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A Big Data Revolution: Who Would Drive It?

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Over the last 30 years, novel applications of information technology have caused strategic change in many sectors of the economy. This article draws on those experiences to inform our thinking about the potential role of Big Data as a force for change in agriculture.

Well, we've all survived 2015's version of both Black Friday and Cyber Monday. Remember when there was only Black Friday and when shopping on that day meant you actually had to visit a real store. Clearly advances in information and communications technology, including the use of Big Data, redefined the retail sector. Although farming is very different from retailing, lessons from that experience can help us anticipate how Big Data's application might affect the strategic landscape of agriculture.

In this article, we'll briefly identify some useful strategic concepts and apply them to the Big Data in agriculture question. This is the last of a six-part series on Big Data in Agriculture.

Insights from Strategic Management

Some ideas are simple and enduring. One of these is that successful innovations provide value to users and generate returns to the businesses supplying the innovation. In last week's article (*farmdoc daily* December 3, 2015), potential sources of value creation for Big Data in agriculture were identified.

Value capture is the process by which the new value earned from use of innovations accrues to the parties involved. In agriculture, consumers historically have been the eventual beneficiaries of innovation. Frankly we don't expect Big Data to change that result. However, the pattern by which firms in the sector benefit from Big Data is a dynamic and more uncertain process.

A strategic concept, the resource-based theory of the firm, has proven useful in understanding and anticipating the dynamics of value capture in numerous settings. Relative to innovation, this approach focuses on the resource portfolios of affected firms. In the competitive marketplace, firms which excel are those who can integrate innovative technologies with existing resources in a manner which fosters sustainable competitive advantage.

Relative to Big Data, we can identify two complementary types of resources:

- The data itself and
- The capabilities to effectively manage and employ Big Data.

Let's consider each of these types of resources in agriculture.

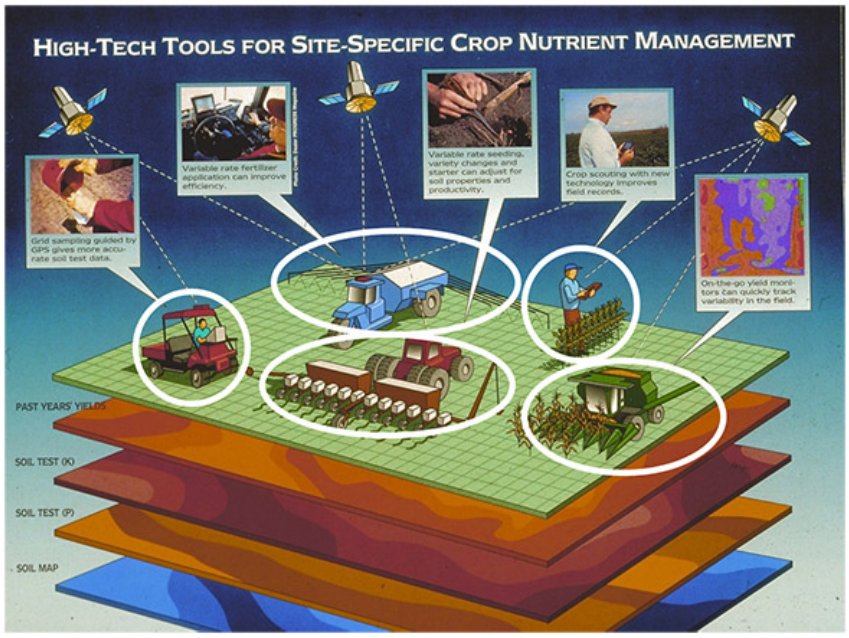
Big Data Resources

As we've noted in prior articles of this series, one of the most profound changes associated with Big Data in agriculture is the potential for on-farm decision making to be informed by evidence from actual farming operations. This potential is fueled by remarkable advances in sensor capabilities that are applicable for farming operations. However, an important lesson from non-ag parts of the economy is that the cost of data acquisition can critically retard adoption innovation. Of course, this actually is a benefit vs. cost calculation. Where benefits are high, for example in the health field, the expenditures to acquire data can be high. However, in commodity agriculture, margins typically are not high. Therefore, low cost data acquisition is a key strategic factor.

Another lesson from non-ag experiences is that one of the cheapest sources of data is data captured for another reason. American Airlines fundamentally altered the airline business by effectively employing loyalty cards to attract customers and to tailor its operations. Except for the customer's loyalty card number, key data needed for the program already was captured as part of the transactions necessary to make reservations, receive payment, and deliver service. The additional cost for acquiring each customer's loyalty card number was minimal. The operations of American Airlines naturally provided it with much of the data needed to operate its then innovative loyalty program. Further, within its marketing and operational personnel, it had the domain expertise to evaluate and exploit novel insights that could arise from analysis of that data.

As we think about Big Data in agriculture, it is natural to focus on the data that can be gleaned by monitoring farming operations. Figure 1 repeats a picture shown in the second article of this series (*farmdoc daily* November 5, 2015). That picture depicts the future for precision agriculture as seen by a group of Illinois farmers, managers, and researchers in the mid-1990s. In that picture, we've drawn a circle around some key farming operations.

Figure 1. Who Naturally Has Data?



Source: Sonka and Coaldrake 1996

Let's consider those five operations from the perspective of the entities which naturally have the access and the domain expertise to exploit Big Data techniques around those operations.

- Clearly the farm operator has access to the data and has key insights in each instance.
- On many Midwestern farms, agricultural retailers are hired to apply lime, fertilizer, and some pesticides. Those retailers naturally need to have a copy of the data generated to document their activities and to learn how to better conduct future operations.
- Soil sampling and crop scouting during the growing season often are done by consultants, either from independent firms or ag retailers. Again, these entities have a natural business purpose to have access to the data generated in the performance of their duties.
- In contrast to the operations just noted, planting and harvesting are more typically done by the farmer (and/or employees of the farm) and the data is captured by equipment of the farming operations itself.
    - In many instances, farm consultants guide decisions regarding future operations. To be most effective, those consultants would use data captured during planting and harvesting.
    - Data on the relationship between yield and seed variety is of considerable interest. While knowing the variety is useful, variety numbers change and don't provide information as to underlying genetics. That information is known to the genetics firms providing seeds.

The purpose of the prior bullet points is to illustrate that typically in Midwest agriculture multiple entities will have natural business reasons to be involved in the capture and learning associated with data from farming operations.[1] Fully exploiting the knowledge potential of Big Data in agriculture, therefore, likely will require collaboration across firm boundaries.

The capabilities to effectively manage and employ the massive data sets associated with Big Data is a second type of resource. While data capture occurs in the field, orchard, or feedlot, a range of sophisticated processes need to occur to effectively transmit, verify and validate, and store the massive data sets captured. The analytics needed to fuse farm operations data with information generated off the farm and to create algorithms necessary to gain new insights will require highly specialized expertise.

Two Summary Points

It's easy to get excited about the techniques and tools associated with the potential for Big Data's application in agriculture.

- Equipment systems that know when they need repairs before they need them.
- Satellites and drones that can monitor growth across thousands of acres to indicate steps that can forestall disease or pest infestations as well as provide information never before available to guide future decisions.
- Algorithms that inform the farmer how to implement better decisions, based on insights gained from their actual farming experience and that of large numbers of similar operations.

In contrast to those exciting possibilities, this series of articles has taken an economics and management lens to consider the future potential for these innovations. That lens leads to the following two summary points.

One relates to pressure for change to what has been a historic strength of Midwestern agriculture, the economic efficiency associated with its commodity-based production and marketing system. A buyer of a bushel of No. 2 Yellow Corn knows what they're buying, even though there is no information about what

[1] Note this discussion focuses on strategy and economics and is separate from legal dimensions of data ownership and from intellectual property issues.

seed variety was used or whether the corn was grown on hilly or flat ground. This system evolved because data capture and communications were expensive. A result was reliance upon a transactions-based business model throughout the sector. With this business model, firms at each stage of the sector focused on their internal operations and sold their product to firms and farms at the next stage. Knowing how the product was produced and how it was going to be employed wasn't part of the business transaction.

Earlier, we discussed the need for collaboration across firms and farms. From a management perspective, collaboration means that activities within one firm are affected by operations of their supplier and/or their customer. This is accomplished through efficient use of data and requires linkages that historically weren't required. In a collaborative business relationship, the variety of corn and the practices employed to produce it can matter.

Effective use of the tools and techniques of Big Data will be one driver for this more collaborative business model. As noted previously, societal pressures and consumer interests also are driving change in how agricultural output is being produced. And Big Data at the consumer level likely will accelerate these pressures and contribute to this move to a more collaborative business model.

The second summary point relates to market-place dynamics. While it is exciting to think about the capabilities associated with Big Data, it also is reasonable to be concerned about the effect on margins and profitability. An oft-overlooked point is that innovations don't have to be adopted. Or even if used for a number of seasons, they don't have to be employed for the next season.

Relative to innovation, economists like to talk about defender and challenger technologies. In this case, Big Data is the challenger technology. Even if technically superior, the challenger must be priced at a level that provides economic incentive for users to adopt and to continue to use that system. If the suppliers of Big Data to agriculture focus on learning to enable farmers to achieve higher profitability, the use of Big Data likely will grow and flourish. If not, farmers use of Big Data likely will not.

Reference

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