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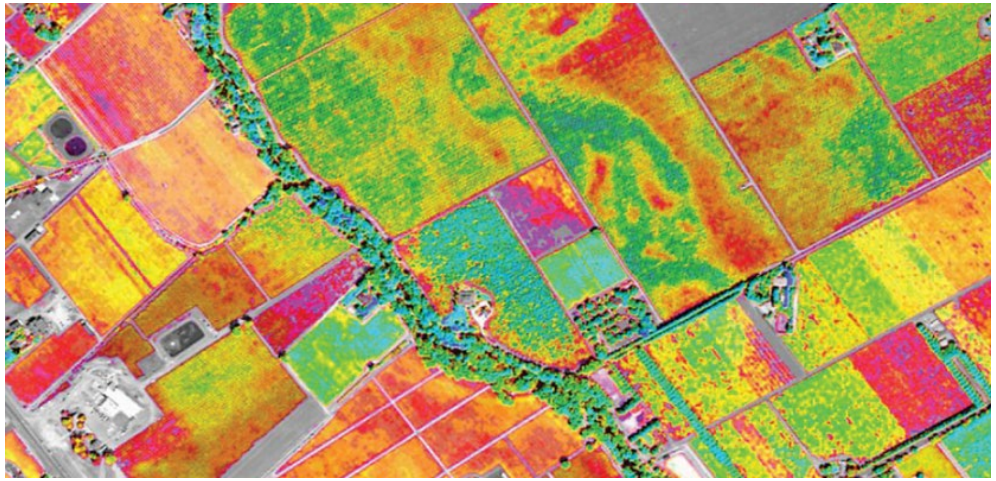
PRECISION AGRICULTURE ECONOMICS AND DECISION MAKING – BEYOND PROFITABILITY

THE SITE-SPECIFIC NATURE OF PRECISION AGRICULTURE ECONOMICS

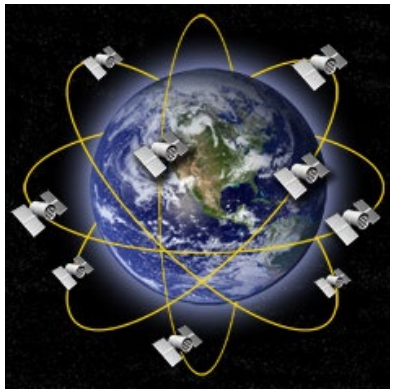
- What is profitable for me may NOT be profitable for my neighbor
- What is profitable on one parcel of land may NOT be profitable on another
- Just like your soils, there's variability



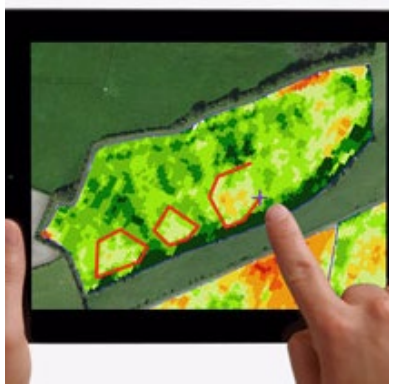
IMPORTANCE OF FOLLOWING A DECISION MAKING FRAMEWORK

- Does the precision technology support your goals and mission of the business?
- Many options to implementing precision agriculture
- Different levels of adoption

Smart Technologies

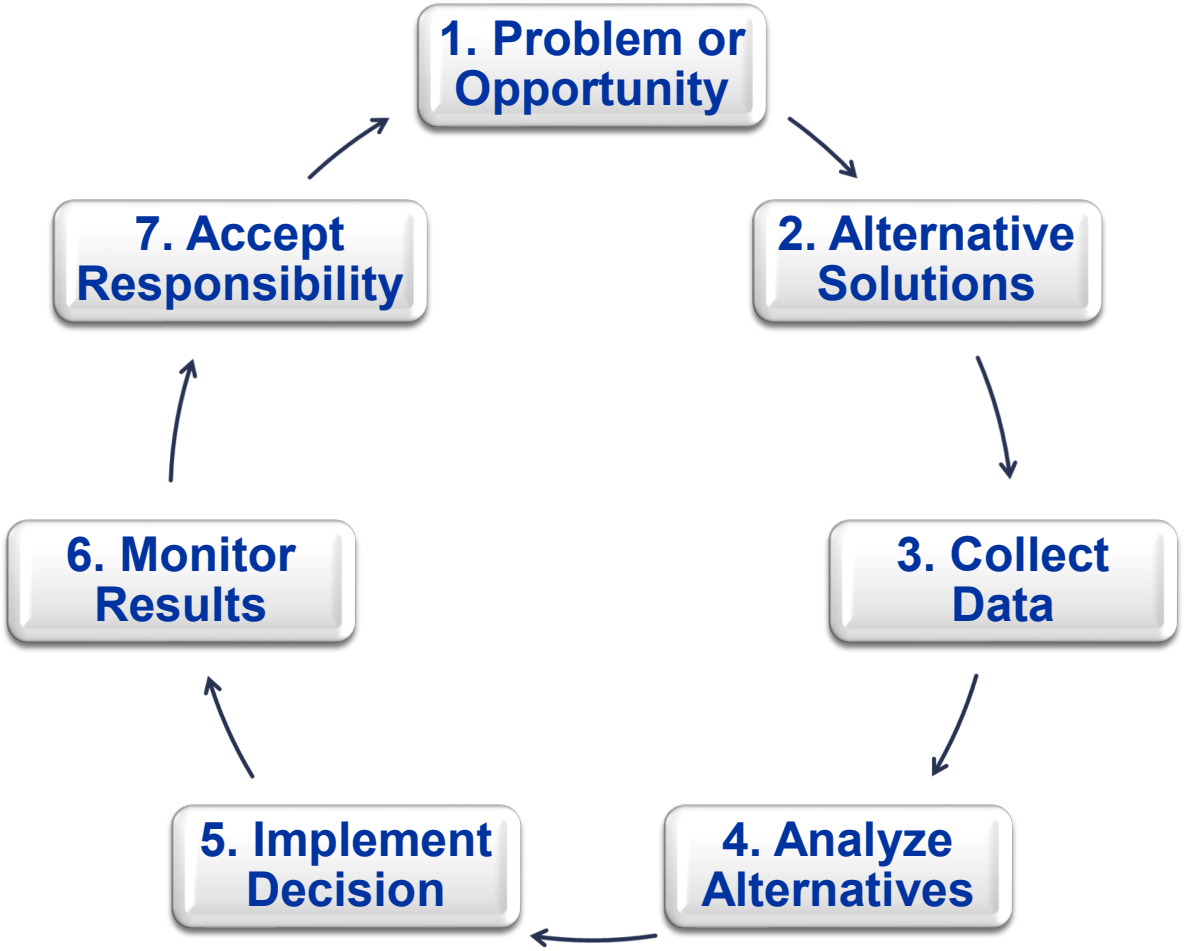


Data Driven Technologies



Big Data & Telematics

7 STEPS TO DECISION MAKING



Source: Kay, R. D., W. M. Edwards and P. Duffy, 2004: *Farm Management*. McGraw-Hill, Boston.

3. COLLECTING DATA AND INFORMATION

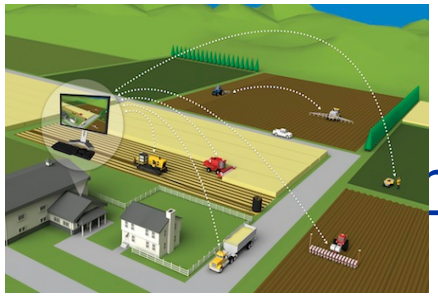
- Economic Cost Considerations
  - Initial investment cost
  - Annual subscription(s)
  - Service and maintenance costs
  - Operating costs
- Economic Benefit Considerations
  - Input savings
  - Yield/Quality increases
  - Value of better management decisions

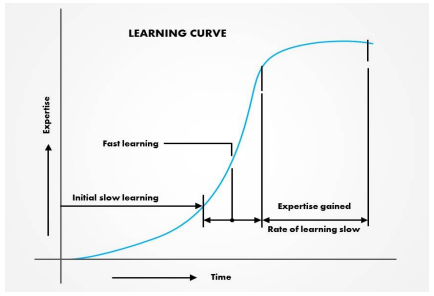
3. COLLECTING DATA AND INFORMATION

Other Key Considerations

Impact Assessment

3. COLLECTING DATA AND INFORMATION

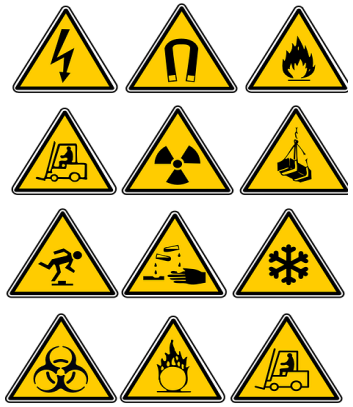




3. COLLECTING DATA AND INFORMATION

Beyond Profitability!!!

BEYOND PROFITABILITY!



3. COLLECTING DATA AND INFORMATION

Environmental Benefits
Beyond Profitability!!!

4. ANALYZE THE ALTERNATIVES AND MAKE A DECISION

- Are you financially capable of making the investment?
- Tools for analyzing the alternative:
  - Partial Budgeting (Simple)
  - Investment analyses (Advanced)
    - Return on Investment (ROI)
      - Net Present Value (NPV)
      - Internal Rate of Return (IRR)
  - Whole farm planning (Expert)

PARTIAL BUDGETING FOR DECISION MAKING

- Convenient and practical method for analyzing the profit potential of partial changes in the overall whole farm plan
- Compares the profitability of one alternative, typically what is being done now, with a proposed change or new alternative
- Focuses on the costs and benefits realized by the producer
- Partial Budgeting Tool: https://www.extension.iastate.edu/agdm/wholefarm/html/c1-50.html

PARTIAL BUDGET FORMAT

- **Additional Costs**: cost that do not exist at current time but will be incurred if the change is made
- **Reduced Revenue**: revenue that is currently received but which will be lost or reduced if the change is made
- **Additional Revenue**: revenue to be received only if the alternative is adopted
- **Reduced Costs**: costs that are now incurred which would be eliminated if the change is made

PARTIAL BUDGET FRAMEWORK

Problem:			
Additional Costs:		**Additional Revenue:**	
Reduced Revenue:		**Reduced Costs:**	
A. Total additional costs and reduced revenue	**$**	**B. Total additional revenue and reduced costs**	**$**
			$
		Net Change in Profit (B – A)	**$**

PARTIAL BUDGET EXAMPLE

UAV's (a.k.a. Drones)

Source: www.kinze.com

Multi-hybrid Planters

High-Speed Planters

PARTIAL BUDGET EXAMPLE

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Multi-hybrid Planters

High-Speed Planters

PARTIAL BUDGET EXAMPLE

- Looking into purchasing a new planter
  - Option 1: “Traditional” 12-Row Planter
  - Option 2: High-Speed 12-Row Planter
- High-Speed planter technology costs an additional $26,400 compared to “traditional” 12-Row Planter
  - Annual ownership cost of $1800 in depreciation and $1300 in interest (@6.75% interest, 8 year economic useful life and 45% salvage value)
- Increased annual repairs and maintenance cost of $1500
- Average annual yield benefit of $5,700 due to timely planting
- Annual operating cost savings (labor) of $3,000

PARTIAL BUDGET EXAMPLE

Problem: Purchase high-speed planter technology

Additional Costs:		**Additional Revenue:**	
Ownership Costs			
Depreciation	$1,800	**Timely Planting**	**$5,700**
Interest	$1,300	**Operating Cost Savings**	**$3,000**
Operating Costs			
Repairs	$1,500		
Reduced Revenue:		**Reduced Costs:**	
None		**None**	
A. Total additional costs and reduced revenue	**$4,600**	**B. Total additional revenue and reduced costs**	**$8,700**
			$4,600
		Net Change in Profit (B – A)	**$4,100**

LIMITATIONS TO PARTIAL BUDGETS

- Only compare the present management plan with one alternative at a time
- If many alternatives, need many partial budgets
- Uses one set of price and yield expectations. If variable, cash flow could become an issue
- Ignores time value of money (use the advanced tools)
  - Capital Budgeting Analysis – Return on Investment (ROI)
    - Tool for evaluating the profitability of investments
    - Capital Budgeting Analysis: https://farmdoc.illinois.edu/fast-tools/capital-budgeting

BE CAUTIOUS WITH ROI

- Don’t trust blanket ROI claims!
  - Remember: The economics of precision ag are site specific
- Ask HOW ROI was calculated
- Simple Rate of Return is often used which is WRONG and WORTHLESS
  - Average Annual Profit / Average Investment
- Capital Budgeting Analysis – Return on Investment (ROI)
  - Capital Budgeting Analysis: https://farmdoc.illinois.edu/fast-tools/capital-budgeting

“PRECISION” ECONOMICS EXAMPLES

- Automatic section control on sprayer
  - Smaller field size and irregular shaped fields proves more profitable
  - Field shape becomes less important as field area increases
  - ROI Range: -3% - 239%
- Guidance on sprayer
  - Large square fields more profitable
  - ROI Range: 43% - 66%

Sources:

- Shockley, Jordan, Carl Dillon, Tim Stombaugh, and Scott Shearer. “Whole farm analysis of automatic section control for agricultural machinery.” *Precision Agriculture* 13, (2012): 411-420.
- Smith, Craig, Kevin Dhuyvetter, Terry Kastens, Dietrich Kastens, and Logan Smith. “Economics of precision agricultural technologies across the Great Plains.” *Journal of the American Society of Farm Managers and Rural Appraisers,* (2013): 185-206

“PRECISION” ECONOMICS EXAMPLES

- Automatic section control on sprayer
  - Diminishing returns as the number of nozzles controlled increases
  - 5 sections controlled
    - ROI Range: 15% - 206% Average: 98%
  - Individual nozzle control
    - ROI Range: -10% - 96% Average: 38%

Source:

- Smith, Craig and Kevin Dhuyvetter. “Determining the economically optimal level of control on sprayers and planters.” *Journal of the American Society of Farm Managers and Rural Appraisers,* (2016): 1-21

"PRECISION" ECONOMICS EXAMPLES

- Improving efficiency reduces economic risk:
  - Machinery efficiency
    - E.g., High speed planting reducing production risk
  - Input efficiency
    - E.g., 4R and reducing overlap reduces production and marketing risk
- Technologies that reduce the potential of variability in profits, reduce economic risk!

Source:

- Shockley, Jordan, Carl Dillon, and Tim Stombaugh. "A whole farm analysis of the influence of auto-steer navigation on net returns, risk, and production practices." *Journal of Agricultural and Applied Economics* 43, 1 (February 2011): 57-75.

“PRECISION” ECONOMICS EXAMPLES

- Reducing crop production inputs through precision technologies reduces your carbon footprint
- Use partial budgeting and break-even analysis to determine a break-even yield for CRP enrollment.
- Meld economics with yield maps to create a spatial CRP enrollment map

Source:

- Dillon, Carl, Jordan Shockley, and Joe Luck. “A spatial economics decision making guide for conservation reserve program.” In *GIS Applications in Agriculture, Volume 4: Conservation Planning.* T. Mueller and G. Sassenrath, eds. pp. 233-244. 2015
- Brown, Rachael, Carl Dillon, Jack Schieffer, and Jordan Shockley. “The carbon footprint and economic impact of precision technology on a corn and soybean farm.” *Journal of Environmental Economics and Policy* (September 2015) DOI: 10.1080/21606544.2015.1090932

Economically Feasible
vs.
Financially Feasible

CONCLUSION

- Does this decision support your mission and goals of the business?
- Follow the decision-making process
- Think deeper than direct input savings and investment costs
- Consider factors beyond profitability
- Use all the tools at your disposal
- Look forward to a short video on using Excel to determine ROI of precision ag technologies
- The economics of precision ag is site specific!!!

THANK YOU!

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