

FORCES DRIVING INDUSTRIALIZATION OF AGRICULTURE: IMPLICATIONS FOR THE GRAIN INDUSTRY IN THE UNITED STATES

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INTRODUCTION

At a conference sponsored by the Economic Research Service, it would seem appropriate that we start the conversation about driving forces with that most basic of motivations, the urge to enhance profits. That motivation also is quite consistent with the notions of differentiation and market segmentation. As we consider the economy in general, the drive to more effectively differentiate a firm's products, often by discerning a stronger linkage with particularly attractive market segments, is a classic marketing response to the declining margins that characterize commoditization of a product.

The paper is composed of four major sections. The first section examines the notions of differentiation and market segmentation as marketing concepts and as driving forces for change. Information and the systems to inexpensively provide information-enhanced products often are critical to the tactics of differentiation and market segmentation. Therefore the paper's second section examines the role of information in the economy, industries, and firms. Five general driving forces in the grains and oilseeds sector are discussed in the third section. The article concludes with a discussion of implications and concluding remarks focused on needed infrastructure to fuel differentiation and market segmentation strategies in the sector.

DIFFERENTIATION AND MARKET SEGMENTATION

I thought it would be useful to provide definitions of the concepts of differentiation and market segmentation early in the conference: Early in his text on strategic marketing, Aaker (1995) defines differentiation in the marketplace. He asserts that "...a differentiation strategy is one in which the product offering is differentiated from the competition by providing value *to the customer* {emphasis added}." (Aaker, 1995, p. 7) I have purposefully added the emphasis to the phrase, "... **to the customer**" in that definition. This, in my opinion, is a critically important point, especially for those of us in agriculture. In my opinion, the misguided use of the term, value added, in agriculture has created an unfortunate perception and understanding among our producer clientele. Quite naturally producers are interested in the concept of value added -- to the extent that the value is added to their profitability. That is natural and to be expected. Unfortunately the reality of the marketplace has a different perspective. Greater profits, either through higher margins or expanded sales, are only **earned** in the marketplace. And, relative to the concepts of differentiation and market segmentation, that added value can only be earned by providing **additional value to our customers**.

As Goldratt (1994, p. 186) so eloquently understates, "The solution to marketing is in the market. So simple. So obvious". As a sweeping generality, the value added discussion in grains and oilseeds has been fundamentally misfocused. Adding value to the farmer's profitability may be the goal but it is not the means. Only by creating value for customers can any organization earn additional value from its operations.

Differentiation can be achieved along several dimensions including enhancing the performance, quality, prestige, features, service backup, reliability, or convenience of the product. In the classic strategic management framework the goal of differentiation is to lead to premium pricing for the product or to achieve increased customer loyalty at parity price (and by so doing, to grow market share). Aaker further specifies that a , “A successful differentiation strategy should:

- Generate customer value
- Provide perceived value
- Be difficult to copy” (Aaker, 1995, p. 197)

This specification is intriguing in that it stresses that not only must the customer be better off with the differentiated product, but they must perceive there is value associated with the purchase of that product.

Recognizing the role of perceptions is critically important. Fundamentally there is, “... a clash between the companies’ perception of value for the product they offer and the market perception of the value for the same product” (Goldratt, 1994, p. 136). “The two perceptions have nothing in common. The perception of value of the companies is based upon the effort that they had to put into the product, while the perception of value of the market is based upon the benefits from using the product” (Goldratt, 1994, p. 136). Historically, agricultural production required physically demanding work. Therefore, it was natural for journalists, politicians and romanticists to focus on the intrinsic value of that effort. Even then, however, the marketplace focused on the customer’s benefit from consuming of the product, not on the effort required to produce it.

Today, in agriculture, we have an additional challenge. For most of the economy, we have come to understand that products and services are tightly interwoven. In our commodity world, a bushel of corn is a bushel of corn. When we consider differentiating that bushel, our natural tendency is to focus on enhancing the physical attributes of those 56 pounds of physical material. Throughout the rest of the economy, however, we understand that products and services are linked. Therefore some customers would find it valuable to know key characteristics of the 56 pounds of physical matter that they are receiving. Knowing the composition may provide significant net benefit to some customers, if it can be done at low cost.

Generally differentiation and market segmentation are tightly linked concepts.

- “Segmentation means the identification of customer groups that respond differently than other customer groups to competitive strategies” (Aaker, 1994, p. 50).
- “Two sections of the market are called segmented from each other if and only if changes in prices in one section do not cause any changes in the other section” (Goldratt, 1994, p. 141).

There are numerous ways to identify customer segments. Historically the common approaches tended to focus on customer characteristics or product attributes. Increasingly use of advanced information technologies systems allow firms to define segments based upon actual response in the marketplace. The traditional approach, for example to define all farmers with sales of more than \$250,000 per year as a segment, used that size measure as a proxy for fundamental

behaviors. Changes in technology capabilities now allow firms to target behaviors not proxies for those behaviors.

Roles of Information in the economy

To understand today's differentiation and market segmentation opportunities, we need to appreciate the cost and benefits of the information systems necessary to execute those tactics. Agricultural economists long have studied the role of price and quantity information as the "invisible guiding" hand of the market economy. In an administratively coordinated food supply chain, however, the role of information extends beyond price coordination. This section first reviews a conceptual approach that focuses on information's role as an economic good that is related to the quality of decision making. This is followed by a discussion of the processes by which information systems fundamentally redefine industries. Both perspectives would be central to marked change in agricultural systems, if that change were to be driven by differentiation and market segmentation tactics.

The economy as an information system: Casson (1997) offers a particularly intriguing framework of the economy as an information system. This framework conceives of economic institutions as mechanisms for allocating decision-making responsibilities and for structuring information flow. Information is noted as having two roles in the economy, coordinating activities and improving the quality of decision making. By approaching information from the decision theory perspective, Casson specifies that the quality of decision-making is a function of information.

The specification that information affects the quality of decision making contrasts with the more typical, and more contrived, general equilibrium approach which ignores the role of information flows in discovering and then reconciling demand and supply (Casson, 1997). To overcome the modeling problems this artificial framework implied, entrepreneurship was cited as a fixed factor limiting the number and size of firms. For the neoclassical firm, therefore, the only strategic decision was how to adjust input and output quantities in response to changes in factor and product prices.

Casson (1997) identifies the role of decision makers as specialized intermediators in the context of information flow. Whereas a purely materialistic view of the economy suggests that the essence of intermediation is production, an information-based view of the economy suggests that the essence of intermediation is the organization of trade. Here trade does not just occur between nations but also between firms, between households and firms, and between firms and consumers. Such intermediation requires resources (has costs) even as it reduces the need for resources by enhancing coordination. Therefore information capture, analysis, and exchange are economic variables. Casson (1997, p. 1) concludes, "as information costs change, so too does the institutional structure of the economy". Pertinent to this conference, as information costs change, so too do the net benefits potentially available from differentiation and market segmentation.

Technological change can affect the optimum amount of intermediation either by enhancing benefits (improving the quality of decisions) or by reducing costs. Emphasizing information

flows highlights change as a continual occurrence rather than as a once-and-for-all event. Whereas the focus of the general equilibrium approach is on identifying the characteristics of a stable equilibrium, the information flows perspective emphasizes that change is the natural state of economics. The economy or a market channel is never likely to be in equilibrium (Schumpeter, 1950).

These factors are relevant in examining the structural implications of the development of systems to deliver differentiated output, as some types of biotechnologically based innovations may require. Historically vertical integration was the typical organizational choice when managers were faced with the challenge of linking adjacent stages of a market channel. In this setting, vertical integration provided internal intermediation by owning and coordinating adjacent stages of production. However, with advances in computation and electronic communication, vertical ownership integration has become less desirable as a communication mechanism (Shapiro and Varian, 1999). Through alternative forms of business organization and with the low cost of capturing and communicating massive quantities of information, new institutional linkages are being tested and employed to provide the intermediation role.

The redefinition of industries: Extensive use of information technology has redefined industries throughout the economy. Although the direct effects often have been described in detail, the underlying mechanisms that fuel industry transformation are less well understood. Sampler (1997) provides an important analysis of these underlying mechanisms. His analysis stresses that, although industry transformation may be the result, we need to understand the impact of information technology at the level of the individual transaction. Based upon Sampler's analysis, two key transaction characteristics are identified:

- Separability refers to the extent to which specific information attributes can be captured in association with each transaction and
- Aggregation potential refers to the extent to which those information attributes can be leveraged to gain economic value beyond the purpose of the original transaction.

Traditionally an economic transaction is perceived as the exchange of a good or service for cash. The information attributes that must be captured for such an exchange are relatively minimal; the amount of cash and the quantity of the product. Clearly the introduction of low cost information systems has materially altered the nature and amount of attributes that are routinely captured in many of today's economic exchanges. Considerable effort is now expended to identify the purchaser, to profile that purchaser in terms of a host of demographic dimensions, and to provide a detailed depiction of the purchase situation itself.

But information technologies are now being employed in settings that require us to alter our perception of what an economically relevant transaction is. Real time sensors can monitor engine performance or tire wear, for example. When equipped with communication capabilities such monitors can alert decision makers of the potential for critical problems before these problems occur.

The second transaction characteristic is aggregation potential. Knowing the purchase habits of one consumer is interesting but there is relatively little economic value that can be gained from that information. However, being able to accumulate and analyze the purchase behaviors of

many consumers can have considerable value. In the case of a sensor tracking engine performance, there is value (which must be at least greater than the cost of employing the sensor system) in knowing the status of that one engine. Again, however, there are additional benefits available if that data can be accumulated, analyzed, and used to predict and enhance future performance.

Aggregation potential typically requires sophisticated analysis, extensive communications, and the ability to capture returns from widespread application of the algorithms defined. As detailed by Shapiro and Varian (1999), these characteristics result in significant economies of scale on the “supply-side” of information economics. First-mover advantages, therefore, accrue to the first firm to effectively create a system that can exploit aggregation potentials. Providing differentiated product offerings to those market segments which can derive particularly large benefits from consuming those products is likely to be a means to achieve those first mover advantages.

FORCES FOR CHANGE WITHIN THE FOOD AND AG SECTOR

The previous section described enhancements to our understanding of the roles and interrelations of information and information technology within firms, industries and the economy. Indeed, this improved understanding may be one of the most important forces for change in the sector, especially because this understanding is not uniformly distributed or appreciated throughout the sector. A host of additional dynamic factors are affecting the forces for change in the sector. In this section, these factors will be grouped as five general forces for change.

Product traceability and biosecurity: Around the world, consumers want to believe that the food they consume is safe. Consumers in wealthy countries increasingly desire assurance that the food they consume is safe. Since the tragic events of 9/11/2001, societies have become concerned that food systems not be disrupted by terrorist acts. Although arising from fundamentally differing sources, these concerns influence the resources devoted to product traceability in the food sector.

If consumers are dissatisfied with a food product, they can express their concern to the grocer who similarly can transmit that concern back to the food manufacturer. DNA testing is now being employed as a means to tightly link the incidence of food-borne illness and the food manufacturer (The Wall Street Journal, 2003). Although still controversial, effective use of such technology could raise the bar as to the level of acceptable food traceback capabilities in the sector. However, the commodity market at the farm level makes it impossible to track the problem back to an individual farm. This characteristic has been a strength of the commodity system because it contributes to low cost, flexible operations at the food processing level. If consumers demand greater levels of traceability, however, that advantage can become a disadvantage. Two trends might cause consumers to desire farm-level traceability. Consumers might become concerned about food safety issues that are affected by operations on the farm and key segments of consumers may want to factor information on the farm practices used to produce the raw agricultural output into their food purchase decisions.

In the last two years, a third food safety concern has been thrust upon society. That concern relates to the food system as a target for terrorist attack. It is unclear, at this point, whether this threat is a significant potential that will drive concentrated government action leading to materially enhanced food traceback capabilities. Although not the direct intent obviously, the information capture capabilities of such a system would have cost implications if those capabilities also could be used to enhance market differentiation tactics in the private sector.

Environmental regulations: In non-agricultural settings, environmental regulations often require that detailed information be maintained on the activities conducted to produce each item. Where possible, systems are implemented to make these reporting processes both verifiable and efficient. In general, environmental regulations for agricultural commodities have not required extensive and verifiable information based upon capture of data as operations occur. However, such requirements could be imposed in the future. The systems necessary to efficiently capture and report such information may not be scale neutral. If per unit cost increases are relatively greater for smaller firms, then the industry's structure will be tilted towards larger firms being more viable.

Biotechnology: Early innovations in agricultural biotechnology focused on enhancing agronomic production traits, reducing the per unit cost of production without materially changing the nature of the output. Therefore the commodity output system was not expected to be effected. In the United States, the actual experience to date has followed those original expectations. However, social and political resistance in other parts of the world has provided some justification for the development of identity preserved systems to segregate agricultural output. As regulations are defined and implemented in nations with key import markets, the long run viability of systems that distinguish products based on the use of biotechnology-based inputs will be determined.

One of the widely discussed promises of this biotechnology has been the potential for development of agricultural output with specific traits that customers prefer to commodity output. Soybeans with higher levels of amino acids to enhance livestock production, rice that has additional amounts of vitamin A, and crops with polymers that can be more efficiently used in industrial applications are examples of such desirable output trait innovations. A key differentiating factor common to these examples is that the capture of the resulting benefits would not occur at the farm production level. The commodity marketing system for major crops is not designed to segregate output based on such traits, which generally are not visible nor easily distinguished. Therefore, systems need to be developed to capture rewards based on benefits resulting far downstream from the farm gate (Sonka, 2001; Bender and Westgren, 2001).

Precision agriculture: Throughout the 1990s, precision agriculture has captured interest and attention throughout the farm community. These practices employ advanced information and measurement technologies to monitor agricultural output levels, capture detailed information on the progress of crop growth, and apply agricultural inputs more accurately. Experimentation and adoption of these practices have been framed by the direct benefits available from their use in commodity agriculture. A recent analysis based upon case studies in Ohio identifies that producers report satisfaction with the technology, because of its information and management enhancing attributes, even if direct net benefits from variable rate application of inputs do not

exist (Batte and Arnholt, 2003). These technologies also have the potential to reduce the cost of providing traceability, complying with regulations, and segregating output (National Research Council, 1997; Sonka, et.al., 1999).

The Internet: Crop farming is inherently a geographically disperse activity. Space is needed for plants to grow. Historically geographic separation has made it difficult to communicate information and to coordinate decisions. Moving people (the sector's traditional approach to business communication) is expensive. Clearly the Internet and the related development of e-commerce changes that cost equation. Although telecommunication constraints currently hinder adoption in rural areas, the benefits can be relatively greater in those settings. Further, wireless solutions may remove even those obstacles.

The five forces just identified can be grouped into two categories. Biotechnology, environmental regulation, and product traceability act like pull-factors, increasing the benefits that would accrue from being better able to track food attributes throughout the food system.. The technologies associated with precision agriculture and internet communications act as push factors, making it less costly to provide those system tracking capabilities. To the extent that the technologies employed to respond to environmental concerns are similar to those needed for tracking food attributes, imposition of such regulations could be thought of as reducing the cost of identity preservation. It is the interrelated effects of the five factors just discussed and the viability of differentiation based tactics based upon enhanced food system tracking that is particularly intriguing. The extent to which any one of the forces might affect the economic viability of the differentiation approach is conditioned by the extent to which the others also are in place.

IMPLICATIONS AND CONCLUDING REMARKS

A key driving force for change in the sector is the desire by entrepreneurs to craft approaches which will earn higher profits for their firms. Technological changes, including those which enhance managerial capabilities, and changing societal needs suggest that further differentiation and market segmentation are likely responses in the grains and oilseed sectors to that desire to raise firm profits. However, those approaches will succeed only if they provide greater net benefits **to the customer**. Logically there are two means by which a supplying firm can provide those benefits to their customer, either by providing a product with enhanced capabilities or by lowering the customer costs associated with acquiring and using the product.

In the grains and oilseeds sector, the last decade has seen massive attention devoted to the promise as startling improved grain and oilseed products. The scientific promise of biotechnology, and the associated potential economic rewards, have largely fueled that attention. To date, however, the marketplace effect of that promise remains speculative. In the rest of the economy, however, much more attention has been devoted to reducing costs associated with transactions between suppliers and customers. As expressed by Goldratt, "We know that there are two types of benefits. Adding something positive or eliminating something negative." (p169). And, "... the more powerful way to increase the perception of value of the market is through bringing additional positives. But we can get the easiest and quickest improvement by concentrating on the eliminating the negatives. They are intimately well known to the customer,

you don't have to persuade him they exist, and you don't have to persuade him that he wants to get rid of them" (Goldratt, 1994, p. 170).

To anticipate the likely evolution of differentiation and market segmentation in the grains and oilseed sectors, therefore, we need to understand the potential linkages between market needs and potential information system capabilities. Table 1 identifies an economic gap that exists in today's grain and oilseed market system. That gap exists between the needs of customers and the capabilities of both the current commodity market system and the current identity preserved market system. Differentiation tactics, that involve farm level products, are inconsistent with the current capabilities of the commodity system. And the current identify preserved market system appears to be too costly to allow for the development of large-scale differentiation efforts.

Although, as noted previously, massive attention has been devoted to the potential for enhanced grain and oilseed products, relatively little attention has been directed towards innovations which would foster differentiation by reducing transactions costs between producers and their customers. Yet technological innovations and societal desires seem to be calling for attention to be devoted to the provision of differentiated grains and oilseed products that better meet the needs of specific market segments.

One way to conceptualize the economic gap identified in Table 1 is to target the lack of information infrastructure necessary to fill that gap with profitable goods and services. The missing infrastructure would provide better information to customers on the tangible and intangible attributes of the grain and oilseeds provided by their farmer suppliers. We know that information systems have cost structures which involve phenomenally high costs for the investments necessary to deliver the first unit of a product offering. Yet the operating costs for such systems tend to be relatively low (Shapiro and Varian, 1999). This cost structure makes it difficult for individual private firms to justify creation of the needed information infrastructure. However, the existence of such infrastructure and the associated organizational structure to operate the infrastructure could provide a substantial competitive advantage to the grain and oilseed sector in the United States.

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Table 1. An economic gap in today's grain and oilseeds marketplace (adapted from Sonka, et.al, 2001.)

<u>Today's alternatives</u>	
Commodity:	Identity Preserved:
<ul style="list-style-type: none">• Large volumes/low benefit• Low cost• Minimal quality standards• Maximum flexibility	<ul style="list-style-type: none">Small volumes/high benefitHigh costSpecific quality standardsMinimal flexibility
<u>Market wants</u>	
<ul style="list-style-type: none">Specific quality standardsConsiderable flexibilityLarge volumesLow costAttractive margins	