Netchain Leadership in the U.S. Ethanol Sector

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1. The Significance of Ownership in Supply Chain Analysis

Vertical coordination and integration studies in the area of biofuels have tended to rely on traditional industrial-organization driven supply chain analysis models. Traditional models often consider industry structure and firm behavior without regard to multiple roles of owners in the value chain. This chapter addresses the evolution of the ethanol value chain from a broader perspective which we call netchain ownership analysis. Netchain analysis considers horizontal, vertical and diagonal relationships across networks (Lazzarini, Chaddad and Cook, 2001). Our analysis includes special consideration of the role of producer-ownership in the biofuels sector as previous studies have shown the allocation of ownership may have an effect on the ability of the chain to generate optimum surpluses (Hendrikse and Bijman, 2002).

The U.S. ethanol industry has experienced a dramatic transformation from a highly concentrated, investor-owned sector to a more atomistic sector. Significant farmer investment is one factor that contributed to this change in market structure. We investigate the driving factors underlying producer investment as well as the challenges faced by producers in vertically integrating. We find a subset of producers were able to overcome these constraints by negotiating a unique nexus of contracts to form a highly-integrated value chain rooted in producer investment and producer control. We concentrate on one investment model that seems to have been successful due to high levels of mutual adjustment across several coordination mechanisms. We conclude by considering what the success of this highly integrated model suggests in terms of strategy recommendations for producer groups.
2. Netchain Analysis of Producer-Owned Organizations: Shifting Perspective from the Farm to the Factory

Historically, research on producer-owned marketing cooperatives has focused on incentives for cooperation among producers and the maximization of rent generation at the farm level. Operating on a service at cost principle, the cooperative's primary function has been to pass revenues to the member in proportion to patronage.

However, producers have been increasing their risk exposure through higher levels of upfront, proactive risk capital investment in processing ventures. Many new ownership models distribute revenues in proportion to investment or tie patronage rights to investment. Therefore, producers are beginning to adopt a more sophisticated multi-level rent generation mentality. In these instances, producers evaluate the performance of their investment in terms of an organization's 1) ability to maximize rent generation at the individual farm level and 2) ability to maximize rent generation at the firm level (Cook and Plunkett, 2006). Instead of focusing solely on farm-level profitability, producers are increasingly providing risk capital to their organizations intending to generate rents at the cooperative level. Producers engaged in the formation of new ventures for the extraction of rents at multiple levels has been referred to as collective entrepreneurship (Cook and Plunkett, 2006). Although the cooperative structure is retained in many of these organizations, we also witness the formation of similar ventures under alternative legal models such as limited liability companies (LLCs) or public limited companies (Chaddad and Cook, 2004; Cook and Chaddad, 2004).

The proliferation of highly integrated models of producer-ownership has challenged researchers to shift the primary focus of their analysis from the farm and to consider multiple rent generation opportunities throughout the value chain. Scholars have also begun to document factors affecting producer's ability to vertically integrate (Hendrikse and Bijman, 2002; McKee and Boland, 2007; Burress, Cook and Klein, 2008).

While producer assumption of ownership rights may lead to more efficient production from the perspective of quality and availability of raw material inputs, we must not assume a producer ownership advantage to apply across variables. For example, producers are better-positioned as owners to improve the quality of raw inputs or to introduce new qualities to the
inputs which may result in higher revenue margins due to increased consumer prices (Sexton and Iskow, 1988). This argument is often put forth with respect to organizational structures in which producer ownership rights are coupled with the right and obligation to deliver (Burress, et al., 2008). In addition, producer-owned organizations may be less vulnerable to price fluctuations in commodity markets as producers of the commodity inputs are highly skilled in risk management practices. However, producers may be at a disadvantage in terms of their ability to market their products while competing with large, established competitors. In addition, they may lack the adequate scale to engage in costly research and development activities.

We find evidence in the literature that suggests producer-owned organizations may confront distinct challenges as they vertically integrate through multiple production levels. These challenges may be rooted in their ownership structure, specifically as a function of the owner's previous experience, knowledge base, and existing networks. As farmers, producers possess knowledge, experience and expertise related to crop production. From a resource-based view of the firm, it is evident producers' human capital asset base may put them at a disadvantage when forming processing facilities and competing with firms whose owners and organizers have developed distinct expertise in processing and marketing. While these assets may be purchased on the market, it is not clear that producers have experience in the recruitment of upper management or the willingness to pay for such expertise during the initial stages of new venture development.

Well-documented in the literature on cooperative development are producers' challenges with respect to accessing managerial expertise, incorporating new technology, gaining credibility and legitimacy, surviving start-up with low levels of working capital, and establishing of marketing and distribution networks (Cook, 1994). We explain reasons for each of these challenges according to a resource-based view of the firm (Peteraf, 1993).

3. Challenges Faced by Producer-Owners in Vertical Integration

3.1 Expertise Unrelated to New Venture, Unlikely to Hire Expertise

Producers who seek to vertically integrate possess expertise in the area of crop production. However, they may be less knowledgeable in managing
processing facilities, especially at the scale necessary for efficiency (Western Plains Energy, 2002). In addition, producer-owners may be less likely to compensate board members and management at competitive levels. Thus, not only do producer-owners not possess adequate expertise in the areas in which they intend to vertically integrate, but studies suggest producers have demonstrated the tendency to be unwilling to compensate board and management at levels competitive with investor-owned firms in order to attract expertise (Dunn, et al., 2002). In a study of California-based cooperatives, Lang and Spatz found producer-owned firms of comparable size compensated their board members at about an eighth of the rate of compensation paid to board members in investor-owned firms (1995).

3.2 Problems Incorporating Unproven Technology, Especially when Designing New Facilities

Given producers' limited knowledge of the construction and design of processing facilities, several scholars have indicated severe difficulties among producer-owned organizations in the timely realization of plant goals related to operational capacity. Construction and design difficulties have resulted in delayed profitability of new ventures as well as venture failure (Trucano, 1997). Newly developed, “unproven” technologies related to plant design seem to increase the probability of start-up difficulties in producer-owned ventures (McKee and Boland, 2007). Newly developed technologies often represent an attractive opportunity for producer-owned groups to generate high revenues associated with new materials and processes. However, commercialization of production with new technologies often involves unforeseen complications that can bankrupt new producer-owned organizations experiencing capital constraints.

3.3 Lack of Existing Marketing and Distribution Networks

Producer-owners are also subject to the familiar “chicken and egg” problem that thwarts many start-ups: it is difficult to develop market prospects prior to beginning production (Gompers, Lerner and Scharfstein, 2005). However, a lack of previous experience in the processing industry often means producer-owners are one step further removed from developing relationships with potential buyers. In addition, producer board directors may be at a
disadvantage in terms of their ability to evaluate marketing relationships developed by hired management teams (Solberg, 1999).

Cooperatives often attempt to overcome these disadvantages through marketing agencies in common, dedicated supply agreements to a single buyer, and niche marketing. Niche marketing strategies are often reliant on consumer demand for local products, products of a specific origin, or products with unique characteristics. Dedicated supply agreements establish a ready-market for products, but may not offer the highest returns in the long run. Marketing agencies in common, or cooperation among cooperatives for the purpose of marketing, may be the most attractive alternative in the long run. However, this level of coordination may involve prohibitive start-up costs for new ventures. Thus, marketing agencies in common are often the product of established producer ventures (Bleyl, 2006). United Sugars is an example of a common marketing agency developed through collaboration among producer-owned sugar beet cooperatives in the U.S. (Torgerson, 2000).

3.4 Producers Lack Legitimacy without an Industry Track Record

Establishing legitimacy has been suggested to have a positive effect on a firm's ability to attract resources and its ultimate survival (Aldrich and Fiol, 1994). Successful farmers are often instrumental in the development of producer-owned ventures as project champions (Tong, 1997). Their reputation as talented businessmen and willingness to invest in the venture often lends legitimacy to the new project, especially from the perspective of their peers. Legitimacy can then act as a self-enforcing mechanism, attracting additional resources to the firm (Deeds, Mang and Frandsen, 2004). Indeed, the process utilized by new generation cooperatives in attracting upfront risk capital contributions from producers performs a dual role of capitalizing the company while sending a strong signal to creditors of the producers' credible commitment to the venture (Trucano, 1997). The role of producer investment as a mechanism to lend legitimacy to new ventures is supported by theories from the entrepreneurship literature that backing from venture capital organizations increases legitimacy (Chang, 2004).

However, in the case of producer-owned organizations, the self-reinforcing nature of investor legitimacy encounters limitations when a producer group seeks support from lenders. Legitimacy gained among peers does not always translate into an ability to raise funds from financial institutions. Producers
are at a disadvantage when they are unable to demonstrate experience or expertise related to the proposed venture (Reuber and Fischer, 1994; Shane and Cable, 2002). As producers' operational plans become further removed from their area of demonstrated expertise, willingness of lenders and other capital providers to finance may diminish. This can result in undercapitalized start-up ventures.

3.5 Low Working Capital Increases Risk for Failure

While cooperative leaders recognize they may be undercapitalized, this does not always translate into recognition of the critical nature of working capital (Chaddad and Cook, 2004; Chaddad, Cook and Heckelei, 2005). The expectation that processing facilities and marketing activities can be developed quickly and efficiently has led many organizations to severely underestimate their working capital needs. Initial revenues generated in processing are expected to mitigate undercapitalization. Thus, any delays or setbacks in design, construction, or marketing subject the organization to substantial risk. These working capital problems may not be unique to producer-owned groups. However, producer-owners are at a disadvantage relative to incumbent firms in determining the reliability of their working capital forecasts as new entrants to the processing industry. In addition, working capital needs are particularly difficult to judge in agricultural processing industries due to high seasonal variations and potential unexpected crop loss.

Producer-owned organizations have mitigated working capital constraints by returning to their members for multiple share offerings (Thyfault, 1996). However, this strategy is not entirely reliable if the venture is experiencing start-up problems. Setbacks can reduce producer confidence in the business plan. And, as raw material providers to the processing facility, processing or marketing difficulties will lead to lower prices returned to the producers for their raw material deliveries. If producers receive low prices for their commodity inputs, this decline in revenue may reduce their ability to invest additional capital regardless of their willingness to invest. And, in the event producers seek lender financing for additional share offerings, lenders will be less likely to provide financing if they are aware the share offering was initiated as a result of venture setbacks.
3.6 Risk Management and the Incentive to Overcommit

As producers, farmers are familiar with the need to manage commodity risk. However, they may overestimate their ability to manage risk related to inputs and products not related to their on-farm business. In other words, experience in managing risk related to fertilizer, corn and soybeans may not prepare farmers to manage risk in natural gas and ethanol marketing.

In addition, by investing in a processing facility, certain producers may increase their risk exposure. Failure to deliver can result in fines to the producer, whereas widespread failure to deliver among cooperating producers can result in venture failure. Crop losses as well as producer over-commitment can translate into an inability to uphold raw material delivery obligations. Over-commitment is especially dangerous for successful cooperatives that consistently pay above-market prices to member-producers, as access to premiums creates an incentive among members to commit to deliveries beyond their production capacity.

3.7 Market Power Drives Demand for Integration but Signals High Entry Barriers

Market power is often cited as a significant factor leading to the development of producer cooperatives (Sexton and Iskow, 1988; Hansmann, 1996). Depressed prices hypothesized to be a result of market structure represent a strong motivator for newly forming producer-owned ventures. Within the ethanol sector, researchers have presented evidence supporting the possibility of both upstream and downstream market power being exercised in the seed sector and processing sector, respectively (Saitone, Sexton and Sexton, 2008).

While issues of significant market power motivate horizontal integration, they may also signal challenges to vertical integration due to the presence of a strong, established competitor in the industry. Downstream integration into the processing sector or upstream integration into the seed sector may necessitate competing with established, competitive firms. Issues concerning market structure indicate producer-groups may be at a disadvantage in vertically integrating by establishing a new venture due to higher entry barriers relative to competitive industries.¹

¹ Given high entry barriers, producer-owned organizations have been founded on either a “beat ‘em” or “join ‘em” strategy. While both strategies recognize the structural issue of market power, the beat strategy is often ruled out due to the associated high
4. Current Value Chain Integration Approaches to Minimize Producer-Owner Challenges

We are currently witnessing the development of innovative netchain strategies that directly respond to the challenges faced by producers as they seek to generate rents at multiple levels. One example of an innovative netchain strategy that ameliorates these challenges is a model developed in the U.S. Ethanol Industry. The specific example we explore in this article is a complex set of agreements negotiated between corn producers and an ethanol company named POET. We refer to this complex set of agreements as the POET model. We examine the strategies used by producer-owners who took a proactive approach to developing joint investment networks coupled with supply chain management agreements.

The POET model lends itself to analysis due to the highly integrated nature of the agreements among investors and the high level of standardization of these agreements across the plant partner network. While the current analysis focuses on the POET model, we recognize components of this approach are utilized by producer organizations in the ethanol sector and other sectors with varying levels of integration. Within the ethanol and biodiesel sectors, the success of the POET model has inspired second-movers to follow suit (Missouri Soybean Association, 2005).

4.1 Producer-Ownership: Transformation of the U.S. Ethanol Sector

In the 1990s, the U.S. ethanol sector was dominated by investor-owned firms. The concentration ratio of the top four firms was estimated at 73%, with approximately 60% of capacity being owned by Archer Daniels Midland (Hendrickson and Heffernan, 2007). Farmer ownership was negligible. By 2007, however, the U.S. ethanol sector had witnessed a dramatic entry barriers. The join strategy is the rationale used for developing dedicated supply agreements with recognized industry leaders.

Subsequent to POET’s success with supply chain integration through producer-ownership, additional actors in the biofuels industry have sought to develop similar joint investment arrangements with producer groups. An example would include Archer Daniels Midland’s 2005 joint investment in biodiesel with Missouri producers.
turn. The concentration ratio of the top four firms is now estimated to be a mere 31.5% (Hendrickson and Heffernan, 2007). The Renewable Fuels Association estimates about 42% of ethanol plants are farmer-owned. These producer-owned plants account for about 39% of ethanol production capacity in the U.S. (Renewable Fuels Association, 2008).

Undoubtedly, this transformation was affected by exogenous factors. Volatility in fuel prices and environmental concerns encouraged investment in ethanol production facilities. In addition, state and federal incentives supported industry growth. These incentives include production incentives, excise tax exemptions and use mandates (Food and Agricultural Policy Research Institute, 2008). Two factors may have acted to increase producer-ownership relative to investor ownership: 1) state incentives directed at small-scale ethanol processing facilities or those owned by agricultural producers and 2) uncertainty with respect to continued state legislative support.

Examples of states actively promoting farmer ownership of ethanol production facilities include Missouri and Minnesota. Missouri established a fuel ethanol incentive to fund the provision of subsidies to processing facilities maintaining at least fifty-one percent producer ownership (Missouri Revised Statutes). Minnesota has enacted similar provisions. After the sale of a farmer-owned cooperative to an investor-owned firm, Minnesota strengthened their commitment to farmer-owned ethanol processing facilities by requiring
repayment of state funds distributed in the previous two years if farmers lose
majority control of the processing plant (Minnesota House of Representatitives,
2003; Morris and Hill, 2006).

Much of the state and federal support was uncertain in the decades
during which farmer ownership grew, decreasing the likelihood that non-farmer
investors would be willing to invest. Minnesota, whose producer payment pro-
gram allowed payments of 20 cents per gallon up to a maximum of 15 million
gallons per year, was drastically cut after budget constraints in 2003: producer
payments dropped to 10 cents a gallon for a maximum of 3 million gallons
(Minnesota House of Representatitives, 2003; Morris and Hill, 2006).

Producers' willingness to invest in ethanol production facilities was
driven by depressed corn prices and interest in developing alternative mar-
kets for corn (Livingston, et al., 1998). This offensive strategy would incite
significant structural changes in the organizational models of producer owner-
ship as their rent generation strategy shifted from 1) a single rent generation
approach focused on returning revenues to the farm level to 2) a dual rent
generation approach in which producer members sought to generate returns
at the farm and firm levels.

How were producers able to effectively organize and invest in plant
ownership to contribute to radical industry transformation the ethanol sector?
Certain contractual arrangements employed by industry leaders were able to
ameliorate constraints of producer integration into the ethanol value chain
and, as a result, unlock significant pockets of wealth across the midwest
United States. Producers now saw an opportunity to leverage wealth that
had been harboured in land equity for risk capital investment in processing
facilities (Stroburg, 2005). We analyze the components of these contractual
arrangements by describing the mechanisms used by an industry player suc-
cessful in negotiating alliances with producer-owners: POET.

4.2 The POET Model

One of the largest ethanol producers in the world, POET currently
operates 26 ethanol plants in the United States. From these plants, POET
markets approximately 1.5 billion gallons of ethanol and 3.5 million tons of
distillers grains a year (Dolan, 2008). Other leading U.S. ethanol produc-
ers include Verasun with a 1.64 billion gallon capacity and Archer Daniels
Midland whose current capacity of just over 1 billion is expected to reach
1.65 billion gallons by 2010 (Archer Daniels Midland Company, 2008;
Renewable Fuels Association, 2008; Verasun, 2008).

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4.3 The Evolution of POET: From Family-Owned Construction Company to Integrated Venture Management

POET originally formed in 1991 as a family-owned company to design and build ethanol plants. U.S. crop producers were interested in investing in ethanol plants in their local area as a way to increase revenue from corn. As POET and farmer-investors began to recognize their mutual interdependencies, they developed a unique business model that allowed for rapid expansion of the ethanol supply chain while minimizing many of the challenges producer-owners were experiencing in attempting to vertically integrate from crop production into ethanol processing and distribution. The basic design elements of this model include raw material delivery agreements, joint risk capital investment, production network management, integrated risk management, coordinated technology development and commercialization, and consolidation of marketing and distribution. These mechanisms work to ameliorate constraints of producer integration into the ethanol value chain.

4.3.1 Raw Material Delivery Agreements

It is important to note that many producer groups investing in ethanol processing facilities developed ownership models that tied risk capital investment and raw material delivery rights to ownership. In other words, producers joined together to buy shares to finance design and construction of the processing facility. These ownership shares were tied to delivery agreements stipulating the owners' obligations for corn delivery to be used in the ethanol plant. The legal entity utilized by producer groups was typically a cooperative, especially New Generation cooperatives, a limited liability company, or a combination of legal forms. Corn delivery agreements arranged and promoted by local farmers represented a dedicated, stable supply of raw material inputs for developing processing facilities.

4.3.2 Joint Risk Capital Investment

Producers utilized strong local ties and dense networks to generate a pool of interested capital providers. Producers' actions in establishing venture legitimacy and attracting credible commitments at the local level was often

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3 Broin and Associates was the original company name. All Broin Companies changed their name to POET in 2007. To avoid confusion, we refer to this company as POET even if the activities we are referring to were conducted when the company was still registered as Broin.
the first step in the development of new ethanol plant ventures. However, many producer groups found it difficult to fulfill their equity requirements when restricting ownership to producer-owners (Livingston, et al., 1998; Thongchua, Powell and Lawless, 2002). Therefore, they developed multi-tier and multi-class organizations to increase the pool of potential investors. Multi-tier and multi-class structures made it possible to vary investor rights with respect to residual distribution, raw material delivery obligations, voting rights, and board representation. In addition, a multi-tier approach, utilizing a cooperative as a major investor in an ethanol-producing limited liability company allowed new ventures to access favourable tax treatment and production incentives.

Table 1: Example POET Plant Ownership Arrangements

<table>
<thead>
<tr>
<th>Location</th>
<th>Initial Primary Producer Group Investor</th>
<th>Primary Investor Ownership Interest</th>
<th>Bronze Ownership Interest (POET)</th>
<th>Board Appointments Controlled by Bronze (POET)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Stone, SD</td>
<td>Northern Growers</td>
<td>77%</td>
<td>22%</td>
<td>2/7</td>
</tr>
<tr>
<td>Macon, MO</td>
<td>Northeast Missouri Grain Processors</td>
<td>82%</td>
<td>9%</td>
<td>1/7</td>
</tr>
<tr>
<td>Bingham Lake, MN</td>
<td>Southwest Minnesota Agrifuels Cooperative</td>
<td>64%</td>
<td>35%</td>
<td>N/A</td>
</tr>
<tr>
<td>Chancellor, SD</td>
<td>Great Plains Ethanol</td>
<td>40%(^2)</td>
<td>16%</td>
<td>2/9</td>
</tr>
<tr>
<td>Wentworth, SD</td>
<td>Lake Area Corn Processors(^3)</td>
<td>88%</td>
<td>12%</td>
<td>2/7</td>
</tr>
<tr>
<td>Glenville/Albert Lea, MN</td>
<td>EXOL</td>
<td>100%</td>
<td>0%</td>
<td>N/A</td>
</tr>
<tr>
<td>Coon Rapids, IA</td>
<td>Tall Corn Cooperative</td>
<td>59%</td>
<td>32%</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Sources: (Thongchua, et al., 2002; Western Plains Energy, 2002; Krumpelman-Farmer, 2005; Campbell, 2006; Lake Area Corn Processors, 2006; Great Plains Ethanol, 2007; Great Plains Ethanol, 2008; Hagy, 2008; Northern Growers LLC, 2008).

1 The percentages noted here were calculated based on Securities and Exchange filings, case studies, and other documents as noted in sources. For the most part, these percentages reflect initial equity investments. Therefore, current equity investments may have changed.

2 The forty percent figure is representative of Class A Shareholders. Class A shares are linked to corn delivery agreements.

3 The forty percent figure is representative of Class A Shareholders. Class A shares are linked to corn delivery agreements.
In an effort to complete their equity drives, farmers actively sought non-producer investment from private investors, local electric cooperatives, local grain elevators, and plant design firms (Krumpelman-Farmer, 2005). Investment by ethanol plant design firms contributed directly to capital financing needs (See Table 1). In addition, an investment on the part of leading design-engineering firms in the ethanol industry helped to establish legitimacy with creditors and other investors as to the viability of producers’ business plans (Campbell, 2006). Finally, investment by the design-build firm signalled POET would have a long-term involvement in the governance of the organization through share ownership. This long-term involvement in governance was expected to have a positive impact on firm performance due to POET’s extensive industry knowledge, contacts and information. POET’s ownership stake also allowed newly developing plants to cite the success of existing plants under POET management as a proxy for their expected progress when seeking lender financing.

Larger investors were cautious to invest in the ethanol industry in the 1990s and early 2000s as a result of low margins in the ethanol industry in the late 1980s (Leonard, 2006). Producers, however, presented themselves as investors knowledgeable with respect to the prospects of the developing ethanol industry. In addition, farmers’ dual rent generation approach made an investment in ethanol feasible. If margins were low at the firm level, farmers still benefitted at the farm level due to their delivery agreements to deliver raw inputs to the processing facility. In addition, farmers’ ability to generate local investor networks proved essential to the development of POET’s ethanol production network. While maintaining relatively low equity stakes, POET was able to deliver capital and legitimacy to farmer-owned ventures, grow their plant network, maintain control rights over the future direction of the facilities they built, and limit their risk capital exposure. Current POET equity in partner plants ranges from three to twenty-six per cent (Dolan, 2008).

4.3.3 Optimization of Production Network through Management Agreements

While eager to invest in ethanol production facilities, farmer-owners recognized their limitations in terms of recruiting and monitoring capable management teams (Western Plains Energy, 2002). In 1994, farmers began
to negotiate management agreements with POET. POET plant management agreements gave producer-owners access not only to POET’s extensive industry knowledge, but also to structural and process improvements being implemented across the plant network. In this manner, the value of enhancements developed and tested at one POET plant could be captured across the plant partner network. By 2008, twenty six plants had negotiated management agreements with POET (POET, 2008).

While managerial and technological knowledge is non-rivalrous in terms of use within the partner network, it is rivalrous in exchange (Antonelli, 2007). The ability of plant partners to extract monopolistic or entrepreneurial rents from these innovations depends on their ability to exclude non-network firms’ access to proprietary knowledge. Therefore, plant partners have developed strict intellectual property right protections to increase the appropriability of returns to innovative management systems as well as technological advances. Property right protections utilized to localize returns to the plant partner network include non-disclosure, non-compete and confidentiality provisions in employee contracts.

Close working collaboration with POET in the design, construction, management and governance has enabled farmers to mitigate start-up concerns with respect to equipment problems and working capital concerns. Even when engaging in new plant development, producer-owners have access to reliable information on which to base their prospectus as the developing plant shares components of its engineering design and management with POET plants across the network. This coordination maximizes the ability of those involved to forecast working capital needs and minimizes the potential for construction and equipment problems that may constrain working capital accrualment.

4.3.4 Integrated Risk Management and Input Cost Reduction

The precursor to POET Risk Management was formed in 1995 to deliver risk management services for corn and natural gas. Plants participate by entering into Corn and Natural Gas Price Risk Management Agreements. This organization, while operating under the POET name, remains independently owned by Commodity Marketing Co., Albert Lea, MN. However, Commodity Marketing Co. has carried out risk management for all POET-managed plants since 1998.
Risk management agreements allow partner plants protection against volatile commodity markets while lowering the costs associated with maintaining redundant in-house staff to carry out this function. While individual ethanol producers can contract similar risk management services, the plant partner network offers additional advantages. Horizontal integration of risk management across the plant network allows POET plants the possibility of pooling risk across facilities.

4.3.5 Coordination of Technology Development and Commercialization

In addition to management agreements, farmers have successfully collaborated with POET in technological development at multiple levels within the value chain: in raw material delivery, in ethanol production, and in coproduct processing. Given difficulties experienced by previous producer-investors in the processing industry, the ability to engage in continuous collaboration with POET engineering experts on production efficiency and the development of new production technology is attractive to producer groups. POET benefits by maintaining a plant network receptive to rapid commercialization of new technologies developed.

However, receptivity is not limited to plant testing and adoption of technologies to be commercialized. Due to POET's extensive collaboration with farmers, POET retains the capacity for close collaboration with producers in the development of technologies that rely on farm-level trials. For example, POET is currently collaborating with producers to discern the most efficient process for harvesting corn cobs for utilization in newly developing cellulosic plants (Sioux City Journal, 2007).

The primary contractual arrangements governing network technology development are technology and patents rights license agreements which producer organizations have negotiated with POET Research. These agreements give individual plants the right to utilize technology developed throughout the POET plant network while limiting the appropriability of these technology developments to ethanol plants outside the network. POET's first commercial ethanol production facility in Scotland, SD is now the headquarters of POET Research which coordinates research and development work with respect to
ethanol production. POET Nutrition\(^4\) engages in research on distiller's grains. The extensive collaboration carried out as a result this netchain strategy has also allowed the POET network to be seen as an attractive partner for organizations such as DuPont, Novozyme and the U.S. Department of Energy. POET is currently collaborating with the U.S. Department of Energy on research and development leading to the construction of a cellulosic ethanol facility in Emmitsburg, Iowa (Bevill, 2008).

4.3.6 Consolidation of Marketing and Distribution

Agreements with POET for the marketing of distillers grains and ethanol products allow producer-owners another mechanism to integrate their processing facilities into distribution networks. Dakota Grains Marketing Association, now POET Nutrition, was developed in 1995 as a marketing agency for distillers grains. In addition to developing market access for producers, POET has developed branded Dakota Gold distillers grain products to increase producer revenues from ethanol co-products. POET Nutrition supports these marketing activities with their research on the nutritional benefits of Dakota Gold products.

In 1997, POET established Ethanol Products, LLC to market ethanol and carbon dioxide released during the fermentation stage of ethanol production. Ethanol Products is also able to act as a collective bargaining agent to supply denaturant to plants. Producer groups facilitated the development of Ethanol Products through minority share interests in the organization (Lake Area Corn Processors, 2006). Marketing services are contracted by plants through ethanol marketing and service agreements. These marketing and service agreements are not limited to partner plants, those plants having negotiated a management agreement with POET. Independently managed plants have also chosen to enter into ethanol marketing agreements to secure market access, as well as information regarding marketing prospects and the feasibility of a certain location (Western Plains Energy, 2002). For new ethanol production facilities, signing a marketing agreement is often essential to securing lender support (Informa Economics, 2007). Therefore, while POET ethanol marketing agreements are an integral part of many plants' success during operational phases, the marketing agreement may also serve a critical role during development phases as well.

\(^4\) POET Nutrition was formerly known as Dakota Gold Research Association, founded in 2002.
The involvement of POET in ethanol marketing through Ethanol Products, LLC gives potential producer investors access to superior information regarding ideal plant locations. Individual producers may exhibit heterogeneous preferences with respect to a building location if they are to bear a share of raw material transportation costs (Tong, 1997). However, these heterogeneous preferences can be unified with evidence that a specific location will improve market access and reduce transportation costs associated with product marketing.

Figure 1: POET model: mutual coordination within the U.S. ethanol value chain

5. Producer Strategies for Achieving Vertical Integration in the Ethanol Supply Chain

In the past, producers looking to invest in ethanol production facilities have retained several different companies to perform services for their new venture. Managing multiple contracts for feasibility studies, design-build agreements, management agreements, and product marketing may prove difficult for
producers stepping outside their area of expertise. In addition, retaining multiple companies presents the possibility for multiple conflicts of interest.

One strategy producers have found to overcome start-up challenges is to join a network of plants operating as an integrated system. Certain producer groups have been successful in developing individual components of this approach in the past. For example, the Renewable Products Marketing Group, founded by a group of farmer-cooperatives, was able to successfully negotiate ethanol producing marketing agreements and reduce input costs by collectively purchasing raw materials (Informa Economics, 2007). However, the POET model represents an opportunity to utilize the integrated systems approach across multiple functions with lower upfront transaction costs. Key design mechanisms of this approach have been adapted by producer-owned organizations to achieve scope economies in transaction cost management.

Farmers present themselves as desirable partners in the development of new ethanol production facilities because they are able to secure a reliable corn supply and utilize their networks to attract willing investors. The POET model facilitates this investment by contributing essential knowledge and services with respect to plant design, governance, management, procurement, risk mitigation, research and development, and product marketing. This seems to constitute a win-win solution for many producers and other local investors. By investing alongside farmers, POET has been able to retain control rights across the majority of their plants. Local producers and investors, by contributing the majority of investment capital to these operations, ensure that residual earnings are distributed locally (see Figure 1).

6. Future Perspectives for Research

POET is an example of a construction company that grew into a chain management service provider for multiple farmer-owned ethanol ventures. The POET model represents one example of an integrated system that was negotiated to respond to several challenges producers experience when attempting to vertically integrate (see Table 2). Future research should seek to identify additional challenges that thwart producers' ability to access rents at multiple levels in the value chain. Hopefully, further identification of these challenges will allow us to explore additional mechanisms producer-owners may utilize to improve supply chain integration.

We find the ability of this integrated systems approach to improve access to debt capital and increase venture legitimacy for new producer-owned ventures particularly intriguing. While the POET case has demonstrated the potential of this model for rural development and local ownership in the context of
the United States, it will be interesting to see whether similar models can be
developed to support enterprising producers in low-income countries. We look
forward to exploring supply chain innovations instigated by various supply chain
actors and in a variety of industries within agro-food-energy networks.

Table 2: Mechanisms for value chain optimization among
producer-controlled entities in the U.S. ethanol sector:
the POET model

<table>
<thead>
<tr>
<th>Value Component</th>
<th>Producer Challenge</th>
<th>POET Model</th>
<th>Contractual Mechanisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable Raw Material Supply</td>
<td>Producers experienced depressed corn prices and were searching for alternative avenues to market their crop.</td>
<td>Producers buy the right and obligation to deliver corn.</td>
<td>Corn Delivery Agreements</td>
</tr>
<tr>
<td>Joint Risk Capital Investment</td>
<td>Producers with no proven track record in the ethanol industry lack credibility, legitimacy with creditors.</td>
<td>POET facilitates plant development and retains governance control by contributing low levels (3-26%) of risk capital to plant construction.</td>
<td>Joint Investment through Shareholder Agreements</td>
</tr>
<tr>
<td>Coordination in Plant Location</td>
<td>Transportation costs create heterogeneous preferences among producers with respect to plant location.</td>
<td>POET works with investors to conduct feasibility studies in conjunction with new plant design, considering the impact of new plant location on product marketing across the network.</td>
<td>Design Build Agreement—with POET Design and Construction</td>
</tr>
<tr>
<td>Co-Optimization of Production Networks</td>
<td>Limited management expertise at processing level puts producers at a disadvantage among large, established competitors.</td>
<td>Integrated plant management across 26 plant network allows for procedural and structural improvements to be disseminated. Attempts are made to retain exclusive command of proprietary managerial and technological knowledge.</td>
<td>Plant Management Agreement with POET Plant Management</td>
</tr>
<tr>
<td>Integrated Risk Management</td>
<td>Producers bear significant risk due to price volatility in commodity markets. Vertical integration represents an attempt to extract value from depressed commodity prices.</td>
<td>Non-redundant risk management staff in combination with pooled risk management across facilities acts to provide another level of risk protection against commodity volatility.</td>
<td>Corn and Natural Gas Price Risk Management Agreement with POET Plant Management</td>
</tr>
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<td>Value Component</td>
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<tr>
<td>Collective Research, Development, and Commercialization</td>
<td>New technology utilization is perceived as a high risk strategy as attempts to scale up technology have proven crippling to newly forming producer-owned groups.</td>
<td>The POET network structure affords the capacity to conduct research and disseminate procedural and technological improvements across the netchain.</td>
<td>Design Build Agreement—with POET Design and Construction</td>
</tr>
<tr>
<td>Consolidated Marketing and Distribution</td>
<td>Producers possess little previous industry experience and thus possess few network ties and information to establish distribution networks for products and co-products.</td>
<td>New plant openings are coordinated within an established system managing logistics, market development, and market information for ethanol, CO2 and denaturants.</td>
<td>Ethanol Marketing and Service Agreement with POET Ethanol Products</td>
</tr>
</tbody>
</table>

References


LANG, M. G.; SPATZ, K. *Cooperative director compensation*. Rural Cooperatives Center, University of California, Davis, Department of Agricultural and Resource Economics (1995).


MISSOURI Revised Statutes Chapter 142, Motor Fuel Tax, Section 142.028.


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