

## Top 10 Technology Trends: ... Precision Ag ... Machinery



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Innovations. Expertise. Networking.  
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## On which title buzz words do we focus?

- We are not going to talk about:
  - The latest cool machinery enhancements offered
    - you can see that in every booth you stop at
  - Top ten trends in machinery and precision ag
    - too confining
- We are going to talk about:
  - How to think through technology investments
  - How precision ag is about more than machinery
    - it is a way of thinking
  - A view to the nearby future for precision ag

Some continuation will follow in a 10:30 breakout session on choosing machinery for farm growth.

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## Technology

- Definition: The application of science to industrial or commercial objectives
- Broadly, agricultural technologies are those processes or machines that impact production agriculture, typically by
  - lowering cost, or
  - increasing revenue
- Requires an investment
  - so, the natural question is will it pay?

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## Technology: Will it pay?

- How much is the investment?
- What is the expected return on investment? (How fast is the payback)
- How confident am I that this will happen?

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## If a profit materializes . . .

- I'd like to apply the technology to more units of production (often, acres)
- So, I bid up rent or land values
  - Just a bit if I'm the only one using the technology
  - A whole bunch if many are using the technology
- It takes only a few viable adopters in an area to dramatically drive up rents

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## • Early adopters

- Adopt to become more profitable
- See the technology as a great opportunity
- Bid up rents and land values

## • Later adopters

- Adopt just to survive
- Sometimes wish things would go back to the way they were
- Sometimes recognize the potential but are too small to justify the investment
- Higher rents mean higher costs, and late adopters find themselves going broke in the face of rents they perceive as “too high”

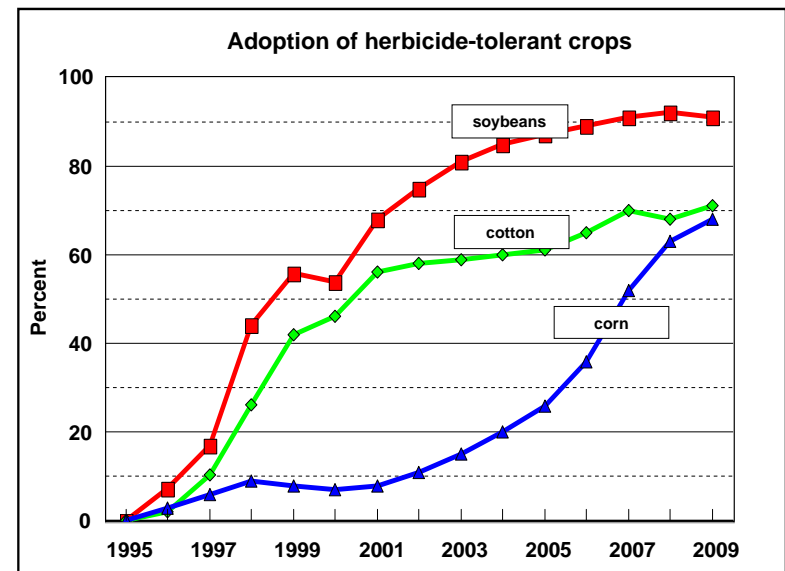
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## Technology: speed of adoption

- Big and obvious gains probably non-existent
- Small but obvious gains, along with small investment, implies fast adoption
  - “belly-button” or “duh” technologies
  - Think of Roundup-Ready soybeans

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## Some technologies are fairly obvious . . .



Source: USDA/ERS

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## Other “duh” technologies (most farms)

- Lightbars (GPS guidance)
  - Gains against overlap and marker alternatives are easily perceived
  - Do take a little more investment so less adopted by small farms until recently
- Tractor cabs
  - Hard to measure gain in \$ but know it’s there
- GPS-assisted steering
  - Larger investment than lightbars but still easy to perceive the advantage
  - Aspects like tractor cabs (reduces stress)

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## Economic analysis of guidance system and section control technologies on sprayer\*

(analysis done with *KSU-GPSguidance.xls*)

Impact of Acres Covered on Economics of Guidance System <sup>1</sup>				Impact of Acres Covered on Economics of Section Control <sup>1</sup>			
Annual acres	Investment supported <sup>2</sup>	Return on investment <sup>2,3</sup>	Payback years <sup>3</sup>	Annual acres	Investment supported <sup>2</sup>	Return on investment <sup>2,3</sup>	Payback years <sup>3</sup>
14,000	\$35,041	60%	1.6	14,000	\$51,109	150%	0.7
12,000	\$30,068	48%	1.8	12,000	\$43,808	127%	0.8
10,000	\$25,030	35%	2.3	10,000	\$36,507	104%	1.0
8,000	\$20,024	22%	2.9	8,000	\$29,205	80%	1.2
6,000	\$15,018	8%	4.0	6,000	\$21,904	55%	1.7
4,000	\$10,012	-8%	6.6	4,000	\$14,603	27%	2.6
2,000	\$5,006	-29%	20.5	2,000	\$7,301	-5%	5.9

<sup>1</sup> Machine and input cost savings reducing overlap from 7.0% to 1.75%

<sup>2</sup> Based on four-year amortization

<sup>3</sup> Given \$15,000 investment

<sup>1</sup> Automatic control of 5 boom sections, input cost savings (guidance already owned)

<sup>2</sup> Based on four-year amortization

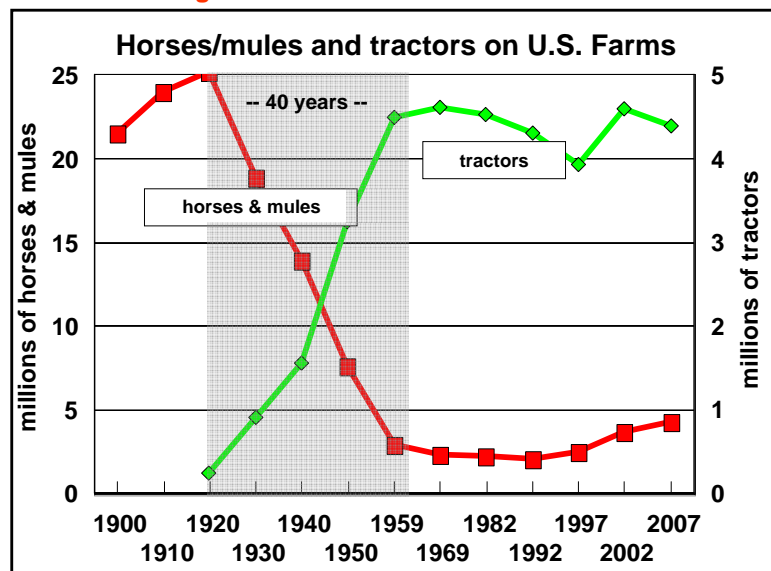
<sup>3</sup> Given \$10,000 investment

Fairly obvious technology to invest in for operations with sufficient acres, but less obvious for smaller operations

\* Results are based on specific assumptions about input costs and field size/shape and thus will not be the same for all farms of these sizes.

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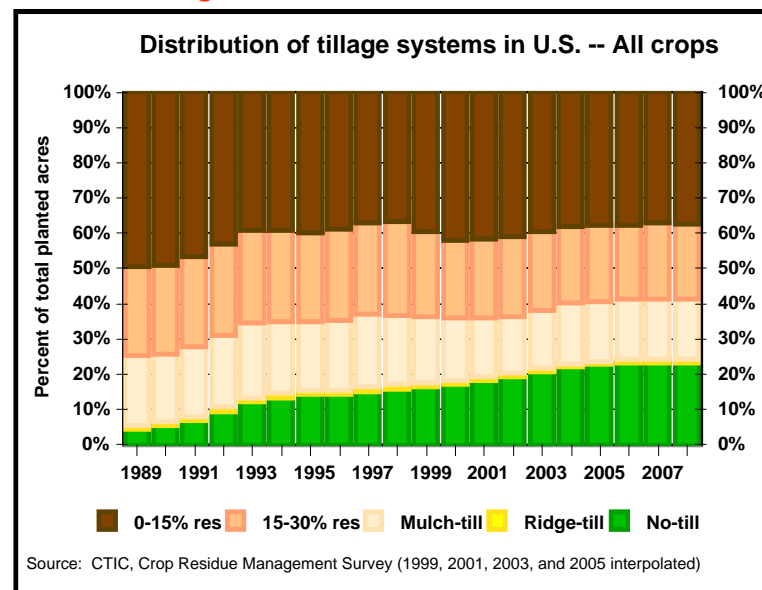
## Some technologies aren't so obvious . . .



Source: U.S. Census of Agriculture



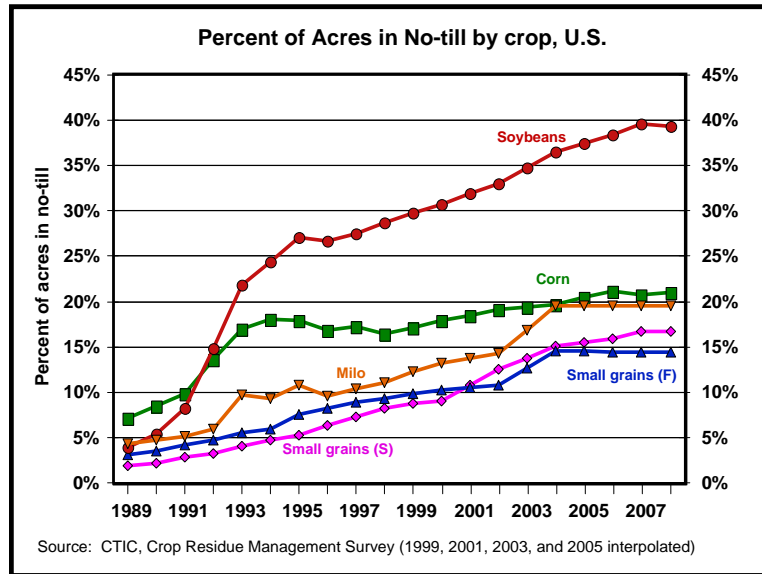
## Some technologies aren't so obvious . . .



Source: CTIC, Crop Residue Management Survey (1999, 2001, 2003, and 2005 interpolated)

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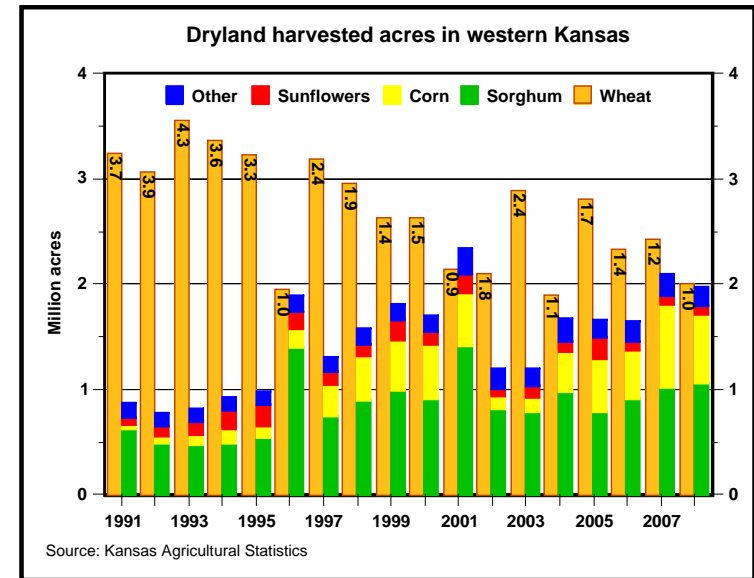
## No-till acres increasing on most crops



... but, more prevalent with corn and soybeans than wheat

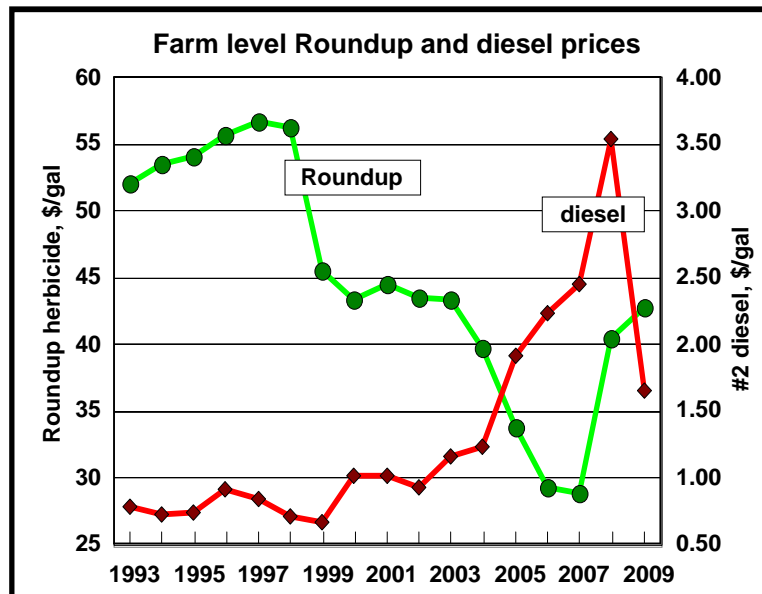
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## Unexpected factors drive technology adoption...



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## Did falling relative herbicide costs hasten adoption?



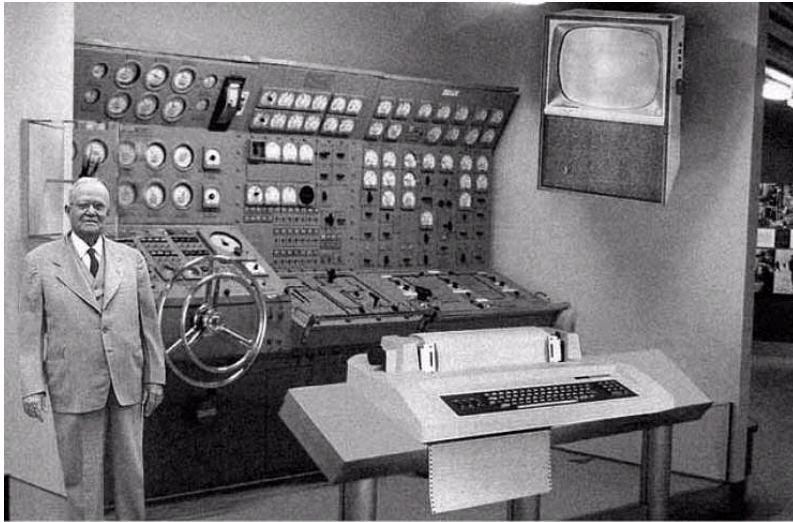
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## Technology: how to get an edge

- Invest in the “duh” technologies quickly
  - You don’t have a choice
- Invest in the slow moving technologies
  - The profits will last for years
- Invest in technologies that DO NOT save labor
  - Most people do not; hence the gains last for years

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But, predicting technologies isn't particularly easy . . .



*Scientists from the RAND Corporation have created this model to illustrate how a "home computer" could look like in the year 2004. However the needed technology will not be economically feasible for the average home. Also the scientists readily admit that the computer will require not yet invented technology to actually work, but 50 years from now scientific progress is expected to solve these problems. With teletype interface and the Fortran language, the computer will be easy to use.*

Popular Science, 1954

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## Technology adoption, fast or slow?

- **FAST**
  - GMO crops
  - GPS-assisted steering
  - Boom/section control of planters and sprayers
- **SLOW**
  - No-till
  - VRA of crop inputs

We'll come back to precision ag stuff . . .

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## But how do I know?

- Think **SCIENCE**
  - No magic
  - Stay away from foo-foo dust
- Think **MARKETS**
  - If the returns sound too good to be true they probably are
- Think **ENGINEERING**
  - What will the technology actually do?
  - What is a technology's potential (opportunity)?
    - After all, costs often fall

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## Land Grant Institutions

- Provide a nice check
  - Kept many from using the myriad silage/hay preservatives in the 1970s
    - But, don't carry that mantra too far. After all, some preservatives actually worked!
- Sometimes too slow
  - Focus on high confidence in their statistical tests
  - Business decisions often made at much lower confidence levels
- But, their science is good, so ask them about the science behind a technology you're considering

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## Technology and farm size

- Large farms adopt technology more quickly
  - Because of investment (economies of size)
- If technologies come out ever faster, then farms will get larger ever faster
- Rapid growth in farm size may become the norm
- End result (intended or not): consolidation

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## Scale-neutral Technologies?

- Roundup-ready soybeans?
- Robotic milkers
  - A robot station is rated at 60 cows
  - Will I get a discount if I buy multiple robots?
  - Can't one person check the "attention list" of more than one robot?
  - New semi-robots coming out for large dairies
- Farm machinery
  - Maxes out at some size so is it scale neutral beyond that point?
    - Multi-unit discounts?
    - Multi-unit tracking and servicing?

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... back to precision ag



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## Early Precision Ag "Movement"

- GPS signal availability early 1990s
  - Yield monitors
  - Grid soil sampling and VRA
- Dreams
  - Salvation for the little guy (free GPS)
  - Salvation for the big guy (can manage like the little guy)
  - No more excessive environmental pollution
  - Higher yields on less inputs (more efficient production)
  - More profit

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## Early Precision Ag “Movement”

- Engineers give us all the cool electronic stuff to work with the GPS signals
- Agronomists help us use the cool electronic stuff to make better crop input decisions
  - Here’s where the money was supposed to have been made!

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## Early on prescient quotes:

- Precision Ag will allow us to make better uniform [i.e., field-scale] decisions

Randy Taylor

- 1) What we learn with PA will give us better field-scale decisions
- 2) Maybe farmers will now “twist the dial” at least at the field scale

- I’m still confused but at a much higher level than before

MIMC program

PA will induce better questions

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## Early on prescient associations of farmer-researchers (like KARA\*)

- Involved university folks, farmers, and agribusiness folks from around the area who:
  - Recognized the deficiencies of public providers of the required knowledge for our farms
  - Recognized the value of on-farm research
- Recognized the value of science at the farm level
  - Increase the scientific aspects of how we gain knowledge as farmers – how we learn
  - Improve our presentations of what we learn to others
  - Increase the amount of critical thinking we do
  - Helps us develop thicker skins

\*Kansas Agricultural Research Association, [www.ksagresearch.com](http://www.ksagresearch.com)

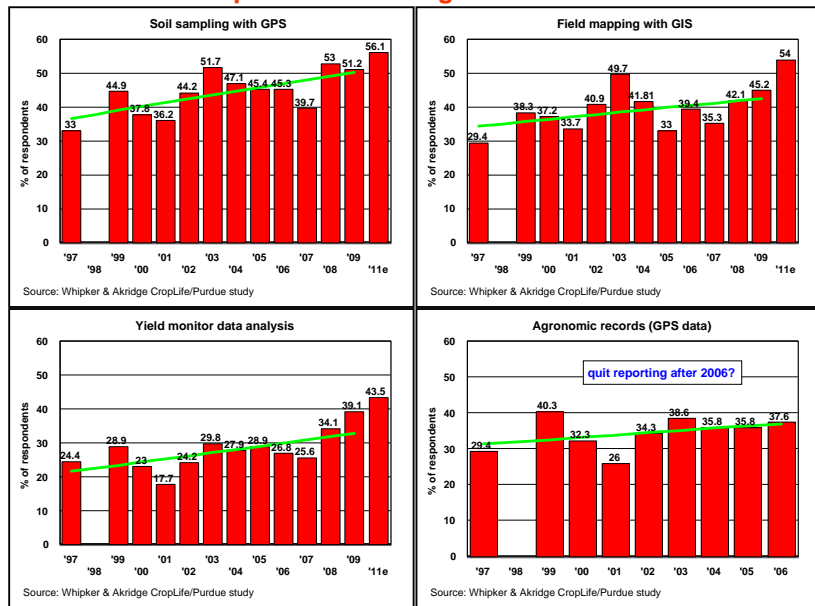
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## Whipker & Akridge CropLife/Purdue Survey

- 1996: what were the greatest opportunities for PA?
  - Better agronomic understanding
  - Improved dealer profit due to offering new services
  - Improved crop yields
- Did it happen? In a 2006 survey all rankings averaged between 3.7 and 4.5 where 1 meant no impact and 7 meant large impact – so sort of ho hum
- Very few (<10%) of dealers believe that PA (essentially VRA) improved crop input efficiency (2006)
  - Apparently, that dream never materialized!

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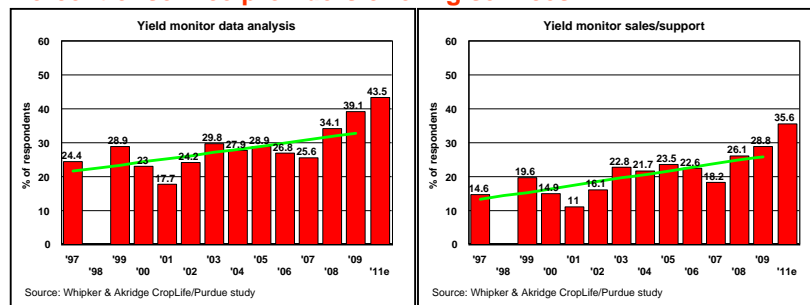
## Percent of service providers offering services



a typical slow-moving technology . . . some things even go away enroute

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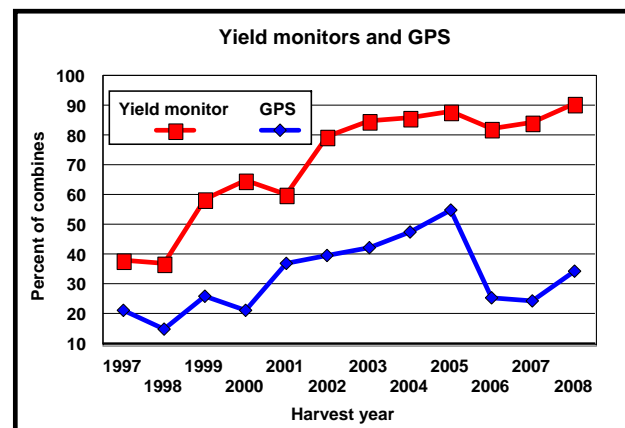
## Percent of service providers offering services



PA started with collecting and analyzing data from yield monitors 15 years ago, but such activities have been somewhat slow in adoption

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## From 151 combines operated by CHAMP members



In 2008, 22.2% of CHAMP members providing yield maps  
Of those providing, yield maps were provided for 20.1% of customers

Yield monitoring is a fast moving technology  
Yield mapping is a slow-moving technology

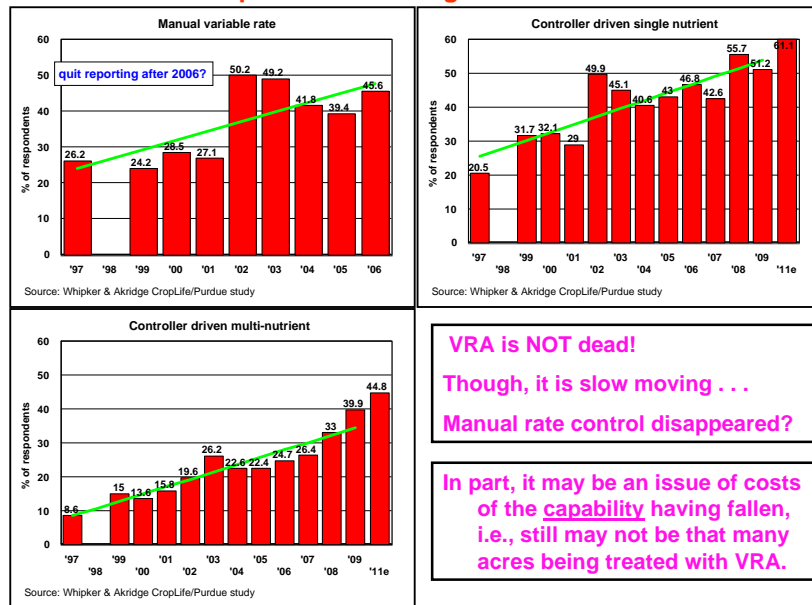
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## A few thoughts on VRA and yield monitors

- Input efficiency improvement not that great
  - Hence acres treated with VRA are still low
  - i.e., users don't know (why?) to do VRA
- Yield mapping slow to be adopted
  - Folks don't know how to analyze the data
  - May be uncomfortable with task of making maps or managing the reams of data that arise
- Yield monitors fast to adopt
  - Require no formal analysis
  - Provide useful subjective & objective information:
    - Grain moisture information is especially valuable
    - Real-time combine performance information, especially along with grain loss monitors
    - Causes operator to think about reasons for yield differences

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## Percent of service providers offering services



VRA is NOT dead!  
 Though, it is slow moving . . .  
 Manual rate control disappeared?

In part, it may be an issue of costs of the capability having fallen, i.e., still may not be that many acres being treated with VRA.

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## VRA continues to grow in adoption

- Likely, users are gradually developing
  - subjective rules from map-based information, or
  - objective rules from area data information
- Likely, rules vary considerably from user to user and year to year – still much experimentation to do
- A very typical slow technology
  - Some figure it out and others do not
  - No clear large benefit to users on average
  - Yet, probably a nice opportunity for long-term profit for those who continue to experiment and learn

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## PA after 10 years (unforeseen sleeper #1) presented at KARA conference, January 2007

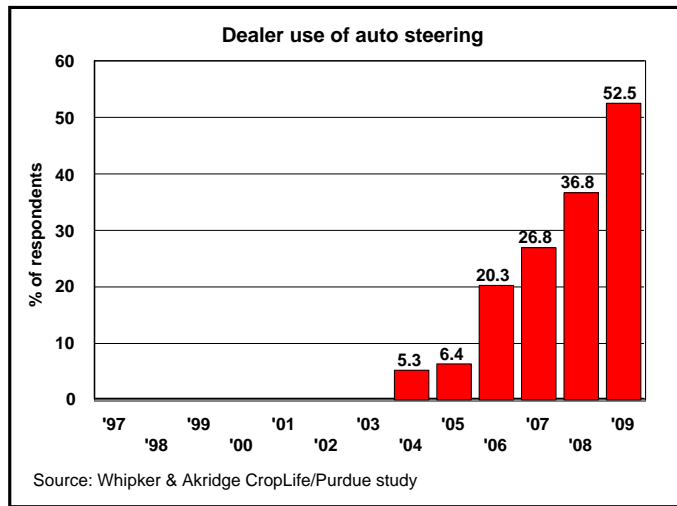
- PA thinking leads to better crop production decisions outside of VRA
  - Taylor was right
  - MIMC was right
- We're recognizing the value of farm-level science
  - Increase the scientific aspects of how we gain knowledge as farmers – how we learn
  - Improve our presentations of what we learn to others
  - Increase the amount of critical thinking we do
  - Helps us develop thicker skins
- Do we care if these things are called precision ag?



## PA after 10+ years (unforeseen sleeper #2) presented at KARA conference, January 2007

- Improvements in machinery efficiency
  - Light bars
  - GPS autoguidance
  - Machine control
- Never underestimate the economic importance of improved machinery decisions
  - COST, not revenue differences explain profit differences
  - Machinery costs is the most important cost category

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a very fast moving technology – improved accuracy of driving and reduced operator pressure likely make it obvious

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## More recent machinery enhancements

- **Boom and section shutoff of**
  - Sprayers
  - Fertilizer applicators
  - Planters and seeders
  
- **KSU-GPSguidance.xls**
  - Available at [www.agmanager.info](http://www.agmanager.info)
  - An updated version, sponsored by CropLife, will soon be available at its website
  - Shows high return on investment in these machine control add-ons
    - If you don't believe it, use the spreadsheet and you'll see that boom and section shutoff controls are no-brainers for many

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## Still needed machinery technologies: improved real time communication

- **between multiple machines operating in same field**
  - Would reduce overlap in headland passes
  - Would allow overlap-reducing boom/section shutoffs
- **between grain cart tractors and combines**
- **between tendering vehicles and field machines**
- **between tech support people and machine operators**
- **between office and field**
- **needs to be pictorial (maps) and data**

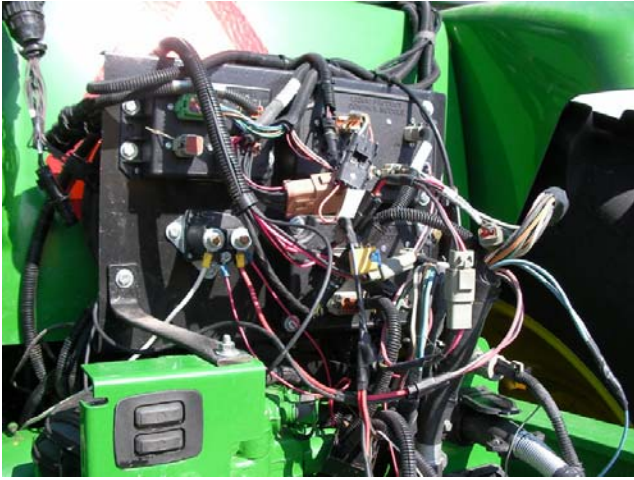
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## Impediments to adoption of cool machinery stuff

- **Could use better dealer support of electronics**
  - Few dealers provide dedicated individuals
  - Enhanced websites/communication mechanisms are needed between dealers and farmers
  - Improved training and support is needed
  - More direct links between engineers and farmers
- **Younger generation, more savvy to electronics will help adoption (more accepting of “change”)**
- **Farm size too small**
- **Operator too close to retirement**
- **Few “bolt right on” solutions for complicated tasks**

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## Impediments to Adoption of Machine Control



Standard two product VRA setup (Bluetooth?)

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## Still needed agronomic technologies: VRA

- No universal “black box” solutions
- Need better algorithms for:
  - Fertilizer rates
  - Seeding rates
  - Herbicide rates
- Still no “cheap” way of getting spatial soil fertility information
  - Intense manual grid sampling
  - Direct automatic soil sampling (like AgroBotics AutoProbe)
  - indirect sampling technologies (like electrical conductivity)
  - Remote sensing approaches
    - airborne, satellite, in-field solutions
- Still need individuals who can compile, process, prepare and make operational the data needed for VRA – *Don't forget validation!*

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## Where is precision ag heading?

- Most machinery enhancements likely will be adopted quickly unless
  - Better tech support at machinery dealers does not emerge
    - (we believe it will emerge)
  - Farm owners have trouble finding qualified, often younger at this point, folks who can handle electronics & computers
    - (we believe this will happen as farms get bigger)
- VRA will continue to be adopted slowly unless
  - We find less expensive ways of gathering spatial soil data
    - (improvements here are very slow in coming)
  - Or, we find ways of moving beyond soil-test-based fertilizer rate recommendations
    - (improvements here are emerging)
- Farms will do ever more scientific research in-house

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## Questions ???



[www.agmanager.info](http://www.agmanager.info)

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