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The Role of Information Technology in the Fuel Ethanol Industry

RBS Research
Report 209

Abstract

This USDA-sponsored study used panels of ethanol industry experts and follow-up interviews with plant owners and managers to examine how information technology has affected the structure, organization, and operations of the fuel ethanol industry. The study examined the following questions regarding the future of the ethanol industry:

(1) Does the present ethanol industry represent a stable structure or a transitional step toward an inevitable concentration of ownership into the hands of a few large processing firms?

(2) Have contemporary information technologies fundamentally changed the information flows, scale of operations, access to markets, conditions of vertical and horizontal coordination, sources of finance, and the competitive landscape for the medium-sized, independent processing firm?

(3) To what degree have cost savings associated with better access to information and financing offset the cost savings traditionally associated with horizontal and vertical integration in processing industries?

(4) What steps do medium-sized ethanol production entities need to take to continue to survive in this new information-based market environment.

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Anthony Crooks and John Dunn
USDA, Rural Development

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May 2006

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Executive Summary

USDA, Rural Development commissioned Informa Economics, Inc., of Memphis, Tennessee, to conduct 2 panel discussions and 12 interviews with ethanol industry participants and service providers to determine the impact of information technology on the competitiveness of ethanol firms. Information from these panel discussions and interviews was analyzed by a study team composed of experts from USDA's Rural Development, Economic Research Service, the Office of the Chief Economist, the University of Minnesota, and Informa Economics.

The principle discoveries from the panel discussions and interviews are:

1. Information technology (IT) has become a driving force in business operations, strategies, structures, ownership, and performance.

   a. IT innovations and applications have brought significant change to the nature of business and its activities.

   b. IT has altered industrial structure, conduct, and performance from vertical "Command and Control" hierarchies to horizontal, multi-dimensional, multi-modal, collaborations that are "real time" sharing and distribution of knowledge and work without regard for geography, distance, or language.

2. Structurally, the emerging fuel ethanol industry is uncharacteristic of typical agricultural processing.

   a. There is a fragmented balance of the traditionally dominant multinational, agribusiness processing firms and the medium-sized farmer-owned, -operated, and -controlled plants.

   b. Ownership of those mid-sized plants is dispersed from production activities.

   c. There have been very few efforts among the largest firms to integrate or assimilate the assets of other firms either vertically or horizontally.

3. The fuel ethanol industry has expanded four-fold and altered its structure significantly since the mid-80s to early 90s:

   a. Then the top 3 of a total 20 firms controlled 80 percent of production; annual production capacity was about 1 billion gallons

   b. Now the top 3 firms control 31 percent of production, and 44 of the remaining 71 plants are farmer-owned; annual production capacity is just over 4 billion gallons.

4. Industry expansion and development was encouraged by a combination of factors including: Federal/State policies and incentives, a natural progression of an emerging industry in a classic "production push" agricultural business model, farmer-owned facilities and associated capital constraints, and oil prices $50+ per barrel.

5. The most prominent business development in the industry is the rise of the ethanol "franchise." These so-called "cookie-cutter" ethanol plants are offered principally by two design/build firms, Broin, Fagen/ICM, who have adopted, ...

developed, and now capitalize on two IT-enabled innovations - process design technology and distributed control systems (DCS).

a. Process design technology standardizes the project design, construction, and equipping of ethanol plants. Included in that design and equipment is the DCS.

b. DCS is the central nervous system of an ethanol plant. DCS facilitates the consolidation of the business process management functions across many plants or firms. DCS enables precise factor/product coordination from established business/bio process metrics and benchmarking that is the result of a massive data collection/analysis effort. DCS results/advantages include sourcing/usage specifications, staff reduction, productivity gains, and cost savings.

c. DCS enables the design/build firms to monitor/manage the operations of many plants simultaneously.

6. Design/build firms offer a “one-stop ethanol shop” of ethanol business services from feasibility to turn-key and beyond -- Hand-holding producer-investors through the entire project process and providing operational contracts into 5th marketing year with:

   i. Marketing “partnerships” for ethanol and distiller grains.

   ii. Procurement “contracts” for feedstock, energy, and inputs.

   iii. Management “agreements” for operations/process benchmarking, trading/risk mitigation, and market analysis/consulting.

7. IT enables design/build firms to practice dynamic specialization -- the digitalization, decomposition, of activities for outsourcing

   a. Supply chain management -- marketing and procurement

   b. Product innovation/commercialization

   c. Customer relationship management

8. IT enables design/build firms to weave together processing networks that encourage coordination across enterprises, companies, and specialties that are dispersed geographically, institutionally, and dimensionally, and are the basis for using “productive friction” to build and accelerate capabilities.

9. By fostering standardization IT -- Strips costs out of system, squeezes time loss out of system by speeding up construction time - groundbreaking to turn-key, and reduces downtime - 320 to 360 days of operation per year. All of these things reduced perceived risk of investment in ethanol plants and facilitates the flow of capital into the industry.

10. By digitizing and decomposing activities for outsourcing IT -- alters asset location requirements, encourages labor mobility, further separates ownership from management, and alters the skill sets needed for management and labor.

11. IT encourages firm transformation by - giving rise to the ethanol “franchise,” supporting a contracts-based industry structure, and creating a “Web” of collaboration across enterprises, companies, and specialties.

12. IT reduces bounds of uncertainty by providing a better understanding of risks that in turn helps to reduce lenders' equity participation requirements, reduce interest rates and the overall costs of capital, and invite participation from outside investors.

13. IT has altered the ethanol industry/market structure by changing the emphasis from gaining market power through accumulation of production capacity to that of the aggregation of information. Market power no longer resides with the ownership of physical capital, but in the control intellectual capital.

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Study background

In recent years, information technology and an increasingly transparent financial sector have become key driving forces in business -- operations, strategies, structures, ownership, and performance. These forces cut across many industries to force changes that, in turn, have had significant economic and social impacts in rural communities.

Structurally, the emerging fuel-ethanol industry is uncharacteristic of typical agricultural processing. As the fuel ethanol industry grows out of its developmental stage into a more embedded role within the U.S. fuels system, a substantial portion of production capacity is characterized by investments of individual enterprises in single plants with annual capacities that range from 50 to 100 million gallons. Not all ventures have succeeded. However, a substantial flow of capital investment continues unabated into and across the industry.

This emerging structure lies in sharp contrast to what is generally observed in sectors that process bulk agricultural commodities. Typically, a commodity sector is composed of a few, large, multi-plant firms that achieve relative prominence after attaining significant economies of scale, size, and scope, and then work to capture additional value through their trading and financial operations. These traditional industries are also characterized by a high degree of vertical integration and/or coordination.

The ability of traditional firms to achieve competitive advantage is predicated, in part, on their capacity to develop efficient, internalized information systems to provide market coordination and linkages between their operations and global commodity and financial markets. However, the rapid and widespread change in information technologies has arguably eroded the power provided to these global processing concerns.

When viewing the emerging ethanol industry from the context of the impact information technology has had upon the development of the industry, the following four questions emerged as central issues for this study:

(1) Does the present ethanol industry represent a stable structure or a transitional step toward an inevitable concentration of ownership into the hands of a few large processing firms?

(2) Have contemporary information technologies fundamentally changed information flows, scale of operations, access to markets, conditions of vertical and horizontal coordination, sources of finance, and the competitive landscape for the medium-sized, independent processing firm?

(3) To what degree have cost savings associated with better access to information and financing offset the cost savings traditionally associated with horizontal and vertical integration in processing industries?

(4) What steps do medium-sized ethanol production entities need to take to continue to survive in this new information-based market environment?

The primary methodology of the study was to gather and synthesize opinions of a number of ethanol industry leaders and experts under a framework built upon contemporary thinking on the nature of the modern firm, business practice, and application of information technologies in a global competitive environment. The study was conducted in two phases. In the first phase, two discussion panels composed of 10 to 12 industry experts were convened and led through a 1-day directed discussion covering a range of topics related to various aspects of the evolution of the ethanol industry, the forces shaping the present and future industry, and how information technology may have influenced that evolution.

The ethanol industry -- then and now

The fuel ethanol industry may very well be in transition toward an inevitable concentration of ownership into the hands of a few large processing firms. At present, however, there seems to be a structural equilibrium among the mid-sized and largest firms. This equilibrium is supported by an industrywide adoption of contemporary information technologies that serves to enhance medium-sized firm access to both markets and factors and simultaneously diminishes the relative importance of vertical coordination activities.

While today's industry is fragmented, it wasn't so very long ago. Fuel ethanol was concentrated among three major players in 1990 -- ADM held 60 percent of the market, Pekin Energy (now Aventine, by way of Williams Bio Energy) and New Energy Co. of Indiana, each respectively held 10 percent. The entire industry was comprised of about 20 firms that produced about 1 billion gallons (see Table 1). At that time, construction costs were around $2.50 per nameplate gallon, conversion efficiency was close to 2 gallons per bushel of corn, and the average-sized plant required around 50 staff members.

Structurally, today's situation is almost a mirror image of the past. The top 3 firms produce about 31 percent of the total, and 44 of the remaining 68 firms are farmer-owned. Over 4 billion gallons of fuel ethanol will be produced this year. Construction costs are about $0.98 per gallon. Fuel conversion efficiency is now almost 3 (2.85) gallons per bushel of corn. A plant requires only 35 full-time staff members and is operational for 360 days per year.

How did the industry get "here"?

The transition from a highly concentrated to a fragmented industry was brought about by several key drivers: *Federal and State policies, natural progression, a classic* "'production push" agricultural business model, farmer ownership, a crude oil price spike, low-priced corn, the development of venture capital interests, and the formation of trade associations.

Federal and State policies

Federal and State policies contribute substantially to the viability of the fuel ethanol industry. As one industry participant commented, "State and Federal incentives cover a lot of mistakes. They provide a safety net."

Ethanol's exemption/credit against the Federal excise tax on motor fuels is a long-standing industry cornerstone. The programs created under the Clean Air Act Amendments of 1990 enhanced demand for ethanol. Those included the Oxygenated Fuels Program, implemented in 1992, to reduce emissions of carbon monoxide, and the Reformulated Gasoline Program, taking effect in 1995, to reduce ground-level ozone (i.e., smog) formation. The Bioenergy Program (CCC-850), established by Executive Order in 1999 under the Clinton Administration, is a key incentive for new facilities because it offsets part of the feedstock costs incurred in starting up or expanding biofuels production. The long-term extension of the excise tax credit in the JOBS Act of 2004, together with the Clean Air Act programs, reduced the "policy risk" associated with establishing and operating an ethanol facility.

State policies also have had major impacts on the industry. However, State production incentives tend to be capped at a certain capacity level and which also contributes to a fragmented industry structure.

Were it not that methyl tertiary butyl ether (MTBE) was found to be carcinogenic, the fuel ethanol industry would not be where it is today. The political fight between the oil/energy sectors and agriculture would have continued. The MTBE phase-out has put both parties on the same side of the issue.

The Minnesota requirement that gasoline be blended with 10 percent ethanol is regarded as a model State policy. State bans of MTBE, a competing additive used to boost oxygen content in gasoline, expanded ethanol use in recent years. Presently, 20 States have implemented or announced bans of MTBE. Most notable among them are California and New York, where bans took effect at the beginning of 2004.

Natural progression

To some extent, fuel ethanol is experiencing what many consider the "natural progression" of an industry. Most industries follow some form of rising developmental growth pattern, wherein an emerging industry begins with a fragmented look and then proceeds through a consolidation phase. The ethanol industry has taken a less predictable growth pattern. It has effectively begun again several times over the years. Each time it was on the verge of death, only to be reborn anew. But the fundamental growth driver has remained the same--world demand for energy.

Table 1—**Summary of changes in ethanol industry over the past two decades**

	Then (mid 80s to early 90s):	Now:
Industry structure	Concentrated structure Top 3 firms held about 80 percent of production About 20 firms total	Fragmented structure Top 3 firms hold about 30 percent 71 total firms (and rising) (44 cooperatives or LLCs)
Production capacity	1 billion gallons	4+ billion gallons
Plant construction cost	$2.50/gallon of production capacity	$0.98/gallon of production capacity
Corn conversion to ethanol ratio	2.2 gallons per bushel	2.8 gallons per bushel
Plant labor requirements labor costs	52 full-time staff members $0.15 /gallon (1998)	32 full-time staff members $0.05 /gallon
Operating days per year	310-320	350-360
Other changes		Energy input/gallon down 50 percent over 20 years Pool of management, design, operations talent starting to grow Ethanol buyers focus only on large lot purchases (500 million gallon deals)

Panelists point out that while ethanol is, in fact, a commodity, its development as an industry has had a social or philosophic component that has carried the industry through periods that may have marked the death of most fledgling industries. To paraphrase one panelist,

> …those involved in this business for 25 years still have the same dream as those who started the generation before. All are a little too naive to realize the size of the uphill battle being fought. But before their eyes the industry became real. There is something about ethanol that makes it more than a commodity. It seems to those involved to be more of a religious experience. It's truly emotional. And the industry survived a number of difficult straits seemingly because of those beliefs.

The ethanol industry has continued to grow in the face of several downturns, each time to be rescued by a new policy or other stimulus that led it to the next phase of growth.

Former President Jimmy Carter started it when he turned down the thermostat in the White House, leading to the first Federal excise tax exemption incentive. The industry soon experienced its first financial crisis and was headed downward, but lead was banned as a gasoline additive in the mid-80s, and ethanol got a second life as an octane enhancer. The industry was headed down for a second time when it managed to get an extension of the federal excise tax exemption, along with the Clean Air Act in the 90s.

Four major events -- excise tax, lead phase-out, excise tax extension, and MTBE replacement -- have occurred to snatch the industry back from its downturns. Meanwhile, it kept expanding production without a clear vision of future demand. The consensus seemed to be built on that Statement of faith, “It's a good idea.” Support for increased ethanol production in the 2005 Energy Bill bears this faith out.

Classic “production push” agricultural business model

In no small way, ethanol is a case of classic “production push” agriculture. Farmers have a long tradition of planting seed in the ground without having much of an idea about how much they will produce or what they will receive for it. The industry philosophy seems also to have been rooted in that same tradition; devoid of any real vision or design.

Nevertheless, the industry is not going away. Support for the continued expansion of ethanol use in the 2005 Energy Bill ensures that industry growth will continue The more important question is, “What will it look like?” The consensus seems to be that unless there is an engineering breakthrough in energy, the industry is headed for a substantial long-term positive growth phase. And the only real distinction among ethanol plants in the last 5 years has been among those that made a “nice” return on investment and those that made a “fantastic” return.

Farmer ownership

The emergence of the “new generation” cooperative and the farmer-owned ethanol plant in the early 1990s played a critical role in the development of the ethanol industry. The cooperative structure provides farmers with the opportunity to collectively raise money to build facilities. The cooperative also serves to distribute the investment risk over the entire group of investors and thereby reduces the risk to any individual investor. In addition, because cooperative membership is often tied to a right and an obligation to deliver corn to the cooperative, corn delivery agreements may have helped the cooperative to survive market fluctuations, in contrast to a privately owned plant faced with purchasing corn in a volatile open market.

However, it's harder to put together a co-op today, because the farmer group within the typical 60-mile grain-hauling radius doesn't have sufficient capital base to invest in the equity requirement portion of the project. The recent history of projects has shown that within the 60-mile radius, there is a limit of about $12 to $18 million in capital to be raised through local equity drives. Nevertheless, some farmer groups are getting more sophisticated about raising capital -- a recent success story involves a co-op that raised $28 million.

Generally, farmers will exhaust their ability to raise equity, then the plant builders, ethanol marketers, and other outside investors will come alongside as necessary partners to complete the capital requirements. Recently, a few Wall Street investors have entered to finish an equity drive in some form of partnership arrangement, or to subordinate the debt.

Crude oil price spike

The most recent impact on the industry is the present energy crisis and fifty-dollar-plus per barrel crude oil.In some sense, the industry has become accustomed to the nurturing effects of world events.

At one time, there was a perception that the viability of the industry was based on subsidies. It was difficult to get New York investors to discuss ethanol. Morgan Stanley was forward-looking enough to pursue some interest, but others declinedThe only real change since then has been the price of oil. Now the institutional investors and money-center banks seem to believe in the long-term viability of ethanol as an energy source.

Low-priced corn

Most producers looked to build ethanol plants to improve their local corn basis. And many plants were financed for that reason, without considering the economics of the grain margin. The ideas was simply that a $20,000 investment in a local ethanol plant could improve a producer's corn basis enough that it became a de facto annuity, returning an additional $0.125 per bushel of corn, in perpetuity. That paradigm drove the financing and building of the 20- and 40- million gallons per year plants. No East Coast money was invested in these projects; only producer capital.

Development of venture capital interests

Farmers recognized the economic incentives and experienced what was called the “back yard syndrome.” Every community wanted 5 or 10 cents more per bushel of corn. Most weren't sophisticated enough at that time to understand the risk-management issues involved or the operating margins. Neither was the possibility considered that there may be a better place to locate a plant other than in their hometown, or that perhaps it should be built by someone other than a general contractor. The sole consideration was basically the desire to increase the corn basis by 5 to 15 cents per bushel. The industry production-standard grew from 15 to 20 million gallons per year to 45 to 50 million gallons.

The success of those plants fueled the enthusiasm to build. Most of the plants now being built in Iowa are not farmer-investments. Moreover, most investment plans today intend to build two or three additional facilities. The Eastern and Western money is involving itself, especially as the price of oil has exceeded $50 per barrel and approached $60.

Formation of trade associations

The information explosion was also a driver behind the formation of ethanol trade associations. Producers grew interested in ethanol production during the late 1990s, and started organizing into groups haphazardly, three groups in one county, two groups in adjoining counties, and started to approach a few institutions for information -- Iowa State University, the Farm Bureau, and the Corn Growers Associations.

These associations recognized the benefit of bringing the groups together to provide them with the information they were seeking -- available production technoogy, different legal structures, sources and availability of financing, etc. They would meet monthly with several groups and watched each evolve through the developmental stages -- fundraising, ground breaking, turn-key, and full production.

The ability to share information was a prerequisite to a distributed and fragmented model. In order to have multiple facilities and many companies forming, each had to have an understanding about what to do and when.

Information needs in the ethanol industry

The role of information in the ethanol industry is no different than that of the other commodity industries: market and price information for marketing products and procuring inputs; operational controls, efficiency, performance, and benchmarking; finance and accounting; forecasts and projection; and policy analysis.

Pricing and market information deficiencies

Price transparency and the transfer of risk

There are two key functions of the futures exchange that people use -- one is the transfer of risk by way of the hedging mechanism, and the other is price transparency. The basic question is would an ethanol futures contract help to make the price of fuel ethanol more transparent?The answer is uncertain because none of the contracts would be disclosed for others to see. If a contract is sold to an end user, it probably won't be executed in its pure form. The end result would be a negotiated freight arrangement -- a piece of the transaction that will reflect some sort of adjustment to the actual price. Only the two trading parties would be privy to this information. So the information necessary for price transparency would not be disclosed.

Furthermore, no one knows what ethanol is selling for in relation to the New York Mercantile Exchange (NYMEX) or the Chicago Board of Trade (CBOT). Those indices are published daily, but the actual price of ethanol is the differential between the referenced index and the privately negotiated transportation arrangement. As long as this procedure continues, the elements necessary for price transparency aren't in place.

Customers shy away from pricing ethanol by way of the indices because they are not tied to gasoline. Ethanol is first and foremost a blend component of gasoline. And contracts are negotiated to allow blenders/refiners to determine their final product price. Ethanol is also traded independently and its price is uncoupled from gasoline. And while that may be useful to ethanol producers, it doesn't necessarily meet the needs of their customers.

The NYMEX gasoline contract has served reasonably well as a risk management tool for the industry, but its usefulness is eroding. The price of gasoline moves independently from the cost of ethanol production. The NYMEX provides an instrument in which the ethanol price can be locked in with respect to gasoline, but NYMEX doesn't cover enough of the country to do it universally. And it's necessary to index against California, Chicago, NYMEX, and a whole pool of indices. So traders in each region adjusted to that reality and developed their own basis and methodology of using it.

These indices only provide the elements for buyer and seller to strike a forward contract to a flat price. The basis is negotiated with respect to the region of origin and destination to provide producers with the ability to lock in that flat price. Without it, they're left riding the cash market.

If it performs, the transparency function of an ethanol futures contract will give traders a way to develop a forward price curve. The industry and all respective parties can then adjust accordingly -- to make decisions, to transfer and manage risks, etc.

The major remaining issue then is delivery. There is no clean delivery function because of the way the industry is set up.

Consider also that while price transparency may be considered a good thing, not every party is equally interested in realizing it. Producers that typically use a marketer prefer transparency. They want to be assured that their netbacks (ethanol revenues less marketing expenses/fees) are comparable to those of their neighbors and that they're getting fair value. Grain firms want ethanol price transparency because they want to project crush capacity and demand base. Energy companies want to project demand for natural gas. In the same way that a calculation is performed for soybean crushing, flour milling, or corn grinding, they want to understand the dynamics of the overall market.

But transparency is not desired by everyone, and particularly not for those connected with the actual trading of ethanol. Because even though the industry appears to be fragmented, with 81 plants highly variable in size, there are only about a half dozen marketers of ethanol. And they're quite competitive against each other. Each marketing firm has its own strategies and business plan, and they are loathe to share with each other.

Futures market

The size of an ethanol futures contract is 29,000 gallons, roughly one rail car in volume. The price is listed in dollars and cents per gallon. Initially, the contract was designed to discourage it from being used predominately as a delivery instrument -- where buyers look to source ethanol. However, the delivery aspect is primary to every futures contract.

Transportation differentials allow traders from different parts of the country to participate in the delivery process. However, differentials are updated once per year, and the cash market changes daily, which limits their accuracy. Instead of differentials, the delivery mechanism on the ethanol contract is a shipping certificate.

A shipping certificate is a negotiable instrument. But if it is held and not sold, the ethanol storage costs must be paid on the shipping certificate. It may be redelivered to the futures market. A shipping certificate is tradable in the cash market, or the holder may demand load-out. If load-out is demanded, the buyer issues shipping instructions to the seller, and the seller is responsible for loading ethanol into cars and arranging transportation to the buyer's location. In the background, buyer and seller privately negotiate any freight charges. Absent a successful private negotiation on the freight charge, the ethanol is delivered to Chicago to the buyer's terminal. Anyone making or taking delivery therefore assumes a Chicago origination/destination, so an important prerequisite is leased storage space at the Chicago terminal.

The Chicago market, just as with other commodities, is priced as the cheapest-to-deliver location, correlates well with other domestic locations and, as such, may be used with no delivery intentions as a risk management tool. However, Chicago is not a staging area for California markets, because once ethanol arrives in Chicago, the State of California considers it a Midwestern product, and subject to California State Midwestern ethanol product delivery limitations.

There is no blend facility in Chicago. Blenders truck ethanol out to their own terminals for blending.

The contract is serial, traded 12 months, every month, starting up to 6 months. There is a market maker --.a firm that signs up to make bids and offers at a specified spread, contracted with the CBOT. The market maker stands ready either to buy or to sell at a certain depth on that specified spread. That ensures the market of liquidity in the initial stages. New contracts tend to have trouble with liquidity.

The nearby pricing time horizon is pretty well defined by the cash market. Trading is available through the next year in both distiller's grains and ethanol.

An international component isn't available at this time, but will need to be introduced. When one looks at the other futures markets, soybean meal for example, Brazil affects the price of beans in Chicago significantly. This same circumstance may occur in a large-scale liquid ethanol futures market.

"Creating" a futures market is a misnomer because a futures market is a derivative, in that it is derived from an active cash market, as opposed to a typical commodity futures market, such as grain, that is based on the fundamental value of the commodity. The challenge with initiating an ethanol contract was the market's relatively small size and newness. It is so fragile. Essentially it really doesn't exist. Any liquidity in the marketplace, if it exists, is derived from physical cash market conditions. An ethanol market grows organically out of cash market conditions.

The challenge is that market demand is quite fragmented and unclear. The NYMEX recognizes some challenges with the CBOT's initiation of an ethanol contract:

a) The uncertainty of the underlying demand for fuel ethanol;

b) The concentration of production; and

c) The physical delivery mechanism seems to be quite difficult to establish.

Prices are very contract-specific, on a transaction-by-transaction basis. Other than that, most contracts are based on discounts and reflect the supply and demand situation. So there is no transparency: the information is proprietary between the two trading partners. This is not a function of lack of information technology because the structure is in place to provide the information. More information would encourage transparency, but at the expense of volume. But that in itself is not a limitation.

The real problem is that a half-dozen sellers are trading with a half-dozen buyers, and each seller trades with every buyer and each buyer trades with every seller. So, why should they publish their trades? Their information is commonly held among themselves, and within their collective, is quite robust. A conversation with any one of the agents involved could reveal what any or all of the others is paying/receiving for ethanol at a given time. This uncertainty has more to do with the cost of logistics/transportation from the production facility to a particular market.

Dried Distiller's Grains (DDG) markets are similar to ethanol. There are basically the same groups of buyers and sellers. However, the markets are more localized instead of regional or national. If there was a market reporter, some transparency might exist. But it's unlikely that more information could be shared among the people who are buying and selling. Again, all the available information is commonly held among every trading party.

USDA does publish for Illinois and California and perhaps some other locations distiller's grain prices in Feed and Grain Weekly. That's somewhat similar to the publication of renewable fuel prices. The Renewable Fuel Association has published fuel ethanol prices for years. But it is also widely known that published prices aren't representative of any individual transaction.

A more representative price might be based on extrapolating the total production activity of the dry mill plants. The production volumes of the integrated plants (ADM and Cargill) are not easily known. Their production capacity is commonly held and a pretty good idea of their activity in the market may be derived, given the sales of everyone else if a total sales value is known.

An important fact to remember regarding distiller's grains, however, is that every plant produces, more or less, a different product. And for that reason, a national market price is even less relevant. But a published monthly average price provides little to no information to someone who trades commodities. A series of monthly average prices might be more useful to a long-term financial planner/model. But in the trading world, it's not all that certain that a futures contract price at 9:30 AM is at all relevant at 11:30AM, much less a monthly average price, because that information is ancient.

But these are two disparate needs regarding price information -- trading/merchandising and decision-making from plant operations standpoint. With respect to financial planning, for the business model or business plan, a monthly average price may be quite representative and useful. Reported prices in that regard are benchmarks, from which a manager can sell for up to a year ahead and that others can base decisions upon.An entire array of financial decision-making tools is at a manager's disposal that requires only monthly average prices for factor costs and product prices. And the risk management profession makes full use of these tools. As decision making tools, the creation and use of these models may be among the greatest technological advances in this industry.

A little more than half of the producers are forward contracting up to 6 months in advance. But virtually none of them are contracting 12 months ahead.

Price information from a futures market could be integrated into the existing plant's financing, but that would probably be used only in the case of an adverse event -- a breach of confidence or contract obligations, a change in market circumstances, or a request from the borrower to change the financing structure. So the bank then may influence the borrower's behavior if there was price transparency. Banks would use the price information to implement secure margins.

Banks can also be viewed as processing companies. They are in the business to make a margin, not to speculate. That's why banks use financing to hedge their input, put a risk mitigation strategy in place to make their margin.

The risk mitigation that's used in several plants now is performing well given available price information. But it should be enhanced by having the increased liquidity and price transparency availed by a futures market. Everyone in the industry stands - and hopes - to gain from the benefits of the futures market. The strategy is well known, as are the players involved. All seek to transfer risk using a variety of tools, whether it's flat price, a spread to gas, or a spread to fuel ethanol. And while, presently no one involved is 100 percent covered, a significant portion of every plant's production and inputs is, in order to protect the margin.

Asymmetric risk profiles

Another issue involving the market liquidity is an asymmetric risk profile between the producer and the buyer. Consider that the future price of ethanol is a major portion of the risk profile for an ethanol plant. But for a blender, the future price is a very minor risk consideration. Blenders consider ethanol a micro-ingredient. From that standpoint, their portfolio is stacked with many other risks that need to be managed before ethanol becomes a consideration. Blenders will not allocate the resources, either financial or intellectual, to manage such an insignificant risk.

In past years, ethanol was a third price -- or third contract. As United Bio Energies, Broin, FC Stone, and National Energy partnerships developed, the so-called “gas-plus spread” contract became more of what is called a "crush margin."A crush margin factors in feedstock and energy procurement costs.

There's a coefficient relationship between the procurement of corn and energy (natural gas) and the production cost of ethanol. Ethanol marketers know that margin and try to lock in a product price that plant managers can be comfortable with. It's a short-term pricing arrangement, 6 months in length. And during a period of favorably high oil and gasoline prices, there's a great margin to work with. In recent years, however, the margin on the corn side was difficult to carry because there was an inversion in the corn/gasoline price relationship. For this reason managers avoid locking in for more than 6 months at a time.

There are two other problems associated with going beyond the six-month time constraint. The annual crop cycle is one issue. The other is price variation attributed to the growing cycles in the Southern hemisphere. However, as the major financial investors enter the industry, arrangements of 12-, 24- and 36-month markets in grain side are being struck and at quite competitive values. Some of this trade is occurring as an alternative to trading with the major grain traders -- ConAgra, Cargill, or ADM -- because of those firms' unwillingness to give up liquidity or transparency.

Research and development

Product innovation and commercializatio -- DDG product development

Land-grant universities and private corporations have worked together to significantly enhance the product value of distiller's grains. Researchers, such as Vern Kelly and Jerry Shurson at the University of Minnesota, have served not only to expand existing markets for distiller's grains as cattle feed, but have also developed new opportunities in feeding to hogs. So instead of being an afterthought or even a waste product as distiller's grains were once considered, DDG are now significant components of a plant's revenue stream.

Early on, some plants were fortunate enough to have Farmland Industries as one of their investors. Farmland's feed division helped market the product. Farmland also sponsored and conducted research on how best to use distiller's grains. Farmland's feed division has since merged into Land O' Lakes, which now markets the DDG, and continued the research in their own facilities and in collaboration with universities.

The ethanol industry has grown enough that there is an excess supply of distiller's grains and the price is tracking downward again. But, all of this was made possible by feed researchers and development groups that were able to educate the industry and develop a customer base. The product is still cheap relative to corn, but feeders will substitute more of it into their ration.

Initially, the product went almost 100 percent into dairy rations. It was dried because wet distiller's grains have a short shelf life and typically weren't as consistent in quality -- both well-known characteristics among local feeders who pressured plants to sell quickly and at a discount. In fact, the best offer most plants received from feeders early on was, “We'll pay the freight to haul it off.” But now, after years of research, some technological developments, and a lot of education, feeders know precisely the value of wet feed.

Information technology and the rise of the ethanol plant “franchise”

Standardized design technology and the “cookie-cutter” ethanol plant

In the early 1980s, a number of people were exploring the idea of small, portable farm stills and million-gallon-a-year plants. They were first to discover that besides being expensive to build, these plants have to be staffed 24 hours a day.

Today, Broin, Fagen/ICM, and others build cookie-cutter plants -- standardized designs that they can put down quite easily in almost any location. They also provide the financing and the feasibility work, and will hand-hold the producer-investors through the entire process. They can offer an entire package -- from feasibility study to turn-key and beyond.

This prospect didn't exist in the early 1990s, when there were still a lot of questions on what was the right way to build a plant. Because there were no standardized designs, builders of a 30-million-gallon-a-year plant had to go a more traditional construction route -- hiring a process firm, a detailed engineering design firm, and a construction management firm. A prospective plant had to assume every responsibility. It may have been the first and only ethanol plant that the hired construction firm had ever built. So the lack of experience and the associated uncertainty added significantly to start-up costs and subsequently to each step in the process.

However, enough plants have been built to develop a body of knowledge and experience to reduce that uncertainty. The time and expense associated with everything, from that first planning meeting, to the training of the start-up crew, to pouring that first gallon, has fallen for the last 10 years. An estimated 6 to 9 months have been trimmed from total project time from fundraising to turn-key.

These standardized designs and business models were pioneered mainly by Broin, Fagen/ICM, and a few others. These firms began with the recognition that producer groups were developing an investment interest in these plants. They also had an understanding of the operating point at which these plants could be profitable at that time, around 10- or 15-million gallons per year.

Compared with 10 or 15 years ago, standardized design technology has cut the costs of construction and the non-energy portion of operations in half. And while it's unfortunate that higher natural gas costs have wiped out that savings in operation expenses, there's no denying that today's plants are built twice as cheaply and operate twice as efficiently as those of the 1990s.

Several factors have contributed significantly to lowering operation cost. One is greater product yields from corn to ethanol, from 2.5 bushels per gallon to 2.85 or even 3.0 on a denatured basis, given the right variety of corn. Another is the reduced cost of enzymes and their increased use efficiency -- enzymes are now half their cost of 10 years ago.

Business processes and information technology

Distributed control systems

Prior to the mid-1980s, process automation was comprised of analog loop controls and complex pneumatic controls with individual, large circuit boards dedicated to each control loop. These systems were normally located in control rooms, so the sensors and controller outputs had to be physically connected to the control room. This resulted in large cable runs full of wires and tubing. Because the systems were bulky and required direct interconnections with the process, there were often several satellite control rooms for each part (or subpart) of the process. These systems required sophisticated maintenance by skilled instrument technicians, and data-logging was done on strip chart recorders. Despite the awkward implementation, these systems replaced hardwired relays and manual controls for critical systems, allowing plants to reduce labor and improve consistency of operation.

But an even greater contributor to plant efficiency has been the development of information technology (IT) systems, the so-called Distributed Control Systems (DCS), and the electronic automation evolved in the plant. DCS were introduced in the late 1980s, enabling centralized process monitoring and control. DCS replaced integrated circuit board controllers. Inputs from field instruments and outputs to valves and pumps were converted to electronic signals. They were generally run short distances to cabinets in the process area that contained a manageable number of control loops. Each DCS cabinet was connected to a main control computer. Process instruments, output to pumps and valves, and controller settings driven from a computer console (dashboard) were located in a central control room. This design also enabled monitoring and control from multiple (and redundant) locations, such as local control rooms, engineering offices, or even remote locations.

During the 1990s, these systems grew in capability alongside the geometric growth of IT applications and abilities. This evolution reduced labor requirements by more than 50 percent over the past 15 years. As computer control, process monitoring, and laboratory capabilities further improved, sophisticated data warehousing and analysis systems were adopted to convert the ever-increasing volume of data into useful information. These systems can now monitor process conditions, control settings, as well as laboratory measurements when integrated with a Laboratory Information Management System (LIMS).

Whereas early systems could only retrieve historical information, today's systems perform complex mathematical manipulations, display graphical results, and project future outcomes all in "real time." Data manipulation and extraction capabilities enable much narrower process tolerances to further reduce costs and simultaneously increase yields and productivity.

The advantages of DCS data warehousing and analysis include: a reduction in manpower by allowing one operator to monitor and control several processes at once; the ability to see small changes in production variables and correlate them to changes in conditions, raw materials, or ingredients; and an increase in overall plant efficiency, since operators can fine-tune process parameters using real-time data and sophisticated analysis. Early plants scheduled several maintenance shutdowns during the year to prevent equipment failures. With the data collection capabilities of DCS, preventive maintenance programs became far more efficient, reducing downtime. These processes and technologies continue to evolve and become even more significant.

Business/bio process metrics and benchmarking

DCS plants all have the same production and business processes and share a data collection and analysis protocol called "benchmarking." Benchmarking is an array of performance measures that are monitored daily, gathered weekly, and summarized monthly to be reported to management and the board. If, for example, a group of 10 plants of common design are all linked together, the business and biological process benchmarks for this group are very well understood. The manager of any one plant is, therefore, able to adjust and refine the process to improve his/her performance and thereby raise the standard of the whole group, in a stair-step fashion. This business process is possible only with today's IT, and even now it's time-intensive, to perform. But this would have been next to impossible 10 years ago.

Firms like Broin and Fagen/ICM were able to expand to their present capacity level because of IT employed by the new plants. Both Broin and Fagen/ICM direct the operations of 20 to 25 plants each.

The talent pool to manage and operate these plants has grown with the process. Both firms employ a cadre of well-seasoned managers who learned during the difficult years how to run a plant efficiently. Both companies provide management services, marketing contracts, and procurement contracts to mid-sized plants. This is a far cry from the old days when managers were still putting contracts out and doing everything by hand.

And now a group has the ability to manage 20 to 25 plants using IT and business process technology to manage them as one. Fifteen years ago it would have been nearly impossible to market the product for that many plants and do a good job. Now an entire array of management services is provided.

These plants could not be managed in this way without the new technology. The plants themselves are physically too far apart. It would be impossible to cover enough of everything in different parts of the country. The necessary staffing wouldn't be available because of the expertise required at the control points.

Mobilizing business functions across many enterprises

Dynamic specialization I -- Consolidated marketing "partnerships"

An important development is the rise of marketing firms. Ethanol is not marketed at the processing plant. Buyers (the refiners and blenders of gasoline) are not inclined to deal with a multitude of plants whose annual production volume amounts to a tiny fraction of the buyer's ethanol requirement. Instead, buyers demand bulk purchasing in hundreds of millions of gallons at a time. Ethanol buyers want to sign delivery contracts for 50 to 180 million gallons and want to trade with someone that sells at least 500 million gallons per year.

IT's first impact on the ethanol industry was as a horizontal coordinator. Many mid-sized firms consolidated their marketing activities out of necessity to bargain with the handful of fuel ethanol buyers who traded in quantities of hundreds of millions of gallons at a time.

Successful consolidated marketing efforts led to innovative applications of these powerful new technologies to coordinate horizontally other activities - procurement and logistics, risk analysis, and eventually plant management, among several plants simultaneously. This horizontal coordination/consolidation role across enterprises, companies, time, and space is now performed by five to six firms in contracted services to a substantial majority of the mid-sized, farmer-owned plants.

Over the last few years, the major producer's (ADM) market share has dropped from 60 percent of the industry to around 30 percent. The balance was taken by the marketing firms -- United Bio Energy, Ethanol Products, and a few others.

The marketing of DDG is also done primarily by a few firms with a few buyers. The traders on both sides are well informed, but the price reporting is of limited use because the product traditionally is highly variable in quality and there are no specified trading standards. DDG quality varies because of corn quality, the heating/drying process, and an inconsistent blending of the DDG with solubles. Each of these problems will result in a highly variable analysis of DDG. The market discounts the price of DDG because of this variability.

Universities provide excellent information on the feeding of DDG to beef cattle, swine, and poultry. Some research indicates that DDG has a nutritional value equivalent of 120 to 130 percent of corn, but it sells at a much lower price.

However, while the potential to feed DDG is large, the feed industry will not incorporate any ingredient into their rations until there is a ready supply in the amount needed to serve their markets. A case in point is ConAgra's consideration of the use of DDG products in their poultry division. They tested products from all over, were pleased with DDG nutritional attributes and its cost, and wanted to incorporate it into their rations. Eventually, however, reliability was the restricting factor. The whole exercise stopped dead when ConAgra asked the simple question, “Can you provide us 3 million tons of it?”If not, they can't be interested because ConAgra makes changes in increments of millions and restricts their business activities to those who can provide consistent and reliable supply subject to their specifications.

DCS benchmarking enabled plants to overcome these problems by collectively standardizing their distiller's grains products to the quality and consistency required by their customers. DCS also gives opportunity for consolidated marketing efforts among partnering plants to have a presence in regional and (soon) national markets because they now have a consistently reliable product, available in sufficient volume, and offered at a very attractive price relative to corn. Consequently, very large feeders such as Tyson Foods, Inc., and ConAgra, are beginning to include DDG in their rations.

Dynamic specialization II -- procurement “contracts”

Corn procurement is not as concentrated as fuel ethanol marketing, although many plants do have procurement alliances with their ethanol marketing partners, e.g., supply agreements and risk management contracts that work in concert with the marketing contract to provide a reasonable assurance to the plant of a working “crush margin.”Corn trading/procurement is more fragmented because it's not necessary for a plant to align itself with a major grain trading company. One reason for that is farmer-owned plants have delivery agreements with their producer members to source a significant portion of the required feedstock locally.

A more important reason, however, is the trading history and market transparency in corn because of the CBOT and futures markets. There's a local corn “basis,” and a historically well known set of transportation differentials. So it's not necessary to align one's self with a major company to procure feedstock efficiently.

Nevertheless, lenders offer incentives to new plants to contract for risk management services as a way of mitigating their own risk in the project. Moreover, each of the project design firms provides to a prospective plant a list of preferred lenders and other specialty service providers to work with, almost all of which are collaborative partners and/or subsidiaries of the project design firm itself.

Dynamic specialization III -- consolidation of process management

The appearance here is of a virtual consolidation taking place. Instead of consolidation through ownership, management is becoming more centralized and concentrated. Companies like Land O' Lakes and Purina, CFC, United Bio Energy, and even integrators like Cargill are offering management services to facilities besides their own. IT has altered the ethanol industry structure by shifting the ownership and control emphasis from the acquisition of physical production assets to the aggregation of IT assets.Economic power in the industry no longer arises from ownership of production capital (plants and equipment), but in the control and manipulation of intellectual capital and property rights.

Summary and conclusions

The impact of IT on the ethanol industry

IT is a key driving force in fuel ethanol business -- operations, strategies, structures, ownership, and performance. IT innovations and applications have cut across the ethanol industry, forcing changes that have significant economic and social impacts in rural communities.

In plant operations, IT serves to strip costs out of the system, promotes standardization, and mitigates production risks. IT squeezes time out of the system by speeding up construction time, from groundbreaking to turn-key, and by reducing operational downtimes, increasing the days of operation from 340 to 361. IT not only gets plants up and running as much as 6 to 12 months sooner than they might otherwise, but also keeps them running to increase plant production efficiency. IT facilitates the inflow of capital into the industry by helping to quantify the risks associated with plant investment/operations to prospective investors.

IT has altered the nature of the firm by digitizing and decomposing on-site activities to be outsourced, off-shored, and otherwise moved around. This changes the economics of plant location by impacting where various assets are deployed. IT changes labor mobility by moving jobs to labor as well as labor to jobs. IT alters the skill sets needed for plant management and labor. IT further separates ownership from management, allowing firms to transform themselves faster.

IT has altered the firm's relationships to business and industry because it supports a contract-based industry structure that creates significant linkages/collaboration and enables coordination across enterprises, companies, and specialties. IT gives rise to the ethanol franchise and has used the standardization of that model to narrow the bounds of uncertainty. A better understanding of the associated risks allows the financial community to reduce lenders' equity participation requirements, to reduce interest rates and the overall cost of capital, and to invite participation among outside investors. IT has altered our view of the traditional market structure. Economic power now lies in aggregating information assets, not in the physical assets of plant and equipment associated with production.

With regard to IT and the future dynamics of the industry, as IT applications within the ethanol industry continue to evolve, competitive forces will spur efficiencies and dynamic growth. Work activities will increasingly be dispersed across geography, institutions, and dimensions as managers and decisionmakers ask, "What else can be digitized, decomposed, and outsourced?" The balance of economic power within the industry shifts daily from the traditional aggregation of physical asset ownership to the aggregation and integration of information services. However, competitive advantage held today is more easily eroded and replaced. This understanding raises the question, "Will the emerging price discovery mechanisms (futures market and market transparencies) change the comparative advantage of the information aggregators?" The dynamic intellectual-property nature of IT continues to shape the competitive structure of the industry. From where will the talent to continue operations in this environment come?

IT has eroded and distributed the market power once held exclusively by global giants. Enhanced access to factor and product markets among mid-sized fuel ethanol firms arising from the adoption of IT may inspire similar developmental opportunities in rural America. The notion that firms may achieve competitive advantage from an efficient, internalized information system instead of the high levels of vertical and horizontal coordination typically garnered solely with "largeness" provides both an encouragement for the relative success of mid-sized firms and a developmental template for similar enterprises in rural areas.

References

Carr, N., Does IT Matter?: Information Technology and the Corrosion of Competitive Advantage, Boston: Harvard Business School Press, 2004.

Friedman, T., The World Is Flat: A Brief History of the 21st Century, New York: Farrar, Straus and Giroux, 2005.

Hale, J.H. III and J. Brown, The Only Sustainable Edge: Why Business Strategy Depends on Productive Friction and Dynamic Specialization, Boston: Harvard Business School Press, 2005.

Informa Economics, "The Role of Information Availability and Technology in the Ethanol Industry," prepared for U.S. Department of Agriculture, Rural Development, Memphis, TN, May 2005.

Novozymes and BBI International, “Fuel Ethanol: A Technological Revolution,” BBI International Publishing, Grand Forks, ND, June 2004.

Smith, H. and P. Fingar, It Doesn't Matter, Business Processes Do: A Critical Analysis of Nicolas Carr's IT Article in the Harvard Business Review, Tampa: Meghan-Kiffer Press, 2003.

Appendix 1: Emerging biotechnologies

Biorefineries

The biorefineries concept is similar to the petroleum refinery concept. Feedstock (biomass, in the case of a biorefinery) is converted to a wide range of products based on market consideration and contractual arrangements. The biomass feedstock is typically fractionated into its various components. Those components are then processed into intermediate and final products. Intermediate products may be combined to produce additional products. The basic concept incorporates multiple products and possibly multiple feed stocks. Flexibility to meet market demands is an important element of the biorefinery concept.

Biorefinery feedstocks may include agricultural crops and agricultural residues, trees, grasses, animal wastes and municipal solid waste, which are organic materials that capture and store solar energy. They may also use various combinations of processing technologies, including mechanical, thermal, chemical, and biological processes. The products produced are nearly limitless. They include fuels, electric power and heat energy, food and feed, and a host of chemicals including plastics, solvents, adhesives, fatty acids, organic acids, paints, dyes, inks, detergents, and more. The extended view of this concept is to develop biorefinery complexes or “biorefinery parks” that produce a wide range of products and use products that were produced by others in the park. This concept would aid in the economic efficiencies of collection, storage and handling of feed stocks, and production of energy, as well as help support the required transportation and distribution infrastructure.

Further improvements in technology may play an important role in increasing efficiency of ethanol plants. New “upfront” technologies that fractionate the grain into starch, cellulose, hemi-cellulose, oil, protein, and lignin may enable ethanol plants to produce a wider set of byproducts and to increase the market value of the byproducts. This change is expected to increase the energy efficiency of the ethanol plant, and reduce other processing costs per gallon of ethanol produced. A major concern, however, when developing a new product is the necessity of simultaneously developing a new market. The balance between sufficient production to supply the market, but not so much as to ruin its profitability, is a delicate one. IT will be used increasingly to coordinate these activities among the marketing firms and their represented plants.

Appendix 2: Relationship of the industry to the educational system

Panelists were asked what role private information flows played in the structure, conduct, and performance of the industry and what role has public information played and how strong are those two information flows in the future. What would be sort of a preference in terms of the overall health and robustness of the industry? So in that sense, let's just talk a little bit about the public versus private information flows. Public information, even if it's reported in the newspapers, tends to come from government sources. Which has been the dominant sort of information flow or source for the industry over the past 10 or 15 years?

Fifteen years ago, the ethanol industry was dominated by private information in terms of what occurred day by day. Now plants are being built based strictly on public policy. The primary source of public information is government departmental sponsored research and development (USDA and Department of Energy) and that of the land-grant universities. This type of project information wasn't available to some of these developers or farmer groups 10 or 15 years ago. The land-grant universities also provide information sponsored by the growers' associations for producers to choose the entrepreneurial path. So there has been sort of a growing cumulative body of knowledge that the industry developed a body of experience that's been published and discussed.

A lot of cooperation goes back and forth between public and private institutions. For example, Land O'Lakes is involved in proprietary research on distiller's grains, but a majority of the large integrators also want to look at information available from the University of Minnesota. Feed buyers and sellers seem to want two sources.

Land-grant information has significantly contributed to the development of the industry. And that information has been of a technical as well as financial nature.

Public information developments

A related question might be, how well does the research information diffuse out and benefit the entire industry?

Iowa State has a tremendous web site that is a resource to a large number of users, particularly those wanting fuel ethanol industry financial and economic information given present technology. But the economic and financial implications of the next technological breakthrough, cellulose processing, which will put the industry into a whole new supply situation, have not been considered. The industry has anticipated cellulose processing for 20 years. And the transition is inevitable because of high energy prices. But how well prepared is the industry for this transition? Here is an excellent opportunity for public information and leadership to look ahead and direct the way.

Hundreds of millions of Federal Government tax dollars are invested in the cellulose research that will eventually be used by the industry. However, the information itself has been incorporated into the discussion in less than 1 percent of the any planning for the industry's future

The DOE and American Petroleum Institute publish storage and statistics for a number of different energy products. Are similar statistics published for ethanol and related products? If this information exists, it is certainly difficult to find.

And on another issue regarding storage, there is widespread interest in DSP facilities. But such information is privately held and unavailable. This information is typically available in other agricultural markets and energy markets. And its availability allows participants to assess market conditions, offer prices, or generate other activity because it provides a higher level of understanding and confidence in market conditions. Credibility obviously would be pretty important and that could only be established with a track record, but a published statistic of “Stocks as of the first of the month” made available on the tenth of the month, would have a significant impact on the industry operations.

Making much of this information public would be helpful for plant decision makers. An understanding of inventories, accurate to within 10 or 15 days, would provide a clearer idea of both present and future prices. This could be a useful tool to plants, marketing companies, and purchasers.

Training future professionals

Is there a consensus with this group then that there probably is not any significant amount of undergraduate/graduate level training in the land grant universities in bioenergy? What education/training is going on that is going to provide the leadership that is needed by this industry?

Not unless it's funded by the industry and the funded research is also used to train scientists. Land O' Lakes does a lot of dual-purpose research, and plants are encouraged to fund it.

There is a history lesson here. Seventy-five years ago, there wasn't such a thing as chemical engineering. A certain amount of chemistry knowledge was emerging out of the fledgling oil industry. But the information itself was not flowing. And to be frank, a lot of things were done badly because information was being created and passed simultaneously by chemists and engineers who each did very well in their respective field, but had no common language by which they could speak to each other much less work together. So chemical engineering had a very difficult start. Unfortunately, the ethanol industry is enduring the same type of growing pains. Eventually, the industry will partner with the university system to develop a “biochemical-biomechanical engineer-- a variant on the chemical engineer concept.

From the three disciplines, a language needs to be created so that each may understand the other. But for now, there is no equivalent language for the ethanol industry. It's a construct of biology and chemical process engineering. There's also research, development, and commercialization. There's no real transfer of information from research to development because the bridge of people needed to communicate across each platform isn't there yet. There are people who think research, and those who think commercialization, but the education necessary to inform both sides from the middle isn't there.

So the oil industry's past is somewhat similar to what some think may be ethanol's future. Particularly with regards for bioengineering refineries, there are biomechanical engineering programs here and there. But as a fundamental discipline like chemical engineering, it doesn't truly exist. And as a consequence, information is not flowing out of public sources. Research information is flowing out of the hundreds of millions spent on government research, but it's not coming out of the universities.

The future of the ethanol industry is hindered because information trickles out in pieces from here and there. Every year or two, a little is discovered on the technical side because there is no overarching understanding.

Now this haphazard development is great for consulting and technical engineering companies, because when no one knows anything, it's easy to sell knowledge. But there is no public system in place to generate the information needed by the industry, nor are people being trained to enter the industry in a functional way.

To summarize, with respect to public information from a technical standpoint information is being generated by the land-grant universities and Federal research institutions, and that information is getting out to the industry. However, not all of what is needed by the industry is being passed, and there are no professional training programs in place to develop the next generation.

Appendix 3: Impediments to rapid industry growth

A "Marshall plan" for fuel ethanol

The panel was asked to imagine a scenario under which it suddenly became in the national interest to have a substantially greater fuel ethanol supply. A range from 8 to 50 billion gallons (from 2 to 12.5 times current production) was discussed. The specific question, "What would it take, in almost a "Marshall Plan" type of effort, to grow the industry by such an order of magnitude?" was asked. This exercise is intended to explore what would be necessary to take the industry beyond incremental growth and address the constraints that might impede production, distribution, and even consumption.

It should be noted that panelists indicated a shock of such magnitude to the world energy complex as implied under this scenario would encourage a whole range of alternative energy technologies not presently competing with ethanol.

The workshop panelists discussed four logistical impediments to a rapid scaling up of the industry:

The present capacities/capabilities of knowledgeable and experienced firms in plant design and construction are already pressed by the current rate of industry expansion at 1 to 1.5 billion gallons of production capacity each year. And while there are several companies not currently involved in ethanol construction with capabilities in chemical plant production, an aggressive sharing of design and expertise would be required to expand the present build rate.

The permitting approval process for building new plants is an evolving hodgepodge of local, State, and Federal regulations and procedures. Each locality presents a prospective builder with a different set of regulatory and permitting challenges. While some time savings have accrued with builders' accumulated experience in this process, a more standardized or uniform set of procedures among all principalities would significantly reduce time lost and ultimately construction costs.

While plant management and operational expertise is improving, the pool of well-trained, knowledgeable, and experienced plant operators remains small. This human capacity constraint would hamper a rapidly growing industry from performing effectively.

The logistical constraints/bottlenecks in the transportation system for corn, ethanol, and distiller's grains present a formidable impediment to any significant expansion in the production or use of fuel ethanol. The rail system is stressed under present loads. How will it manage an industry expansion of 12 to 13 times its current size?

Other ancillary constraints to an ethanol expansion were also identified:

Some States restrict the ability of ethanol to be blended with gasoline. For example, the State of California requires a 5.7 percent blend instead of the nationally accepted 10 percent rate because California producers are presently unable to meet a 10- percent demand level, and there is a political perception that Midwest producers would benefit at the expense of California producers. To expand Californian production, the state is offering tax credits, but a 10-percent blend requirement would provide a much greater expansion incentive despite any temporary benefit to be realized by Midwest producers.

The oil companies' seeming reluctance to install and promote E-85 or other ethanol blends also impedes expansion. How will consumers use blended fuel if they are unaware of E-85 fuel pump locations? Are there enough fuel pumps to dispense E-85? Do the automobile companies offer an E-85 model for every car they manufacture? Do the other transportation systems (modes of transportation, e.g., buses, trucks, etc.) have E-85 engines available?

While not an immediate impediment, another significant issue to confront will be the traditional "fuel v. food" concerns in the event of a crisis. An ancillary concern is the market impacts and adjustments after a tremendous demand base for corn is created that cannot be undone. And while an 11.8-billion bushel corn crop relieves some of the immediate pressure of that concern, fuel ethanol production levels of 8, 12, or 15 billion gallons will require from 20 to 35 percent of average annual corn production. Moreover, the coproduction of DDG will also have to be accommodated by the marketplace as ethanol production increases 8 to 15 billion gallons per year. There is particular concern because DDG are integrated back into the animal feeding system, regarding the saturation point for the DDG market and will certainly be an issue at 12 or 15 billion gallons. And while it is also true that a number of intermediate uses for the coproduct are yet to be explored, there are still a finite number of rations that may be formulated with DDG.

Another significant logistical impediment is the rising cost of natural gas. The oil prices exceeding $60 per barrel, the days of cheap natural gas are behind us. The huge demand base built when gas was cheap and every project was powered by natural gas is largely the main reasons for today's circumstance. Most new ethanol plants are going in with the coal-fired or a cogeneration plant to take advantage of $2 to $2.50, in some cases less, in British thermal unit conversion rates. However, 85 percent of the Nation's ethanol plants use natural gas for the production of processing steam and coproduct drying and remain at a significant disadvantage.

The 10 percent mandated Reformulated Fuel Standard (RFS) is now law in the United States. The importance of decisionmakers and authorities to begin taking steps toward lifting the encumbrances that presently block the way is an important consideration. But perhaps a more important issue is how will a 10 percent RFS affect the price of oil and gasoline? There is a belief that a relatively small supply change can have a significant price impact, perhaps more than people realize. Because supplies are so tight, the Nation has a 57-day supply of unleaded gasoline, on the margin, small changes in supply can impose significant price adjustments. Even a two-day adjustment in the oil inventory has traditionally had a major impact on the oil prices.

Another looming concern is China's growing influence in world energy markets. The Chinese economy is growing in leaps and bounds and its energy demands are increasing commensurately. China's activities are already profoundly felt in world energy markets. By some estimates, the Chinese have less than a 20-day strategic reserve of oil. The nation has accumulated cash with the expressed intent to purchase its own oil company. In the immediate term, the Chinese are expected to build their strategic reserve with any favorable movement in crude prices.

An additional 5 or 10 billion gallons to the domestic fuel supply may provide some relief. Some have Stated that a realistic look at the Nation's strained refining capacity and rising world crude oil prices can easily portend a return to energy prices of the world crisis of 1979-81. And while the domestic circumstances are nowhere near such a point of crisis, prices can rise considerably higher. A harbinger of such a development would be when the oil companies begin to acquire ethanol assets in a significant way.

Appendix 4: Discussion panel members and interviewees

Minneapolis and Omaha panel members:

Randy Aberle	Ag Country FCS
Chuck Adair	Nesbit Burns
Sean Broderick	Commodity Specialists Corp
Scott Cavey	E-Markets
Scott Charbo	USDA, Office of the Chief Information Officer
Pradip Das	Monsanto
Mark Hanson	Lindquist & Vennum, PLLP
Bob Harris	TVA Public Power Institute
Pat Hemsworth	NYBOT
Larry Johnson	Delta T
Tom Kell	Nebraska Energy
Pete Kitzman	Land O'Lakes Feeds
Ejnar Knudsen	Kruse Investments
Greg Krissek	United Bio Energy
Phil Madson	KATZEN
Ron Miller	Aventine
Lucy Norton	Iowa Renewable Fuels Assn
Tom Solon	Cascade Grain
Fred Seamon	CBOT
Jeremy Wilhelm	FCS America

Firms/associations interviewed in follow-up interviews:

Abengoa Bioenergy Corp.
Ag Processing, Inc.
Al-Corn Clean Fuel
Aventine Renewable Energy, Inc.
Clean Fuels Development Coalition
Commercial Alcohols, Inc.
Corn Plus, LLP
Iogen Corp.
Little Sioux Corn Processors, LP
MGP Ingredients, Inc.
National Corn-to-Ethanol Research Center
Nebraska Ethanol Board
Renewable Fuels Association
Renewable Products Marketing Group
Tate & Lyle PLC

Appendix 5: Study team members

John R. Dunn, Chair	USDA, Rural Development
Tony Crooks	USDA, Rural Development
Peggy Caswell	USDA, Economic Research Service
Vernon Eidman	University of Minnesota
Jim Hrubovcak	USDA, Office of the Chief Economist
Hosein Shapouri	USDA, Office of the Chief Economist
Scott Richman	Informa Economics
Tom Scott	Informa Economics

U.S. Department of Agriculture

Rural Business–Cooperative Service

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Rural Business–Cooperative Service (RBS) provides research, management, and educational assistance to cooperatives to strengthen the economic position of farmers and other rural residents. It works directly with cooperative leaders and Federal and State agencies to improve organization, leadership, and operation of cooperatives and to give guidance to further development.

The cooperative segment of RBS (1) helps farmers and other rural residents develop cooperatives to obtain supplies and services at lower cost and to get better prices for products they sell; (2) advises rural residents on developing existing resources through cooperative action to enhance rural living; (3) helps cooperatives improve services and operating efficiency; (4) informs members, directors, employees, and the public on how cooperatives work and benefit their members and their communities; and (5) encourages international cooperative programs. RBS also publishes research and educational materials and issues *Rural Cooperatives* magazine.