Regulations (SFCR) applies to food for human consumption (including ingredients) that are imported, exported, or inter-provincially traded for commercial purposes. It also applies to the husbandry and processing of animals from which meat products to be exported or inter-provincially traded may be derived.

SFCR has three main objectives:
1. Improve food safety oversight to better protect consumers
2. Strengthen and streamline legislative authorities
3. Enhance market opportunity for the Canadian industry

The SFCR will come into effect on January 15, 2019.

Source: http://www.inspection.gc.ca/food/sfcr/toolkit-for-businesses/handbook-for-food-businesses/eng/1481560206153/1481560532540?chap=0#s3c1
Summary
Precision Ag and supporting technologies become the new center of gravity...replacing crop science.

Small shifts in farm structure continue in line with historical trends. Large farms continue to get larger, *primarily through cash rent*. Primary operators continue to get older. Most *land remains in families*...for now.

Precision agriculture is widely adopted, replacing crop science as the *new center of gravity* in crop production.

Clear platform leadership in the precision ag space is *still contested* by hardware providers, crop science companies, start-ups, and, possibly, a new high-powered tech entrant.

One or more well-capitalized new entrants will enter agriculture, unfettered with existing supply or distribution channels to *address unmet needs*.

New equipment use arrangements become more dominant (Power by the Hour). Autonomous power units introduced and equipment practices start evolving.

Quality, affordable *labor continues to be a constraint* to farm size, especially high value / specialty crops.
Land ownership and farm operators begin to change as autonomous power units come on the scene.

A new type of land ownership begins to take shape as more land transfers. Operators are more tech-savvy and data-driven and open to new ways to manage the business. They also report to non-family shareholders.

Autonomous power units are adopted, enabling operators to farm more acres with less labor. There is a demand for smaller HP power units. New entrants will take advantage of unmet needs.

Ag equipment dealers are challenged to recruit and retain the type of talent required to maintain autonomous power units, drones, etc.

The most trusted advisor on the farm is the person or entity that provides enterprise-wide insights.

Full implementation of the FSMA coupled with adoption of blockchain drives transparency and traceability for fruit/vegetable producers via an enterprise ag management platform integrated with PAg tools.
Corporate-like management of land combined with interoperability of PAg, ERP, and Blockchain

The farmland owning/renting model of 2018 is fundamentally different, due to massive land transfers and technology. Most land is owned by either small (hobby) farmers or large, corporate-like operators.

Imagery and in-field monitoring empowered by AI assess field conditions 24/7, make *instant economically-rational* CP decisions to manage on a plant-by-plant basis.

Distribution channels are less defined by the products they offer and more defined by *the services provided*.

Traditional channels are now services-based, providing value across multiple segments of production agriculture.

Blockchain-like technology, coupled with enterprise ag management and PAg, enable *opportunities* for purpose-grow, identity-preserved crops. *Traceability is a way of life.*
Industries Of The Future: The Trends, Companies, and Categories the Top VC Firms Are Betting On

It is difficult to provide an “apples to apples” comparison of ag tech funding to other sectors because many of the start-ups counted in slides 27-34 were developing technology for more multiple sectors or industries, to include agriculture. The data below provides insights on the number of deals, but not on absolute dollar investments.

Ranked by number of deals, early stage deals only 2010-2016

<table>
<thead>
<tr>
<th>Rank</th>
<th>Sector</th>
<th>Deals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Internet</td>
<td>2197</td>
</tr>
<tr>
<td>2</td>
<td>Mobile &amp; Telecommunications</td>
<td>894</td>
</tr>
<tr>
<td>3</td>
<td>Software (non-internet/mobile)</td>
<td>179</td>
</tr>
<tr>
<td>4</td>
<td>Healthcare</td>
<td>120</td>
</tr>
<tr>
<td>5</td>
<td>Consumer Products &amp; Services</td>
<td>110</td>
</tr>
<tr>
<td>6</td>
<td>Consumer Hardware &amp; Services</td>
<td>104</td>
</tr>
<tr>
<td>7</td>
<td>Industrial</td>
<td>39</td>
</tr>
<tr>
<td>8</td>
<td>Electronics</td>
<td>37</td>
</tr>
<tr>
<td>9</td>
<td>Business Products &amp; Services</td>
<td>36</td>
</tr>
<tr>
<td>10</td>
<td>Energy &amp; Utilities</td>
<td>27</td>
</tr>
</tbody>
</table>

### Industries smart money VCS invest in

**VCS invest in**

Ranked by number of deals, early-stage deals only 2010-2016

<table>
<thead>
<tr>
<th>Rank</th>
<th>Industry</th>
<th>Deals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Internet &amp; Software Services</td>
<td>1714</td>
</tr>
<tr>
<td>2</td>
<td>Mobile Software &amp; Services</td>
<td>776</td>
</tr>
<tr>
<td>3</td>
<td>E-commerce</td>
<td>462</td>
</tr>
<tr>
<td>4</td>
<td>Mobile commerce</td>
<td>92</td>
</tr>
<tr>
<td>5</td>
<td>Consumer electronics</td>
<td>63</td>
</tr>
<tr>
<td>6</td>
<td>IT Services</td>
<td>59</td>
</tr>
<tr>
<td>7</td>
<td>Biotechnology</td>
<td>43</td>
</tr>
<tr>
<td>8</td>
<td>Scientific, Engineering Software</td>
<td>32</td>
</tr>
<tr>
<td>9</td>
<td>Consulting &amp; Outsourcing</td>
<td>23</td>
</tr>
<tr>
<td>10</td>
<td>Medical Devices &amp; Equipment</td>
<td>21</td>
</tr>
<tr>
<td>11</td>
<td>Business Intelligence, Analytics &amp; Performance Management Software</td>
<td>19</td>
</tr>
<tr>
<td>12</td>
<td>Gaming</td>
<td>19</td>
</tr>
<tr>
<td>13</td>
<td>Renewables</td>
<td>19</td>
</tr>
<tr>
<td>14</td>
<td>Drug Development</td>
<td>17</td>
</tr>
<tr>
<td>15</td>
<td>Computer Networking Equipment</td>
<td>16</td>
</tr>
<tr>
<td>16</td>
<td>Healthcare Software</td>
<td>16</td>
</tr>
<tr>
<td>17</td>
<td>Telecom Devices &amp; Equipment</td>
<td>16</td>
</tr>
<tr>
<td>18</td>
<td>Aerospace &amp; Defense</td>
<td>15</td>
</tr>
<tr>
<td>19</td>
<td>Database Management Software</td>
<td>15</td>
</tr>
<tr>
<td>20</td>
<td>Machinery &amp; Equipment</td>
<td>14</td>
</tr>
</tbody>
</table>

### Industries smart money VCS invest in

**VCS invest in**

Ranked by number of deals, early-stage deals only 2010-2016

<table>
<thead>
<tr>
<th>Rank</th>
<th>Industry</th>
<th>Deals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Business Intelligence, Analytics &amp; Performance Management Software</td>
<td>211</td>
</tr>
<tr>
<td>2</td>
<td>Marketplace</td>
<td>166</td>
</tr>
<tr>
<td>3</td>
<td>Social</td>
<td>158</td>
</tr>
<tr>
<td>4</td>
<td>Advertising, Sales &amp; Marketing</td>
<td>123</td>
</tr>
<tr>
<td>5</td>
<td>Health &amp; Wellness</td>
<td>121</td>
</tr>
<tr>
<td>6</td>
<td>Customer Relationship Management</td>
<td>117</td>
</tr>
<tr>
<td>7</td>
<td>Education &amp; Training</td>
<td>113</td>
</tr>
<tr>
<td>8</td>
<td>Monitoring &amp; Security</td>
<td>111</td>
</tr>
<tr>
<td>9</td>
<td>HR &amp; Workforce Management</td>
<td>108</td>
</tr>
<tr>
<td>10</td>
<td>Apparel &amp; Accessories</td>
<td>99</td>
</tr>
<tr>
<td>11</td>
<td>Application &amp; Data Integration</td>
<td>84</td>
</tr>
<tr>
<td>12</td>
<td>Conferencing &amp; Communication</td>
<td>74</td>
</tr>
<tr>
<td>13</td>
<td>Gaming</td>
<td>74</td>
</tr>
<tr>
<td>14</td>
<td>Accounting &amp; Finance</td>
<td>72</td>
</tr>
<tr>
<td>15</td>
<td>Collaboration &amp; Project Management</td>
<td>70</td>
</tr>
<tr>
<td>16</td>
<td>Video</td>
<td>67</td>
</tr>
<tr>
<td>17</td>
<td>News &amp; Discussion</td>
<td>63</td>
</tr>
<tr>
<td>18</td>
<td>Payments</td>
<td>59</td>
</tr>
<tr>
<td>19</td>
<td>Data &amp; Document Management</td>
<td>52</td>
</tr>
<tr>
<td>20</td>
<td>Food &amp; Delivery</td>
<td>50</td>
</tr>
</tbody>
</table>
References, Sources, and Additional Background (1 of 2)

Page 14: USDA NASS Census of Agriculture (various years)

Page 15: USDA NASS, 2014 Tenure, Ownership, and transition of Agricultural Land Survey and USDA NASS, 2014 Farms and Land in Farms report
https://www.agcensus.usda.gov/Publications/2012/Online_Resources/Highlights/TOTAL/TOTAL_Highlights.pdf
Personal Interview with Iowa State University Extension and Outreach
Map explanation: State data is available for the 25 solid-colored states. States with dots are in regional totals only.

Page 16: Iowa State University Extension and Outreach
https://www.extension.iastate.edu/agdm/wholefarm/html/c2-78.html
“Farmland Ownership and Tenure in Iowa 2012”, revised Feb 2014

Page 17: Table: Context Expert estimates;
Graph: https://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1259
Note that the NASS data were pulled from QuickStats, which hypothetically catches all the revisions

http://apps.investigatemidwest.org/afida/

Indigo Agriculture investor presentation
McKinsey Global Institute Digital America Executive Summary December 2015


References, Sources, and Additional Background (2 of 2)


Page 36-39: The Context Network 2016 Precision Ag Multi Client Project

Page 40: The Context Network 2017 U.S. Ag Retailer Study (multi-client)

Page 47: The Context Network 2017 U.S. Ag Retailer Study (multi-client)


Page 54: 2012 Food & Health Survey: Consumer Attitudes toward Food Safety, Nutrition and Health

Page 55: USDA-ERS Organic Market Overview, Kevin Kelly Extrapolations; Food, 2014


Page 57: https://app.cbinsights.com/research/blockchain-grocery-supply-chain

Page 58: https://app.cbinsights.com/research/blockchain-grocery-supply-chain

Page 59: http://www.feedtrackur.com
Use of Images

Images that do not contain a specific citation are from a stock photo library that Context has purchased and has permission to use. However, that permission does not grant AEM the ability to re-purpose those images for other materials, such as collateral or websites. Context can provide AEM with the source of the image and AEM can purchase the rights to use the image for other purposes.
thank you
Context is the **premier global agribusiness consulting firm** helping *each client* achieve remarkable results **AND ADVANCE AGRICULTURE**

**PRACTICE AREAS WE SERVE**

- AG INVESTMENT
- AG INPUTS
- AG PRODUCTION
- AG OUTPUT DISTRIBUTION
- AG SUSTAINABILITY
- FOOD MANUFACTURERS
- FOODSERVICE & RETAIL
- AG DEVELOPMENT

**CLIENTS WE SUPPORT**

- Multinational Agribusiness Companies
- Multinational Food Companies
- Technology Providers
- Industry and Trade Organizations
- Local, Regional and National Governments
- NGOs, Private Institutions and Charitable Organizations

**SERVICES WE PROVIDE**

<table>
<thead>
<tr>
<th>STRATEGIC Consulting</th>
<th>MANAGEMENT Consulting</th>
<th>INSIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Developing a Strategy</td>
<td>- Product/Portfolio Management</td>
<td>- Industry Benchmarking</td>
</tr>
<tr>
<td>- Analyzing Market Attractiveness</td>
<td>- Strategy Implementation</td>
<td>- Future Outlooks</td>
</tr>
<tr>
<td>- Assessing Opportunities</td>
<td>- Operational Efficiency</td>
<td>- Competitive Intelligence</td>
</tr>
<tr>
<td>- Conducting R&amp;D Optimization</td>
<td>- Regulatory Compliance</td>
<td>- Market Research</td>
</tr>
<tr>
<td>- Market Entry &amp; Go-to-Market Analysis</td>
<td>- Alliance &amp; Acquisition Support</td>
<td>- Multi-Client Reporting</td>
</tr>
<tr>
<td></td>
<td>- Program Evaluation</td>
<td></td>
</tr>
</tbody>
</table>