Drones and Autonomous Vehicles in Agriculture

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Employment Trends Nationwide

- Current unemployment is in U.S. 3.7%
  - Down from 6.7% in 2014
- Washington unemployment 4.3%
  - Down from 5.4% in 2016
- Unemployment of 4% is target
- Agriculture unemployment is non-existence
Employment trend from 2004-2018
Ag Graduates, Nationwide

Agriculture students make up less than 1% of the total number of students enrolled in postsecondary education. I really AM the 1%!
Unemployment?
Where?
Where are the career opportunities
(national data base, AgCareers.com)

Seven categories

-- Agribusiness Systems
-- Animal Systems
-- Environmental Service Systems
-- Food Products & Processing Systems
-- Natural Resources Systems
-- Plant Systems
-- Power Structural & Technical Systems
What is the employment situation in Agriculture?

Any Idea?
What is the employment situation in Agriculture?

- 3:1 ratio

Employment opportunity (Job): Agricultural based graduate

(source: AgCareers.com 2018 data/research findings)
What is a Precision Ag Specialist?

Definition:

**Job Description:** Apply geospatial technologies, including geographic information systems *(GIS)* and Global Positioning System *(GPS)*, to agricultural production or management activities, such as pest scouting, site-specific pesticide application, yield mapping, or variable-rate-rate irrigation. Use of computers to develop or analyze maps or remote sensing images to compare physical topography with data on soils, fertilizer, pests, weather and determine economic analysis on financial viability of agricultural business.
- Unmanned spraying helicopters
- Agricultural drone (multi functional)
- Agriculture drones (data services)
- Agricultural drones (data scouts)
- Robotic implements (simple vision tech for organic farms)
- Robotic intelligent implements (weeding)
- Robotic fresh fruit picking
- Robotic strawberry harvesting
- Autonomous tractors (fully unmanned autonomy or level 5)
- Autonomous tractors (autosteer or level 4)
- Autonomous tractors (tractor guidance)
- Autonomous agricultural small robots (multi platform)
- Autonomous agricultural small robots (weeding)
- Autonomous agricultural small robots (data scouts)
- Mobile dairy farm robotics
- Static milking robots
CHN Tractor and Planter
CHN Tractor & Ford/New Holland Planter
Blend of all machinery companies working together, Kinze mgf in Iowa
Autonomous Farming Equipment
What is a UAS or Drones?

**Definition**: FAA published a document in 2013 classifying anything flying without a pilot/crew; tethered by radio control link or preprogrammed

- 1990 FAA authorized the use of unmanned aircraft in the National Air Space (NAS)
- Currently not legal in Class B airspace
- FAA issued a 75 page document that is more specific to the type of operation intended by the pilot in command (PIC) in 2013
- Hobbyist and development of First Person View (FPV)
Where have we seen the use of UAS? or as many of us know them as “Drones”

- Movie Industry
  - Tom Selleck movie “Run Away” 1984
  - Gene Hackman and Will Smith movie “Enemy of the State” 1998
- PBS Special “Rise of The Drones” 2013
  - NOVA Special
The Rise of UAS or Drones
Rise of UAS or Drones

It is all about Precision Agriculture (PA)
Blend of GPS, GIS, Technology & Management
In terms of UAS we are in the same place we were with biplanes right after WWI, what is the potential of UAS?

David Deptula, retired Air Force
PBS special, Rise of the Drones, 2013
Rise of UAS or Drones

- Revolutionary War

- WWII
  - Selected reconnaissance planes

- Cold war and Vietnam era
  - Skunk works project late 50’s and early 60’s
  - U-2 (1957) SR-71 (1964)
  - Boeing Museum of flight

- Current Military situation
  - Drones in Afghanistan (10,000) view from 5 miles
  - Use of F-16
Rise of UAS or Drones

Engineer Mr. Karem is an aeronautical engineer who designed military aircraft with support from Defense Advanced Research Projects Agency (DARPA) is the father of the albatross concept UAV or UAS or Drones
Military Drones/UAS

7,362 RQ-11 Ravens
990 AeroVironment Wasp Ills
1,137 AeroVironment RQ-20 Pumas
306 RQ-16 T-Hawk (small UAS systems)
246 Predators & MQ-1C Grey Eagles
126 MQ-9 Reapers & 491 RQ-7 Shadows
33 RQ-4 Global Hawk (large platform 36 hours flight time)
<table>
<thead>
<tr>
<th>Military Drones/UAS utilization/Search &amp; Rescue</th>
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<tbody>
<tr>
<td>- Security and Control</td>
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<tr>
<td>- Battlefield Management</td>
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<tr>
<td>- Chemical, Biological, Radiological and Nuclear</td>
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<tr>
<td>- All Terrain search and rescue</td>
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<td>- Secure communication</td>
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<td>- Anti-Tank Missiles</td>
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<td>- Wide Area Munition Depolyment</td>
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<td>- Waterways &amp; Shipping</td>
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<td>- Pollution Control &amp; Air Sampling</td>
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<tr>
<td>- Air to Ground missiles</td>
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<td>- Air to Air Missiles</td>
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Ag Drones/Other Key Players

3D Robotics Inc.
AeroVironment
Agribotix LLC
AutoCopter Corp.
Delair-Tech SAS
DroneDeploy
Eagle UAV Services
Honey Comb Corp.
Parrot SA
Trimble Navigation Limited
Yamaha Motor
Ag Drones on the market

1. AG Eagle LLC  Fixed wing  (Raven Industries)
2. DJI (2017 revenue 2.7 billion)
   New Zenmuse XT2 thermal imaging camera, MOU w/Dow/AвиATION for crop protection in China
3. Sentera LLC,
   builds for ag, mining, security & public safety
   Crop health data measurement in a single flight, NDVI & high res RGB
4. Aribotix LLC partnered with AgCo “all-in-one”
   FarmLens, clud based launched in 2015
5. Precisionhawk  Sydney, Australia
   Mgf. of drones, software, sensors, analytics, consulting, drone pilot network
   2018 raised 75 million in venture capital
   Deliver new algorithm detects wheat nitrogen levels from drone-collected imagery
Projected application of Drone technology

- Wildland mapping (conservation of animals)
- News coverage, sporting events, movie industry
- Humanitarian Aid & Disaster Management (mobile drone stations)
- Law enforcement
- Defense
- Telecommunications (mobile drone stations)
- Weather monitoring
- Maritime
- Freight transportation (normal, emergency, pizza)
- Aerial imaging/mapping
- Pizza delivery
- Agricultural Monitoring
- Disease control
List of Drone Utilization in Agriculture

**Soil and field analysis**
- 3-D maps for soil analysis for planting, seeding patterns, irrigation and nitrogen-level management.

**Planting**
- Drone planting systems to improve uptake rate and planting cost, site-specific nutrient

**Crop Spraying**
- With distance-measuring equipment, ultrasonic echoing and lasers (LiDAR)
- Estimates that the drone will be 5 times faster than traditional equipment
List of Drone Utilization in Agriculture

- **Crop monitoring**
  ◦ Capable of providing time-series animation, showing precise development of a crop & production inefficiencies

- **Irrigation**
  ◦ Hyperspectral, multispectral or thermal sensors isolate dry sections in the field

- **Health assessment**
  ◦ Spot bacterial or fungal infections on plants (annual or orchards) using visible or near-infrared light
  ◦ Document of insurance claims
Projected growth Agricultural Drone Growth

- Valued at 670+ million in 2017

(Data from 14 industry segments serving 600 clients in ag.)
What is a Precision Ag Specialist?

Agricultural production or management activities
- Pest scouting
- Site-specific pesticide application
- Yield mapping
- Variable-rate irrigation
- Analyze maps or remote sensing images to compare physical topography with data on soils, fertilizer, pests, or weather
- Analyze profitability of agricultural enterprises
- Equipment designer for major companies
What are some of the tools of a Precision Ag Specialist?

- Agricultural Based Education
- Computer and software knowledge
- Network and Transportation
- Ability to see the field
  - Remote satellites, airplane, UAS
  - Land based systems, tractors and working units
What are Challenges at the WSU

- Curriculum changes
  ◦ Additional course work
  ◦ Revision of current courses
- Matching up industry needs with curriculum
  key: industry needs to have direct connection with programs
How do We Address these Challenges

- Vision
  ◦ Advisory groups to help drive the education process

- Needs at the University
  ◦ Basic funding into these evolving programs
    ◦ (faculty support through endowments)
    ◦ (facility development, building-class room)
What is happening at WSU

- 1995  Introduced Precision Ag
- 1998 Western Precision Ag Conference
  ◦ Pasco, 325 people attendance
- 1999 Western Precision Ag Conference
  ◦ Boise, similar attendance
What is happening at WSU

- Changes in curriculum
  ◦ AgTM 305 Basic precision ag.
  ◦ AgTM 405 Advanced precision ag
  ◦ Soils 368 Intro to GIS
  ◦ Soils 374 Introduction to remote sensing
  ◦ BioSy 491
  ◦ China 30 programs
Current Activities

AgTM 305 & 405 Classes
- Purchased 2 DGI drones with funding from Carol Quigg
- Students in both classes learn to fly the drone
- During summers work with Hinrichs Trading Company
  - Supervise the summer internship program
  - Interns fly two drones to evaluate chick peas for any variation they can detect in the field
    - Much easier to walk to the site and examine, pull samples send to WSU lab.

BSysE 491  Advanced Topics “Unmanned Aerial Systems in Ag”
new for spring 2019
Current Activities on UAS

- At WSU we are at the adoption phase of technology
- Like to think we are on the leading edge of technology, not the bleeding edge.
- Analogy compared to software in 1998
  - 15 companies at our WPAC in 1998
  - Today many changes and fewer companies
Rise of UAS or Drones
What is best for you?

- Number 1 “What is the Objective”
- Number 2 as to investment what is ROI?
- Don’t wait because you will be behind the adoption curve.
- Number 3 Adhere to the FAA regulations
Future Activities
“Agriculture is the only industry that we think about three times a day”
Questions?

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