

# Maximizing the Probability of New Technology Adoption Success

John K. Schueller  
University of Florida  
*[schuejk@ufl.edu](mailto:schuejk@ufl.edu)*

1934 (!!!) World's Fair



# John K. Schueller

- Professor of Mechanical and Aerospace Engineering
- Affiliate Professor of Agricultural and Biological Engineering
- Chair, Mechanical Engineering Program Committee
- Director, Center for Manufacturing Innovation
  
- Editor-in-Chief, *Computers and Electronics in Agriculture*
- Fellow, Society of Automotive Engineers
- Fellow, American Society of Agricultural and Biological Engineers
- Fellow, International Academy of Agricultural and Biosystems Engineering
- Honorary Vice-President, International Commission of Agricultural and Biosystems Engineering
- Founder Member, European Society of Agricultural Engineers
- Management Committee, Club of Bologna
- Life Member, Indian Society of Agricultural Engineers
- Senior Member, Society of Manufacturing Engineers
- Member, American Society of Mechanical Engineers
- Member, Institute of Electrical and Electronics Engineers
- Member, American Society for Engineering Education

## Generalist with wide exposure

- > 40 countries visited
- > 400 graduate student supervisory committees in ten majors
- Worked at universities in Indiana, Texas, Germany, Japan, and Malaysia
- Worked for small, medium, and large (Caterpillar) companies
- Gets about 50 magazines/month



# John K. Schueller

- Professor of Mechanical and Aerospace Engineering
- Affiliate Professor of Agricultural and Biological Engineering
- Chair, Mechanical Engineering Program Committee
- Director, Center for Manufacturing Innovation
  
- Editor-in-Chief, *Computers and Electronics in Agriculture*
- Fellow, Society of Automotive Engineers
- Fellow, American Society of Agricultural and Biological Engineers
- Fellow, International Academy of Agricultural and Biosystems Engineering
- Honorary Vice-President, International Commission of Agricultural and Biosystems Engineering
- Founder Member, European Society of Agricultural Engineers
- Management Committee, Club of Bologna
- Life Member, Indian Society of Agricultural Engineers
- Senior Member, Society of Manufacturing Engineers
- Member, American Society of Mechanical Engineers
- Member, Institute of Electrical and Electronics Engineers
- Member, American Society for Engineering Education

## Generalist with wide exposure

- > 40 countries visited
- > 400 graduate student supervisory committees in ten majors
- Worked at universities in Indiana, Texas, Germany, Japan, and Malaysia
- Worked for small, medium, and large (Caterpillar) companies
- Gets about 50 magazines/month

• Old

## Difficult to predict best technology adoptions

- **Which** technologies to adopt
- **What** characteristics and parameters they should have
- **Who** should supply them to you
- **Where** they will be appropriate
- **When** they will make sense



## Can make a rough division into two major categories

- “Systems” technologies
- “Drop-In” technologies

Great differences in ...

- Complexity of evaluation
- Rate of adoption



## Agriculture 4.0 – the Challenges Ahead & What to Do About Them



## Can make a rough division into two major categories

Great differences in ...

- Complexity of evaluation
  - Rate of adoption
- 
- **Systems technologies** --- adoption of a technology will have impacts throughout the system
  - **Drop-In technologies** --- adoption of a technology will only impact where it is dropped



# Classic Agricultural Systems Technology --- Replace Horses and Mules with Tractors

- It took over forty years to have the needed manufacturing, distribution, dealer, fuel, service, implements, training, etc., systems throughout the USA

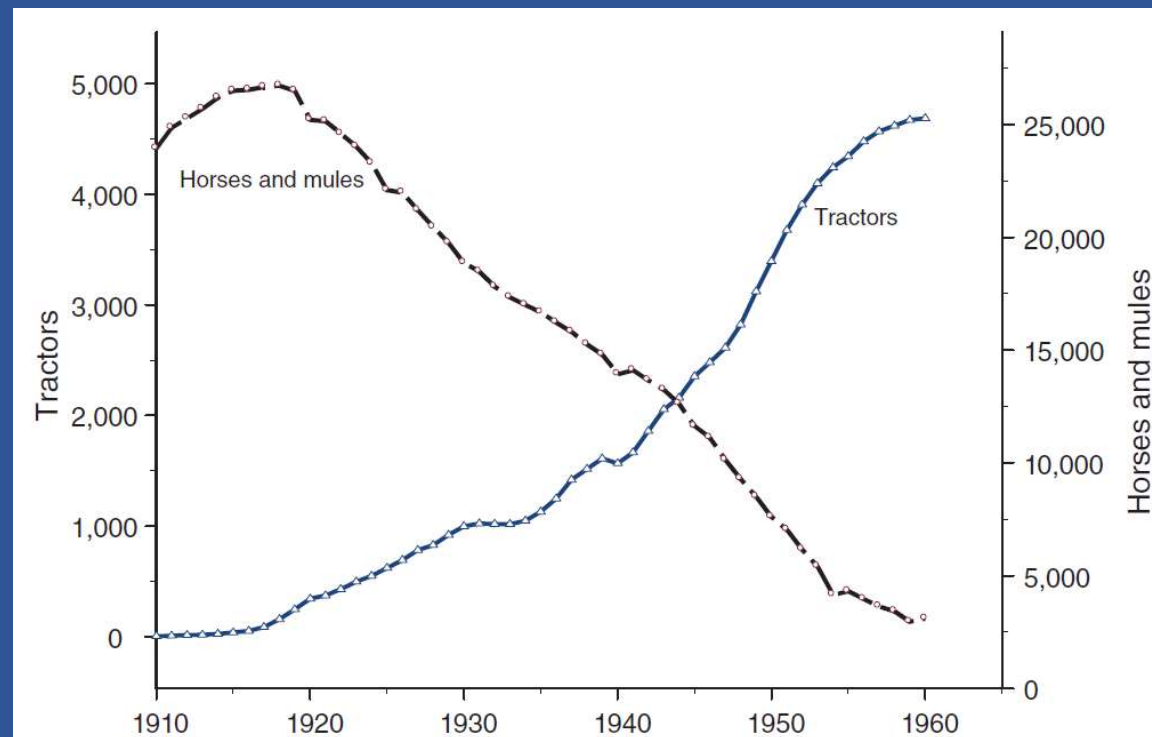


FIGURE 1. HORSES, MULES, AND TRACTORS IN FARMS: 1910–1960

# Classic Agricultural Drop-In Technology --- Hybrid Seed Corn

Note the rapid adoption because just put new seed into planter

Florida Example:

Sugar cane harvest: 30% mechanized in 1987  
100% mechanized in 1993

(expedited by Simpson-Mazzoli Act)

January, 1950

Research Bulletin 372

## Acceptance and Diffusion of Hybrid Corn Seed in Two Iowa Communities

By BRYCE RYAN AND NEAL CROSS

AGRICULTURAL EXPERIMENT STATION  
IOWA STATE COLLEGE OF AGRICULTURE  
AND MECHANIC ARTS

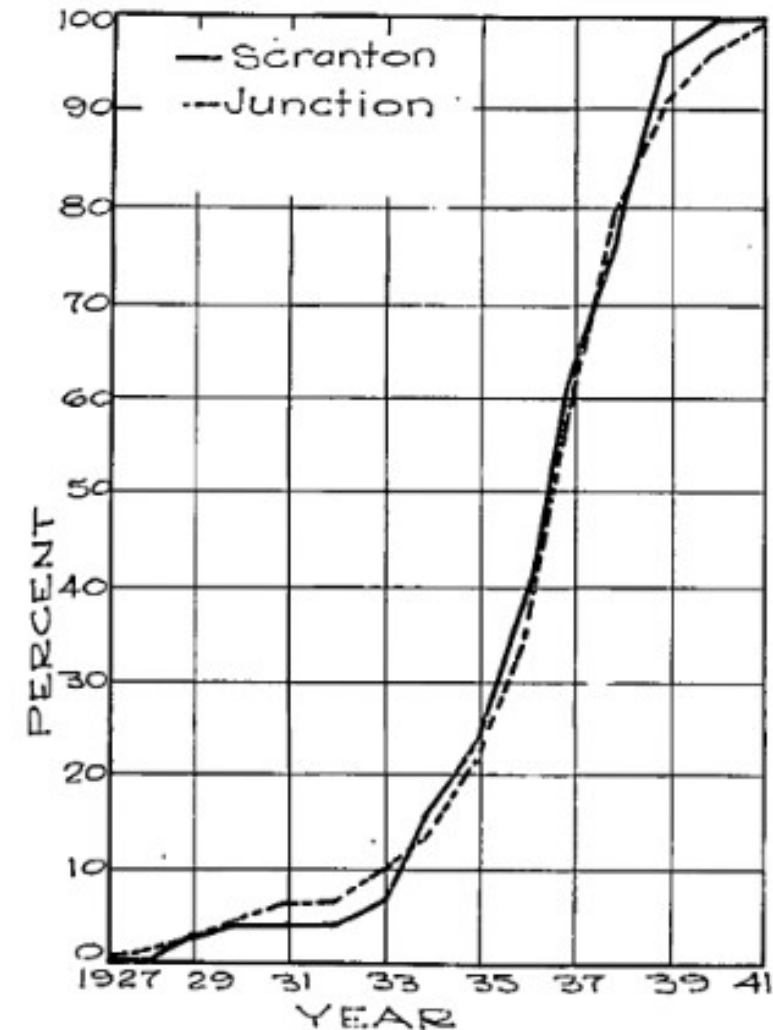


Fig. 1. Cumulative percentages of operators accepting hybrid seed in the two communities during each year of the diffusion process.



# Contemporary Drop-In Technology --- GPS Steering

When buying a new tractor, it is easy to buy one with GPS steering

GPS STEERING THE FASTEST  
TECHNOLOGY ADOPTION IN HISTORY OF  
AGRICULTURE  
May 5, 2008

American farmers have been very quick to adopt GPS steering technology over the past few years. According to a just-released industry study, GPS steering adoption rates may go down in history as the fastest ever. So concludes Caledonia Solutions, a business research and consulting firm in Minneapolis.

<https://www.agrimarketing.com/s/49157>

[assets.cnhindustrial.com](http://assets.cnhindustrial.com)



### THE INTEGRATED APPROACH

- PRECISION • PRODUCTIVITY • PORTABILITY**  
Reap the benefits of a very capable single screen solution. Performance monitor, vehicle set-up, record keeping, mapping, video and AFS AccuGuide™ are all in one place – on the AFS Pro 300 or AFS Pro 700 touch screens and 100% part of your operating environment.
- PLUG AND PLAY CORE COMPONENTS**  
Navigation controller, AFS Pro screen & AFS 372 receiver can easily be used with your entire Case IH fleet.
- FLEXIBILITY**  
With a range of accuracies (OmniSTAR® HPXP or RTX/HPXP/G2) your investment remains completely flexible.
- OPTIMISE YOUR OPERATION**  
Navigation controller with T3™ enhanced compensation technology improves accuracy when driving straight lines across sloping terrain.



#### MULTIPLE ACCURACY LEVELS

OMNISTAR® HP 5.0CM	OMNISTAR® HP 10.0CM
RTX 2.5CM	RTX ELEM8SS 3.0CM

#### COMPATIBLE DISPLAYS



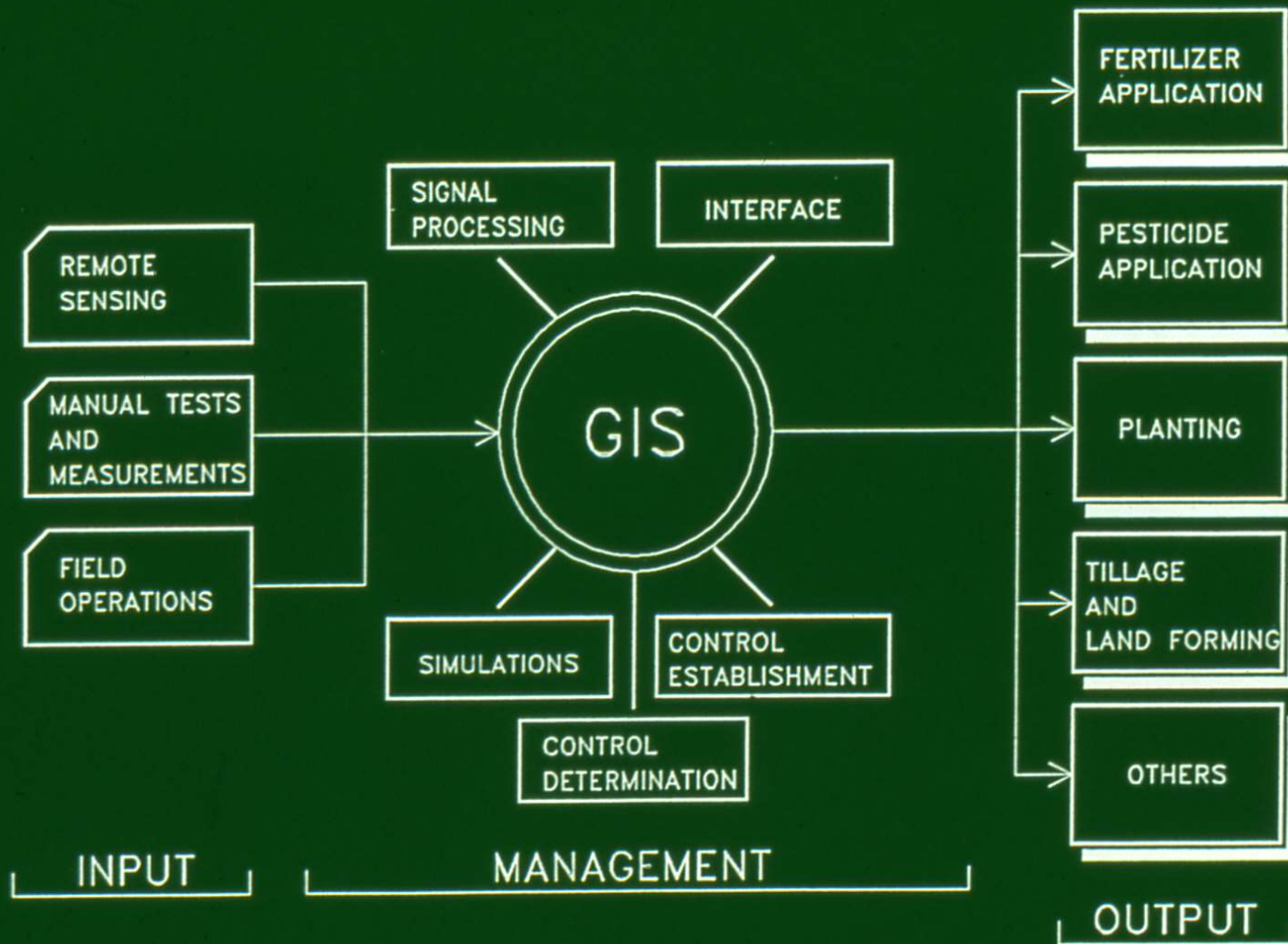
AFS Pro 300



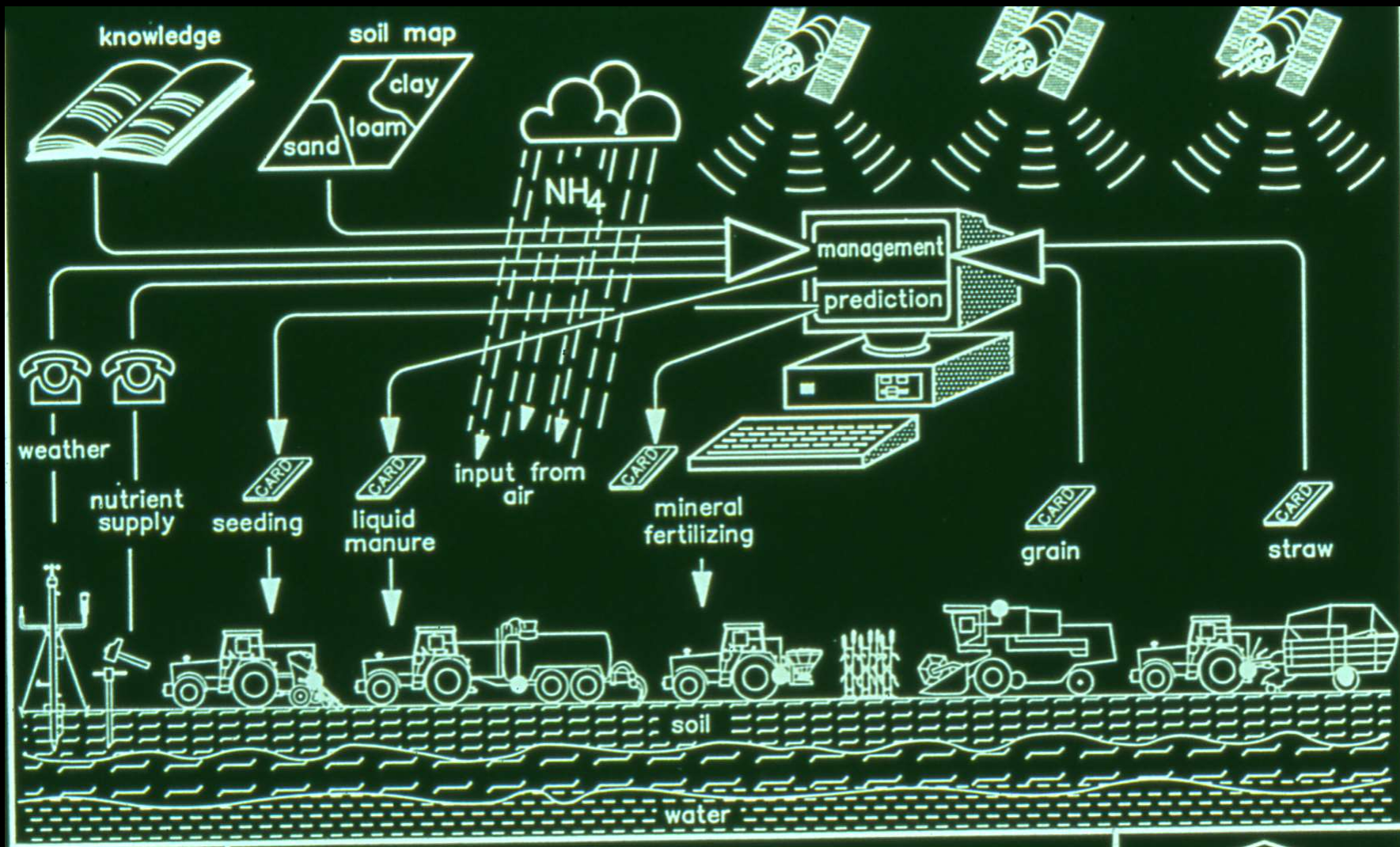
AFS Pro 700

8

Contemporary  
Systems  
Technology---  
Precision  
Agriculture



INTEGRATED SPATIALLY-VARIABLE DATA FLOW



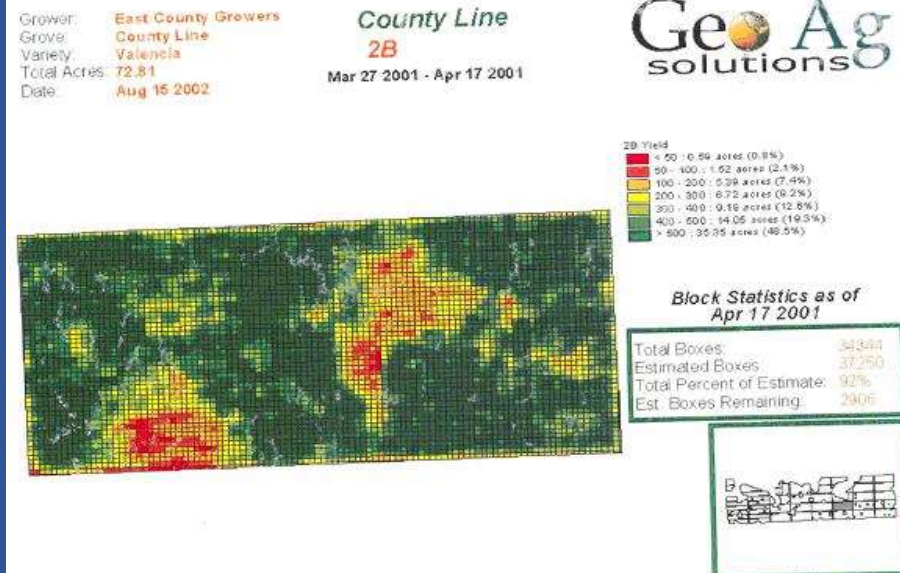
Auernhammer, H. and J.K. Schueller. 1999. Precision farming. In B.A. Stout and B. Cheze, eds., CIGR Handbook of Agricultural Engineering



## An Example Technology Which Was NOT Successful

- Required extra effort at busy time
- Did not automatically integrate in production management system
- Economic value not completely obvious

Schueller, J.K., J.D. Whitney, T.A. Wheaton, W.M. Miller, and A. E. Turner. 1999. Low-cost automatic yield mapping in hand-harvested citrus. *Computers and Electronics in Agriculture*. 23(2): 145-153.



# But Efforts for Technology Adoption Should Continue



Wild, K.M., T. Schmiedel, and J.K. Schueller. 2018. Measuring the sharpness of knives in agricultural machinery with a mobile device. ASABE 1801602

## ZeloSens ©

**Das Messerschärfe - Handmessgerät**



**Immer scharfe Messer durch die Bestimmung des optimalen Schleif- und Austauschzeitpunkt Ihres Messers**

**Messung der Schärfe bei jedem beliebigen Messer**

**Nutzung für alle landwirtschaftlichen Messer**

- Feldhäcksler
- Ladewägen
- Ballenpressen
- Mähdrrescher
- Mähwerke

**Optimierung der Schleifstrategie durch**

- Kein unnötiges Schleifen mehr
- Verlängerung der Messerstandzeit
- Verringerung des Dieselverbrauchs
- Verbesserung der Häckselqualität

**Einfache Bedienung per Smartphone**



- Eingabe des Messertyps
- Eingabe der Erntebedingungen (falls gewünscht)
- Aufsetzen des Messgerätes
- Ablesen des Schärfewertes
- Empfehlung für Schleifen oder Messeraustausch





Zentrum für  
angewandte Forschung  
und Technologie e.V.  
an der HTW Dresden





Gefördert durch:



Bundesministerium  
für Wirtschaft  
und Energie

aufgrund eines Beschlusses  
des Deutschen Bundestages

## “Look before you leap”:

- What are the effects of the technology throughout the system?
  - Even “drop-in” can have system effect, especially on system reliability

“In the early 1960s, seed corn companies began to use male sterile cytoplasm so that they could eliminate the previous need for hand detassling to save both money and time. This seed was eventually bred into hybrid crops until there was an estimated 90% prevalence of Texas male sterile cytoplasm (Tcms) maize, vulnerable to the newly generated Race T. The disease, which first appeared in the United States in 1968, reached epidemic status in 1970 and destroyed about 15% of the corn belt's crop production that year. In 1970 the disease began in the southern United States and by mid-August had spread north to Minnesota and Maine. It is estimated that Illinois alone suffered a loss of 250 million bushels of corn to SCLB. The monetary value of the lost corn crop is estimated at one billion US dollars.” Wikipedia



## “Look before you leap”:

- What are the effects of the technology throughout the system?
  - Even “drop-in” can have system effect, especially on system reliability
- What are the effects on sustainability?
  - Economic
  - Environmental
  - Social/Political (Will we have another “Simpson-Mazzoli”?)



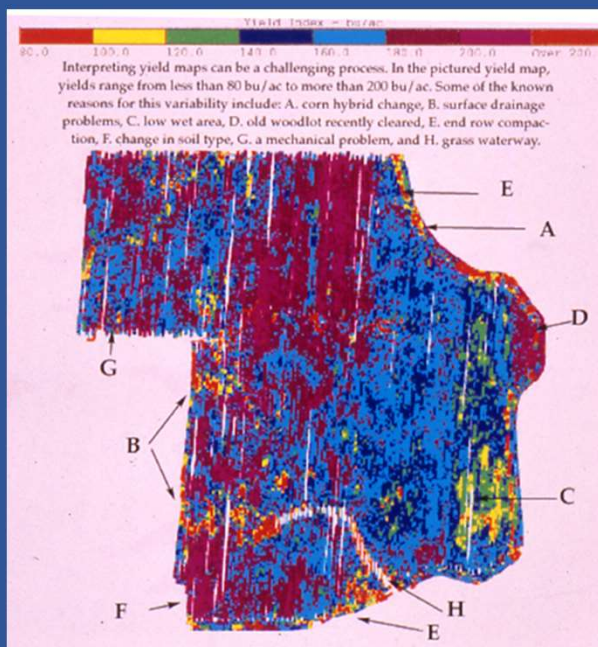
[www.caseih.com](http://www.caseih.com)

[www.deere.com](http://www.deere.com)



## “Look before you leap”:

- What are the effects of the technology throughout the system?
  - Even “drop-in” can have system effect, especially on system reliability
- What are the effects on sustainability?
  - Economic
  - Environmental
  - Social/Political
- Will system outputs be improved?



## “Look before you leap”:

- What are the effects of the technology throughout the system?
  - Even “drop-in” can have system effect, especially on system reliability
- What are the effects on sustainability?
  - Economic
  - Environmental
  - Social/Political
- Will system outputs be improved?
- Can perturbations and local failures be tolerated?
  - Redundancies
  - “Limp-home” modes

“Limp Home Mode (LHM)

Limp home mode is a set of parameters the engine computer will use as a strategy to get you home without causing further damage to the drive-train of your car.

It means the computer noticed something wrong or lost contact with an important sensor that could ruin the engine or transmission and has de-rated the power so you can get home without the car stopping or damaging itself.” [www.quora.com](http://www.quora.com)

## “Look before you leap”:

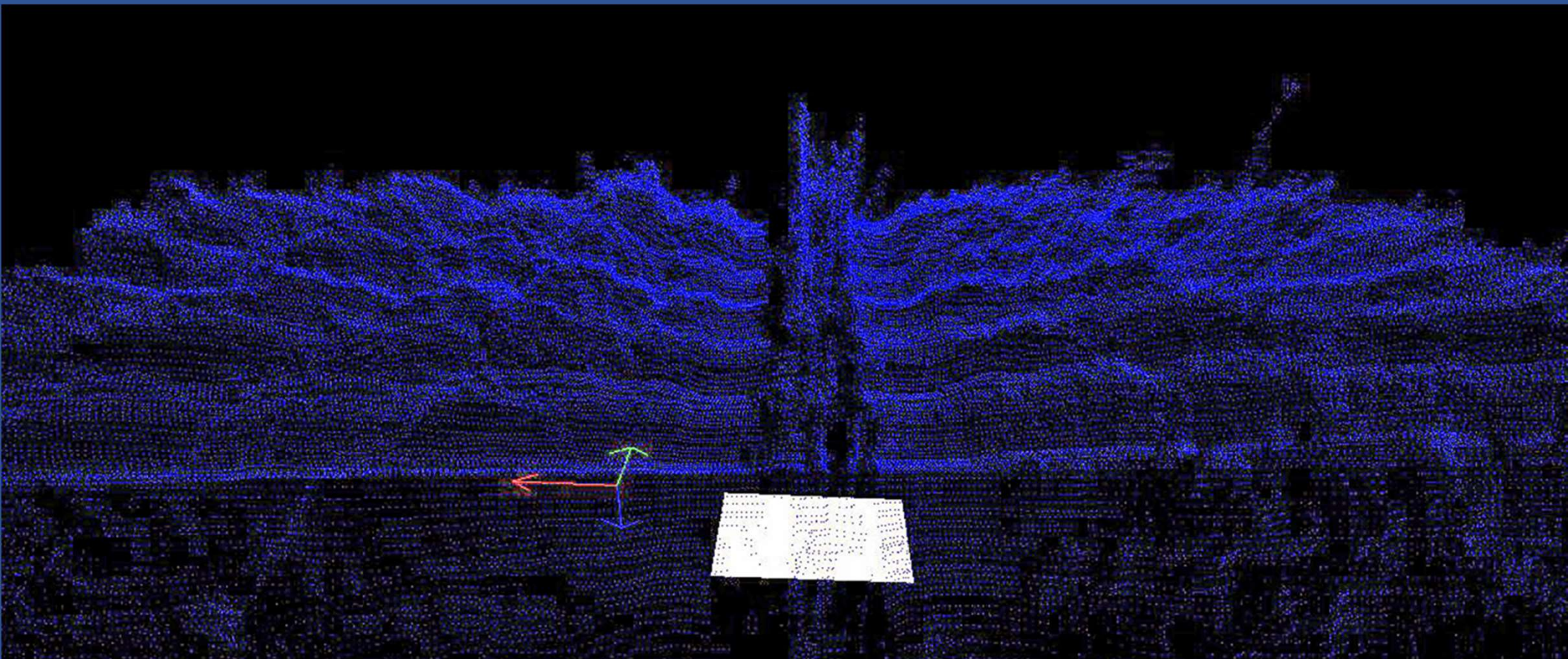
- What are the effects of the technology throughout the system?
  - Even “drop-in” can have system effect, especially on system reliability
- What are the effects on sustainability?
  - Economic
  - Environmental
  - Social/Political
- Will system outputs be improved?
- Can perturbations and local failures be tolerated?
  - Redundancies
  - “Limp-home” modes
- Is the technology mature enough for adoption?



In my opinion ...

Biggest machinery engineering issue is accurate and reliable sensors

(Example: My unsuccessful attempt to use a laser scanner to find watermelon)



## But there are real advances in such fields as...

- Computing speed
- Machine vision
- Spectral sensing
- Artificial intelligence
- Networking
- Datamining
- Autonomous vehicles
- Etc., etc.

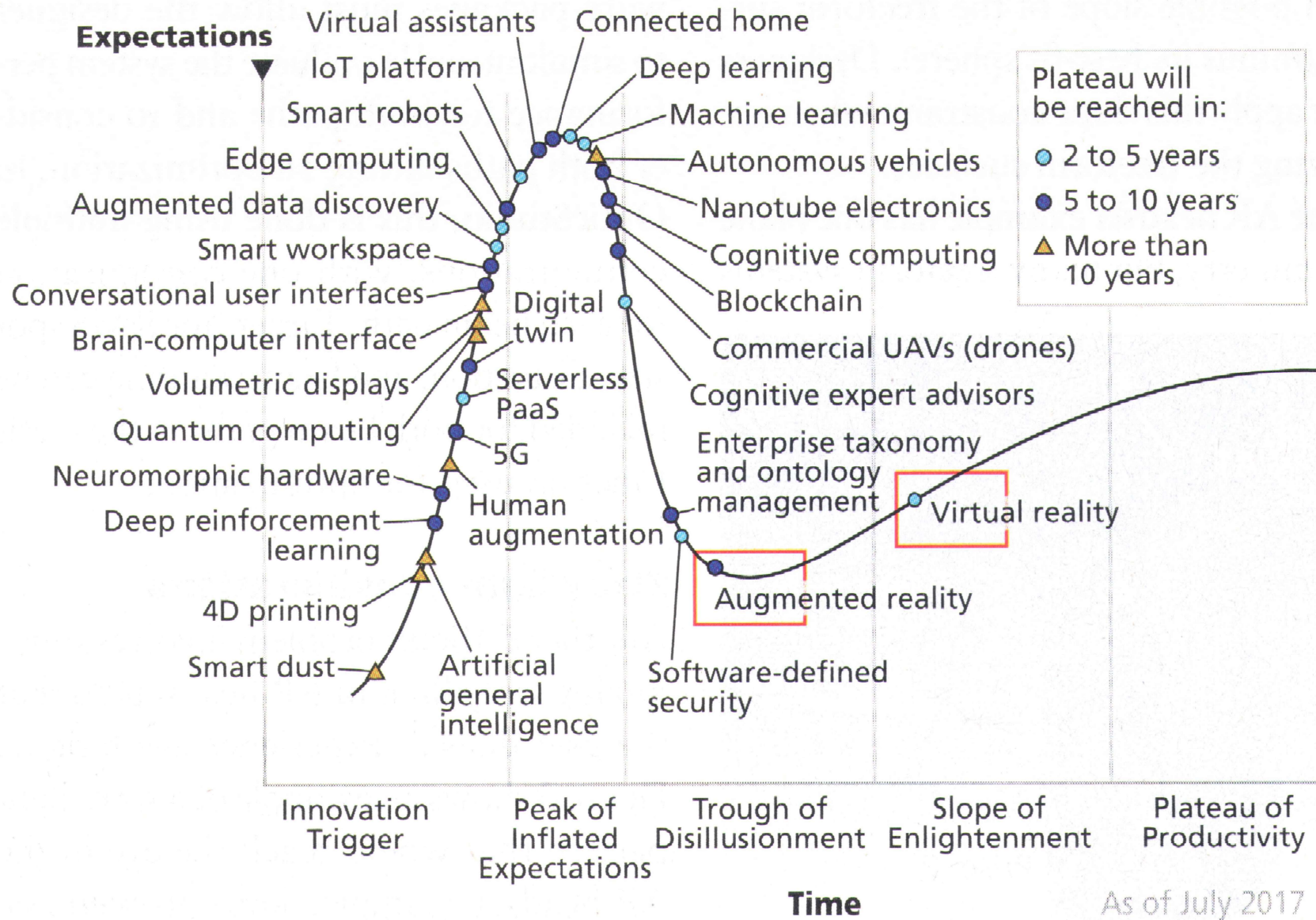


# Neglecting the Hype, When Will They Be Productive?

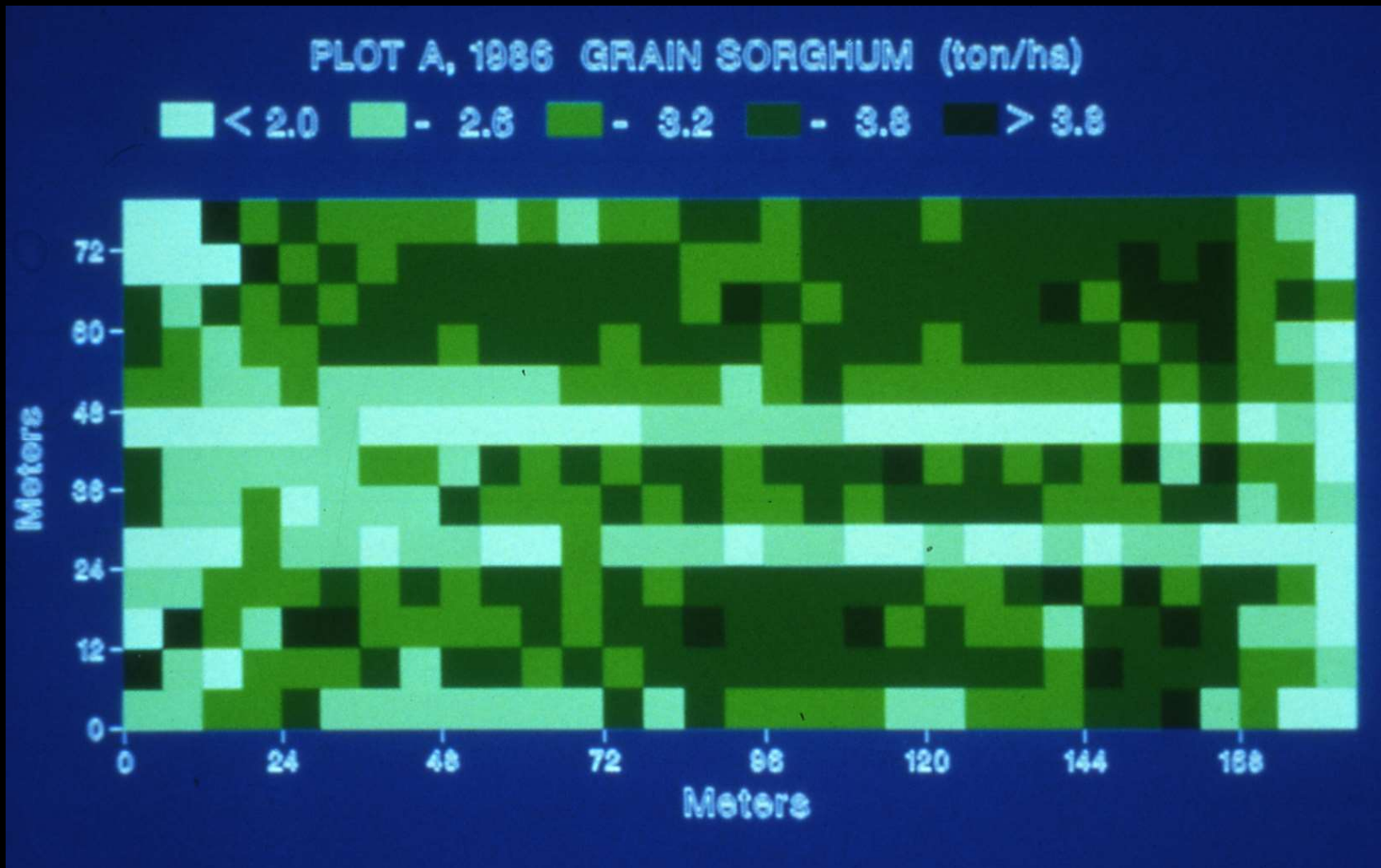
Gartner Hype Cycle

Gartner, Inc.

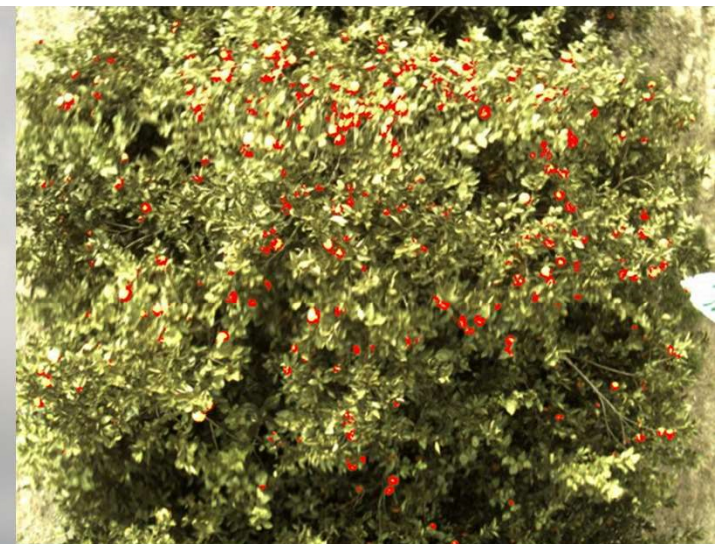
[www.laserfocusworld.com](http://www.laserfocusworld.com)



## Research Often Takes Time to Widespread Commercial Adoption

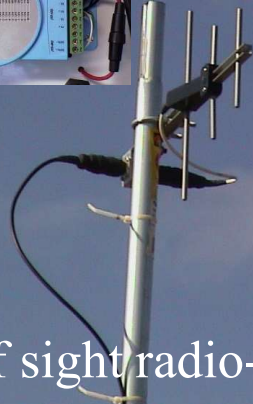




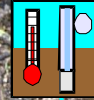
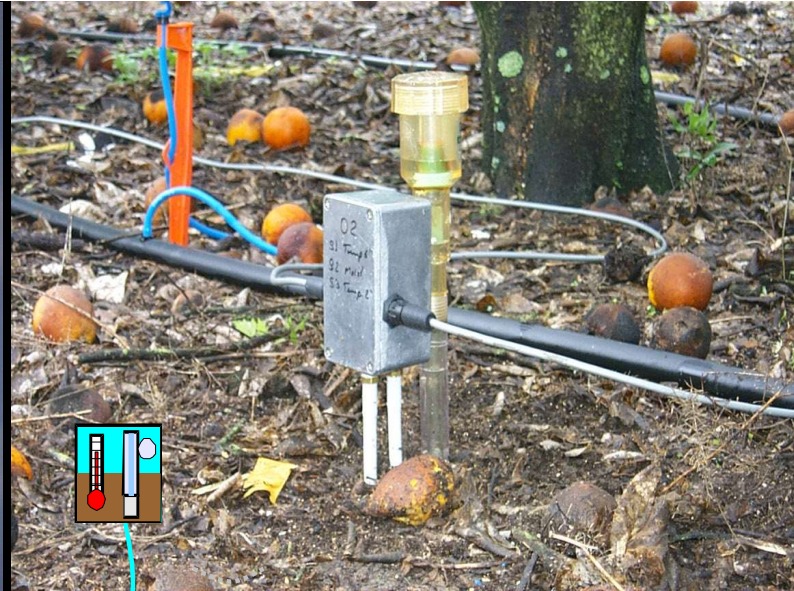


**MacArthur, D.K., J.K.  
Schueller, W.S. Lee, C.D.  
Crane, E.Z. MacArthur,  
and L.R. Parsons. 2006.  
Remotely-piloted  
helicopter citrus yield  
map estimation. ASABE  
Paper No. 063096.**

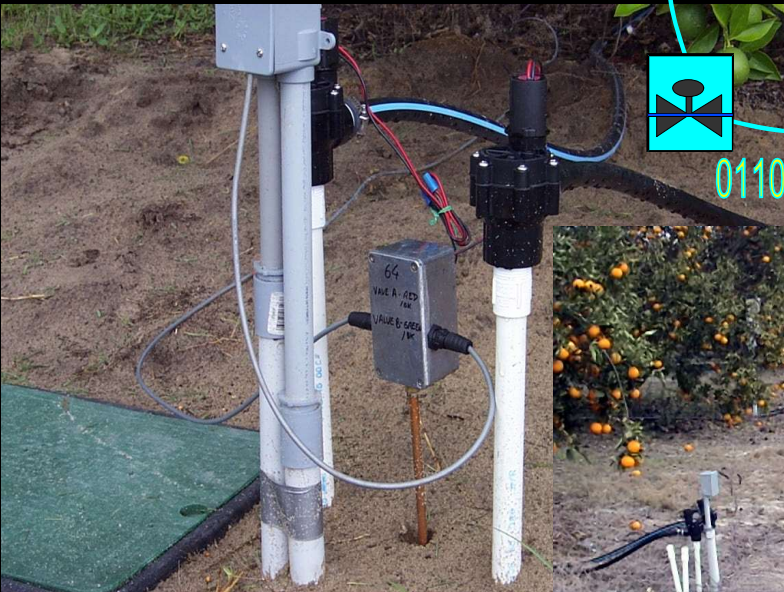




Line of sight radio-modem



011010011





Microsoft Excel - Janeiro2001

Arquivo Editar Exibir Inserir Formatar Ferramentas Dados Janela Ajuda

Arial 8

C23 = 0.36

GEO255 1/3/01		Rain mm	Matric Potential 6" cbar	Matric Potential 6" cbar	Matric Potential 6" cbar
	Ground	Row:sensor 1:1	Row:sensor 1:2	Row:sensor 1:3	Row:sensor 1:4
1					
2	0:00	0	6.74	6.86	7.1
3	1:00	0	6.68	6.81	6.6
4	2:00	0	6.65	6.76	6.4
5	3:00	0	6.57	6.79	5.7
6	4:00	0	6.74	6.91	6.2
7	5:00	0	6.69	6.86	6.1
8	6:00	0	6.7	6.85	6.0
9	7:00	0	6.86	6.98	6.8
10	8:00	0	6.96	7.03	7.1
11	9:00	3	7.21	7.48	7.5
12	10:00	8	7.28	7.12	8.5
13	11:00	1	6.42	6.62	7.2
14	12:00	0	3.44	4.03	0.97
15	13:00	0	0.14	0.53	0.91
16	14:00	0	0.05	0.23	0.4
17	15:00	0	0	0	0
18	16:00	0	0.02	0.02	0.02
19	17:00	0	0.1	0.1	0.1
20	18:00	0	0.23	0.23	0.23
21	19:00	0	0.25	0.25	0.25
22	20:00	0	0.28	0.28	0.28
23	21:00	0	0.36	0.36	0.36
24	22:00	0	0.37	0.37	0.37
25	23:00	0	0.38	0.38	0.38
26					
27	<b>Minimas</b>		0		
28	<b>Máximas</b>		0		
29	<b>Médias</b>		0.00		
30					
31	<b>Total/dia</b>	<b>0.00</b>			
32					
33	<b>GEO 255</b>		<b>Matric Potential 6" cbar</b>		
34	0:00	0			
35	0:05	0			
36	0:10	0			

Pronto

GEO255 Collect.vi

File Edit Operate Project Windows Help

13pt Application Font

### Geo255 - Agricultural fixed instrumentation system

Temperature 6" (°C)  
Position 2:4

Version 1.0

Reading cycle (sec) 0 COM: 3

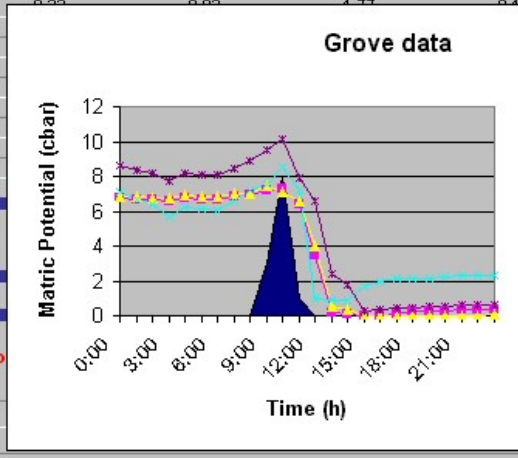
Time/Date 09/19/2000 11:27

Saving interval (min) 5

Saving mode Save to Excel

Logging

Stop



Latching Solenoid.vi

File Edit Operate Project Windows Help

13pt Application Font

### LATCHING VALVE CONTROL

Enable control

Valve A Valve B

Flow reading

0 gl

RESET

ID 51 Serial port 0 Status serial 0 STOP



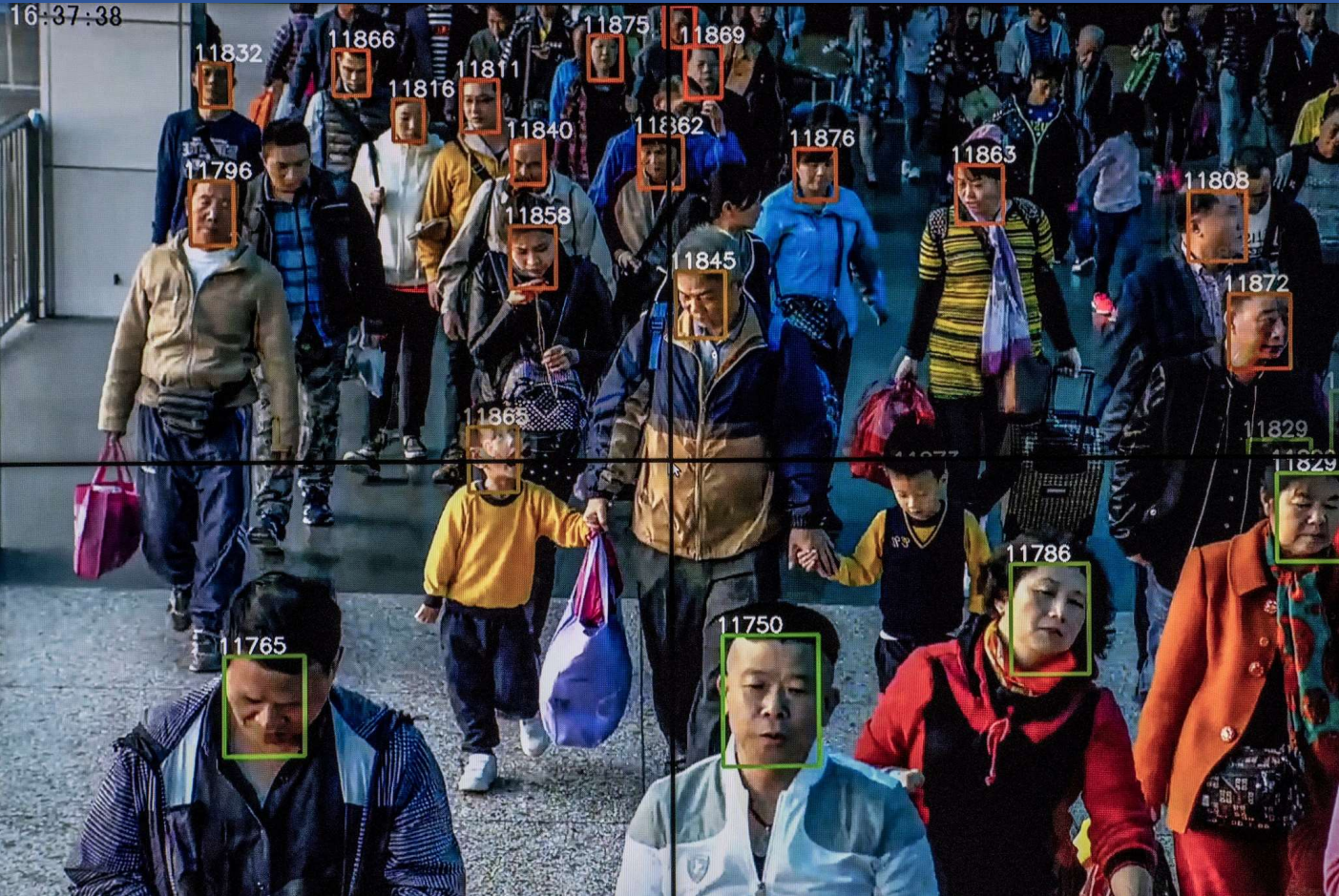




**Agricultural Technologies Will Benefit If Parallel Work in Related Other Private and Public Sector Applications**

# Agricultural Technologies Will Benefit If Parallel Work in Related Other Private and Public Sector Applications

Megvii



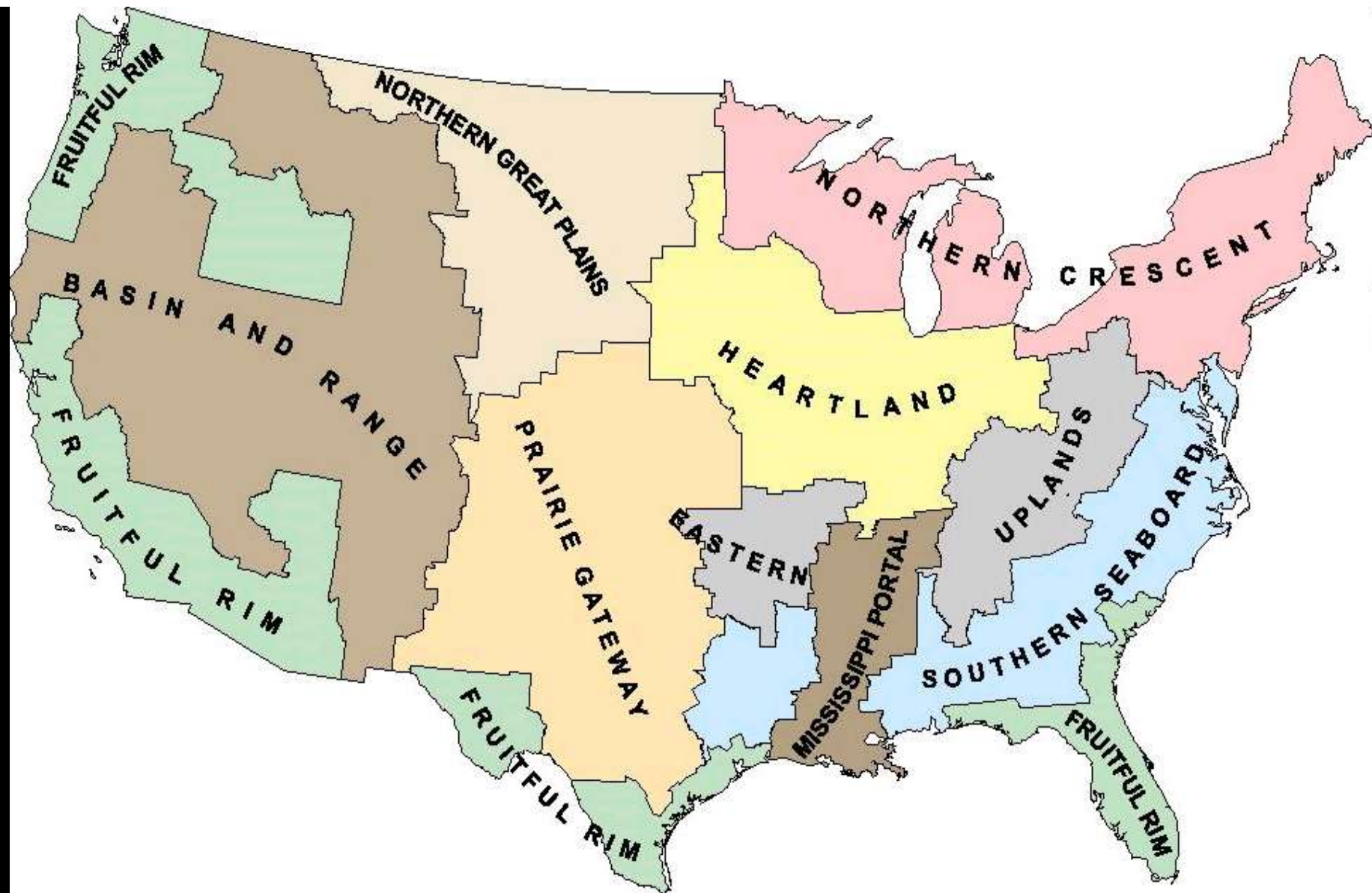
**Example  
Application of  
Machine Vision  
and Artificial  
Intelligence**





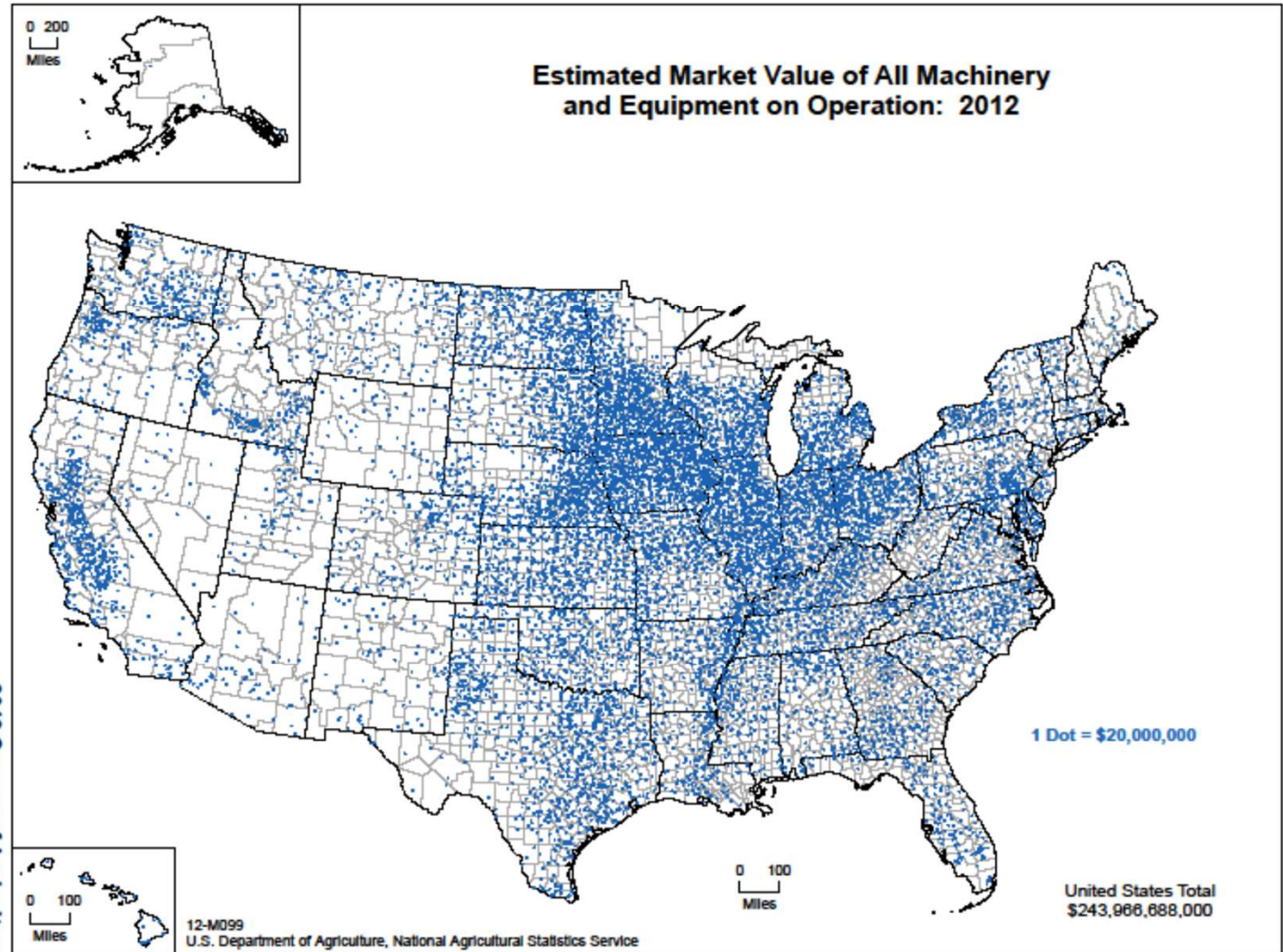
But we in Florida agriculture have a problem...

Technology development and largest markets are in Heartland and California



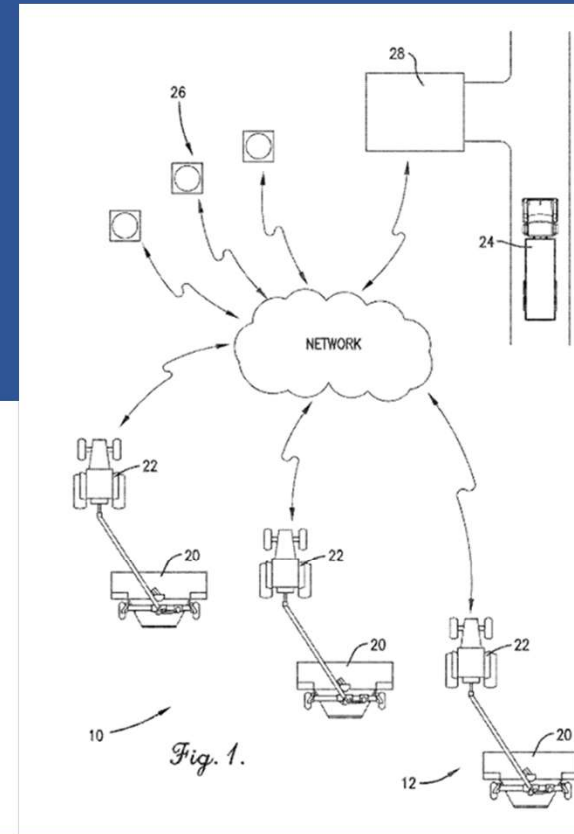
But we in Florida agriculture have a problem...

Technology development and largest markets are in Heartland and California



# Need to understand whether technologies can be transferred from

- Other industries
- Other commodities
- Other locations



(19) **United States**

(12) **Patent Application Publication**  
Schmidt et al.

(10) **Pub. No.: US 2017/0083026 A1**  
(43) **Pub. Date: Mar. 23, 2017**

(54) **ISOBUS WIRELESS NETWORKING OF  
AGRICULTURAL MACHINES IN A  
COLLABORATIVE AGRICULTURAL  
PROCESS**

(52) **U.S. Cl.**  
CPC ..... **G05D 1/0297** (2013.01); **H04L 67/12**  
(2013.01); **H04L 12/66** (2013.01); **G05D**  
**1/0022** (2013.01); **G05D 1/0027** (2013.01);  
**H04W 84/18** (2013.01)

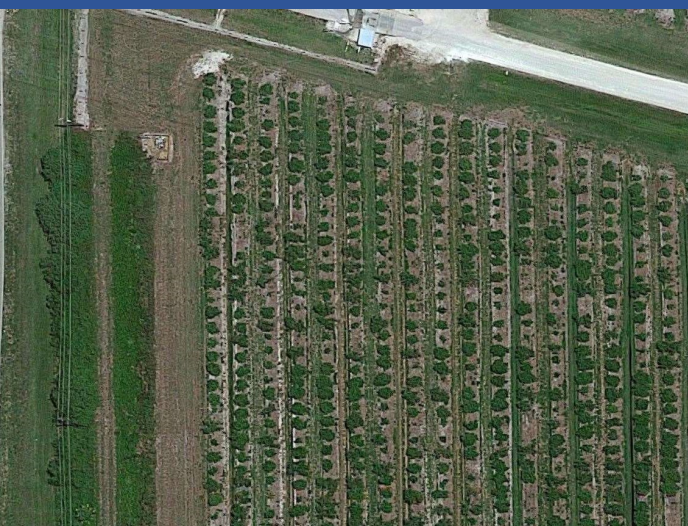
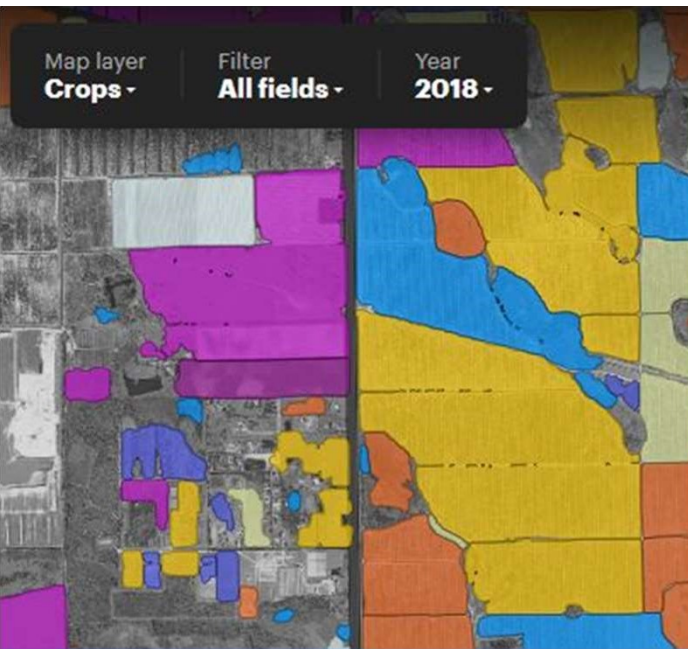
(71) Applicant: **AGCO Corporation**, Hesston, KS (US)





**OneSoil (<https://onesoil.ai/en/>) uses satellite imagery and machine learning algorithms to classify fields around the world**

**My parents' former farm in Wisconsin is fairly well classified**

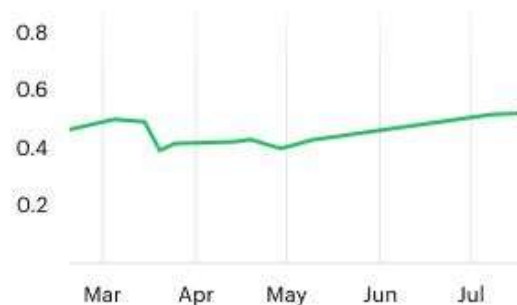


Just east of the SWFREC, it is a different story...

Crop: **Maize**      Field size: **138.5 ha**

Field score <sup>?</sup>  
**0.47**

Field development by NDVI <sup>?</sup>



 [Go to OneSoil Platform →](#)

[Wrong field boundaries? Inform us](#)  
[Wrong crop? Inform us](#)



Some technologies don't succeed,  
but many eventually become useful

Timing is everything

Example:

Technologies from John Reid's 1986 pathbreaking  
dissertation implemented in 2016 ---30 years later!



NATIONAL ACADEMY OF ENGINEERING

The National Academies of  
SCIENCES  
ENGINEERING  
MEDICINE

Publications

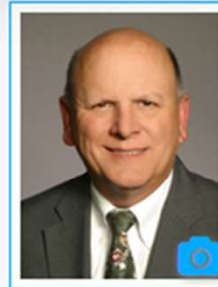
Members

Events



Members

Dr. John Reid



Dr. John Reid

MEMBER

Director, Product Technology & Innovation | John Deere  
Company

Moline, IL, United States

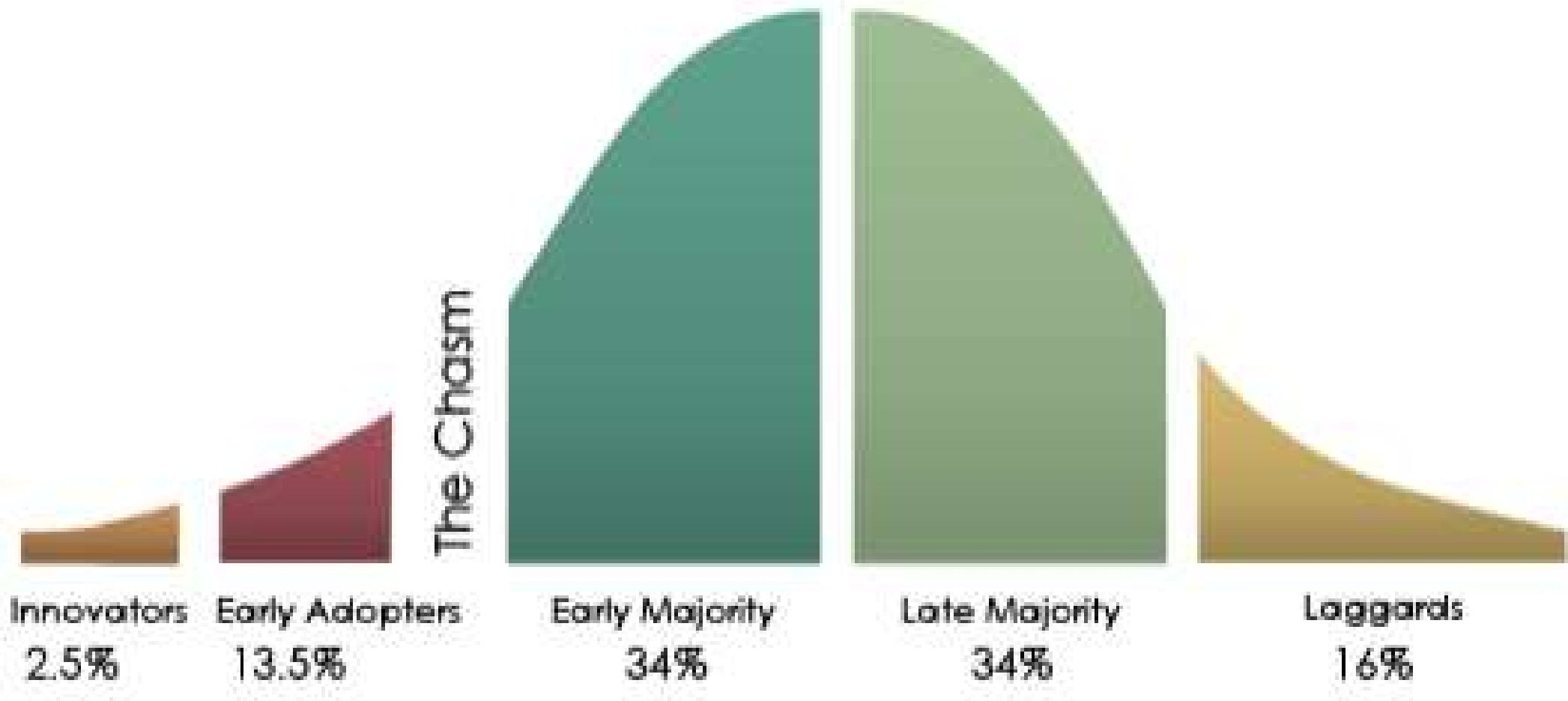
ELECTION YEAR	2019
PRIMARY SECTION	Special Fields & Interdisciplinary

▼ Election Citation

For innovation in automation technologies for agricultural systems.

# Adoption Comes at Different Times to Different People

Rodgers Innovation Diffusion Curve [www.cisco.com](http://www.cisco.com)





Some Things I Think  
Will Come Fast

Some Things May  
Take Longer...



**KOREAN STORE UNVEILS 'GENIUS'**

**BANANA PACKAGING TO AVOID**

**OVERRIPE FRUIT**

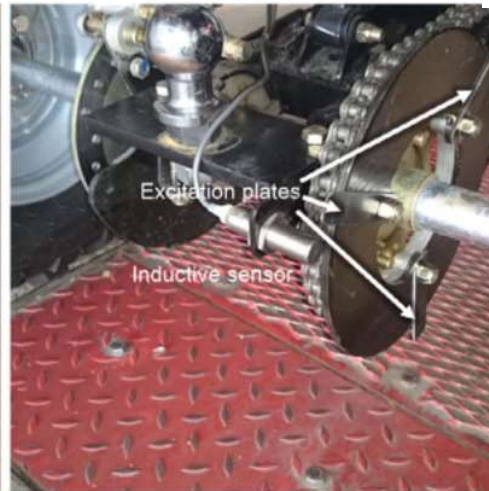


Automated early yield prediction in vineyards from on-the-go image acquisition

Arturo Aquino, Borja Millan, Maria-Paz Diago, Javier Tardaguila



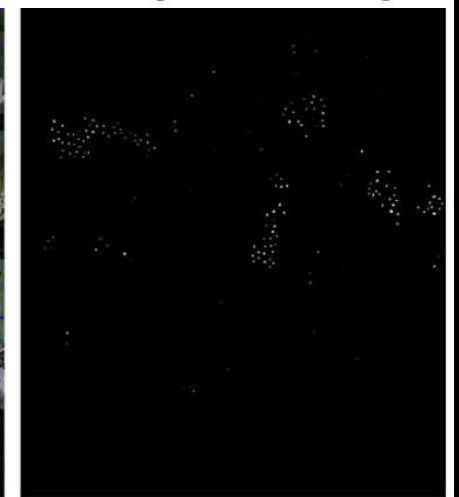
(a)



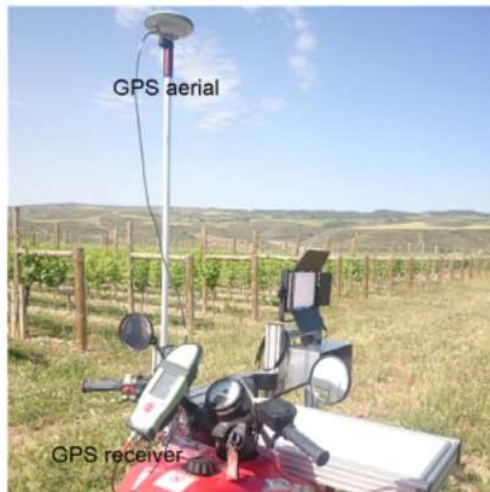
(b)



(a)



(b)



(c)



(d)



(c)



(d)

## Difficult to predict best technology adoptions

- **Which** technologies to adopt
- **What** characteristics and parameters they should have
- **Who** should supply them to you
- **Where** they will be appropriate
- **When** they will make sense



Inside Japanese plant factory



# But Technologies Are Coming...

Cell Phone Controlled Vegetable Irrigation in Tanzania



# But Technologies Are Coming... And Many Are Great Improvements

## Minimize Risk:

- Consider Entire System
- Evaluate Carefully
- Learn From Past
- Think Globally/Act Locally





# Maximizing the Probability of New Technology Adoption Success

John K. Schueller  
University of Florida  
*[schuejk@ufl.edu](mailto:schuejk@ufl.edu)*

1934 (!!!) World's Fair

