Information Technology and Value Creation

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A recent article discussed the importance of new technologies to crop agriculture. In this article, we continue this theme by discussing the value of information. Upcoming articles will discuss the critical role of information in today's uncertain business climate, possible payoffs of precision agriculture, automation and robotics, and gaps in skills pertaining to the adoption of new technologies.

The use of information technology systems or digital technology has evolved through a number of stages over the last two to three decades. During the 1990s, it was recognized that more accurate and timely data could be used to make better decisions. However, in the 1990s, in many cases, the information technology systems needed to collect and analyze data were perceived to be costlier and more difficult to implement than the data was worth for decision making. Improved communication and sensing technologies in the early 2000s allowed better data analysis and communication within the farm as well as with suppliers and buyers, but information and communication technologies (ICT) as well as limited connectivity in rural areas continued to present cost and implementation challenges. Today, the combination of cloud computing, artificial intelligence (AI), Big Data and the Internet of Things (IoT) technologies is breaking through the cost and effectiveness barriers to adoption. For this reason, experts believe we are in the early stages of a digital transformation in the farming sector.

THE VALUE OF INFORMATION

The concept of information means different things to different people. In this discussion, we will distinguish between three important concepts: 1) knowledge, 2) data, and 3) information.

Knowledge involves broad-based concepts, theories, principles, and models that are necessary to understand a particular phenomenon. Knowledge can be applied broadly across many sets of facts and circumstances or contexts. It is not data specific or unique, but helps one sort through the vast quantities of data available to determine what is relevant.

Data are more specific than knowledge, and can be quantitative or qualitative in nature. Data is distinguishable from knowledge in that data is specific while knowledge is general. Clearly this clean distinction becomes fuzzy at times.

Information is different from data or knowledge in two important dimensions: first, it is context specific, and second it is decision focused. In essence, if knowledge and data are combined and applied to a specific context (for example, a specific crop and parcel of land) and a specific decision (the proper level of fertilizer to apply to obtain a particular yield of a particular crop), they are transformed into valuable information. Data that is context specific and decision focused becomes information; information combined with knowledge results in improved decision making and better physical and financial performance.

Information has many attributes. It must be timely – appropriate to the decision context and not out-ofdate. It must be technically accurate and scientifically sound. It must be objective and unbiased, and/or value judgements must be explicitly identified. It must be complete (as opposed to partial) so as to be useful to decision making, or its partial or incomplete nature must be clearly specified. It must be understandable – communicated in such a way that the user can comprehend it. And finally, it must be convenient – available when and where and at what time the user needs or wants it. These attributes will determine the value of information.

ACCURACY AND RESOLUTION

As has been noted earlier, data becomes valuable as information as it becomes context specific and decision focused. In crop production, data are becoming more unit or activity specific. Geographic information and mapping systems combined with GPS guidance systems are being used to increase the resolution and accuracy in evaluating soil productivity characteristics and crop growing conditions by location in the field and make appropriate fertilizer, chemical, and other input adjustments to increase yield and/or reduce cost. This site specificity results in the potential for more precise crop farming.

At the same time as our measuring and monitoring systems have the potential to become more site or unit specific and real-time, the techniques for summarizing this data and converting it into decision focused information are becoming more common. Geo-referenced guidance linked to variable rate seed, fertilizer, and pest control application systems has the potential to generate not just yield maps, but profit or operating margin maps that enable us to assess which locales (acres, parcels, grids, etc.) generate the highest returns. And this data analysis system could even project or simulate during the growing season the profit potential of additional within season variable rate applications of fertilizer or insect and weed control informed by real-time sensing of the plant growth process.

Most standard farm accounting systems are driven by bottom-line, whole farm, or enterprise financial results with significant lags in measurement. With increased capacity to measure and monitor the process of crop growth combined with increased emphasis on process control to increase efficiency and improve quality, more of the record keeping activities must focus on process monitoring and measurement or activity accounting. This level of specificity and resolution is generally not yet part of standard accounting and data acquisition systems in agriculture, but changes are coming.

A point of caution concerning accuracy and resolution. Some decisions require further refinement of accuracy and increased resolution; this is particularly the case with tactical decisions in the production and marketing area where there will be an increasing emphasis on process monitoring and control. Other decisions, particularly strategic decisions, may not require as much data specificity and resolution. One must be careful to not become immobilized in the decision-making process by too much data or too high a level of data specificity. Also, it is important to note that data gathering incurs a cost as well as a benefit. Thus, the level of data specificity must be matched to the decision that is being made, and the cost of gathering that data at an increased level of specificity or resolution must be compared to the benefits received.

COLLECTING DATA

Some argue that "I can't waste my time collecting data that I'm not sure will be useful in making decisions; and when they show me it is useful, I will start to collect it." That seems to be a reasonable argument, but it has a fatal flaw. Data that is available but not recorded is lost forever – for example it is virtually impossible to reconstruct yield data from different areas in a field if it is not collected and linked to specific location when the crop is harvested. Once we had the technology to make variable rate applications to more accurately apply seed and fertilizer to locations in the field where it could have the most potential to increase yield, we needed yield maps to inform the variable rate decisions. If we had not yet collected the data to generate a yield map, we could start to do so to enable us to make more informed decisions in future years. But given the complexity and the high level of variability in crop production, one or two (or even three or four) year's data observations doesn't provide very accurate information to make agronomic management decisions. Science based decision making indicates that multiple observations are required to have the accuracy needed given the complexity and high level of variability in rain-fed crop production. And with the annual production cycles for crops like corn and soybeans, the number of observations one can collect is severely constrained even over a farmer's lifetime. A missed observation lost forever is a high loss in long cycle-time crop production agriculture when data and information are an increasingly more important source of higher profitability and better financial success. Data must be collected and recorded when it is available – you can't wait until it is proven to be useful!

CONCLUDING COMMENTS

This article discussed the value of information. The accuracy and resolution of data has improved markedly in recent years. Even if the payoff of data is still marginal, collecting data in anticipation of technological improvements would be prudent. Remember the adage, you can't manage what you don't measure.

Upcoming articles will discuss the critical role of data in today's uncertain business climate, possible payoffs of precision agriculture, automation and robotics, and gaps in skills pertaining to the adoption of new technologies in production agriculture.

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