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International Food and Agribusiness Management Review

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EDITOR'S NOTE

Dear Readers,

The Editorial staff at the IFAMR is very excited about this latest issue. Not only are there a nice set of research manuscripts and a compelling commentary by Dr. Daniel Conforte of Massey University in New Zealand, but this issue contains an important supplement. The Agribusiness, Economics, and Management (AEM) section is one of the largest sections within the Agriculture and Applied Economics Association. Each year it produces an agribusiness track of several sessions and a dinner at the annual meeting. Last year the AEM section and the IFAMR decided to produce a special supplement resulting from last year's annual conference in Denver. Ta Da! We did it. This issue of the International Food and Agribusiness Management Review contains the articles from session 3003 entitled, "The Nascent Bioeconomy for Industrial Markets: Green Goes from Plant Material to Spandex." To prepare the articles for this issue the IFAMR added its own review process plus a guest Managing Editor to supplement the conference's submission procedures.

This is the beginning of a great partnership between the Agriculture and Applied Economics Association (AAEA) and the International Food and Agribusiness Management Association (IFAMA). For session organizers and authors interested creating special supplements or special issues please contact our office at ifamr@ifama.org. The IFAMR is an open access online journal listed on every major journal catalogue service. We are self-published so we provide fast turnaround and a uniquely intimate level of service to special issue editors and authors. We use our own proprietary email list and directly distribute the journal to over 11.5k scholars, managers, and policymakers world-wide. Most recent statistics show that 7,800 articles were downloaded in March 2011, our highest month ever.

So enjoy this issue.

Peter Goldsmith, Executive Editor, IFAMR

International Food and Agribusiness Management Review
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SPECIAL GUEST EDITOR'S NOTE

Special Guest Editor: Dr. Eric Micheels, Assistant Professor, Department of Bioresource Policy, Business & Economics, University of Saskatchewan (*Appointment begins: July 2011*)

Dear Readers,

IFAMA-AAEA Special Collaborative Supplement on Analyzing Bio-Based Industries

Included in this edition of the International Food and Agribusiness Management Review are three timely articles that develop a framework for analyzing bio-based industries. While work on the biofuels industry is ongoing, more attention is being paid to the growing number of opportunities for innovative agribusiness firms in the plant-based polymer industry. For example, PepsiCo recently announced the introduction of a 100% plant-based bottle (Financial Times, March 15, 2011), which follows their earlier introduction of plant-based packaging in their Sun Chips line of snack foods (WSJ, August 10, 2010). The three articles in this series examine how agribusiness firms might develop new supply chain partnerships to source needed plant material as well as some challenges firms may face in the course of such development. Also discussed is the role of firm and supply chain innovativeness in determining the degree of success achieved through innovations in plant-based industries. We hope you find these timely articles thought provoking and that they lead to greater understanding of this growing sector.

WSJ article on Sun Chips:
http://online.wsj.com/article/SB10001424052748703960004575427150103293906.html

FT article on Pepsi Bottles:
http://www.ft.com/cms/s/0/41381f04-4eb0-11e0-874e-00144feab49a.html#axzz1GmFzt2EH

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The Increasing Multifunctionality of Agricultural Raw Materials: Three Dilemmas for Innovation and Adoption

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Abstract

Agricultural raw materials are increasingly being used for multiple industries or sectors beyond the traditional fiber and nutrition industries: energy in the form of ethanol and biodiesel, industrial products such as polymers and bio-based synthetic chemicals and fibers, and pharmaceutical/health products such as functional foods, growth hormones and organ transplants. A combination of the new science of biotechnology, the new potential end uses of the products of that science and the broadened social/public goals that these products can respond to surfaces at least three fundamental challenges or dilemmas: (1) the competing goals dilemma, (2) the incumbent vs. new entrant competition dilemma, and (3) the industry boundaries dilemma. This paper reviews the innovation and adoption research related to renewables and the bio-economy, and then frames the three dilemmas with the objective of identifying important research issues and the conceptual frameworks that might be useful to analyze these issues.

Keywords: Bio-economy, industry convergence, renewables, disruptive innovation, multifunctionality

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Introduction

The agricultural sector is increasingly becoming a source of raw materials for industries or sectors beyond the traditional fiber and nutrition industries: energy in the form of ethanol and biodiesel, industrial products such as polymers and bio-based synthetic chemicals and fibers, and pharmaceutical/health products such as functional foods, growth hormones and organ transplants. Technological developments and innovations in the bio-economy have important implications for the convergence between the previously relatively independent food, energy, industrial product and pharmaceutical industries. This may lead to severe competition in resource use, blurring of industry boundaries and dramatic changes in the competitive setting of down-stream markets. Hence, these new products and end-uses will have profound implications for the structure and operations of the supply chains in the agricultural industry as well. Hardy has suggested that "the bio-based economy can and should be to the 21st century what the fossil-based economy was to the 20th century" (Hardy 2002, 11).

More specifically, first generation bio-based energy in the form of ethanol from wheat, corn, sugarcane or sugar beet and bio-diesel from different raw material sources such as soybean and palm oil or rapeseed is now common-place in the market. Second generation biofuels from cellulosic material are under development. According to a USDA study the growth potential for bio-based chemicals is significant with the opportunity to move from a current market share of 20% in fine and specialty chemicals to a potential market share of 50% in 2025. Such products include cleaners, solvents, adhesives, industrial gums, and paints. Examples of bio-based polymers include plastics from corn starch. With consumption of renewable polymers projected to increase by 22 % annually in the U.S., the market size for biodegradable polymers generated from renewable natural sources, such as plant and animal biomass, is growing significantly (GIA, 2006). Other bio-based products include industrial enzymes, acidulants, amino acids, vitamins, food conditioners, nutraceuticals, pharmaceuticals, and cosmeceuticals. Moreover, edible vaccines are in efficacy and safety testing for human and domesticated animal diseases.

The different applications of agricultural resources leverages the importance of this industry becoming an input supplier for at least four different industries: (1) food and nutrition products, (2) energy, (3) industrial chemical products (including synthetic fibers, plastics, wall coverings, and other products that have historically been derived from the petrochemical industry), and (4) health and pharmaceutical products. Thus, agriculture is being transformed from an industry that produces and processes commodity products to one that biologically manufactures specific attribute raw materials for a broader set of end uses. The results of this transformation will not just be seen in the within-firm production, processing and marketing activities, but also in the creation of new value and supply chain relations leading to a redefinition of industry boundaries and structure as well as changing the competitive landscape. Hence, the process of technology-driven convergence—what we observe in other industries like telecommunication and electronics merging due to a fusion of technologies in line with digitalization of data (Kodama, 1992) which has led to "new competitive landscapes" (Bettis and Hitt 1995)— is part of the agri-food industry and related industries.

The purpose of this paper is to review the innovation and adoption research related to the bio-economy and renewables, and to frame three dilemmas with the objective of identifying some of the important researchable issues in this area and the conceptual frameworks that might be useful

to analyze these issues. In this paper we seek to contribute to the evolving innovation management literature on convergence in particular (e.g. Curran et al. 2010) and apply it to the emerging industry sectors of the bio-economy.

The remainder of this paper is organized as follows; the brief introduction in this section is followed by a literature review focusing on innovation and adoption of innovations in the context of the bio-economy. This discussion also includes a closer look at patents in the bio-economy, to better illustrate what the bio-economy is really focused on and why agricultural raw materials are becoming increasingly multifunctional. Having elaborated on the context of the bio-economy, we then discuss three dilemmas associated with innovation and adoption in the bio-economy. This discussion of these dilemmas will emphasize the extant literature, connect different streams of theory and reflect these against the context of the bio-economy in order to derive and frame research questions. This is followed by final comments.

Innovation and Adoption in the Bio-economy

To account for the large variety of opportunities for innovation, we define innovation in the broad sense as proposed by Schumpeter (1934). Hence, innovation is a process of creative destruction, where the quest for profits pushes to innovate constantly, by breaking old rules to establish new ones. For Schumpeter, this implies not only the introduction of new products but also the successful commercialization of new combinations, based on the application of new materials and components, the introduction of new processes, the opening of new markets or the introduction of new organizational forms. The Schumpeterian definition of innovation is clearly applicable to the emerging bio-economy as so-called bio-renewables have the potential to break the rules of existing markets and to challenge established technological platforms such as petrochemicals (Nameroff et al. 2004).

Innovation is essential to respond to the critical concerns of society such as climate change and global warming, food/energy scarcity and security, and environmental challenges or resource use/sustainability. Many innovations will be in the form of products/services or processes that improve the effectiveness and efficiency of responding to these social/economic challenges (e.g., dealing with the measurement and mitigation of negative externalities). Others will be institutional innovations such as new markets for carbon sequestering or a cap and trade system to reduce greenhouse gas emissions, or new management systems such as lifecycle analysis to respond to resource constraints, environmental problems and sustainability issues. Some of these innovations will be in the form of creative public/private sector ventures such as the agreement between Novartis and the University of California for basic research in agricultural genomics (Klotz-Ingram and Day-Rubenstein 1999).

What kinds of innovations are likely to characterize the bio-economy? And which industry is most successfully developing these? First of all, patents are one indicator of innovation and R&D in this emerging field. Over 3200 green chemistry patents were granted in the U.S. patent system between 1983 and 2001, with most of them assigned to the chemical sector (Nameroff et al. 2004). A closer look at recent patents awarded in the U.S. and EU in the field of biofuels, bio-products and bio-energy between July and August 2009 reveals for instance, that the highest patenting activity could be observed in the field of bio-conversion and bio-production (see Figure 1, Garratt, 2009).

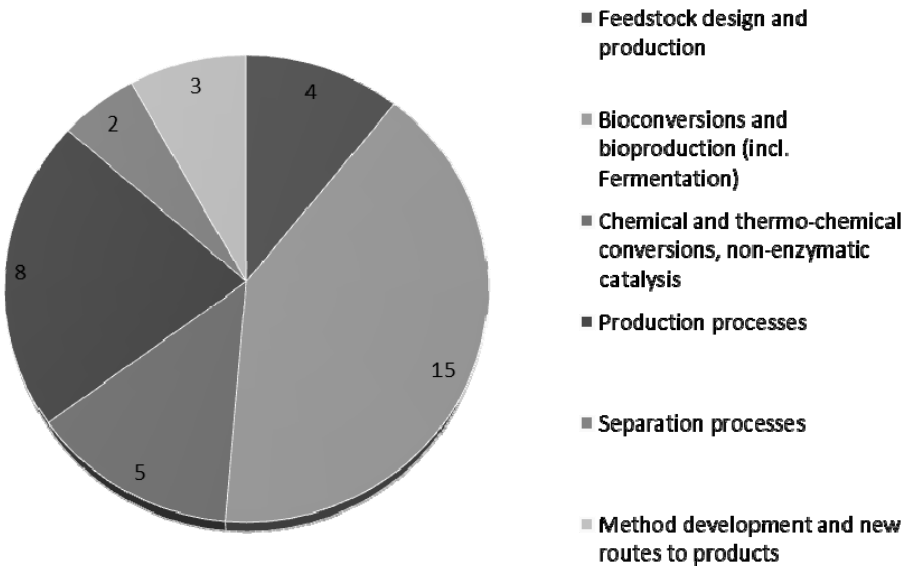

Figure 1. Level of grant and application activity in patenting in fields of the bio-economy
Source: Garratt (2009)

How, if and when will these patented inventions find their way to the market? Commercialization of innovation requires linking with complementary assets such as marketing expertise, brands, and logistics and supply chain networks, all in support of the innovation (Teece 1992). The extent to which a new product innovation can be mastered by existing complementary assets depends on the degree of innovativeness. Following Veryzer (1998), product innovations can be distinguished along the dimensions "technological capabilities" and "market capabilities." Depending on the degree to which an innovation requires new capabilities, it may create conflicts within the existing firm. This view can be extended to include the capability requirements of an innovation on the customer side, and even along the entire value chain (Bröring et al. 2006). The more disruptive an innovation is from a customer's view, the more assets need to be changed; hence, the less likely is the adoption of that innovation. This is because the customer may not want to invest in specific complementary assets to make adopting the innovation feasible (in case of B2B markets), or the customer may not want to invest in extra search and information costs (in case of B2C markets).

The market success of each innovation depends on its initial adoption and diffusion in the relevant markets (Rogers, 1983). However, adoption and diffusion may also be influenced by a number of external factors and they differ in B2B and B2C markets (Goshdal and Barlett 1988). Looking at the adoption of innovations in the bio-economy this differentiation becomes even more relevant as bio-technology has and still is facing multiple barriers for adoption (Klerck and Sweeney, 2007). In this regard, Verbeke (2007) investigated consumers' acceptance of the usage of biotechnology in bio-renewables. Consumers are increasingly interested in sustainability and more sustainable production methods but, especially in Europe, they have been quite critical toward particular applications of genetic modification (GM). While there is little doubt that the

sustainability issue entails substantial opportunities for bio-renewables, the GM issue--posing either a threat or an opportunity -- is less straightforward (Verbeke 2007). Attitudes towards and acceptance of GM in the production of bio-renewable energy have not been investigated in depth thus far, leaving numerous questions unresolved.

At this stage it also remains unclear how the limited adoption of biotechnology by European consumers may impact the adoption rate on an industrial scale. This is because the management decision to adopt bio-renewables is a function of factors that maximize the expected benefits from adoption and minimize anticipated costs of adoption. Expectations (the likelihood of earning a given target return) and anticipations (the cost of process innovation adoption given the earning's expectation) are not directly controllable by the adopter. To conclude, the adoption of innovations in the realm of bio-renewables and in the bio-economy depends significantly on how decision makers frame and value the risks and rewards associated with it.

Dilemmas in Innovation and Adoption Associated with Agriculture's Increasing Multifunctional Role

The lynch-pin to the development of new end-uses for agricultural raw materials is the improved scientific base for understanding plant and animal product growth and processing. Genetic manipulation, enzyme development and biotechnology combined with traditional biological, chemical and engineering advances have resulted in innovations that are disruptive. A combination of the new science of biotechnology, the new potential end uses of the products of that science and the broadened social/public goals that these products can respond to surfaces at least three fundamental challenges or dilemmas:

(1) the competing goals dilemma,
(2) the incumbent vs. new entrant competition dilemma and
(3) the industry boundaries dilemma.

As concerning competing goals, the development of the bio-economy and the growing use of renewables have intensified the discussion of the complementary or competitive nature of the economic motivation of creating value and the "social motivation" of "environmental responsiveness and sustainability" (Shrivastava 1995). And as often occurs with disruptive innovations, new end-uses result in new customers that previously were not even recognized by incumbent firms, potentially enabling new entrants to be more successful in gaining market position and eventually dominating the traditional participants (Christensen and Raynor 2003). The third dilemma concerns the structural changes that will occur in the industries and firms involved in this "new" industry. This is because traditional supply chains no longer prevail as new value and supply chain structures are emerging in the bio-economy. Hence, previously relatively independent industries of agricultural/nutrition products, energy and industrial products and health/pharmaceutical products are now intersecting, industry boundaries are being blurred or redefined and the competitive landscape is being redefined (Bröring 2005).

The Competing Goals Dilemma

The growing interest in renewables and the bio-economy is driven in part by the potential to respond to: 1) on the one hand the rising costs of fossil fuels and the growing market potential of biodegradable products (the economic motivation); and 2) on the other hand the increased concern about issues of sustainability and environmental challenges of continuing to be heavily dependent on fossil based raw materials (the social motivation).

Science and technology have powered the world's economy and economic progress in the recent decades, but along with wealth and prosperity they have caused unintended ecological problems including climate instability, ozone depletion, concerns about water and energy availability, declining biodiversity, and toxic waste (Shrivastava 1995). As natural resources become increasingly scarce, businesses can expect to encounter limited access to inputs and increased costs of those inputs.

Businesses, and specifically agribusinesses that rely heavily on natural resources, cannot ignore environmental and social issues that have become prevalent in today's society. Faced with increasing government regulations and strengthening public opinions, businesses are becoming more accountable for their impacts on society and more transparent in their activities as part of their corporate social responsibility. Thus, businesses are increasingly concerned about sustainability. But what is sustainability in detail? A plethora of different definitions of sustainability exist, but all share the common rationale as described in the *Brundtland Report of the World Council on Environment and Development* in 1987, "Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs." On a more detailed level, the extant literature distinguishes different dimensions of sustainability (e.g. Andersson et al. 2005); they can be summarized in three major dimensions with different sub-categories as detailed in Figure 2 below.

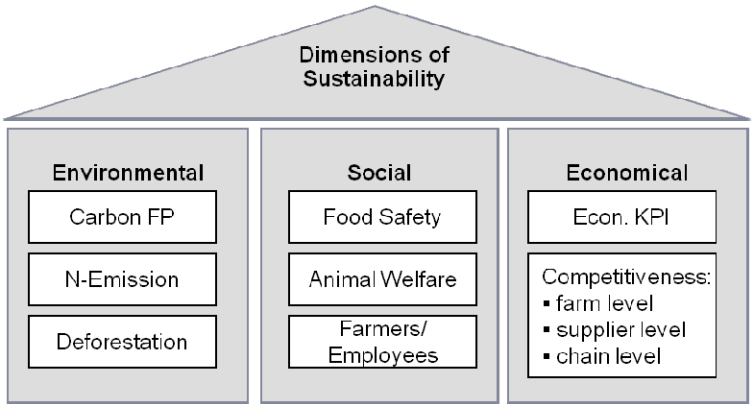

Figure 2. Dimensions of sustainability with different reinforcing or conflicting goals
Source: Bröring (2009)

An often expressed concern in the agricultural sector is the potential trade-offs between the three different dimensions as for instance a trade-off between environmental goals and economical goals (e.g. environmental sustainability and productivity). Companies and stakeholders often

hold the belief that sustainability measures come at the expense of productivity and competitiveness within the industry. By taking into account environmental and social concerns, companies must internalize more costs and face additional constraints. Such arguments make it exceedingly difficult for management to receive the needed support for pursuing sustainability initiatives (de Voil et al. 2006).

In this context conventional industrial agriculture is being challenged to change its production, manufacturing, and distribution processes to be more environmentally or sustainability focused. Such challenges also provide new opportunities for implementing sustainable business strategies and entering market niches for environmentally-friendly products (Jansen and Vellema 2004). And bio-renewables are proposed and strongly promoted as such products. Those companies that see emerging environmental issues early and include them in their strategy have the potential to be perceived as more innovative and entrepreneurial than competitors. Consumers concerned with lowering their costs and environmental footprint often distinguish such companies as more prepared to deal with unpredictable market forces and more apt to meet customer needs. For instance, UK-based retailer TESCO and U.S. based Wal-Mart have launched a "carbon-foot-print" initiative, so that consumers get direct access to the CO^2 production involved with the products they purchase. The ability to acquire customer loyalty is essential for creating brand value, which in turn drives sales, premiums, and closer relationships with stakeholders (Esty and Winston 2006).

Technology and innovation in production processes and product development is at the core of environmental performance (Jansen and Vellema 2004). Increased pressures on natural resources and the threat of serious potential environmental effects add to the importance of the role technology can play. The vital role of science and technology in reducing the environmental footprints of companies and consumers relies on the ability to measure their impacts.

Increasingly, what have been perceived as conflicting goals are now being defined and repositioned as goals that are complementary. A recent survey by MIT's Sloan Management Review editors of 50 sustainability thought leaders and corporate CEO's indicated that 50% judged their company had a compelling business case for sustainability with the impact on the company's image and brand being the dominant component of that business case. Berns et al. (2009) present the business case arguments in terms of pricing power, cost savings, employee engagement, market share, new market entry, risk premiums and cost of capital as summarized in Figure 3. But other business leaders (including some in the same organizations as the thought leaders) are not convinced – only 10% of the 1500 business executives surveyed indicate that their company had a compelling business case for sustainability.

A second critical issue in responding to the potential economic vs. social motivation dilemma is that of adoption of innovations – both the rate/spread of adoption and the motivations for adoption. Kennedy and Fiss (2009) have expanded the classic two stage adoption/diffusion model of Tolbert and Zucker (1983) to include issue interpretation and decision logic. Issue interpretation in essence is whether an issue (and thus the change/innovation that will respond to that issue) is framed as an opportunity or a threat. Issues that are interpreted as opportunities imply that gain is possible, control can be exercised and thus there is increased potential to take action and to innovate and implement organizational change. In contrast issues that are interpreted as threats imply a loss, little control and resistance to innovation or change.

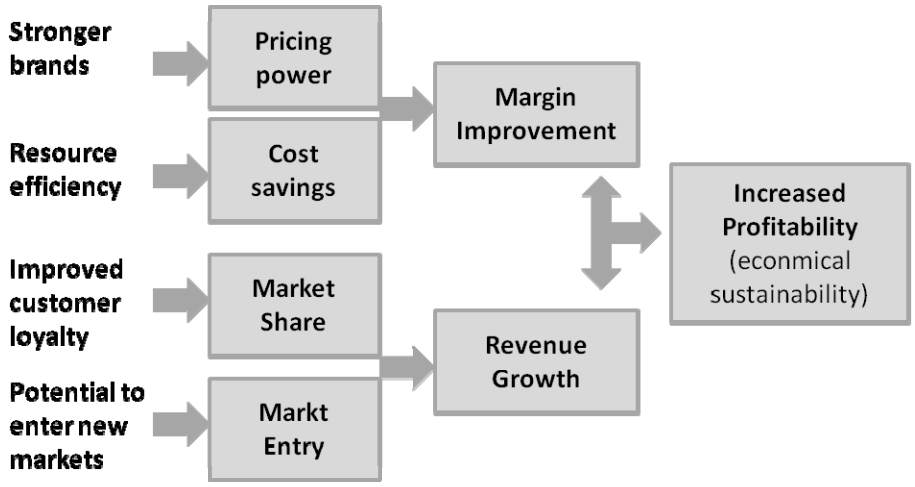

Figure 3. Creating goal conformity among social, environmental and economical goals of sustainability
Source: Adapted from Berns et al. (2009)

As to decision logic, Kennedy and Fiss (2009) focus on technical efficacy and social legitimacy. They argue that technical efficacy and efficiency gains incent more rapid adoption consistent with the logic of creating value. Social legitimacy is in essence an image or conformance decision logic – the desire to be perceived as "looking good" "politically correct" or not a laggard – to appear legitimate to both customers and competitors. Kennedy and Fiss (2009) summarize their analytical framework as in Figure 4 and conclude that early adopters will have framed the issue as an opportunity and use a combination of technical efficacy (creating value) and social legitimacy decision logic. In contrast, late adopters will frame the issue as a threat and use primarily technical efficacy (creating value) decision logic.

The implications of this analytical framework for innovation and adoption in the bio-economy and the resolution of the goals/motivations dilemma (value creation vs. sustainability) are straight forward: those firms that frame the issue of participation in this new market as an opportunity and use both technical efficacy and social legitimacy as decision logics in their strategic decision making will be more aggressive in innovation and institutional change and thus be leaders in the industry. Those who view the bio-economy developments as a threat and use primarily technically efficacy (creating value) as their decision logic will delay their innovation and participation in the bio-economy/renewables industry. A fundamental and critical research question is what industry and infra-firm characteristics and external forces and factors impact the issue interpretation and decision logic of firms in the agricultural and renewable industries. Additional research would focus on the financial performance of those who successfully resolve the motivations/goals dilemma compared to those who do not.

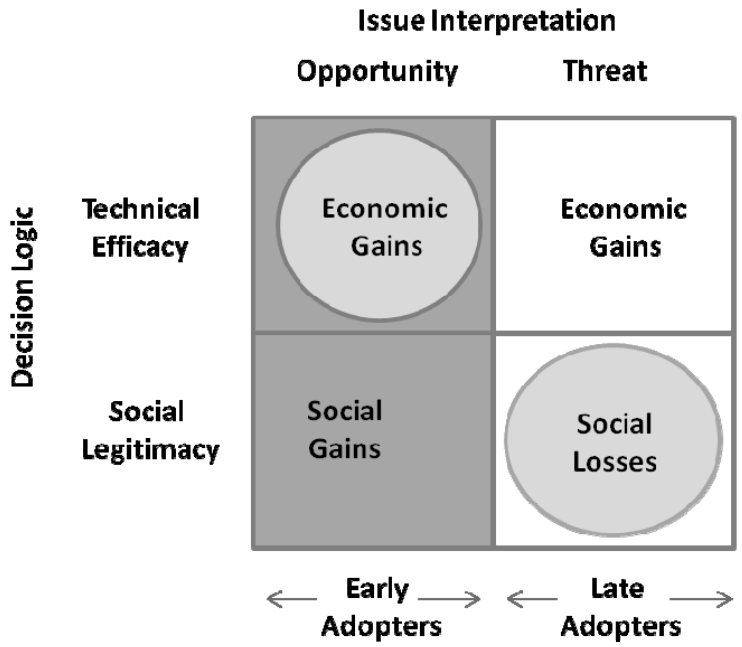

Figure 4. Motivations for adopting innovations
Source: Adapted from Kennedy and Fiss (2009)

The key researchable questions that might provide insight into the competing goals dilemma include the following:

1) What is the specific magnitude of the trade-offs (if any) of the economic and environmental goals for specific renewable products?
2) What strategies can firms embrace that will integrate the technical efficacy and social legitimacy decision logics to enhance their potential first mover/early adopter advantage?
3) What specific renewables innovations (both product and process) appeal to both the technical efficacy and social legitimacy decision logics and have the most potential for rapid adoption?
4) What strategies and decisions can be implemented to create value through sustainability initiatives in specific renewable markets?
5) What are the key determinants (firm characteristics, competitive conditions, regulatory regimes, etc.) of the issue interpretation and decision logic that will impact the speed of adoption of innovations in the renewable/bio-economy sector?

The Incumbent/New Entrant Dilemma

The second dilemma concerns the issue of the opportunity for new entrants to successfully enter the market and replace the incumbents who have been the dominant players in the industry. Bain's (1959) seminal analysis characterized the barriers to entry as structural or strategic -- structural resulting from natural costs or marketing advantages including those from regulation, and strategic resulting from deterring strategies of incumbents. Deterring strategies are typically in the form of price discounting and/or capacity expansion. More recent work has argued that the

most effective and dominant entry barriers are a result of asymmetries between incumbents and new entrants –structural differences resulting from control of essential resources, economies of scale/scope/learning, and marketing advantages commonly referred to as the "umbrella effect" of branding which both increases switching costs of current customers and attracts new customers who respect the brand (Baumol et al. 1982). Innovation in both product and process can facilitate a new entrant's challenges of these structural entry barriers that favor the incumbent. The degree of innovativeness – "new to the world" products compared to incremental "repositioning" of products – has a significant impact on structural entry barriers. Disruptive/radical/discontinuous innovation by a new entrant can facilitate entry by: 1) use of new/different resources/inputs, thus challenging the incumbent's control of essential resources, 2) dramatically lowering the cost of production/distribution, and 3) introducing superior performing or lower cost products that offset the switching costs for current customers and attract non-customers.

In the context of disruptive or radical innovation as likely characterizes the bio-economy, Christensen and Raynor (2003) suggest that one potential characteristic of such innovations is that they frequently create the most value and thus are most attractive to non-customers, or those who are likely not the focus of the sales force and marketing strategy of incumbents. They classify such disruptive innovations as "new-market" disruptions. Such innovations "enable a whole new population to begin owning and using the product, and to do so in a more convenient setting …the disruptive innovation doesn't invade mainstream markets; rather it pulls customers out of the mainstream value network into the new one because these customers find it more convenient to use the new product" (p.45-46).

The implications of these arguments for the evolving nature of the bio-economy and the role of incumbents relative to new entrants in that sector are profound. As agricultural raw materials become increasingly important to new customers in the industrial product sectors and the health/pharmaceutical industries, the opportunity exists for new entrants to more effectively serve these new customers compared to incumbents. New participants in the bio-energy market such as POET that have challenged the market dominance of incumbents such as ADM are but one example. The longer-term implications are for significant challenges to incumbent agricultural production technology firms, as well as product processing firms, as renewable and biological based raw materials become the feedstock's not just for food and fiber end-users (the old customers), but for the health/pharmaceutical and industrial products end-users (the new customers) as well. And the resolution of this issue leads directly to the third dilemma – redefining industry boundaries to be discussed shortly.

Traditional Porter Five-Forces (Porter 1980) analysis frames rivalry and the threat of new entrants as a fundamental challenge to the market position of an incumbent and the competitive character and profitability of an industry. Such questions as: rate of industry growth; significant cost differences among firms; degree of product differentiation among sellers; buyers' costs of switching from one competitor to another; strength of exit barriers; importance of reputation or established brand loyalties in purchase decisions; entrants' access to distribution channels; entrants' access to raw materials; entrants' access to technology/know-how; entrants' access to favorable locations; experience-based advantages of incumbents; network externalities: demand-side advantages to incumbents from large installed base; government protection of incumbents;

and perceptions of entrants about expected retaliation of incumbents provide specificity to the analysis of these forces (Besanko et al. 2007)). Assessing the evolving bio-economy from the perspective of these questions would provide some evidence of the competitive characteristics of the industry and the opportunities for new entrants to replace incumbents.

Recent analysis in the bio-energy industry by Ng and Goldsmith contributes analytically to this issue of incumbents vs. new entrants (Ng and Goldsmith 2010). They indicate that the arguments of the resource based view (RBV) of strategy focused on gains from unique sources of competitive advantage resulting in part from specialized assets must be combined with those from Organizational Ecology (OE) that emphasize market uncertainty and flexibility to understand the challenges (risk) and opportunities (first mover advantage) of market entry. More specifically, they argue and numerical evaluate the differences in entry strategies of firms in the traditional first-generation dry milling ethanol industry compared to the second-generation cellulosic ethanol industry, and conclude that market uncertainties combined with specialized assets in cellulosic ethanol production favors delayed entry compared to the earlier entry strategy for less specialized dry-milling technology participants in the market.

The key researchable questions that might provide insight into the incumbent/new entrant dilemma include the following:

1) What strategies should traditional downstream firms in the food/nutrition industry consider to compete successfully with new entrants from the energy/industrial products and health/pharmaceutical industries?
2) What specific dimensions of rivalry and threat of new entrants will be most impactive in determining the competitive position and success of incumbents versus new entrants in the renewables/bio-economy industries?
3) What are the key determinants of success in bringing disruptive innovations to market in the renewable sector/industry?
4) What are the opportunities for collaborative activities between leading firms in the agricultural industries and the industrial products or pharmaceutical industries to bring new renewable products to market?

The Industry Boundaries Dilemma

Industry convergence, which has been observed in various industries, plays an increasingly pivotal role in shaping markets and industry segments. In industries such as telecommunications, information technologies and electronics, formerly distinct sector boundaries have already largely faded (Gambardella and Torrisi 1998; Kodama 1992). More recently, this phenomenon can also be found in the emerging bio-economy or bio-renewables industry as different industry players are seeking to shape and benefit from this emerging sector. What are the implications of industry convergence? The process of convergence leads to “new competitive landscapes” (Bettis and Hitt 1995); actors from different formerly distinct industries are suddenly becoming competitors.

Moreover, value chains are becoming increasingly interlinked and interdependent. Even though agricultural raw materials still are the main starting point for the value chain of many sectors of

the bio-economy, other industries such as energy or chemicals are entering the downstream stages of the value chain. For instance the chemicals industry that has exhausted to a high degree, classical levers for reducing costs and improving efficiency is devoting substantial R&D budget expenditures to bio-renewables in order to build more knowledge and potentially substitute bio-based feedstocks in petrochemical pathways (Lenk et al. 2007).

What are the consequences of the increasing interdependency of formerly distinct value chains for R&D and innovation? Cross-scientific research is increasingly enabling the chemical sector to utilize the technological developments in its neighboring scientific disciplines (e.g. biotechnology and agriculture). Strategic alliances between food and cosmetics and/or pharmaceutical companies are increasing in the emerging subsectors of the bio-economy. These are targeting foods with health benefitting characteristics leading to the production of Nutraceuticals and Functional Foods (NFF: a combination of nutrition and pharmaceuticals) (Bröring et al. 2006; Bröring 2005). But also the energy production sector is increasingly investing in the field of not only bio-energy, but also bio-based materials (Lenk et al. 2007). Thus, as Figure 5 depicts there are a number of established and previously distinct industries moving closer together due to fusing technology and resource platforms.

In addition, due to converging technology platforms new supply chains are emerging that are both complex and are with new unfamiliar industry players. This complexity is multiplied because there are sectoral systems of innovation that differ across industries (Malerba 2002). Cross-industry alliances are a precondition to successfully build new value chains in the bio-economy. Hence, innovation may necessitate the development of novel cross-chain relationships as well. For example, as illustrated in Figure 5 nutraceuticals and functional foods presents a new inter-industry segment between food and pharmaceuticals -- thus, a trend of convergence of food manufacturing and pharmaceutical industries. To exemplify the supply chain relationships, an innovative food manufacturer may rely on its ingredient supplier for technological application knowledge (Bröring et al. 2006).

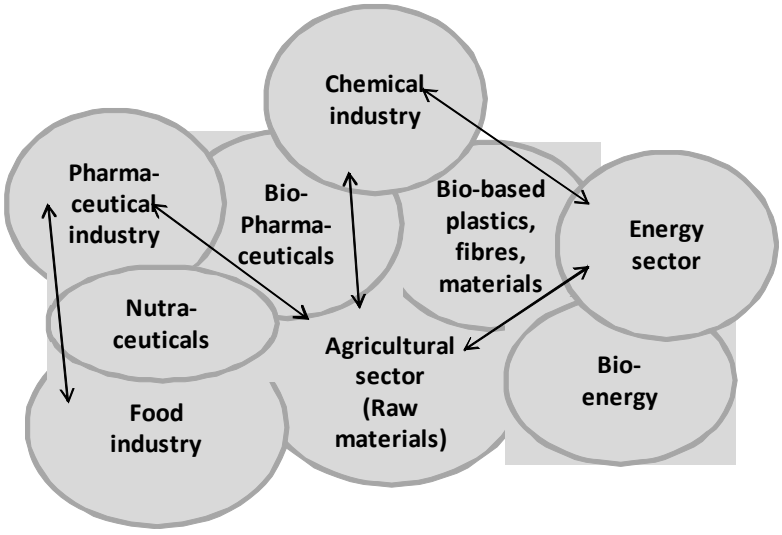

Figure 5. Fields of industry convergence in the bio-economy
Source: Adapted from Bröring (2005)

While these new industry segments present a plethora of opportunities for new fields of business and economic growth, they are often also quite challenging as firms have to employ knowledge and technologies not within their traditional framework of expertise or core businesses -- they frequently lack the knowledge and experiences necessary to cope with the risks and uncertainties of the new field. Naturally, in most cases of convergence, sourcing the essential knowledge and experiences from beyond their own factory gate is necessary and key to successful innovation management.

At this point one may anticipate a competition for the resources and capabilities to benefit from the bio-economy. But which of the detailed industries will be most successful to build a competitive advantage in these emerging fields? As the patent analyses given in Figure 1 shows, there are many ongoing activities in the area of establishing new bioprocesses, e.g. bioconversion and bio-production including fermentation – but it is not yet clear which industry player (agro, vs. chemicals, vs. energy) will be most successful in the newly emerging industry sector.

To conclude, the issue of industry convergence poses many research questions:

1) How will the development of the bio-economy and renewable products incent the development/reconfiguration of supply chains in the agricultural, industrial and pharmaceutical industries?
2) What types of renewable innovations have the most potential to disrupt the agricultural, industrial and pharmaceutical industries and result in industry convergence?
3) How will risk motivations incent collaboration and joint ventures between firms in the agricultural, industrial and pharmaceutical industries to commercialize renewable innovations?
4) What is the role of open innovation in the process of convergence in the emerging bio-economy?
5) To what extent and by what measures (e.g. patent analysis) can companies anticipate trends of either technology or market convergence in the bio-economy?
6) What is the role of path dependencies for the development of successful innovation strategies and industry convergence in the bio-economy?
7) What are the challenges for cross-industry collaborations since different industry players are following different approaches as regards innovation and R&D?

Final Comment

The agricultural sector is increasingly becoming a source of raw materials for industries or sectors beyond the traditional fiber and nutrition industries. The different applications of agricultural resources leverages the importance of this sector becoming an input supplier for at least four different industries: (1) food and nutrition products, (2) energy, (3) industrial chemical products (including synthetic fibers, plastics, wall coverings, and other products that have historically been derived from the petrochemical industry), and (4) health and pharmaceutical products. The development of the bio-economy and the disruptive innovation that supports it creates three interconnected dilemmas: (1) the competing goals dilemma, (2) the incumbent vs. new entrant competition dilemma, and (3) the industry boundaries dilemma. These three dilemmas frame a number of important research questions, which can only be resolved in a close

interdisciplinary collaboration of technology and innovation management scholars, economists and biological/natural scientists in order to provide the necessary insight into new technology developments in the bio-economy. This paper discusses these dilemmas and identifies a number of research questions related to each of the three dilemmas that will provide a more complete understanding of the innovation and adoption challenges and opportunities in the bio-economy sector.

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Innovativeness and Innovation: Implications for the Renewable Materials Supply Chain

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Abstract

This paper leverages the current literature on innovativeness to provide a framework that summarizes the characteristics of firms that exhibit a culture of innovativeness. This framework can assist firms entering the renewable raw materials market in identifying gaps in their internal capacity for innovation as well as the necessary characteristics of supply chain partners that will match their own innovativeness—a necessary albeit insufficient requisite for success in the development of renewable raw materials supply chains.

Keywords: innovativeness, innovation, supply chain management, triple bottom line, corporate social responsibility

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Introduction

The agricultural sector is significantly redefining its traditional markets to include not only food and fiber but also energy, industrial products, and pharmaceutical/health products (Boehlje and Bröring 2011). Indeed, there are indicators that attractive markets may exist for agriculture beyond its traditional markets. For example, Sporleder and Goldsmith (2011) point out that demand for non-biodegradable plant-based plastics is forecasted to increase from just 23,000 metric tons in 2008 to nearly 600,000 metric tons in 2013, replacing a portion of the more traditional petroleum based plastics. As the utilization of renewable raw materials from agriculture is adopted by industries beyond food and fiber, such as the petroleum based and pharmaceutical industries, successful agribusiness companies will likely be characterized by their capacity to provide innovative products and processes both within their firm and across the supply chain of these two industries. These concepts are highlighted in the short description of Syngenta, a multinational agribusiness company, which is pursuing innovative efforts in the sugar industry in an effort to capitalize on society's demand for a renewable fuel supply. Innovation is especially important to firms engaged in emerging markets, like the renewable raw materials markets that agriculture is increasingly engaging in, where change is frequent and the rules and traditions of conducting business are dynamic (Bröring et al. 2006). In the context of renewable markets, innovation must not only produce economically profitable products, but these new products and processes must also meet environmental and social performance metrics increasingly associated with corporate social responsibility (CSR) (Andersson et al. 2005; Amaeshi et al. 2007; Bröring 2009). Moreover, these sustainable innovations will need to extend beyond one individual firm to a connected supply chain of firms needing to innovate together to reach a new market's potential. For example, Sporleder and Goldsmith (2011) point out that supply chain partners in the renewable raw materials chain will likely have to invest in complementary assets for the chain as whole to reach its full potential. These linked investment decisions will require supply chain partners to have a high level of trust, which is more likely to occur among firms with similar goals and cultures.

The linkage between the innovative firm and its supply chain is even more important when one considers that a sustainable supply chain is one of the few remaining ways for a company to achieve a sustainable competitive advantage (SCA) (Markley and Davis 2007).[1] Today's public increasingly demands a sustainable supply chain and this new market is increasing the onus on individual firms to make sure that other firms in the supply chain adopt appropriate management practices if they wish to protect their brands (Amaeshi et al. 2007). To be turned into a SCA, research by Preuss (2005) suggests that firms must work with their supply chain partners, both upstream and down, to deliver a truly sustainable product. Thus, for a firm to be successful in the renewable raw materials market, they must have a culture that puts an emphasis on sustainability and attracts supply chain partners with similar innovative cultures.

[1] In Porter's (1984) seminal book, the phrase sustainable competitive advantage was defined as "the fundamental basis of above-average performance in the long run" (p. 11). Given the very nature of this paper, the word sustainable is occasionally used also in reference to the more modern concepts of environmental, social and economic sustainability. The double use of this term is unavoidable, but care has been taken to remove as much confusion as possible.

While the need for innovation is well recognized, agreement quickly erodes when managers and academics discuss how innovation arises. The myriad of innovation types (Damanpour and Wischnevsky 2006; Armbruster et al. 2008) likely adds to the lack of consensus. For example, one firm in a supply chain may focus on producing innovative products that require intentional and substantial investments in research and development efforts focused on the creation of something new, while other firms in the supply chain focus on innovative business models (e.g., eBay's introduction of online auctions). Still other firms in the supply chain might look to innovate through adoption of the new products developed by innovative product firms. Even though these types of innovations differ and each firm in the supply chain might choose to pursue different forms of innovation, all managers face the question of how they manage for innovation. When managers consistently push their employees to focus on innovation and the creation of something new, they instill a culture in their organization that is centered on recognizing and then capitalizing on opportunities. This type of corporate culture is known as innovativeness, a culture where all employees and functions of the organization seek to innovate. If a culture of innovativeness is going to provide benefits for a renewable raw material supply chain with all of the required metrics of sustainability, then firms all along the renewable supply chain must share a similar culture. The challenge management teams must figure out is how to develop a culture of innovativeness within their firm, and how they ensure their partners in the global renewable supply chain seek to match their innovativeness culture in order to deliver on the common value of sustainability. In the context of renewable markets, solutions to these challenges need to result in economic, social and environmental sustainability, leading to a better triple-bottom line for all supply chain participants (Andersson et al. 2005; Amaeshi et al. 2007; Bröring 2009).

This paper leverages the current literature on innovativeness to provide a framework that summarizes the characteristics of firms that exhibit a culture of innovativeness. This framework can assist firms entering the renewable raw materials market in identifying gaps in their internal capacity for innovation as well as the necessary characteristics of supply chain partners that will match their own innovativeness, a necessary albeit insufficient requisite for success in the development of renewable raw materials supply chains.

Innovativeness Framework

The key tenet of this paper is that until each supply chain member is investing in and implementing an innovativeness culture focused on delivering sustainable products and services through renewable raw materials, the supply chain itself will struggle to be sustainable. The framework in Figure 1 shows how each firm in the supply chain has a set of distinctive characteristics, those that give them a competitive advantage in the marketplace in recognizing opportunities. These characteristics culminate in the firm's strategic culture. The literature suggests that the specific characteristics of a firm associated with strategic intent, organizational structure, and processes can lead to a culture of innovativeness. The discussion that follows explores the characteristics of firms that exhibit a culture of innovativeness.

The literature in business, economics, marketing and psychology fields bear witness to various schools of thought on the topics of innovation typology and managerial intent. Specifically, Fallah and Lechler (2008) identify five key dimensions for managing innovation: (1) innovation,

(2) organization, (3) innovation processes, (4) resource allocation, and (5) innovation culture. They note that these five dimensions are interrelated and understanding these relationships is crucial for a firm seeking to achieve optimal performance from their global innovation strategy. Our focus is on a deeper understanding of the characteristics of an innovation culture.

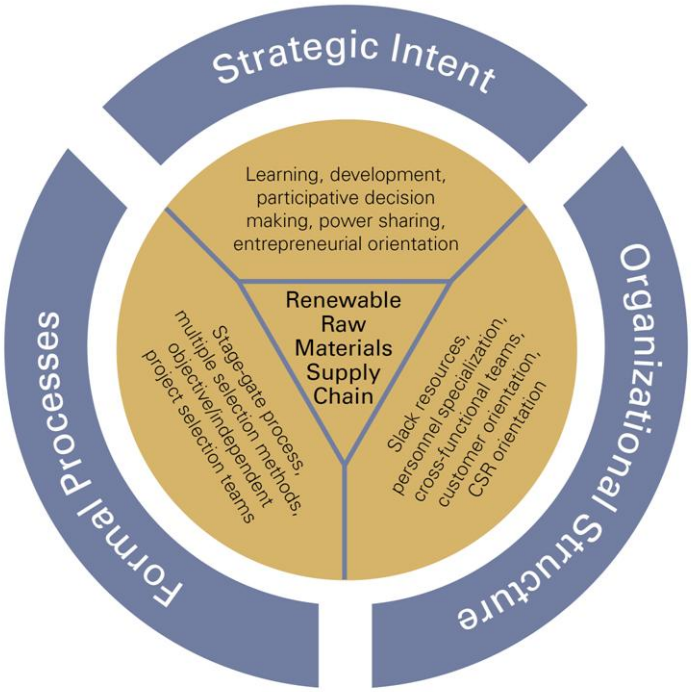

Figure 1. Sustainable Renewable Raw Materials Supply Chain Innovativeness Framework

This paper adopts Hurley and Hult's (1998) definition of innovativeness: "the notion of openness to new ideas as an aspect of a firm's culture…a measure of the organization's orientation toward innovation." Innovativeness deals with the culture and thinking of the firm; innovation is an outcome sought. Given that innovativeness has a direct relationship to innovation, it is expected that firms pursuing innovation as a strategy would pursue innovativeness as part of their culture, striving to make it a core competency. Innovativeness, according to Hurley and Hult (1998), is obtained through "cultures that emphasize learning, development, and participative decision making." And, while it is true that innovativeness is not a sufficient condition to yield innovation, it typically serves as a catalyst for innovations to occur because it creates a firm's internal environment that fosters the exploration of customer information or new operational processes (e.g., the development of new relationship structures with supply chain partners) in ways that fulfill current unmet and/or anticipated future needs.

While conceptually innovativeness makes sense, finding a typology that sufficiently captures innovativeness is a challenge. Many recent studies have concentrated on how firms innovate, and have discovered a positive connection between innovation processes and firm performance (Klomp and Van Leeuwen 2001; Vincent et al. 2004). Despite efforts to explore innovativeness,

its structure and dimensions at the firm level, let alone across a supply chain, are still being developed. In addition, numerous scales for measuring a firm's innovativeness are offered across the literature. As a result, there is no commonly accepted typology and measurement of innovativeness.

Based on Hurley and Hult (1998) and the findings of Klomp and Van Leeuwen (2001) and Vincent et al. (2004), we argue there are three critical dimensions to a culture of innovation: strategic intent, organizational culture, and formal processes. Building a culture of innovativeness through sustained strategic emphasis is an antecedent to consistently delivering innovation. In addition, how the firm implements its innovative culture through its organizational structure and formal processes has a great impact on its success. It is important to note that the degree of flexibility in what is practiced is limited in the strategic emphasis stage but expands with choices a firm has when implementing the strategic emphasis. The innovativeness framework suggested here (presented in Figure 1) draws on the relationship between strategic emphasis, organizational structure and formal processes. Each dimension of innovativeness is explored below to identify specific characteristics of firms that exhibit an innovative culture.

Strategic Emphasis

As pointed out by Subramanian and Nilakanta (1996), "the adoption of innovations by an organization is a consequence of strategic initiatives proactively pursued by decision makers in the organization." They also argue that the adoption of innovativeness as part of a company's culture is a response to the external environment of the firm. Hurley and Hult (1998) argue innovativeness is part of the organizational culture and that this culture embraces the notion of openness to new ideas as an aspect of a firm's culture. Thus, if the top management of a firm makes the decision to compete on innovation, they are making a decision about the culture they want to create and support (Fortuin et al. 2007). Furthermore, the culture of innovativeness is a measure of the organization's orientation toward innovation (Hurley and Hult 1998). If a firm wants to be successful at competing in an innovative industry, it would help its cause by being committed to innovativeness as an organizational culture.

Damanpour (1991) finds cultural items like management's attitude toward change to be positively related to innovation as well. Other research has determined that the mindset of the organization (i.e. their orientation), has a significant role in innovation. In particular, Slater and Narver (1993, 1994, and 1995) note that it is important for firms to have an entrepreneurial mindset, a feat more difficult as companies grow in size. Large, successful firms particularly run the risk of developing established routines and patterns that as a rule have managers following the mantra, "If it's not broke, don't fix it." This entrenchment occurs because these firms face the dilemma of already being committed to the production of a product or service, while the entrepreneurial firms have a greater incentive to replace the status quo. Entrenchment runs counterintuitive to Schumpeter's creative destruction tenant, which revolves around firms in a capitalistic economy making dramatic improvements/innovations in products and/or process that leapfrog the competition in order to achieve monopoly type profits (Schumpeter 1942). Consequently, agribusinesses wanting to break into the renewable materials supply chain must encourage their employees and managers to seek new opportunities, products, services, and ventures that are in line with the company's competencies, even if these projects are risky and

bold. Instead of settling for the status quo, it is crucial that managers continuously seek to improve processes and products. By having an entrepreneurial orientation, a firm improves their innovativeness.

A culture of innovativeness requires that all functional areas – like sales, manufacturing and operations, distribution, information technology, customer relationship management, and human resources – be open and committed to the idea that innovativeness helps to keep the firm's brand relevant to their customers (Gerzema and Lebar 2009). This openness to innovation happens by managing in such a way that the firm's attention is on recognizing the need for new ideas and action in the organization (Van de Ven 1986). To establish this culture, firms must emphasize learning, development, participative decision-making, power sharing, support and collaboration (Hurley and Hult 1998). As Zaltman et al. (1973) note, without this initiation toward innovativeness as part of the culture, it will be difficult for an organization to have success with innovation. Thus, this organizational innovativeness can be conceptualized as an aspect of organizational culture that precedes innovation (Hurley and Hult 1998).

In addition, this also requires that all functional areas be open to the idea of corporate social responsibility (CSR). Zadek (2004) notes that CSR has to be integrated into a company's business model (i.e. with its functional areas). In the long-run, the integration of CSR into the functional areas will help a company begin the process of having an innovativeness culture that is grounded in CSR. Thus, for companies focused on renewable products to be truly innovative, their strategic emphasis will have to have a CSR orientation (Ansett 2007). The ultimate goal is for the company, along with all of its collaborators in the supply chain, to reach what Zadek (2004) calls the "Civil Stage" – i.e. everyone along the chain is employing responsible practices in the products and processes they produce. Before the supply chain reaches the "Civil Stage," a firm must reach the "Strategic Stage" – i.e. it has realized that utilizing responsible business practices in the products they produce and the processes they use to produce them gives their company a competitive edge.

Organizational Structure and Characteristics

Hurley and Hult (1998) indicate that innovativeness of the firm's culture acts in concert with various structural properties of the company to affect the innovative capacity of the organization. Therefore, in addition to establishing a culture of innovativeness, the firm must also pay attention to organizational functions. This focus is especially true with increasing globalization and speed of change, elevating the necessity of a structure that is conducive to innovation by firms if they wish to stay competitive (Damanpour 1991; Fallah and Lechler 2008). Companies must have the willingness to innovate, as well as the capacity and resources to be responsive to the market. If they fail to have the necessary structure in place, they will be unable to turn their will into action, and as a result forego potential future revenue streams. Fortuin et al. (2007) go even further by purporting that if the organizational structure is not conducive for encouraging and enhancing innovation, then the structure will impede successful innovations being brought to the market.

Given the importance and sustained prominence in management, the organizational characteristics that influence innovation have been the subject of numerous studies in varying disciplines (Kimberly and Evanisko 1981; Damanpour 1991; Germain 1996; Subramanian and

Nilakanta 1996; Nystrom et al. 2002; Fallah and Lechler 2008). A distinct set of attributes specific to the organization of a firm have been identified to be more prevalent in innovative firms versus non-innovative firms (Subramanian and Nilakanta 1996). These include the degree to which decision-making is centralized, the degree of formalization in the firm, how much resource slack exists, and the degree of personnel specialization (Damanpour 1991; Subramanian and Nilakanta 1996). Comparing the findings of Damanpour (1991) and Subramanian and Nilakanta (1996) highlight the fact that these are not a one-size-fits-all type of model. For example, Subramanian and Nilakanta (1996) find that formalization and size of a firm lead to the adoption of administrative innovation, while Damanpour (1991) finds that formalization is negatively related to the creation of innovation. However, there is common ground between these studies. Both find slack resources and personnel specialization to be positively correlated with innovation.

With respect to slack resources, Subramanian and Nilakanta (1996) and Damanpour (1991) find that firms who have extra resources that can be dedicated to ideas and opportunities found better success with innovation. Wernefelt (1984) echoed this concept when observing that those firms that derive their competitive advantage from innovativeness do so by funneling resources into the development of new products, processes, and/or services. This does not mean the most innovative firms are the ones who have the largest research budgets, instead; it is those firms that allocate their funds in a method that maximizes earnings. This can only be accomplished if a firm has knowledge of all their competitors' likely responses to any actions that they take and of any first-mover advantages that could be captured by if being the first to market (especially if the innovation is patentable).

Personnel specialization (human capital) refers to the existence of employees within the organization that have particular skills in one or more functional areas of the firm (Subramanian and Nilakanta 1996). While personnel specialization has much to do with education – i.e. firms involved in the renewable biofuels supply chain would need to hire petroleum and agricultural engineers— and having codified operations manuals and procedures (explicit knowledge). The focus also lies with the tacit knowledge that is embedded in the minds of a firm's employee. Tacit knowledge is not easily codified into operations manuals like explicit knowledge. Instead, it is developed over time through experience, training, organizational learning, and education. Thus, unlike explicit knowledge, tacit knowledge is not easily transferable from one employee to the next. However, tacit knowledge when combined with explicit knowledge allows employees to generate ideas that can be turned into products, processes, and/or services with a higher probability of successful commercialization because employees have the ability to understand how these innovations must address societal needs. Moreover, since tacit knowledge is not easily transferable, it requires companies to be diligent in the hiring of new personnel – i.e. businesses must constantly be searching for potential employees who have shown the ability to commercialize their innovations. By focusing on personnel specialization, firms ensure that they have the necessary components in place to be an innovative firm.

A firm whose organizational structure is oriented towards gaining customer insights may greatly improve their chances of success in innovating (Baker and Sinkual 2005; Gourville 2005; Batterink et al. 2006; Grinstein 2008). A customer orientation is driven by the need to have a detailed understanding of what task customers are trying to accomplish, trends in their customer needs, alternative solutions to meet these and latent customer needs. Consequently, customer orientation allows firms to capitalize on both incremental (customer-lead) and radical (lead-the-customer) innovation practices (Baker and Sinkual 2005; Grinstein 2008). If this market knowledge provides new insight, then the company can reshape their effort to help their customers accomplish these tasks more conveniently and efficiently, and/or at a lower cost than before (Slater and Narver 1995). Thus, customer orientation based on learning should aid innovation that improves existing products/services (customer-led/incremental innovation) and/or creates new products/services (lead-the-customer/radical innovation) that improve the competitiveness of the business's customers.

Formal Processes to Manage Innovativeness

Beyond strategic intent and organizational structure, a firm must establish a set of processes that encourage innovativeness and increase the firm's success in commercializing innovations. It is one thing to create the ideology in a firm to seek out creation with every aspect of the company. It is another thing to manage that creation mill in order to maximize profits and minimize risks. Although many ideas fit under this umbrella, we focus on two general managerial objectives: minimizing exposure and allocating resources.

Innovation is risky due to the associated costs and the uncertainty of payoff. Take, for example, new products. They have a failure rate that can be as high as 90% for some product categories (Gourville 2005). This high failure rate is why it is important to manage the innovation effort aggressively to minimize the

Innovativeness in the Biofuels Channel

In 2011, Syngenta Corporation is planning to introduce its innovative new sugar cane product called Plene to the market. Plene is likely to redefine the way sugarcane is planted and ultimately reshape the entire sugar and biofuels industry. Rather than the traditional manual planting system that requires significant labor, Syngenta's new process creates a seed-like product from the sugar cane by precisely cutting it, by machine, into 4-inch pieces that are each capable of growing a new sugar cane plant. These 4-inch pieces can be coated with treatments to protect the seedling from pests and can be sorted and selected for particular characteristics allowing for more efficient improvements in genetics, traits, etc…

Plene was discovered by Syngenta employees that were focusing on the needs of Syngenta's key customers, the sugar processors that had vertically integrated into cane production. The processors had expressed a need to improve the cost of producing their raw materials, reduce the impact of the harsh environment for planting sugarcane for its employees, and allow more sustainable ways to grow the sugar business, particularly as it related to the traditional planting activities for sugar cane.

risks and maximize potential profit. Firms successful at producing serial innovations, for example, have learned how to pull a project before it incurs a significant monetary loss. In other words, successful firms have learned how to fail cheaply (Fortuin et al. 2007). This is in line with Thomke (2003), who purports that failing often is positive if it comes early in the life cycle of the innovation. Therefore, firms should have processes that strategically determine if a company should continue forward with an innovation or if they should redirect or abandon unsuccessful projects at the earliest possible stage of development (Fortuin et al. 2007).

There are numerous processes a firm might adopt to manage this fail-cheap concept. The overriding strategy is for firms to shut down those product and/or process innovations destined for failure as early as possible. Davila et al. (2006) suggest that innovative firms follow one of two strategies for their innovations: 1) The ‘‘Play to Win’’ strategy, where innovation will create the firm’s future core competency; and 2) The “Play Not to Lose’’ strategy, where the company uses innovation to maintain its current competitive advantage. Thus, the culling of those products, processes, or services that are not going to generate profitable growth for the business through the creation or maintenance of core competencies means more resources can be allocated to innovations that can accomplish this task.

Once those products, processes, or services that do not contribute to the core objectives of the firm have been culled from the innovation list, firms need to establish objective criteria for systematically assessing the remaining potential innovations and remove the dead weight from the innovation pipeline. This process is often known as a stage-gate model (Cooper 1985 and 1992). An example metric for judging whether an innovation should continue to receive funding is projected net present value (NPV), which is a staple calculation in capital budgeting analysis. In recent years, software packages, such as @Risk and Crystal Ball, have allowed for the development of complex NPV models that are able to incorporate risk associated with variables that are key to the success of an

Innovativeness in the Biofuels Channel-*Continued*

Because of Syngenta’s strategic emphasis on innovation as their core capability and their pervasive culture of innovation, senior management allowed the team that discovered the sugar processors’ need to pursue alternative solutions over an extended period of time. Syngenta’s organizational structure allows teams to work autonomously to find solutions for their local markets and rewards teams for their ingenuity. In addition, Syngenta has adopted a set of processes and procedures that allow teams, like the Plene team, to access resources and expertise both within the company and outside of the company to assist in the discovery process. Ultimately, this innovativeness culture led to the manufacturing process that creates the Plene product.

However, Plene had no currently available means of reaching the market (there was no machine to plant the new product). Therefore, Syngenta had to seek a supply chain partner to develop a mechanism for planting Plene. They teamed up with John Deere to produce the planter because of John Deere’s record of accomplishment of an innovative culture and John Deere’s desire to enter the sugar cane market. In addition, the true value of Plene to the marketplace will be its ability to deliver improved productivity in terms of genetics, traits, and crop protection.

innovation (costs, competitive response, sales, cannibalization, etc.). In the past four decades, numerous project selection methods have been proposed to help organizations make better decisions regarding innovation. These selection methods include informal methods (Johnston 1988; Whitney 2007), graphical analyses (McGrath and MacMillan 2000; Australian National Audit Office 2003; Day 2007; Huurinainen 2007; Terwiesch and Ulrich 2008), structured assessments (Meade and Presley 2002; Mohanty et al. 2005), economic models (Faulkner 1996; Luehrman 1997; Cooper et al. 2001) and complex models (Graves et al. 2000; Ringuest and Graves 2005). No single selection method presents overwhelming advantages. They all have drawbacks and are actually extremely complementary of each other, leading many such as Cooper et al. (2001) to find that the best innovators use numerous selection methods.

Even with processes in place to act as gates or filters that determine if a project is continued, additional processes are needed to prioritize projects and thus determine allocation of monetary and other resources. Davila et al. (2006) offers, as one example, the idea of a firm setting up their own venture capital system, or granting agency, that distributes funds from the company's innovation budget. For example, firms looking to participate in the renewable fuels supply chain using cellulosic materials might have employees constantly searching for companies that have innovative products and/or processes related to cellulosic materials. The granting agency would be responsible for screening the submitted innovation ideas to make sure they fit with the firm's strategy, perhaps using some combination of the previously mentioned selection methods. In addition, the granting agency would be responsible for ensuring that the company maintained a queued portfolio of innovations to maintain a proper influence in the renewable materials supply chain (Davila et al. 2006).

Davila et al. (2006) also note that a granting type agency is critically important for encouraging radical innovations. Because these types of innovations do not generate short-term profitability and are extremely risky, they run counterintuitive to the goals of managers, whose incentive is to avoid risks and create profits now. By

Innovativeness in the Biofuels Channel-*Continued*

Some of these capabilities are contained within Syngenta, but the expertise in genetics of sugar cane is not. Syngenta has now established research agreements with leading sugar cane genetics companies in Brazil to enhance further the value of Plene to the marketplace. All of these efforts are focused on the renewable raw ingredients marketplace.

While this short description provides only anecdotal evidence of the characteristics of a renewable raw ingredients supply chain that is built on innovation and sustainability, it is illustrative of the types of across supply chain innovations that will be needed to capture the potential of the agricultural industries expansion beyond the traditional food and fiber markets. It is also illustrative of the need to have supply chain partners that have similar cultures and motives. Sporleder and Goldsmith (2010) point out that innovation and supply chains are inextricably linked by the need for complementary assets. In the example, this manifests itself in Syngenta's need for a partner in developing the planting equipment needed and collaborates in enhancing the genetic productivity of sugar cane. All of these partners need to make investments in complementary assets for the innovative new supply chain to come to fruition. This investment in complementary assets does not happen unless the partners all share common elements in their culture to innovate and create markets.

removing the decision from internal management, employees are free to innovate without worrying about repercussions from their immediate supervisors if their innovation fails. Furthermore, these potential innovations, especially the radical ones, will likely generate new competitive advantages, which results in long-term profitability. Without an objective implementation system like the one described here, the incentive for innovativeness by the company's employees can erode over time.

Without a supportive organizational structure and formal processes, firms can fall victim to innovation entrapment (McGrath and MacMillan 2000). Innovation entrapment occurs for a variety of reasons, but chief among them are: the need for people involved with the innovation to defend and confirm their initial decisions and judgment; the desirability of avoiding the waste of sunk costs; the possibility of providing an opportunity for the project to succeed; the treatment of negative feedback as a learning experience (a cue to revise inputs rather than cancel them); and the social costs and benefits, relating to image and reputation, that are at risk if a project is terminated (Proctor 1993). By having a formal and objective criterion and process for evaluating these opportunities, companies are able to lessen the effects of innovation entrapment and increase the incentive for innovation among their employees.

Implications for the Global Renewable Materials Supply Chain

What does the innovativeness framework suggest about a supply chain for renewable raw materials? First, given the global nature and network of most renewable materials supply chains, many of the chain partners are not owned or operated by one company, making diffusion of a common culture of innovativeness difficult. Secondly, many of the chain partners often operate in different countries and the culture of these countries may not place the same emphasis on innovation in a manner that is consistent with CSR. As suggested by Boehlje and Bröring (2011), CSR presents competing dilemmas for firms, especially for firms that operate in countries whose citizens value environmental and social concerns, as they attempt to balance the trade-off between profitability and sustainability. Thus, the formation of a sustainable global renewable materials supply chain whose innovations seek to address the triple bottom line will be difficult. There exists the potential for tremendous future economic growth in bio-renewables as consumers become increasingly concerned with the environmental footprint of companies (Boehlje and Bröring 2011).

To accomplish the aforementioned task, the global renewable materials supply chain will need to establish an efficient method for effective knowledge management transfer. In other words, firms, through knowledge sharing and open innovation, will provide information to chain partners on the processes they use for creating a culture that focuses on delivering sustainable solutions to the problems in the marketplace (McAfee et al. 2002; Peterson 2002; Wadhwa and Saxena 2007). It would seem that the global renewable materials supply chain would be eager to implement such initiatives, especially as they relate to innovation driven by sustainability since the failure to understand the importance of the triple bottom line by any one firm in the chain can lead to significant disruption in the performance for the whole supply chain (Salem, 2009). Zadek (2004) notes that this task is daunting, given the complexity of the issues as well as stakeholders' volatile and sometimes under-informed expectations about businesses' capacities and responsibilities to address societal problems, which would make the need for a method for

effective knowledge management transfer all the more crucial. For example, Solér et al. (2010) find that in supply chains, those firms who are closest to the end-consumer have a better understanding of perceived environmental consumer demand. Recently, retailers like TESCO and Wal-Mart have reacted to this consumer demand for environmental information and have begun tracking the carbon dioxide (CO2) production associated with the products they sell in their stores (Boehlje and Bröring 2011). In this situation, Wal-Mart and TESCO, the firms closest to the end-consumer, must relay this information back through the supply chain to the other chain partners about the demand for products and/or services that comply with the end-consumer's environmental needs. The visibility of these preferences across the renewable materials supply chain would encourage investments in complementary assets and innovative projects, which should improve the profitability of firms across the supply chain and capture first-mover advantages (Jansen and Vellema 2004; Esty and Winston 2006; Sporleder and Goldsmith 2011). Thus, it is critical that firms all along the supply chain understand that by addressing sustainability issues, they will be able to create value.

Ansett (2007) goes on to note that individual companies cannot solve these societal issues alone, and that it will take companies along the supply chain working together, i.e. by combining and sharing their respective competencies, expertise, knowledge, and resources, to develop solutions. This will require the renewable materials supply chain to host multi-stakeholder meetings that allow for the development of new relationships and learning from peer companies, trade unions, non-government organizations, etc., to find solutions for creating a supply chain that meets the needs of a social and value-generating civil society, while at the same time creating profit for the supply chain members (Peterson 2002; Ansett 2007). Boehlje and Bröring (2011) indicate that the participation in a sustainable supply chain will require that all firms understand the opportunities and challenges a sustainable bioeconomy creates for them and that the only way to capitalize on these opportunities and minimize the challenges is to pursue innovation that is driven with technical efficiency and social legitimacy. These meetings and initiatives will require active participation from all chain partners, and likely be driven by leading multinational agribusiness companies.

Agricultural firms involved in new markets, such as the renewable fuels market, should seek to align themselves with partners who value CSR and seek innovative solutions that credibly respond to society's changing awareness of particular social issues (Zadek 2004). For example, Salem (2009) suggests that chain partners should seek to employ Purchasing Social Responsibility (PSR) -- i.e. an agricultural firm would seek to purchase inputs and sell outputs to partners that are socially responsible, and by doing so would create competitive advantages for both the firm and its chain partners. In addition, research shows that chain partners with shared values (in this case, a commitment to innovations that address the triple bottom line) have positive influence on both commitment and trust between chain partners (McAfee et al. 2002). These concepts can be readily demonstrated by returning to the renewable fuels example, where chain partners are likely to include raw material producers (likely farmers), handlers (such as grain elevators), and/or processors of raw materials to be used as replacements for the nonrenewable products. Due to the newness of this market for these players, the supply chain partners will have to innovate the products they produce, the processes used for producing and handling them, as well as the market mechanisms used to determine the sharing of profits and risk among supply chain partners. In the U.S., for example, much of the current research suggests

that the most efficient way to produce cellulosic fuels is likely to come from crops such as Miscanthus. However, developing a supply chain for cellulosic fuels will require innovation from farmers in terms of the type of crops they produce, equipment manufacturers to develop mechanical means for harvesting the crop, and logistics companies to ship the material from the farms to the cellulosic ethanol plants. Relative to current markets, a market for Miscanthus to replace crude oil as a raw material in the production of liquid energy would be a significant innovative undertaking. As such, our innovativeness model would suggest that individual firms that are more similar with respect to innovativeness as a culture will be more likely to work together given that there is less flexibility with this set of decisions. If all of the chain partners are committed to CSR and they engage in knowledge sharing when innovating the products and process used to meet the demands of this new market, the development of the renewable fuels will be more efficient and effective.

Conclusion and Summary

Firms in a supply chain focused on the market for renewable raw materials, a new and dynamic market that is marked with dynamism and emerging rules will need a strategic emphasis on innovativeness within firms and across the supply chain to be successful and sustainable. The framework presented in this paper summarizes the characteristics of firms that pursue a culture of innovativeness. Regardless of whether a company is trying to manage production innovation, business model innovation, and/or adoption innovation, the company must first have a culture of innovativeness if it hopes to realize success repetitively. Even if the structure and implementation of innovation are different for each of the businesses involved in the supply chain, they will share common characteristics about the value of innovation as a part of their strategy, the necessary organizational structures, and formal processes necessary to deliver the innovative solutions that are aligned with CSR and the triple bottom line that underlies the movement to renewable raw materials.

In the nascent renewable raw materials supply chain, individual companies will be challenged to create a shared value among all supply chain partners of what innovations will be necessary in the production, handling and processing of the raw materials, and the appropriate sharing of risk and rewards to incent each supply chain partner to participate fully. In particular, long-term success for the renewable materials supply chain will require that each player understands the tasks users of renewable materials are trying to accomplish and a commitment to strengthening the perceived value of renewable raw materials relative to non-renewable raw materials through innovations in products, processes, and business models. The most likely path to success will be a global renewable supply chain populated by firms with a similar culture of innovativeness dedicated to finding sustainable solutions to societal problems.

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Supply Chains for Emerging Renewable Polymers: Analysis of Interactive Sectors and Complementary Assets

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Abstract

Revitalized interest in biobased or renewable ingredients in manufacturing has emerged in recent years due to rising real petroleum prices, concerns regarding environmental impacts of crude oil, and national security issues related to petroleum resources. This research analyzes the complexities of renewable supply chains. In particular, polymers manufactured from renewable feedstocks will augment various industrial markets, such as plant material used as a renewable ingredient in paint manufacture, partially substituting for crude oil derivative ingredients. The analysis defines polymer industrial supply chains and estimates the market opportunity for renewable polymers. A section of the analysis is devoted to complementary assets as a new product development bridge to supply chain issues.

Keywords: supply chains, renewables, economics of biobased industrial markets, complementary assets

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Emerging Biobased Industrial Markets

For several decades, plastics derived from fossil fuels have grown at a faster rate than any other group of bulk materials (Crank et al. 2005; Weizer 2006). Although the first plastics were developed from polymers derived from renewable materials (Stevens 2002), petroleum-based polymers are cheaper and consequently dominate industrial markets. Although most polymer markets are expanding, growth in specific polymer products is expected to be quite variable in the future, ranging from a negative 8.9% annually to an increase of 71% over the next several years, Table 1.

Table 1. Estimated growth in the polymer industry by product, various authors

Product	Growth Rate	Reference
Co-polyester	7.31% CAGR over 2006-2013 to reach 28 million by 2013	GIA
Starch	6.44% CAGR over 2006-2013 to reach 17 million by 2013	GIA
Starch	11.9% GAGR from 2005-2010 starting with 8 tonnes in 2005	Platt
Others (Lignin, soybean, water-soluble, polycaprolactone)	5.62% CAGR over 2006-2013 to reach 3 million by 2013	GIA
PLA	11.06% CAGR over 2006-2013 starting with 18 million pounds in 2006	GIA
PLA	18.7% CAGR over 2005-2010 starting with 9.6 tonnes in 2005	Platt
PLA	71% CAGR from 2005-2010 starting with 0.1 tonnes in 2005	Platt
Synthetics	18.4% CAGR from 2005-2010 starting with 3.6 tonnes in 2005	Platt
Chlorine	-8.9% drop in output in 2008 from 2007	Stork
Sulfuric Acid	-1.8% drop in 2008 from 2007	Stork
Ammonia	-6.9% drop in 2008 from 2007	Stork
Propylene	-7.7% decline in output in 2008 from 2007	Stork
Ethylene	-8.4% drop in output in 2008 from 2007	Stork

Interest in biobased or renewable polymers has emerged in recent years due to rising real petroleum prices, concerns regarding environmental impacts from crude oil, and national security issues related to petroleum resources (Crank et al. 2005). With advances in technology, renewable polymers are increasingly competitive with petroleum-based polymers in cost and performance and may offer additional advantages. Specifically, renewable polymers are often biodegradable and not toxic to produce (Paster, Pellegrino, and Carole 2003).

The economic prospects for promoting renewable polymers are great. The market size for biodegradable polymers generated from renewable natural sources, such as plant and animal biomass, is growing significantly (GIA 2006). With consumption of renewable polymers projected to increase over the next five years by 22 percent annually in the U.S. (Pira 2006), a strategic economic growth opportunity arises from the emerging linkages between the polymer processing sector and the agricultural sector.

There are several key trends driving the demand for renewable polymers. Renewable materials help mitigate the effects of increasing demand for oil and volatility in supply and price (Conway and Duncan 2006; Paster et al. 2003). Rapid technological progress opens many prospective industrial markets based on renewable polymers. Biotechnology and plant breeding continue to produce crops with higher yields and desirable plant composition for bioproduct applications. Further plant improvements, combined with advances in chemistry, engineering, and manufacturing, will further enhance efficiency by lowering relative costs compared with petroleum-based counterparts (Paster et al. 2003; Perlack et al. 2005).

Concomitant with these technological advances is considerable growth in consumer preference for "environmentally-friendly" and sustainable products. As a result, more U.S. businesses, including major retailers such as Walmart, are adopting policies that promote environmental and social responsibility. These policies may require suppliers to innovate by introducing more sustainable materials, especially in product packaging (Brody 2006). Industry members, who produce products marketed by major retailers, are pursuing strategies to integrate the use of renewable materials into their product lines to enhance their market position (FPA 2006).

In the United States, for example, the Federal Biobased Products Preferred Procurement Program (USDA 2007) now requires federal agencies to purchase renewable products (made from plant or animal sources) in designated categories. This opens potentially large markets for vendors of renewable products and services, further stimulating demand. In addition, compliance costs for petroleum-based industries are escalating. New national environmental policies or international agreements (such as the Kyoto Agreement) may internalize costs of pollution and greenhouse gas emissions. Current costs associated with environmental regulation are significant for petroleum-based industries (Deloitte 2005). Another demand factor is rapidly escalating disposal cost for solid waste disposal. Renewable products can be removed from the solid waste stream and composted, rather than deposited in landfills. This effectively reduces costs and provides environmentally favorable alternatives (GIA 2006).

Emerging technologies related to a renewable polymer production from natural sources, such as plants, animals, and microorganisms, have opened substantial economic opportunities and potentials within the chemical, agricultural, and polymer clusters[1] over the past few years. What is currently not known is the magnitude of the economic impact of this emerging renewable polymer cluster and the promise of future market opportunities for renewable polymers. The research reported herein focuses on precise definition of the emerging renewable polymer supply chain. The goal of the applied research is to provide an economic assessment of the market opportunity for renewable polymers.

Polymer Supply Chains

While this analysis focuses on polymers it is important to include petroleum and chemicals in a supply chain context to capture the economic complexity of biobased industrial markets. Polymers represent a significant subset of the chemical industry but the basic chemicals industry supplies the specialized chemicals (such as polymers) to industrial markets (Deloitte 2005).

[1] A business cluster is a geographic concentration of interdependent businesses, suppliers, and associated institutions in a particular economic sector. Clusters enhance the efficiency and/or productivity of all firms within the cluster so they may compete on a more sustainable basis within global markets.

Polymers Defined

Analysis of the chemical and polymer industrial markets requires careful definition. Polymers are substances consisting of molecules with a large molecular mass made of repeating structural units, also called monomers, and connected by covalent chemical bonds (PolymerOhio 2008). There are four classes of polymers: thermoplastics, thermosets, fibers, and films and coatings (Carlsson 2002). Some well-known examples of polymers include plastics, DNA, and proteins (GIA 2006). A polymer consists of various chemical compounds composed of monomers linked together. Some polymers occur naturally while others are artificially created, but polymers are used widely in industrial markets for plastic, glass, concrete, and rubber. Synthetic polymer industrial markets include automobiles, computers, planes, buildings, eyeglasses, and paints. Polymers are the newest addition to the bulk materials arena, having only been used for five to seven decades, but in substantial amounts (Crank et al. 2005). There are several different types of polymers used: polyester, polysaccharides, polyurethanes, and polyamides (Crank et al. 2005). The majority of feedstocks used to make polymers are derived from oil, a finite resource. With volatile prices that the petroleum market experiences, it is important to understand the economic linkages between conventional polymer production and crude oil. Conventional polymer production utilizes crude oil in three ways: as a raw material or feedstock, as a source of energy during polymer manufacturing, and as a fuel source in transporting finished polymer products (Task Force Report 2008).

Renewable Polymers

Renewable polymers (sometimes referred to as 'biopolymers' or 'bioplastics') are substances derived from biomass such as a living plant, animal, or ecosystem, which has the ability to regenerate itself (GIA 2006). Renewable polymers are derived from biomass feedstocks such as corn, potatoes, wheat and soybeans. A biopolymer is a macromolecule formed in a living organism such as starch or proteins. Biobased polymers include co-polyester-based, polylactic acid, starch-based, soybean-based, lignin-based (from wood), water-soluble and polycaprolactone (GIA 2006; Platt 2006), Table 2.

The term "renewable polymers" is used throughout this research as opposed to other popular expressions such as "biopolymers", "bioplastics", and "bioproducts". The majority of feedstocks for plastics today are derived from crude oil. A source is renewable if it can be replenished at a rate comparable or faster than its rate of consumption; thus, it has a sustainable yield (USDOE 2007). Polymers made from biomass' monomers are known as renewable polymers, which can be replaced by growing more biomass and repeating the extraction process.

Biodegradable Complexities

The terms "bioplastics", "biopolymers", and "bioproducts" regularly confuse the public because they tend to associate "bio" with the definition of "biodegradable". These terms can be confusing since petroleum-based polymers can be biodegradable and plant-derived (renewable) polymers can be non-degradable (NNFCC 2007). This is why the term "renewable" more accurately reflects the characteristics of biobased polymers.

Table 2. Most important types of bio-based polymer groups

Bio-based polymer group	Type of polymer	Structure/Production method
Starch polymers	Polysaccharides	Modified natural polymer
Polylactic acid (PLA)	Polyester	Bio-based monomer (lactic acid) by fermentation, followed by polymerization
Other polyesters from bio-based intermediates 1. Polytrimethyleneterphthalate (PTT) 2. Olybutyleneterephthalate (PBT) 3. Polybutylene succinate (PBS)	Polyester	1. Bio-based 1,3-propanediol by fermentation plus petrochemical terephthalic acid (or DMT) 2. Bio-based 1,4-butanediol by fermentation plus petrochemical terephthalic acid 3. Bio-based succinic acid by fermentation plus petrochemical terephthalic acid
Polyhydroxyalkanoates (PHAs)	Polyester	Direct production of polymer by fermentation or in a crop
Polyurethanes (PURs)	Polyurethanes	Bio-based polyol by fermentation or chemical purification plus petrochemical isocyanate
Nylon 1. Nylon 6 2. Nylon 66 3. Nylon 69	Polyamide	1. Bio-based caprolactam by fermentation 2. Bio-based adipic acid by fermentation 3. Bio-based monomer obtained from a conventional chemical transformation from oleic acid via azelaic acid
Cellulose polymers	Polysaccharides	a)Modified natural polymer b)Bacterial cellulose by fermentation

Source: Adapted from Crank et al. (2005)

Biodegradable refers to a material that biodegrades by microorganisms (bacteria, fungi, and algae) found in the environment and will eventually biodegrade completely into carbon dioxide or water. The American Society for Testing and Materials standard ASTM-6400-04 specifies the criteria for biodegradability of plastic, which requires 60% biodegradation within 180 days (ASTM 2008). Compostable polymers are plastics that degrade by biological processes during composting to yield carbon dioxide, water, and inorganic compounds and biomass at a rate consistent with other compostable materials and leave no toxic residue. Polymers can be either biodegradable or not. In addition, biodegradable polymers can be manufactured completely from petroleum-based resources (Crank et al. 2005).

Economic Analysis of Polymer Industrial Supply Chain

An input-output (I-O) economic model consists of a set of linear equations where each equation explains the distribution of an industry's production throughout other industries representing the rest of the economy (Blair and Miller 1985). The I-O model was developed by Wassily Leontief in the late 1930s and is a well-established method that has been widely used to analyze changes in interindustry activity (Blair and Miller 1985).

The I-O model captures what each business or sector purchases from every other sector to produce a dollar's worth of goods or services. The I-O model is used to capture the economy-wide interdependencies so as to analyze demand changes (Lee and Schluter 1993). The model captures industry interdependencies since each industry employs the outputs of other industries as its raw materials or as factors of production. Uncovering these interdependencies can show how much of each industry's output is used by other industries in the economy. Economic measures the I-O model provided for each sector are total employment, estimates of the direct purchases per dollar of output, income, contribution to gross domestic product (GDP), and the total dollar value of output. In this application, the I-O model is useful in developing the precise details of the interdependencies inherent in an industrial polymer supply chain.

The Chemical, Polymer, and Petroleum Cluster Industrial Supply Chain

Scope of the Supply Chain

To illustrate the magnitude of the polymer industrial supply chain, an input-output model that precisely defines the polymer supply chain is estimated for 2007, Table 3. The table is constructed so that the total polymer supply chain is accounted for in the top portion. The supply chain consists of five sector components, listed by the degree of value add the sector represents in the total industrial supply chain. The five components are 1) petroleum and natural gas extraction, 2) chemical manufacturing, 3) polymer manufacturing, 4) mold and equipment manufacturing related to polymer production, and 5) chemical and polymer wholesale distribution. These five sectors, each composed of numerous industries, represent the industrial supply chain for polymers. Consequently, the industrial supply chain for renewable polymers is embedded within the supply chain defined in Table 3.

Since there is focus on polymers and renewable polymers in this research, detailing the polymer sector as defined in Table 3 is useful. The polymer sector is comprised of five manufacturing subsectors: 1) coated and laminated packaging, paper, and plastics film, 2) plastics material and resin, synthetic rubber, and organic fibers, 3) paints, coatings, and adhesives, 4) plastic products, and 5) rubber products. The most economically important subsector in most studies is plastic product manufacturing. The primary feedstocks for this sector come mostly from the chemical manufacturing sector consisting of four manufacturing subsectors: 1) petroleum and coal products, 2) basic chemicals, 3) soap, cleaning compounds, and toilet preparations, and 4) chemical products and preparations. Similarly, the primary feedstocks for the chemical manufacturing sector are purchased from the petroleum and natural gas extraction sector.

Table 3. United States Polymer Supply Chain: Output, Gross Domestic Product, Income and Employment, 2007[a]

	Total Output	Gross Domestic Product (GDP)	Income	Employment
Polymers, Chemicals, and Petroleum Cluster	***$ Thousands***	***$ Thousands***	***$ Thousands***	***Person Years***
Petroleum and Natural Gas Extraction	**542,595.5**	**271,523.9**	**247,448.5**	**783,594**
Oil and Gas Extraction	278,448.1	161,763.3	145,877.9	368,451
Support Activities for Mining	137,401.4	65,944.8	64,425.8	306,243
Natural Gas Distribution	126,746.0	43,815.8	37,144.8	108,900
Chemicals	**975,457.9**	**199,105.0**	**192,988.7**	**465,877**
Petroleum and Coal Products Manufacturing	598,362.6	106,336.8	103,592.0	111,593
Basic Chemical Manufacturing	220,611.2	41,160.4	38,404.0	148,368
Soap, Cleaning Compound, and Toilet Preparation Manufacturing	105,192.5	38,537.1	38,226.7	106,455
Other Chemical Product and Preparation Manufacturing	51,291.6	13,070.7	12,766.0	99,461
Polymers	**409,717.2**	**103,967.3**	**100,448.7**	**981,867**
Coated and Laminated Packaging Paper and Plastics Film Mfg	19,713.0	4,780.8	4,705.1	47,746
Plastics Material and Resin, Synthetic Rubber, and Organic Fiber Mfg	133,432.3	22,179.3	20,819.0	105,763
Paint, Coating, and Adhesive Manufacturing	39,164.8	9,258.7	9,066.7	63,507
Plastics Product Manufacturing	171,738.1	53,029.3	52,034.5	618,661
Rubber Product Manufacturing	45,669.0	14,719.2	13,823.4	146,190
Mold and Equipment Manufacturing Related to Polymer Production	**21,470.6**	**7,961.8**	**7,741.8**	**111,837**
Plastics and Rubber Industry Machinery	4,688.9	1,531.0	1,480.5	17,853
Industrial Mold Manufacturing	5,621.3	2,686.2	2,637.9	39,953
Boat Building	11,160.4	3,744.6	3,623.4	54,031
Chemical and Polymer Distribution (Wholesale)	**144,491.8**	**97,325.9**	**76,327.7**	**1,405,976**
Total Polymers, Chemicals, and Petroleum Cluster	**2,093,733.0**	**679,883.9**	**624,955.4**	**3,749,151**

Table 3. *Cont.* United States Polymer Supply Chain: Output, Gross Domestic Product, Income and Employment, 2007[b]

	Total Output	Gross State Product (GSP)	Income	Employment
	$ Thousands	*$ Thousands*	*$ Thousands*	*Person Years*
General Manufacturing & Service Sectors				
Farm Inputs, Equipment & Professional Services	153,349.6	57,042.1	1,581.4	1,269,932
Farming	412,492.5	168,779.2	3,156.4	3,101,493
Food Processing	761,694.1	132,360.0	4,999.6	1,628,260
Wood Processing	365,450.1	103,025.8	3,792.2	1,400,406
Food Services	579,681.6	281,631.9	8,566.2	10,560,608
Mining	50,004.3	29,300.8	299.2	119,279
Stone, Clay & Glass	157,337.2	66,720.3	3,592.5	581,330
Metal Industries	631,549.2	188,779.8	17,125.2	1,754,911
Construction	1,623,849.5	690,847.0	19,236.8	11,364,947
Textiles, Apparel, Accessories, Yarn & Leath	159,544.5	36,039.5	588.2	678,758
Machinery, Equipment & General Manufacturing	689,542.7	245,806.1	13,091.5	2,653,416
Motor Vehicles, Allied Equipment & Services	666,379.3	183,218.7	13,563.7	2,814,053
Transportation & Communication	886,622.6	387,687.5	16,481.3	5,193,896
Computer & Electronic Products	769,322.4	341,368.3	7,999.3	3,723,557
Publishing & Information Technologies	1,014,941.2	538,742.7	13,059.4	3,416,372
Wholesale & Retail Trade	2,355,366.0	1,586,513.3	43,918.4	24,534,532
Business, Professional & Personal Services	3,206,556.0	1,969,766.5	62,537.4	22,892,686
Financial, Legal, & Real Estate	3,636,687.3	2,328,950.3	51,346.3	18,167,928
Leisure Activities & Entertainment	810,840.2	428,173.8	6,357.6	6,975,940
Health Care & Social Assistance	1,819,678.9	1,081,789.1	39,726.4	18,233,684
Electricity, Gas & Sanitary	484,965.6	313,837.9	7,721.4	1,005,386
Education Services	794,942.1	701,171.9	22,681.6	13,360,840
Government, Military, & Non-Profit	1,478,660.6	1,266,163.8	36,640.5	17,456,938
Total of Manufacturing & Service Sectors	**23,509,457.5**	**13,127,716.3**	**398,062.7**	**172,889,152**
Total U.S. Economy	**25,603,190.5**	**13,807,600.2**	**1,023,018.1**	**176,638,303**

Note: The wholesaling sector is one sector in the input-output model but is disaggregated. *County Business Patterns 2006* is used to estimate the percentage of payroll and employment in the polymer, chemical and petroleum cluster. The percentage of payroll (6.54) is used to estimate the proportion of PCP cluster output, GCP, and income.
The percentage of employment (6.42) is used to estimate PCP cluster employment. [a] Includes diverse service items such as advertising, cleaning, hair salons, and funerals
Source: Computed

Size of the Supply Chain

The input-output model is designed to estimate the industrial supply chain for polymers in the United States. The estimated model provides a summary of the entire United States economy by sector and the corresponding numbers for the value of output, gross state product, income and the number of persons employed by each sector, Table 3. The model consists of 39 sectors with a total gross domestic product (GDP) for 2007 of $13.8 trillion. Total economic output for the entire economy in 2007 was $25.6 trillion, with total employment of almost 177 million. The chemical, polymer, and petroleum supply chain's share of total GDP is $679.9 billion, or about 5% of total GDP. This translates into the supply chain generating about $4.92 of each $100 of U.S. total GDP. This lends a quantitative perspective to the importance of this industrial supply chain to the national economy.

More specifically to the polymer sector of the supply chain. The polymer sector accounts for $104.0 billion of the cluster's total GDP of $679.9 billion, or about 15%. The industrial supply chain cluster GDP of $679.9 billion is divided among its five components. The largest component of the cluster's GDP comes from the petroleum and natural gas extraction sector that accounts for $271.5 billion, a share of 40%. The chemical sector's $199.1 billion GDP is about 29% share for the entire supply chain. This contribution consists of over $106 billion from both the petroleum and coal products manufacturing, a 53% share of the total chemicals manufacturing GDP contribution. Another $41.2 billion of GDP is accounted for by the basic chemical manufacturing subsector. Soap, cleaning compounds, and toilet preparation manufacturing subsector adds another $38.5 billion to GDP while the chemical products and preparation manufacturing contributes $13.1 billion.

The largest segment of the polymer manufacturing sector is plastics product manufacturing subsector, representing $53.0 billion in GDP, or over half the total GDP for the entire polymer sector. The next most significant subsector of the polymer sector is plastics material and resin, synthetic rubber, and organic fiber manufacturing which contributes about $22.2 billion to GDP for the entire polymer sector, or over one-fifth of the polymer total.

The chemical and polymer cluster contributes 1.45 million jobs to the United States economy. The polymer sector of this cluster represents the largest share, contributing nearly 982 million jobs, or about one in four jobs in the total industrial supply chain cluster. The chemical and polymer distribution sector contributes the most to employment, accounting for over 1.4 million jobs. This accounts for about 37 in every 100 jobs for the entire supply chain.

Industrial Market Trends for Renewable Polymers

Types of Renewable Polymers

Polymers made from renewable feedstocks are emerging and facilitate cleaner production of a broad array of chemicals. There are three primary types of renewable polymers: starch, polylactide acid (PLA), and biopolymer poly-3-hydroxybutyrate (PHB).

Starch and starch blends account for about 80% of the renewable polymer market. Pure starch compounds can absorb humidity and is used for drug capsules in the pharmaceutical sector. Polylactide acid (PLA) is a transparent plastic made from natural resources, such as corn. It not only resembles conventional petrochemical mass plastics in its characteristics but also does not require specialized processing equipment. PLA and PLA-blends generally are shipped as granulates and are used in the plastic processing industry for the production of foil, moulds, tins, cups, bottles and other food and non-food packaging. The biopolymer poly-3-hydroxybutyrate (PHB) is a polyester produced from renewable feedstocks. Its characteristics are similar to those of the petrochemical-produced plastic polypropylene. The South American sugar industry has decided to expand PHB production to an industrial scale (Biomass Research and Development Technical Advisory Committee, 2008). PHB produces transparent film at a melting point higher than 130 degrees Celsius yet is biodegradable without residue.

Trends in the Renewable Markets

Biobased products are slowly penetrating markets in the United States. The American Chemistry Council (2009) forecasted that in 2005 the U.S. chemical industry would increase 5% to $700 billion. However, they estimated that overall, chemical industry production would fall 1.5% in 2008 and this trend would continue through 2009, falling again 1.5% compared with a 2007 growth. The National Petroleum and Refiners Association estimated that the U.S. chemical industry output declined by 3.2% in 2008 from 2007 (Storck 2006) predicting that production of virtually all major petrochemicals would decline in 2008 after a rise in 2007 (O'Reilly 2009). Industry sales rose by 2.4% compound annual growth rate (CAGR) and production increased by 2.6% CAGR during the 1998-2007 period, Table 1. Some longer-term studies suggest dramatic renewable chemical and polymer growth from 2020-2050 (Patel, et al., 2006).

Global demand for renewable polymers, which include plastic resins that are biodegradable or derived from plant-based sources, is forecasted to reach 890,000 metric tons in 2013 (SPI). Primary drivers for this four-fold increase over 2008 levels include the development of bio-based feedstocks for commodity plastic resins, enhanced restrictions on the use of certain plastic products such as plastic bags, and enhanced demand for environmentally-sustainable products. Bioplastics are expected to become more cost-competitive with petroleum-based resins in the intermediate term. Biodegradable plastics, such as starch-based resins, polylactic acid and degradable polyesters, accounted for almost 90% of the bioplastics 2008 market.

Nonbiodegradable plant-based plastics are anticipated to be the primary driver of bioplastics demand. Demand for non-biodegradable plant-based plastics is forecasted to increase from just 23,000 metric tons in 2008 to nearly 600,000 metric tons in 2013.

Western Europe is the largest renewable polymer producer, accounting for about 40 percent of world demand in 2008. Renewable polymer sales in the region benefit from strong consumer demand for biodegradable and plant-based products, a regulatory environment that favors bioplastics over petroleum resins, and an extensive infrastructure for composting. However, future increases are forecasted to be relatively more rapid however in the Asia/Pacific region, equaling West European market production levels by 2013. China is expected to open over 100,000 metric tons of new renewable polymer capacity by 2013.

The BREW Project

In 2006, several universities and research institutions in the EU collaborated to produce the "BREW Project", which estimates the growth opportunities for biobased chemicals in Europe (Patel, et al. 2006). This research identifies three scenarios for the growth of the biobased chemicals industry in Europe applied to a specific set of biobased chemicals and their petrochemical counterparts. Growth rates for the biobased chemicals industry are applied to volumes of tonnage of each biobased chemical (Patel, et al. 2006). The growth rates used in the "BREW Project" are a result of primary data collection that codified expert opinion. Because the "BREW Project" employed expert opinion and is recent (2006), it is considered an important global reference in forecasting the dynamics of renewable polymer industrial markets.

Future Renewable Chemical and Polymer Industrial Markets

Emerging technologies related to renewable polymer production from natural sources, such as plants, animals, and microorganisms, have opened substantial economic opportunities and potentials within the chemical, agricultural, and polymer clusters of the state over the past few years. What is currently not known is the magnitude of the economic impact of this emerging renewable chemical and polymer cluster and the promise of future market opportunities for renewable polymers. This knowledge is critical to stakeholders within the renewable polymer cluster if private sector firms make the investment necessary to become leading producers of innovative renewable products and materials.

The BREW report utilizes a CAGR of 1-3% to construct all its scenarios for the future. Considering additional industry reports within the United States, the 1-3% annual growth rate seems reasonable. Growth rates and technical substitution potentials for the renewable chemical and polymer cluster depend on several factors. These factors include crude oil prices, alternative feedstock prices, and biotechnology development (Sporleder 2005). For example, renewable industrial markets will be slow to emerge if 1) global crude oil prices are sustained at relatively historic low levels, 2) alternative feedstock prices are higher than crude oil prices, and 3) minimal biotechnology innovation related to renewable polymer advancement occurs.

Individual Firm Innovation Strategy and Complementary Assets

From the viewpoint of senior managers, the innovation strategy for a firm in the chemical/polymer industrial supply chain is important to the future competitiveness and sustainability of the firm. Innovation in agricultural biotechnology has been rapid and encourages and facilitates designer genes from various germplasm sources to become renewable polymer ingredients in a wide array of applications never before possible. Hence, the individual firm strategy relative to innovation is a vital aspect of how firms will develop and participate in emerging renewable polymer future supply chains. The problem can be captured in the first-mover theory that isolates key factors regarding managerial decision-making about renewable polymers.

First-Mover Strategy

Pioneer firms are first-movers that attempt to gain advantages over rivals from being first with an innovative product or service in a market. These first-mover advantages may include strong image and reputation, brand loyalty, technological leadership, and being in an advantageous position relative to the 'learning curve' involved in managing a specific product or process innovation.

Three advantages may be realized by pioneer firms: 1) the preemption of rivals, 2) the imposition of switching costs on buyers, and 3) the benefit that accrues from being seen by customers as a technological leader compared to rival firms (Sporleder et al. 2008). Second-mover or follower firms have the advantage of lower costs through less expensive imitation of first-mover products (or processes) and the resolution of market or technological uncertainties faced by first-movers. Taken together, market pioneers deploy innovative products or processes with high initial costs and risks, but yield high potential returns. This also implies that second-movers or followers experience lower costs because imitation is less expensive than innovation. How do firms decide to engage in first-mover compared to second-mover strategies for new product development (NPD)? What factors influence this decision? What role might the supply chain play in making this decision? These questions are key to the success of innovation in renewable polymers. One useful construct for better understanding the linkage between supply chain issues and firm innovation strategy is complementary assets.

Complementary Assets as Bridge from Firms to Supply Chains

Capture and sustainability of first-mover advantages are related to complementary assets (Teece 1986). Commercialization of innovation requires linking with complementary assets such as marketing expertise, brands, and logistics and supply chain networks, all in support of the innovation.

In general, a firm's competitive advantage is a function of the unique organizational skills that determine how it combines and orchestrates assets over time. The degree of innovativeness of a new product is related to whether the new product can be produced and marketed by existing complementary assets available to the firm. When an innovation requires new capabilities, it may create intrafirm conflicts. The more disruptive the innovation is from a customer's view, the more the portfolio of existing assets needs to be changed. Hence, the probability of innovation adoption declines for any time t or the rate of adoption slows (i.e. slower diffusion). This is because the customer may not want to acquire or build complementary assets to make innovation adoption feasible, as in the case of B2B or industrial markets.

The strength of appropriability regimes also may influence the sustainability of economic rents to innovators. Appropriability refers to the ability of various stakeholders to retain the economic rents generated from the commercialization of an innovation. Weak appropriability regimes imply that stakeholders will have difficulty in capturing sustainable economic rents from their innovation. Economic rents from commercializing an innovation potentially are shared among the innovator, customers buying the innovation, suppliers to the innovation, and second-movers or followers. Commercializing innovation by firms that lack complementary assets, or in the event that only 'generic' general-purpose assets are required, leads to weak appropriability.

What is the most appropriate characterization of chemical/polymer supply chains regarding appropriability? What specific implications does this have for supply chain coordination and the potential for sustainable rent capture from innovation in renewable polymers aimed at industrial markets? These questions need systematic analysis to better understand this emerging area of renewable polymers.

Conclusions

The objective of this research was to precisely define the polymer industrial supply chain in the context of value added industries. The research is only a beginning at analyzing emerging industrial supply chains that link renewable germplasm from agriculture to manufacturing sectors. The input-output model provides inter-industry linkages among various sectors and industries that form the total U.S. economy. The model is designed to maintain significant detail in the chemical and polymer cluster. This facilitates estimates of the economic importance of this entire cluster, along with the industries of the general manufacturing and services sectors. The economic measures of importance provided are output, gross domestic product, income, and employment.

The input-output analysis indicated that in 2007 the chemical and polymer cluster output accounted for about 5% of total gross domestic product. United Sates GDP was $13.8 trillion with about $679.9 billion accounted for by the polymer industrial supply chain. The chemical and polymer industrial supply chain cluster contributes $4.92 of each $100 of United States GDP.

Four manufacturing and one distribution sector defines the chemical/polymer industrial supply chain. These include: 1) petroleum and natural gas extraction, 2) chemicals manufacturing, 3) polymer manufacturing, 4) mold and equipment manufacturing related to polymer production, and 5) chemical and polymer wholesale distribution. The polymer manufacturing sector includes five subsectors: 1) coated and laminated packaging, paper, and plastics film, 2) plastics material and resin, synthetic rubber, and organic fibers, 3) paints, coatings, and adhesives, 4) plastic products, and 5) rubber products. The polymer sector contributes about 15% of the total GDP contribution accounted for by the entire industrial supply chain. The largest subsector within the polymer sector is plastics products manufacturing, which accounts for over half of the total GDP contribution by the polymer sector. Three-fourths of the contribution from the polymer sector comes from plastics products manufacturing, and plastics material and resins and synthetic rubber manufacturing.

Individual firm strategy relative to innovation is a vital aspect of how firms will develop and participate in emerging renewable polymer supply chains. The strength of appropriability regimes within emerging chemical/polymer supply chains will influence sustainable rent capture for firms within the chain. Weak appropriability regimes imply that stakeholders will have difficulty in capturing sustainable economic rents from their innovation. Economic rents from commercializing an innovation may be shared among the innovator, customers buying the innovation, suppliers to the innovation, and second-movers or followers. These issues will be resolved over time as dynamic supply chains for renewables emerge globally.

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Agricultural Value Chains in Developing Countries
A Framework for Analysis

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Abstract

The paper presents a framework for developing country value chain analysis made up of three components. The first consists of identifying major constraints for value chain upgrading: market access restrictions, weak infrastructures, lacking resources and institutional voids. In the second component three elements of a value chain are defined: value addition, horizontal and vertical chain-network structure and value chain governance mechanisms. Finally, upgrading options are defined in the area of value addition, including the search for markets, the value chain- network structure and the governance form of the chain. Part of this component is the identification of the most suitable partnerships for upgrading the value chain. The three components of the framework are derived from major theoretical streams on inter-company relationships and from the literature on developing country value chains. The framework is applied in a case example of a developing country value chain.

Keywords: Developing country value chains, research framework, upgrading

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Introduction

Globalization and expanding international markets as well as the fast-growing middle and high income classes in many developing countries offer opportunities for developing country producers to operate in emerging national and international markets. This means that producers must gain better control over production, trade and distribution in order to guarantee the quality and value added of their products and to operate in a cost-effective way. Moreover, these producers must adapt to stringent quality and safety standards and regulations in these markets (Dolan and Humphrey 2004). Important barriers for developing country producers in this respect are the lack of an enabling environment offering institutional and infrastructural support, availability of resources and efficient and effective coordination in value chains. In particular small-scale producers are at a disadvantage because they have little capital to invest, use traditional techniques, depend on family labor and lack contact with (international) market players (De Janvry and Sadoulet 2005; Daviron and Gibbon 2002; Reardon and Barret 2000). In the literature a multitude of cases are described where small farmers search for new forms of collaboration so as to increase their bargaining position in the value chain (Rondot and Collion 2001).

Global value chains are characterized by falling barriers on international trade due to decreasing tariffs and the lowering of price support and export subsidies in the last decades. At the same time we see increasing concentration and consolidation in all links of these chains. Furthermore, advances in communication technologies and declining transportation costs facilitate coordination between chain actors (Gibbon et al. 2008), not by vertical integration but by standardization of processes and sophisticated information and communication technology, meaning that *''the rising integration of world markets through trade has brought with it a disintegration of multinational firms…''* (Gereffi 2005, 80). Developing country producers that want to enter these chains are confronted with asymmetric power relationships (e.g. because of increasing global power of Western retailers and industries) that again impact on the distribution of costs and benefits over the chain participants, keeping value-adding activities in Western countries.

However, value chains can also be seen as a vehicle by which new forms of production, technologies, logistics, labor processes and organizational relations and networks are introduced. An important example is the car industry, in which increasingly fine-meshed production and distribution networks have emerged worldwide and developing country suppliers have been able to take their share of R&D and sophisticated production processes (Ivarsson and Alvstam 2005). Such an example shows how Western technological standards and systems to guide and control processes and flows of goods and information are increasingly used by developing country producers that participate in these value chains as well as in the newly emerging modern domestic value chains. In this respect, in the food sector, supermarkets in many Latin American and Asian countries have initiated total quality management programs for perishables like fresh fish, meat and vegetables. However, an important challenge for the still by far largest number of developing country producers is how to enter these value chains and how to improve so as to compete in these new markets. Therefore important questions to be tackled are the following:

- How can developing country producers become more efficient and value adding and collaborate with parties in value chains that are able to capture new market opportunities?
- How can value chains, as embedded in the international, domestic and local economic, legal and social-cultural environment, optimally use their business environment?
- What major upgrading opportunities are available and which parties are most suited to facilitate value chain upgrading?

The current literature does not offer an integrated approach to deal with these questions and a framework with key elements for an integrated study of value chains is lacking. Therefore this paper proposes a framework for research on developing country value chains to deal with this gap in the literature. Based on the framework, options for improvement of these chains will be drafted. Although the paper addresses various sectors of the economy, the major focus will be on agriculture, as this is for most developing countries still the largest sector (highest employment, contribution to GDP, etc.).

The next section will first describe the business environment of these value chains by defining major developing country constraints. Section 3 will describe various perspectives from different theoretical streams on value chains, capture the basic elements of these theories and propose the framework for value chain analysis. Section 4 explains value chain analysis whilst section 5 discusses upgrading options in value chains, applying the framework in a case and provides management and policy implications.

Constraints for Developing Country Value Chain Upgrading

The main aim of a value chain is to produce value added products or services for a market, by transforming resources and by the use of infrastructures – within the opportunities and constraints of its institutional environment. Therefore, constraints for value chain development are in our view related to market access (local, regional, international) and market orientation (e.g. Grunert et al. 2005), available resources and physical infrastructures (Porter 1990: factor conditions) and institutions (regulative, cognitive and normative; Scott 1995).

Market Access and Market Orientation

Quality demands, internationalization and market differentiation have led in developing countries to the emergence of distinct food sub-systems with specific quality and safety requirements, leaning on different market channels, e.g. local, national and international markets (see Figure 1).

Figure 1 illustrates the key distinctions between three sub-systems. The A-system can be characterized as the local low-income chain. Producers are usually small with traditional production systems. These chains aim at local market outlets with staple products. Local value chains may deliver to local markets. However, these chains may also connect to low-end markets further away. Because of many intermediary parties (traders), these A-system chains are relatively long, implying limited availability of (end-) market information, distribution of value added over a large number of actors, and longer transportation distances (both in distance and time). A-systems in developing countries deliver a high share of agricultural production volume,

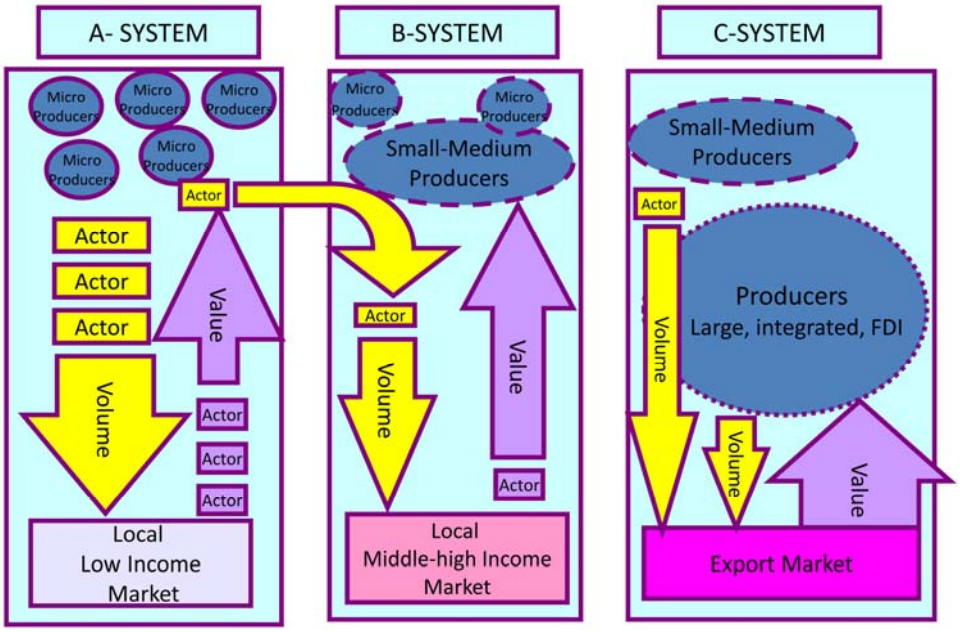

Figure 1. Economic sub-systems in developing countries (Ruben et al. 2007)

but generate relatively little value. An example of an A system is the production of cassava or sorghum by small local West African producers for local markets. Often these products enter into complex distribution networks for local markets in different places. The B-system can be characterized as the local middle to high income chain. These producers aim at the emerging supermarket sector in many developing countries. Most of the volume in these chains is delivered by small/medium size producers, organized in cooperatives and/or linked in subcontracting arrangements. Micro producers deliver inputs on demand to balance demand and supply in this system (buffer function). Although the production volume produced by B-systems is smaller than that of A-systems, the value generated is larger. B-systems increasingly produce according to national and sometimes international retail quality and safety standards. An example of a B-system value chain is the production of vegetables in Kenya for modern South African retailers operating in Kenya (Reardon et al. 2004). Finally, the C-system can be characterized as the export chain. It is completely focused on export, although low quality or rejected products are sold at the national, in many cases retail, market. The trend is towards increasing economies of scale and foreign direct investments. Export chains tend to become more integrated and with fewer actors. Although volumes are small compared to local markets, the value added is relatively high. An example of a C-system value chain is the South African table grape chain that focuses on export (Trienekens and Willems 2007), or the international flower value chains with production in Kenya and Ethiopia (Vollebrecht et al. 2010).

These sub-systems function largely independently, although one system may use input from another system to balance demand and supply (see for example the flow between the A- and B-systems in the figure). The co-existence of such weakly connected sub-systems poses important challenges to the development of harmonized quality and safety standards in developing countries (Ruben et al. 2007).

Market access is dependent on technological capabilities of producers, available infrastructures, bargaining power and market knowledge and orientation. Market orientation and market knowledge are conditional to market access. In this sub-section we focus on market orientation and market knowledge. Grunert et al. (2005) define market orientation of a value chain as *"..chain members' generation of intelligence pertaining to current and future end-user needs, dissemination of this intelligence across chain members and chain wide responsiveness to it"*. The more heterogeneous the end-market, the more market-oriented activities are expected to take place by upstream parties in the chain. This implies, in particular for non-commoditized products with high added value, that market orientation should be present at multiple parties in the chain. Therefore, to be able to participate in high value adding value chains, various parties in the chain up to the primary producer should have knowledge of and be willing to comply to demands in the value chain's end-market (Grunert et al. 2006). Therefore, a key condition for producers to be included in successful value chains is that they have access to market information and possess the ability to translate it to market intelligence. The further upstream market information on product quality and other product attributes requested penetrates the value chain, the more heterogeneous markets can in principle be served, assuming that producers can comply with market demands. In this way developing country producers may diversify their production portfolio and capture larger added value from differentiated market channels.

Resources and (physical) Infrastructures

Getting access to markets is not a sufficient condition for developing country value chains to be able to sell their products. Supporting infrastructures, resources including knowledge and capabilities are conditional for these chains to be successful. According to Porter (1990), factor conditions relate to the nation's endowment with resources such as physical, human, knowledge, technology and infrastructure. These factors enable or constrain value chain upgrading. Typical constraints faced by companies in developing countries include lack of specialized skills and difficult access to technology, inputs, market, information, credit and external services (Giuliano et al. (2005).

First, low levels of available physical resources such as input materials for production and other input supplies (e.g. energy and water) constrain value chain upgrading. For example, high energy costs in many Eastern African countries limit growth possibilities for companies and value chains. Second, the geographic position of a company or value chain may impact its competitive position, for example if it is located far from high-value markets (such as countries and regions in Central Africa). Third, availability of educated labor and the availability of knowledge (production, distribution, and marketing) is an important condition for innovative behavior of value chain actors. A fourth category is the level and availability of technology that can be used for production and distribution activities in the value chain.

Besides availability of resources the presence of an adequate distribution and communication infrastructure is a basic condition for value chain development and upgrading. Weak infrastructures hamper efficient flows of products to markets and exchange of market information upstream in value chains.

Institutional Voids

The third component we recognize in the business environment of value chains is institutions. Institutions impact organizational life. In our definition of institutions we follow Scott (1995), who makes a distinction between regulative, normative and cognitive institutions. Regulative institutions encompass legislation and government regulations and policies that companies can use and/or have to comply with. Normative institutions are embedded in business practices, business policies and ethical standards. Cognitive institutions reflect the way people interpret and make sense of the world around them on the basis of rules and schemata. Hence, diverse cultural belief systems, values and identities inform people (in different roles as consumers, producers, policy makers, citizens, etc.).

Developing countries are often characterized by institutional voids, defined as *"situations where institutional arrangements that support markets are absent, weak or fail to accomplish the role expected from them"* (Mair and Marti 2008). Government legislation, regulations and policies can constrain value chain upgrading, amongst other ways by setting trade barriers for production materials and production technology, by limiting the flow of information, national as well as international, by imposing unfavorable taxes and by denying infrastructural investments that would benefit value chains. Furthermore, business practices and characteristics of business relationships can limit value adding and profit orientation in valued chains. For example, inter-personal and inter-company relationships may enhance the social capital of a company, but also imply relational constraints that limit a free flow of goods and information (Lu 2007). Moreover, cognitive institutions may prevent innovations in products or processes and can limit a free flow of information and knowledge, mobility of labor, and relationships between communities.

A facilitating government that supports innovation and upgrading is often considered conditional for development (e.g. Murphy 2007). Moreover, standards, norms and regulations set by Western retailers and industries and supported and enforced by local governments and NGOs shape the institutional environment of developing country producers (Perez-Aleman and Sandilands 2008; Rissgaard 2009; Muradian and Pelupessy 2005; and, Dolan and Humphrey, 2000).

The next section proposes key elements for the investigation and assessment of developing country value chains by discussing the potential contribution of four theoretical streams in the literature to value chain analysis.

Theoretical Approaches to Value Chains

During the past decades there has been extensive theory building in the field of value chains (Lazzarini et al. 2001), reflected in many definitions and analytical approaches. Scientific disciplines that add to the development of value chain theory can be grouped into four streams with different perspectives on inter-company relationships, as outlined in figure 2:

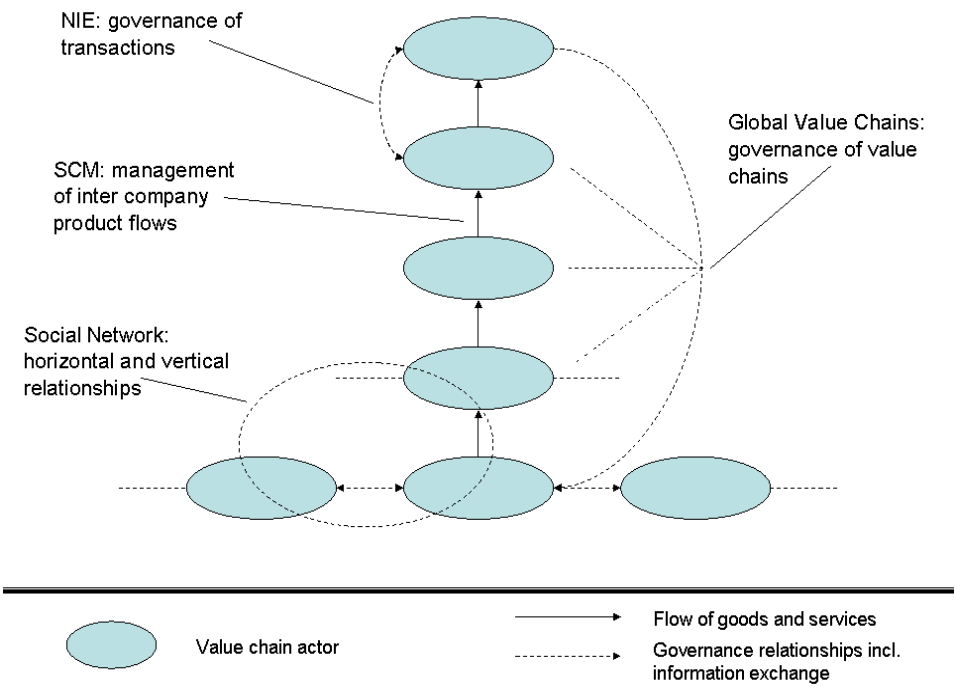

Figure 2. Perspectives of theoretical streams on inter-company relationships

- Global value chain analysis focuses on the position of the lead firm in value chains and power relationships between developing country producers and Western markets or multi- national companies (MNCs).
- Social network theory focuses on the inter-relationships between economic and social interactions in (production) networks composed of multiple horizontal and vertical relationships between value chain actors.
- Supply chain management studies management and control of inter-company operations (flows of products and services).
- New institutional economics studies the governance/organization of transactions between companies.

Global Value Chain (GVC) Analysis

GVC analysis originates from the commodity chain approach (Gereffi 1994) and investigates relationships between multi-national companies, the "lead firms", and other participants in international value chains. In this theoretical stream power relationships and information asymmetry are key concepts in the analysis of global value chains. Therefore, the focus is on governance and upgrading opportunities in developing country value chains (Gereffi 1999, Gereffi et al. 2005; Kaplinsky 2000; Kaplinsky and Morris 2002; Sturgeon 2001; Gibbon 2001; and, Gibbon and Bair 2008).

Kaplinsky (2001) made an important contribution to this theoretical stream by viewing value chains as repositories of rent. According to Kaplinsky (2001), rent arises from unequal access to

resources (entry barriers, Porter, 1990) scarcity of resources and from differential productivity of factors, including knowledge and skills. Economic rent is in principle dynamic in nature.

Nadvi (2004) extends the global value chain view to the poverty perspective by investigating the impact of engagement of local actors in GVCs on employment and income. He finds that employment and income are positively affected by inclusion of companies in global value chains, in particular when MNCs are involved. Although, at the same time, workers in GVCs become increasingly vulnerable to changing employment contracts and casualization of work.

Supply Chain Management

A literature stream that investigates management of operations in value chains is supply chain management. Supply chain management emerged in the logistics literature of the 1980s and initially focused on logistics planning and optimization of inventories across the supply chain. Supply chain management is customer oriented, i.e. customer demand is leading in this approach, and aims towards the integration of business planning and balancing supply and demand across the entire supply chain from initial producer to the ultimate customer/consumer (Bowersox and Closs 1996; Cooper et al. 1997). Information and communication systems are considered the backbone of smoothly running supply chains.

The term value chain, alongside similar approaches like the "filiere" approach (from French origin and the commodity chain concept that originated from world systems theory, Raikes et al. 2000), was first brought up by Michael Porter (1985) in the 1970s and 1980s, reflecting the value adding character of business processes within the borders of the company. Both supply chain and value chain approaches focus on primary processes, i.e. transformation and transaction processes in and across vertically related companies. From the developing country perspective, SCM focuses on process and quality improvement and optimization of distribution processes In the food sector, for example, a lot of research has been devoted to integrated quality management systems; such as the study by Francis and Simons (2008) on quality improvement programs in the red meat chain between Argentina and UK.

A third stream of literature focuses on governance of (bilateral) transactions between companies.

New Institutional Economics

New institutional economics (NIE), with branches such as transaction cost economics (TCE) and agency theory, investigates the rationale for governance choices regarding in-company and inter-company organizational relationships. In TCE transactions between companies are the basic unit of analysis (Rindfleisch and Heide 1997; Williamson 1985, 1999). Companies select the governance form that minimizes transaction costs, under conditions of bounded rationality and opportunistic behavior of partners. Value chain actors safeguard against risk of opportunism through joint investment, monitoring systems and specific organizational arrangements such as contracts. In agency theory one party (the principal) delegates work to another (the agent), who performs that work (Eisenhardt 1989). Roughly, agency theory defines governance solutions ranging between measurement of output of the supplying party/agent (transferring risk to the agent) and measurement of behavior/processes of the agent (transferring risk to the principal).

NIE is increasingly used to determine the best agreement/contract for developing country producers in highly uncertain business environments with opportunistic behavior of actors involved and weak (institutional) enforcement regimes (see e.g. Ruben et al., 2007).

Network Approach

The fourth theoretical stream of relevance for developing country value chain research is social network theory. The social network approach views companies as embedded in a complex of horizontal, vertical and business support relationships with other companies and other organizations supporting inputs and services (such as advisory services, credit facilitators and transportation companies). According to network theory, relationships are not only shaped by economic considerations; other concepts like trust, reputation and power also have a key impact on the structure and duration of inter-company relationships (Uzzi 1997). Since the 1990s, social capital theory has become an important branch within the network approach. Network relations may enhance the "social capital" of a company, by making it feasible to get easier access to information, technical know-how and financial support (Coleman 1990; Burt 1997) and by encouraging knowledge transfer between network partners (Humphrey and Schmitz 2002), thereby reducing transaction costs and improving access to markets (e.g. Gulati, 1998). In the last decade a lot of literature has emerged in the field of regional clusters, where intra-cluster vertical and horizontal relationships may support efficiency and effectiveness of business networks (Giuliani et al. 2005). In the context of NIE, network theorists argue that trust, reputation and dependencies dampen opportunistic behavior, implying that inter-firm relationships are more complex than NIE would predict (Gereffi 2005; Lu 2007; Ruben et al. 2007).

Based on these theoretical streams and the constraints to value chain upgrading discussed in the previous section, we propose below a framework for value chain analysis in developing countries.

Framework for Developing Country Value Chain Analysis

Our framework views value chains as production networks in which business actors exploit competitive resources and operate within an institutional environment. Therefore, we conceptualize a value chain as a network of horizontally and vertically related companies that jointly aim at/work towards providing products or services to a market. Building on Ruben et al. (2007), we characterize a value chain by its network structure, its governance form and the way value is added:

- *Network structure:* From supply chain management and network theory we draw the network structure of the value chain, including the market outlet (local, regional, international). Supply chain management focuses on vertical connections between economic actors aiming to jointly produce for a market. Network theory combines horizontal and vertical relationships between actors.
- *Value added:* From supply chain management, new institutional economics and value chain analysis we draw value added production. Supply chain management focuses on how value is added throughout the chain (value added can be defined in terms of (high)

quality, (low) cost, delivery time etc.). New institutional economics and specifically transaction cost economics focus on transaction costs. Value chain theory encompasses important discussions on where in the value chain value is added.

- *Governance form:* From new institutional economics, value chain theory and network theory we draw the governance and bargaining position of value chain actors, and related distribution of value added. New institutional economics investigates the optimal governance structure between economic actors. Value chain theory has developed a theory on chain-wide governance structures. Network theory focuses on (formal and informal) governance of horizontal and vertical relationships.

Changes in the institutional environment or the competitive base or in enabling infrastructures and availability of resources may alter the functioning and performance of value chains, thereby forming main constraints for value chain development. Alternatively, value chain actors may be motivated to improve their position in the chain, e.g. by getting involved in a different market channel, by enhancing value added (by improving quality and delivery conditions or lowering costs) and by re-organizing the collaboration with value chain partners. Such upgrading strategies may also be fostered by non-value chain actors such as governmental agencies, NGOs, public-private partnerships and development organizations.

Figure 3 depicts our framework. The arrows reflect a possible order of analysis of value chains: define constraints for the value chain under study – study (redesign) opportunities for this value chain – define upgrading options, taking into consideration value chain constraints.

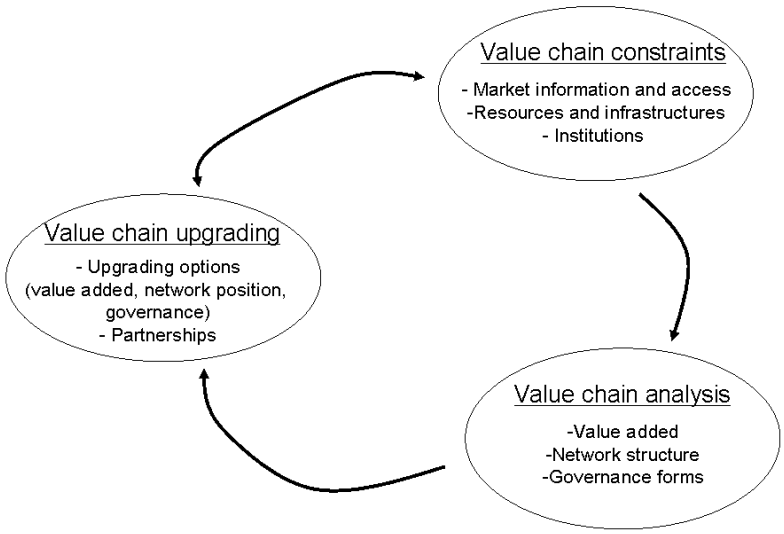

Figure 3. Value chain analysis framework

Value chain constraints have been discussed in the previous section. In the following sections the other elements of the framework will be discussed: Value Chain Analysis and Upgrading Options for developing country value chains.

Value Chain Analysis

In the previous section we presented three components of value chain analysis: network structure, value added and governance structure.

Network Structure

A network structure has two dimensions: vertical and horizontal. The vertical dimension reflects the flow of products and services from primary producer up to end-consumer (i.e. the value chain or supply chain). The horizontal dimension reflects relationships between actors in the same chain link (between farmers, between processors, etc.). Lazarrini et al. (2001) developed the concept of the netchain to show the interrelationships between the horizontal and vertical dimensions in value chains (figure 4).

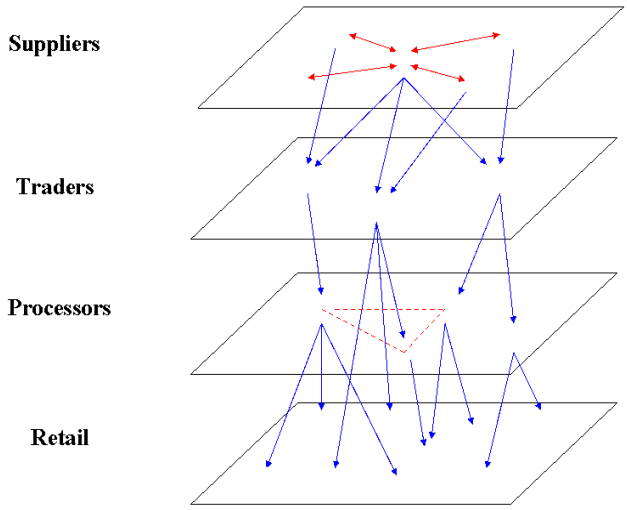

Figure 4. Netchain (Lazzarini et al. 2001)

Figure 4 shows vertical relationships between the various value chain links and horizontal relationships between actors in the same link. Vertically relationships may follow all stages in the value chain or may skip value chain links, for example, relationships between traders and retail. Horizontal relationships between actors can also have various shapes, such as farmer cooperatives or price agreements between traders. The structure of a network (netchain in figure 4) is largely dependent on the market channel(s) that are chosen by various parties. A marketing channel bridges the gap between producers and market and may be defined as a value chain or supply chain forming a "channel" for products and services that are intended for sale at a certain market.

A company's position in a market channel is dependent on the following key decisions (adapted from Stern et al. 1996):

- Which products or services will be delivered to which market. What are the required intrinsic characteristics of the product or service and the required extrinsic characteristics of the production process?
- Whether the company will adopt a single or multi-channel strategy. One company can deliver to more than one market (in terms of market requirements like quality level, delivery conditions, pricing).
- The number of stages in the channel. For example a producer can deliver directly to customers further downstream the channel or through intermediary partners (such as traders, distributors or processors).

Channel choices are heavily constrained by market access limitations such as supporting infrastructures to reach markets, access to demand and price information and specific demands from these markets such as production according to quality standards. Moreover, the ability of companies to take part in market channels is strongly related to characteristics of these markets, knowledge of market demands at the producer and the technological abilities of the producer. (Grunert et al. (2005) find that the more heterogeneous and dynamic the supply of raw material to the value chain, the more market-oriented activities can be expected to take place upstream in the value chain. Conversely, from an end-user market perspective, they find that the extent of heterogeneity and dynamism of end-user markets is a determinant of the degree of market orientation in the chain.

Market channels vertically structure the value chain/network. The horizontal dimension is shaped by purchasing, production and delivery dependencies between parties that are positioned in the same value chain links, such as sourcing or marketing cooperatives, or collaborative agreements between small and medium size processors, such as exchange of packaging materials in case of demand fluctuations. It may be clear that market access, market information and exchange of information through the vertical chain, but also control of quality standards, may be strongly stimulated and enabled by horizontal collaboration and information exchange, through communication of knowledge and through joint investments in supporting systems.

A value chain/network structure is in principle dynamic. For all sectors of the economy, globalization has led to increasingly fine-meshed sourcing, production and distribution networks around the globe. For example, Gereffi (1999) showed for the apparel industry how the global sourcing network evolved from links between Asian low labor-cost producers and Western value added producers, to links between Western brand producers and Asian added value producers. Asian manufacturers had moved a step forward in the production of value added products and developed multi-layered global sourcing networks for themselves, such that low-wage assembly could be done in other parts of Asia (see also Bair and Gereffi, 2003, for similar developments in the apparel industry in Mexico, where the industry was upgraded from mere manufacturing to R&D and design). Also in the food sector, with coffee (Kaplinsky and Fitter 2001) as a good example, differentiation in the last decades has led to further specialized distribution and sales networks worldwide. Fair trade and specialty coffee to be sold at specialty shops, for example, have achieved increasing market shares.

However, factors such as international regulations and legislation have also had a big impact on the formation of distribution networks. For example, Gibbon (2003) shows the important role of

international trade regulations on shaping international distribution structures, by discussing the impact of the US African Growth and Opportunity Act (AGOA) on the relocation of manufacturing facilities in developing countries. AGOA conferred a quota- and duty-free status, from 2000 to 2008, to clothing articles directly imported into the United States from beneficiary countries that meet certain political and economic conditions. This led to an almost immediate move of clothing manufacturing activities from countries like South Africa and Mauritius to Lesotho and Tanzania.

Value Added

Value added is created at different stages and by different actors throughout the value chain. Value added may be related to quality, costs, delivery times, delivery flexibility, innovativeness, etc. The size of value added is decided by the end-customer's willingness to pay. Opportunities for a company to add value depend on a number of factors, such as market characteristics (size and diversity of markets) and technological capabilities of the actors. Moreover, market information on product and process requirements is key to being able to produce the right value for the right market. In this respect finding value adding opportunities is not only related to the relaxation of market access constraints in existing markets but also to finding opportunities in new markets and in setting up new market channels to address these markets.
Value added capture can be divided into five major categories (Kaplinsky 2000):

- trade rents (forthcoming from production scarcities or trade policies)
- technological rents (related to asymmetric command over technologies)
- organizational rents (related to management skills)
- relational rents (related to inter-firm networks, clusters and alliances)
- branding rents (derived from brand name prominence).

To capture these rents a number of conditions have to be met: availability of resources, including knowledge and capabilities of chain actors, the infrastructure to bring the products to a market and comparative advantage in that market, for example through specific value added or economies of scale. According to Kaplinsky (2000) access to high income yielding activities, with high added value, requires participation in global value chains aiming at markets demanding products with high added value. As discussed before, these global value chains are often linked through long-term relationships and supported by foreign direct investments.

For commodities with low value added, however, the terms of trade with Western countries are in a downwards spiral(Fitter and Kaplinsky, 2001; Kaplinsky and Morris, 2002). This was very well illustrated by Nadvi (2004) in a study on a boom in the vegetables and fruit sector of several East African countries, that, however, did not lead to an equal increase in production of high value added products nor a decrease of poverty: *"In Kenya , exports of fresh vegetables rose by over 200% in value terms between 1993 and 1999 [….]. However, over half the population fell below the poverty line in the late 1990s, and rural poverty was particularly acute."* Moreover, for food production the upstream part of the value chain is not very suited for product differentiation, as in most food chains heterogeneity of raw materials upstream in the value chain is not exploited for serving market heterogeneity downstream in the chain. Raw materials are first made homogeneous and are differentiated again in processing and distribution stages (e.g.

through packaging), because of the high costs of separating and controlling various materials flows upstream in the chain (Grunert 2005). In international value chains this upstream part is in many cases located in developing countries; this being another explanation of why only little value added production in these chains takes place in developing countries.

There does however seem to be increasing room for specialization in fair trade and organic products from developing countries, while traditional commodity chains such as coffee increasingly show differentiation tendencies. For example, Fitter and Kaplinsky (2001) illustrate that nowadays in Western coffee specialty stores (such as Starbucks) the cost of coffee only represents a very small proportion of the price of a cup of coffee (4% in the case of a cappuccino). The remainder is in the ambiance, the brand, etc. For this type of specialty products, branding and adding additional value has become a conditional strategy to gain market share (Gereffi1999). At the same time, branding and labeling of specialty products by developing country producers is constrained through the private-label policies of many Western supermarket chains. Dolan and Humphrey (2004) show a rise in private-label penetration of retail in the UK from around 22% in 1980 to around 43% in 2001. Another example is given by Gwyne (2008), who shows that Tesco's private label of Chilean wine (Tesco Finest) covers more than 50% of wine sales in its shops. The trend towards increased private-label sales is ongoing in most Western countries, but it appears to be increasing at the highest rate in the UK.

Value adding in food production focuses in particular on safety and quality of the product. Quality can be divided into intrinsic characteristics of the product itself (e.g. color, taste, tenderness) and extrinsic characteristics of the process which cannot be measured on the product (e.g. organic or fair trade production). To safeguard the quality and safety of end-products, since the 1990s, Western retailers have defined various standards for the production and processing of food, such as British Retail Consortium (BRC), Gobal-GAP, Safe Quality Food (SQF). These standards are now applied by supermarkets and importers all over the world to coordinate supply chain activities and control food quality and safety. Besides generic quality standards that focus on quality and safety of food, we now increasingly find standards which combine intrinsic with extrinsic characteristics, e.g. high quality (and sustainable) *"Utz" coffee or the "Rainforest alliance"* bananas of Chiquita. While until recently these specific product and processing attributes focused on niche markets in Western countries, they now are swiftly integrated in basic retail and industry standards as indicated above. For producers to get access to modern retail markets, certification according to these standards is conditional (Jahn et al. 2004). However, because of these standards access to these markets for small and medium size producers is difficult and in many cases impossible, as was pointed out before (Dolan and Humphrey 2000). Perez-Aleman and Sandilands (2008) state that *"these well-intended social and environmental norms, or sustainability standards",* (from a Western consumer point of view), represent significant barriers to entry for these producers (Vellema and Boselie 2003; Giovannucci and Reardon 2001). Compliance with standards implies high certification costs (for producers) and high monitoring costs (for buyers). Although, in some cases we now see inclusion of small-holders in modern quality schemes, e.g. through cooperative governance forms or through retail or food industry programs (e.g. tea production in Kenya for Unilever; coffee production for *Nescafe* in Brazil).

Value added is produced in value chains aiming at certain markets and constituting a number of actors. The next section will discuss the governance of relations between these actors, the third element of our framework.

Governance and Bargaining Position of Value Chain Actors

Firms in value chains are linked in a variety of sourcing and contracting relationships, i.e. forms of governance (see e.g. Williamson 1985; 1999; Gereffi et al. 2001). We distinguish two perspectives in the concept of governance of developing country value chains:

- the transaction (cost) perspective that focuses on governance of transactions in vertical bilateral relationships between firms (Williamson, 1985 and 1999; Rindfleisch and Heide 1997);
- the global value chain perspective of Gereffi, Kaplinsky and others, where power relationships, the position of the "lead-firm" and consequences of the distribution of value added are the subject of study (Gibbon et al. 2008). Gereffi (1994, 97) defines governance as: *"authority and power relationships that determine how financial, material and human resources are allocated and flow within a chain"*.

From the transaction (cost) perspective, transactions between firms are governed under conditions of bounded rationality and opportunism of the actors involved. Transaction characteristics are largely explanatory for governance structures in a value chain. According to Williamson (1995, 1999) joint investments, the ability to measure the agent's performance and uncertainty are deciding factors for the costs of transactions. If transaction costs are low, actors will favor market governance. If they are high, they favor contracting or integration, thereby lowering these costs. Governance forms range from (spot) market relationship, through hybrid governance forms (e.g. contracts) to vertical integration or hierarchy (meaning bringing the activities of various companies together within one legal entity).

In this respect developing country business relationships are subject to many uncertainties caused by poor physical infrastructures (storage facilities, roads, telecommunication, etc.), weak institutional infrastructures (government support, sanction systems, etc.), unbalanced trade relationships (dependencies, opportunistic buyer behavior) and unfavorable social and political conditions, leading to uncertainties and risks for developing country producers (see also previous sections). Transactions are enabled and need to be supported by information exchange about characteristics of the product/service and delivery conditions. However, information exchange between companies in developing countries is in many cases hampered by information asymmetries between chain partners, lacking communication infrastructures, and diffuse market channel structures. This makes monitoring of transactions difficult (David and Han 2004; Grover and Malhotra 2003). An extremely promising development in this respect is the increasing use of cell phones by producers in developing countries, enabling them to transfer information about market demands and sales opportunities (Trienekens and Willems 2007; Ruben et al. 2007). At the same time, in the context of the food sector the introduction of quality and certification schemes goes hand-in-hand with increased monitoring and control by, in most cases, Western buyers and more integrated governance in the value chain, such as long-term contracts, thereby reducing the uncertainties stipulated above (Hueth 2002). In this regard the use of standards

implies reduction of coordination costs, but it may also reduce innovation capabilities that could lead to new value added, as innovation and standardization seem to be opposite forces in value chain development (Dolan and Humphrey 2006).

Summarizing, in general business relationships in international and modern domestic value chains with high investments, uncertain supply markets and weak monitoring and enforcement regimes are safeguarded through more integrated governance forms such as long-term contracts, joint ventures or vertical integration. Control over international value chains does not necessarily mean ownership over production activities throughout the value chain. Coordination and control are in many cases facilitated by standardization and advanced monitoring and communication systems (Trienekens 2009; Gereffi 2005). As also pointed out above, standardization may support consolidation of existing value chain structures where most production of value added takes place in Western countries.

From the global value chain perspective, Gereffi et al. (2005) developed a categorization based on three factors explaining the structure and organization of these chains:

- the complexity of information and knowledge transfer required to sustain a particular transaction, particularly with respect to product and process specifications;
- the extent to which this information and knowledge can be codified and, therefore, transmitted efficiently and without transaction-specific investment between the parties to the transaction;
- the capabilities of actual and potential suppliers in relation to the requirements of the transaction.

They arrive at a categorization of five governance types (market, modular, relational, captive and hierarchy) that reflect differences between the position of the lead firm and specific power/dependency relationships in the chain. This typology is intrinsically dynamic in the sense that governance types can develop from one type into another, from market type in the direction of hierarchy but also from hierarchy type in the direction of market depending on changing market demands and supply structures. The shift can be caused by a number of factors:

- Information complexity changes as lead firms seek to obtain more complex outputs and services from their supply-base.
- Within industries there is a continuous tension between codification and innovation.
- Supplier competences change overtime.

From the global value chain perspective, suppliers roughly rank from commodity suppliers, delivering products through arms-length market relationships, to turn-key suppliers, delivering customer-specific products produced with advanced capabilities (see also Gereffi et al. (2005) and Sturgeon (2001)). Moving from turn-key to commodity supplier information asymmetry and power balance is in most cases in favor of the Western value chain partner. In that respect increasing capabilities of suppliers and subsequent de-commoditization (Fitter and Kaplinsky 2001) of the value chain can lead to more balanced power and bargaining relationships in these chains. Additionally, horizontal relationships, in particular farmers cooperatives or associations

increase bargaining power of small farmers and at the same time lower transaction costs for retailers associated with purchasing from smaller farms.

Roles of value chain partners may change over time. For example, Dolan and Humphrey (2006) describe a development in the UK fresh vegetables and fruit market in which importers are given the role of category managers by the large retail chains, with tasks such as organizing the supply chain, integrating the management of the (whole) chain, developing the category and information exchange on prices, costs and margins. The rise of global value chain "managers" or coordinators (also, for example, 4th party logistics providers, Hsiao et al. 2009) leads to a specific form of relational rent accruing from governorship itself, as already defined by Kaplinsky (2000). In this regard, Gereffi et al. (2005) speak of "mundane" transaction costs – the costs involved in coordinating activities along the chain. These mundane transaction costs rise when value chains are producing non-standard products, products with integral product architectures, and products whose output is time sensitive (Baldwin and Clark 2000). Agricultural value chains are very time sensitive, meaning that highly developed coordination capabilities are needed in these chains, such as in the Dutch flower chain where flowers from countries from all over the world have to be distributed through the auction halls in The Netherlands to customers all over Europe and the rest of the world in a very limited time frame (Vollebregt et al. 2010). The auction organization (a growers cooperative in The Netherlands) is the global value chain coordinator in this respect.

Distribution of Value Added

Distribution of value added over various actors is strongly related to the governance form of the chain and depends on the power and bargaining position of actors, information asymmetry between chain stages and also the production technology used. Although inclusion in global value chains often brings a larger share of value added to developing country producers (Nadvi 2004), prices in Western markets do not automatically translate into prices for developing country suppliers. As Fitter and Kaplinsky (2001) showed, increasing differentiation of coffee prices at the retail or specialty shop outlets does not translate into increasing variance in prices paid at the farm gate (see also Bacon 2005). Differences in market power and dependency relationships have a clear impact on the (choice of) governance regime in trade relationships. A powerful party can dictate governance mechanisms (e.g. Schmitz 1999). In this respect, small-scale producers depend in many cases on downstream parties in the chain, such as intermediaries, transporters or exporters, for input supplies and credits on the one hand and market access on the other.

In communities with strong social structures, trust and number and intensity of relationships play an important role in collaborative agreements between horizontal parties and a subsequent increase of bargaining power. Therefore, the embeddedness of small-scale producers in a network of social relationships can provide them with the social capital to strengthen their position in the value chain (Gulati 1997; Coleman 1990). Trust may play an important role in both horizontal and vertical relationships. Trust is dependent on the duration of a relationship, consistency of exchanges between parties and (economic and social) reputation. In many value chains, trust and reputation replace more integrated governance mechanism as a safeguard against opportunistic behavior and to keep transaction costs low. The next section discusses the third part of our framework: upgrading of value chains.

Value Chain Upgrading

In defining upgrading options we build on the work of Gereffi (1999), Kaplinsky (2000), Humphrey and Schmitz (2002), Nadvi (2004), Guliani (2005), and Gibbon et al. (2008). For example, Gereffi (1999) defines upgrading as: *"…. a process of improving the ability of a firm or an economy to move to more profitable and/or technologically sophisticated capital and skill-intensive economic niches."* McDermott (2007:104) defines upgrading as: *"the shift from lower- to higher-value economic activities by using local innovative capacities to make continuous improvements in processes, products and functions"*.

Kaplinsky (2000) gives four directions in which economic actors can upgrade: increasing the efficiency of internal operations, enhancing inter-firm linkages, introducing new products and changing the mix of activities conducted within the firm. Building on Kaplinsky and others, Pietrobelli and Saliola (2008) define the following upgrading options: entering higher unit value market niches, entering new sectors, undertaking new productive functions and in all cases enlarging the technological capabilities of the firms. In most cases upgrading of value chains is achieved through attention to multiple business aspects, such as combined attention to product and process upgrading or collaborative product upgrading in combination with contractual arrangements. For instance Roy and Thorat (2008), in their study of the Indian grape cooperative Mahagrape, conclude that upgrading capabilities were largely related to the combined attention to innovative marketing in export markets and concurrent provision of technical assistance, inputs and (market) information to the farmers.

In this article we group different upgrading options from the literature according to the value chain elements of our framework: value added production, chain-network structure and governance:

- upgrading of value added production: through innovative products and product differentiation, innovative processes and innovative marketing activities;
- value chain-network upgrading: reaching for the right market and being part of the right market channel
- upgrading of governance form: choosing the right organizational form with horizontal and vertical value chain partners.

Upgrading of Value Added Production

Most approaches to upgrading found in the literature focus on upgrading of value added production. This can take various forms:

- upgrading of products (and packaging)
- upgrading of processes
- functional upgrading (insourcing production or distribution functions)
- inter-sectoral upgrading (where chain actors introduce value adding processes from other sectors to offer new products or services: e.g. a farmer who enters into tourism activities).

Product and process upgrading are most common in developing country value chains. Functional and inter-sectoral upgrading occur less often as most developing country producers are still commodity suppliers for Western value chain partners. Giuliani et al. (2005, referring to Humphrey and Schmitz, 2002b) show that although inclusion in global value chains may facilitate product and process upgrading, *"…firms become tight into relationships that often prevent functional upgrading and leave them dependent on a small number of powerful customers''* (see also Kaplinsky and Morris 2002).

Upgrading of value added in products is always related to (potential) demands in a market. As pointed out before, these can be related to intrinsic (product quality, composition, packaging, etc.) and extrinsic product attributes, which are related to typical process characteristics. In the last decennia attention paid by Western consumers to these extrinsic characteristics has increased considerably, leading companies to increase their attention to corporate social responsibility (CSR), ranging from issues such as labor circumstances to issues such as animal welfare. This has led to a boom in the introduction of CSR principles by Western industries and retailers, offering opportunities for value added niche market production by developing country producers. Figure 5 depicts key dimensions producers and value chains can focus on when upgrading extrinsic product attributes.

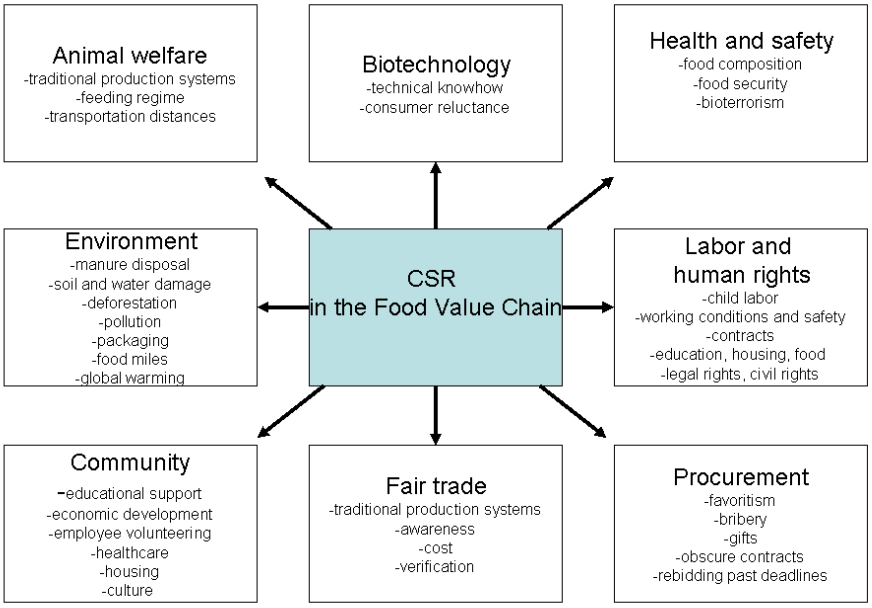

Figure 5. Dimensions of corporate social responsibility in the food chain (adapted from Maloni and Brown 2006).

Process upgrading focuses on the one hand on upgrading the product and on the other hand on optimization of production and distribution processes. The latter includes introduction of new technologies such as automated production and packaging lines, cooling installations and modern transportation technology as well as improved communication facilities in the supply chain such as internet connection, GPS systems or the intense use of mobile phones in production and transportation planning. For example, Francis and Simons (2008) describe how the processes of

the Argentina - UK red meat value chain are continuously improved via programs of waste identification, quantification and root cause elimination, to facilitate continuous learning within this value chain.

As mentioned before, a key issue for developing country producers is functional upgrading, for example to perform value adding activities in developing countries instead of just being commodity producers of products to be upgraded in the country of the Western customer. Aside from in production stages of the value chain, functional upgrading can also take place in intermediary functions, such as in the export sector, where exporters can achieve a role in collection, category management, packaging and sales of products (Dolan and Humphrey 2000). The developments in the apparel sector as described by Gereffi (1999) are a typical example of how value adding activities have been moved from developed to developing countries leading to new and more fine-meshed industry structures worldwide. Although primary processing activities, such as assembly of cars and processing of fruit juices are increasingly moved to developing countries, specialized processing, branding and marketing are still largely located in developed countries. Lowering of tariffs through the new WTO agreements and market differentiation by developing country producers as a response to increasing market segmentation in developed countries can support further development of value added production in developing countries.

Upgrading of Value Chain-network Structure

Upgrading of the network structure includes upgrading of horizontal as well as vertical relationships focusing on taking part in the right market channel. As discussed in previous sections, collaboration with horizontal partners may include joint purchasing of production inputs, joint use of production facilities and joint marketing of products. Moreover, in its most sophisticated form, horizontal collaboration might result in product differentiation combining value adding activities with other sectors of the economy (inter-sectoral upgrading). Many studies on developing country value chains focus on upgrading of horizontal relationships through the formation of producer associations or cooperatives (e.g. Roy and Thorat 2008; Bijman 2007; Rammohan and Sundaresan 2003).

An interesting example of regional upgrading is given by Fisman and Khanna (2004), who describe how the establishment of business groups in underdeveloped regions in India may support the entire development of the region. Large business groups attract supporting industries that can stimulate economic development. They can spread the costs of infrastructure buildings over more assets than a single firm. These improvements at the same time make it more enjoyable for skilled workers to live in the area. Also rotation of skilled workers is commonly used by the groups. Group firms often have an extensive supplier network that also serves them in more remote locations and they have offices in cities where the financial sector is well developed. Additionally, these groups usually have good government contacts to facilitate land-intensive projects. Establishment in less-developed regions is often supported by tax reductions.

Upgrading of vertical network (structure) relationships should focus on being part of the right channel aiming at the right market. Developing country value chains are now increasingly trying to differentiate their market outlets, which makes them less dependent on their current

customers, often Western retailers or industries. However, the previous sections have shown how difficult it is, in particular for small producers, to move to another market channel. Alternatively developing country producers might look for channels to more easily accessible markets, such as South African fresh producers accessing emerging economy markets in Asia, Brazilian pork aiming at the Russian market where quality and safety demands are less severe than in the EU, or Mango producers from Burkina Faso that aim at the Niger domestic market instead of at the European market (Nadvi 2004; Trienekens and Willems 2007; Trienekens et al. 2009; Humphrey 2006).

Upgrading of Governance Structures

Modern market-oriented chains have the tendency to become shorter (with fewer actors) as intermediaries between producers and downstream parties in the chain become superfluous because of the emergence of direct trading relationships between large producers (or producer groups) and downstream parties (e.g. Bair and Gereffi 2003). An example is the transformation of export-oriented producers to producer-exporters in some countries in order to lower transaction costs and exert full control over the supply chain. Inter-company relationships in these chains are often enforced by (transaction-specific) investments of processors or exporters (such as investments in cold stores, seeds, pesticides, credits) to decrease delivery uncertainty and increase quality and quality consistency of deliveries. In general, increased collaboration of actors in value chains may increase market power and facilitate a smooth flow of products and information.

In food chains, quality standards and certification are in particular relevant for business relationships and are often included in contracts. In vertically integrated companies certification by an independent party is of less importance, although the use of standards may be required.

Business relationships are supported by agreements between the parties involved. These can range from oral agreements to written contracts. A distinction can be made between a classical version of a comprehensive contract (where everything is fixed ex ante for the entire duration of the contract, covered by the law of contract) or a relational version (allowing for gaps not closed by contract law, embedded in a social system of relationships and subject to continuous re-negotiations). Because there is no such thing as a “complete” contract – especially not in developing countries with weakly developed institutional structures – many companies tend to prefer relational contracts implying interpersonal relationships and trust.

Horizontal collaboration between actors is in many cases considered an important enabler of value chain upgrading. Mesquita and Lazzarrini (2008), in their study of the impact of network relationships on market access, find that strong network ties between companies help substitute for the lack of a strong institutional setting to support arrangements between companies and in value chains. SMEs can exploit complementary competencies, share knowledge, technologies and inputs and develop greater responsiveness to global demands, and attain greater export levels as a result. Lu (2007, 2008), in his study into the relationship between social capital (Guanxi in China) and performance of vegetables chains, finds that producers with tighter social relationships with other economic actors in the value chain tend to be more successful.

Moreover, he shows that relationships considered traditional in these communities are of great importance to get access to modern markets.

Other studies focus on the role of clusters in upgrading. Gibbon (2001) finds that cluster-based upgrading demands an external push to be successful, such as a linkage to export networks. Giuliani et al. (2005) study relationships between clustering and innovation focusing on Latin American cases. They find that product and process upgrading may be strongly supported by knowledge and technology in related industries (e.g. plants and seeds). Also, public-private action through business-government-research institute collaboration can support innovation and upgrading processes in these clusters. Additionally, Murphy (2007) shows in a study on the Tanzanian furniture industry in Mwanza that insufficient government support and lack of collaboration due to mistrust (stealing of ideas) prevent cluster development.

In summary, upgrading of developing country value chains is related to:

- addressing markets that offer opportunities for increased value added,
- innovation in products, including marketing activities, and processes,
- vertical and horizontal organizational arrangements that enable chains to capture value from markets for various chain actors.

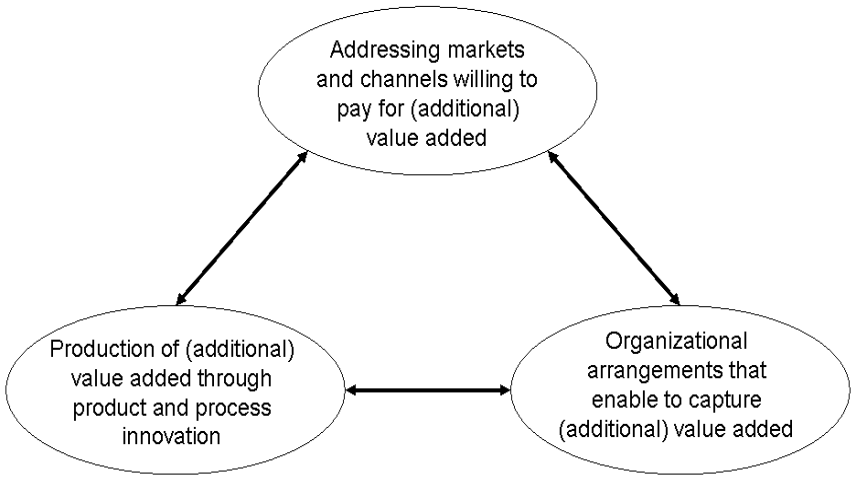

Figure 6. Developing country value chain upgrading options

Figure 6 shows the upgrading triangle. All three upgrading options are closely related. Production of value added only makes sense when there is a market for it. Distribution of value added over various actors is dependent on the governance structure (organizational arrangements) in the value chain. Organizational arrangements are closely related with power relationships in the value chain and thereby with the type of market addressed (e.g. local versus international market).

Application of the Value Chain Framework

We applied the above framework to the bottled Tawilis value chain case, as presented in Almazan et al. 2011). Tawilis is the only freshwater sardine in the Philippines, which can only be found in Taal Lake. For more than a decade, Tawilis has been processed into "Spanish sardines" in oil, more popularly known as bottled Tawilis. To date, Tawilis is reported to be exploited at the rate of 62% of the stock per year compared to the optimum of 30 to 50%. The main reason for the dwindling supply of Tawilis is the illegal operation of active fishing gear, overfishing, proliferation of cages and deterioration of water quality. In this research we investigated the current value chain and options for upgrading it towards a sustainable fish production chain. A survey among fishermen, traders and processors was performed in 2010. Figure 7 depicts the main features of the Tawilis value chain structured according to our framework.

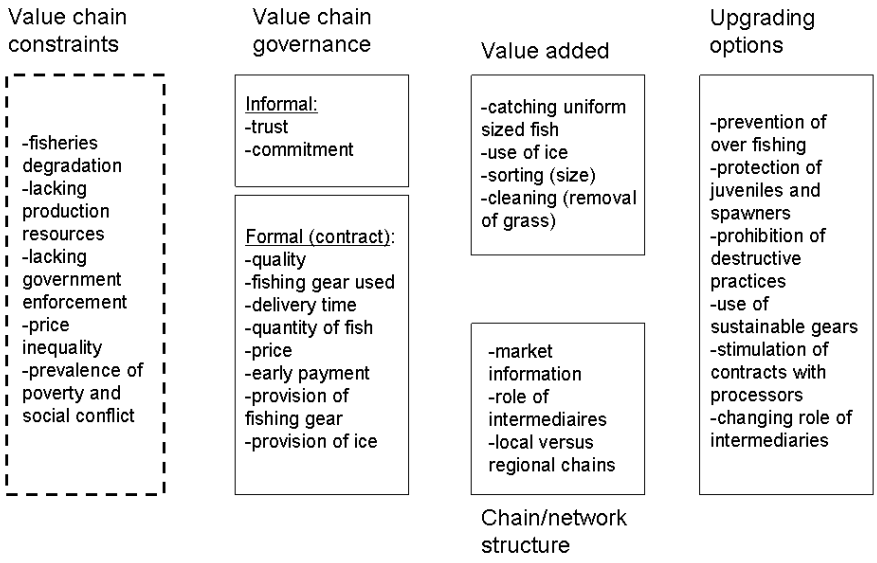

Figure 7. Main Features of the Philippine Tawilis Value Chain

Value chain constraints: Degradation of the sector has not been stopped through new government legislation or enforcement of current regulations. Fishermen also lack the means to buy the right gear or (a share in) a boat. They depend on the informal sector for credits, which prevents them from buying new fishing gear or using ice. Moreover small fishermen in particular are confronted with decreasing catches of fish, in part because of competition from larger fishing companies, leading to lower incomes of these fishermen and poverty in the fishing community.

Value chain governance: Most relationships in the value chain are long term, with family members or intermediaries who are members of the same community, based on trust and commitment. Many fishermen are dependent for credits on these intermediaries and remain with the same ones for years. Larger-scale fishermen often have formal contracts that specify product quality (size), delivery conditions, payment, and in some cases provision of fishing gear and ice.

Value added processes: The use of ice, sorting (size) and cleaning are the most important value adding processes in the current chain.

Chain-network structure: Information on local prices is well known by most actors. However, information about prices and requirements for bottled Tawilis in regional, and recently in national markets, is not shared broadly in the community. Especially for local production (by far the largest share in the current situation) intermediaries have a strong position in the chain even surpassing the position of the processors or retailers who depend on them for their supplies.

Upgrading: Upgrading of the production process through the use of sustainable gear is required in order to protect the main resources in the area (Tawilis sardines), but also for the fishermen to be able to deliver uniform-sized fish (product upgrading) to their customers. Moreover, the government should play a much stronger role in enforcement of legislation that supports this development. Upgrading of the channel (chain-network) structure can take the form of direct deliveries from fishermen to local processors or regional traders, thereby opening up opportunities for new markets. This will decrease transaction costs but also enable fishermen to enter into contracts with these processors who have the largest interest in uniform-sized fish and can reimburse quality and sustainability enhancing efforts of the fishermen. In fact one of the (preliminary) conclusions of this research is that contracts combined with transparent and formal credit facilitation between processors and fishermen may be the best guarantee for sustainable fishing practices in the future.

Reflecting on our value chain analysis framework (figure 3), value chain upgrading possibilities depend on the type of products and processes, and related value adding possibilities (uniform size and cooled fish), the market(s) addressed and possible channels to that market (through intermediaries or through direct contracts in the Tawilis chain), and finally the organizational arrangements between actors of these channels (trust and commitment alongside formal contracts for larger producers). Furthermore, these possibilities are constrained by the business environment of the value chain: market access/barriers (lack of information about more distant markets), available resources and infrastructures (lacking for small fishermen) and the institutional environment (weak enforcement regime of the government). This case shows the need and usefulness of an integrated analysis of this value chain and the role played by the elements of the framework we propose.

In the next section we will address management and policy implications for value chain upgrading which can be drawn from the framework and other studies referred to in this paper.

Management and Policy Implications

Upgrading in value chains can only be achieved through partnerships: private-private (between actors in the value chain) and public-private (between actors in the value chain and facilitated by an external party).

Upgrading by value chain actors (private-private) is in by far the most cases initiated by a lead party in the value chain (Gereffi 2005). The incentives for such a party can be access to higher quality materials or products, more efficient production and distribution processes, ensuring

supply of input materials in sufficient quantities (e.g. by a cooperative), or access to new markets. Examples of private-private upgrading have been given in previous sections, such as Unilever's inclusion of small tea producers from Kenya in its value chain or Nestle's move of value added *Nescafe* production to Brazil.

Non-chain actors can facilitate upgrading processes either by providing technological, organizational, political and educational support or by changing the macro-cultural discourse in general. For instance, in his case study on the upgrading process of the Argentinean wine industry, McDermott (2007) describes how the government facilitated the farmers in training and R&D and launched new collaborative arrangements among public and private actors. Also in other studies the presence of a third, external, party is mentioned as a major enabler of change and upgrading. For example, Perez-Aleman and Sandilands (2008), in their analysis of the sustainable production program of Starbucks, show the power of NGOs that brought about significant changes in the purchasing policies of Starbucks and also point at the presence of an independent external certification organization in the upgrading process of the value chain. Riisgaard (2009) points at different "actors for change" in defining and upgrading labor standards in the East African cut flower industry: in Tanzania the lead was taken by the labor unions, while in Kenya NGOs are the key player in the upgrading process. He also underlines the important role of Western retailers setting up CSR standards for their developing country suppliers.

However, evidence in the literature on the positive role of third parties in upgrading is far from conclusive. For example, Hanna and Walsch (2008), in their study on cooperation among small manufacturing firms, conclude that networks developed with the help of brokers were less successful than networks operated by the companies themselves. They show that networks developed with the aid of brokers focused on reducing costs and enhancing business processes, whilst firms developing their own networks focused on the ability to coordinate skills and joint targeting of market opportunities. This case shows that it is not only the parties that collaborate that enlarge chances of success but also the focus of their joint upgrading efforts.

Actors for change may include value chain actors (retailer, industry, producer cooperative) or non-chain actors (governmental organizations, NGOs or other parties in the business environment of the chain such as banking institutions or service providers). We will distinguish in value chain upgrading support from government and NGOs and support from chain actors and other economic actors.

Governments and NGOs may support value chain upgrading through legislation, regulations and policies that relax value chain constraints (figure 3). These may:

- provide market access through negotiating lower barriers for (international) trade;
- support physical infrastructure development to achieve a smoother flow of products through the value chain (better roads and distribution facilities such as storage of products and better communication infrastructures);
- give access for value chain actors to production technology and other resources through for example import subsidies, and provide access to credits;

- support knowledge infrastructure development by setting up well-functioning education systems and providing training facilities;
- provide a stable economic, political and legal climate.
- (e.g. Germott, 2007).

Businesses, in particular lead parties in the value chain, play a key role in value chain upgrading. These can be individual businesses, in many cases large companies, or groups of smaller businesses, such as horizontally organized cooperatives or producer groups (Ton and Bijman, 2006). Important activities may include:

- supporting product and process innovation linked to market requirements;
- developing and setting standards (quality, labor, environmental, trade, etc.) tuned to the possibilities and constraints of value chain producers;
- streamlining the value chain through better communication and planning and provision of communication means;
- setting up vertical governance mechanisms that facilitate a smooth flow of products and better distribution of value added;
- setting up horizontal governance mechanism to improve the power balance in the value chain and enhance the bargaining position of small producers(e.g. Ruben et al. 2007; Gibbon 2001).

A reflection on the elements contained within this framework could be useful in achieving balanced upgrading solutions for developing country value chains.

Conclusions

In this paper, we introduce value chain analysis in terms of its theoretical background and its application to value chains in developing countries. Although studies on value chains have provided valuable insights into their operations, our understanding of how value chains develop toward improved performance, termed ‘upgrading’, is limited. Most value chain studies to date focus on market relations and pay little attention to the business environment in which chain actors operate. Yet, this environment may both enable and constrain value chain upgrading processes. For a balanced analysis of value chains we proposed three key elements: network structure, of horizontal and (vertical) market channel relationships; value added, as related to the key competitive aim of any business chain; and governance, covering organizational arrangements between value chain actors. These elements should always be studied as embedded in the value chain’s business environment, where we focus on markets, resources and infrastructures and institutions. Moreover, they form the basis for our categorization of value chain upgrading options. Value chain actors may be motivated to improve their position in the chain by changing their production of value added, their relationships (governance) with other actors in the value chain and by choosing different market channels for their products. Finally, the role of non-value chain actors, such as development organizations and interest groups, in upgrading value chains has not been widely examined. However, with recent developments such as corporate social responsibility and pro-poor market development, these actors are likely to play a pivotal role in value chain upgrading.

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Strategic Group Analysis of U.S. Food Businesses Using the Two-step Clustering Method

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Abstract

Utilizing strategic group analysis, this study classifies food businesses based on their propensity toward the different generic strategies and planning intensity. Data from a national survey was analyzed using the two-step clustering method. The resultant three groups are profiled based on their generic strategies and planning efforts, as well as their planning flexibility, view of industry volatility (dynamism), strategic emphasis on innovation, innovation, size, experience and financial performance. Managerial implications are made for each of these groups based on the profiles.

Keywords: strategic group; planning; strategy; performance

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Introduction

The food processing industry may be a mature industry, but it is an important sector of the American economy. Essman (2009) estimates that this industry generates approximately one trillion in annual sales. According to the most recent Census of Manufacturers, in 2002 there were 31,000 food and beverage processing establishments in the United States, owned by 25,800 companies (Gayle 2005). More current data gathered by the United States Department of Agriculture indicated that in 2005, these plants accounted for 13 percent of the value of shipments from all U.S. manufacturing plants (Martinez 2007).

This significant industry faces enormous competitive pressures and ever changing consumer demand. Firms operating in this arena must find a way to compete. Porter (1980) notes that a firm can choose among three generic strategies: overall cost leader, differentiation, or focus/niche. The academic literature and business press are replete with suggestions on how firms ought to conduct varying functions in order to execute their decisions regarding how they choose to compete. But how does a firm know which activity to execute given a particular generic strategy? Is there a common practice of combining planning and competitive strategy choice? Does such a practice really matter with respect to firm performance?

Utilizing strategic group analysis – also referred to as typologies, gestalts, modes, archetypes, strategic scope groups, and competitive groups (Short, et al. 2008) – this study classifies food businesses based on their propensity toward the different generic strategies and planning intensity. The resultant groups are profiled based on their generic strategies and planning efforts, as well as their planning flexibility, view of industry volatility (dynamism), strategic emphasis on innovation, innovation, size, experience and financial performance. The results provide insight into firm behavior and offer suggestions for existing and nascent food companies, as well as other companies in environments similar to the food industry.

The paper begins with an overview of the various factors considered by this study. Then the data and method utilized are explained and the results presented. The paper ends with conclusions and implications for practitioners.

Literature Review

It is important for a firm in any industry to understand the competitive landscape. Dess, Lumpkin and Eisner (2010) suggest that "How firms compete with each other and how they attain and sustain competitive advantages go to the heart of strategic management" (p.156). It is the former topic, how firms compete with each other, that has motivated many researchers to conduct strategic group analysis of industries. However, strategic group analysis is but one name used for this type of research. Others include:

> typologies (e.g. Miles and Snow 1978), gestalts (Miller 1981), generic strategies (Porter 1980), modes (Mintzberg 1973), archetypes (Miller and Friesen 1978), strategic groups (Porter 1980), strategic scope groups (Houthoofd and Hene 1997), and competitive groups (e.g., Leask and Parker 2007; Short et al. 2008, 1054).

Regardless of the moniker, the intent of these studies is to group firms by like strategies. Dikmen et al. (2009) note that this type of work increases the understanding of how an industry is structured, how firms compete, and how dynamic the competitive environment is. The objective of the current study is to determine general groups of food processors based on their strategy, and as a result empirically determine the competitive structure of the industry.

Price and Newson (2003) identified three dimensions of strategy in any strategic problem: 1) strategy content, 2) strategy process, and 3) strategy context. Strategy content is the competitive strategy demonstrated by a firm. The strategy process is how the business comes to that competitive strategy. Finally, strategy context deals with the competitive environment and the business's capabilities and resources. Dikmen, et al. (2009) identify variables for all three categories and identified three distinct groups based mainly on the strategy process and context variables.

The type of competitive strategy exhibited by businesses is one such topic. Miller and Friesen (1978), Miles and Snow (1978), and Porter (1980) are three of the seminal studies in setting a typology for competitive strategy, with Porter's typology being arguably the most widely adopted. Since these studies, authors like Dess and Davis (1984) and more recently Dikmen et al. (2009), have shown that firms do exhibit a specific competitive strategy. The first group-determining criterion for the current study is the choice of generic strategy. According to Porter (1980), three generic strategies enable a firm to make sound decisions in pursuit of an advantage over their competitors in the long run: overall low cost, differentiation, and focus. Overall low cost strategy focuses on attaining the least cost position relative to competitors while not ignoring quality, service, or other product/value chain attributes. The differentiation strategy focuses on creating a novel product or upgrading existing products, which should demand higher than average market prices. Finally, a focus or niche strategy concentrates on customer segments and intensive responsiveness to those segments. Specifically, this identifies the attention paid to customer service and after-sales support. Since Des and Davis (1984) operationalized these generic strategies, several studies have explored their importance to a firm's success. Studies like Dikmen et al. (2009) and Panayides (2003) used generic strategies to conduct strategic group analysis. Other studies looked at the influence on firm performance of competitive strategies in conjunction with other factors (e.g. Baier et al. 2008; Craig et al. 2008).

Closely tied to a firm's choice of generic strategy, and thus the second group-defining criterion in the current study, is the concept of planning. It is through the process of planning that the decision regarding generic strategy is made and/or carried out. Whether formal or informal planning is the best fit for stable versus unstable market environments, is a classic debate in management research (Ansoff 1994; Ansoff 1991; Mintzberg 1991; Mintzberg 1994a, and 1994b). Brews and Hunt (1999), in an effort to put the debate to rest, reported on three studies that encapsulated other works by either reviewing multiple studies or conducting a meta-analysis (Boyd 1991; Miller and Cardinal 1994; Schwenk and Shrader 1993), and stated the inconclusive evidence in these articles was the foundation for Mintzberg (1991) favoring the learning school, or emergent style of planning. The debate has continued in recent publications (e.g., Rudd et al. 2008). This sustained effort clearly illustrates the importance of considering planning when profiling firms.

Although the current study identifies like groups based on generic strategy and planning style, other factors help to more fully explain the competitive landscape among the resultant strategic groups. The firm characteristics of concern for this study include planning flexibility, perception of industry volatility (dynamism), strategic emphasis on innovation and innovation itself. In addition, firm size and age are considered as economies of scale and experience may play a role in firm performance. Each characteristic is discussed in turn below.

As noted in articles like Brews and Hunt (1999), a counter argument to formalized planning is the need for a firm to stay flexible in the direction they are willing to take as a result of strategic planning, especially when the business environment is turbulent (Dreyer and Grønhaug 2004). Specifically, Rudd, et al. (2008, 99) define this flexibility as "…the extent to which new and alternative decisions are generated and considered in strategic planning, allowing for positive organizational change and adaptation to environmental turbulence." The need for flexibility in turbulent environments was first empirically demonstrated by Kukalis (1989). Since then, many studies have looked at the role of flexibility in a firm's success (e.g. Barringer and Bluedorn 1999; Rudd et al. 2008; Zahra et al. 2008).

Given the arguments for flexibility, it stands to reason that the firm's perception of volatility or dynamism in their business environment is important to consider. Slater and Narver (1994) found that this turbulence can reduce a firm's performance and in turn reduce the organizational slack enjoyed by a firm. Zahra, Neubaum, and Huse (1997) measured how export performance was affected by a firm's perception of industry-wide changes in advertising, manufacturing, product, and technological innovations. How a firm sees stability in their industry and their approach to planning is clearly intertwined.

Beyond planning, flexibility and dynamism, the extant literature identifies innovation as a significant factor in a firm's performance. There are primarily two facets to innovation: the strategic emphasis on innovation and practice of innovation. The strategic emphasis on innovation has been separated out as an important facet of the firm's strategy (Davis et al. 2002). As part of a strategic focus, innovativeness then would be part of the mindset or culture of the organization. It is this corporate culture of innovation that Hurley and Hult (1998) argue gives a firm a distinct advantage in innovating. Several studies have investigated the result of this process – innovation. Medina, et al. (2005) and Miller and Friesen (1982) looked at what leads firms to innovate, Dougherty (1992) looked at what impact innovation has on firms, and Baker and Sinkula (2005) looked at the interaction of innovation with other factors to explain firm performance.

In addition to the factors noted above, a firm's size and experience set may influence their ability and sophistication of planning. Pelham (1999), for example, noted that small and large firms are not on level playing fields with respect to performance. Many explanations exist, in particular the economies of scale that play a factor in cost structures, access to larger customers, and production knowledge. Swan and Newell (1995) note that smaller firms, especially micro enterprises, certainly have a different set of resources. Of course, the small firm enjoys nimbleness over its larger competitors. With a larger firm, the possibility of organizational slack increases, which can have various impacts on firms (Cyert and March 1963; Fama 1980; Jensen and Meckling 1976; Pfeffer and Salancik 1978). Size of a company is often positively correlated with experience and/or age of the firm. As a firm gains experience, it is expected that they are

learning and growing in their capabilities. The power of learning with respect to a firm's long-term performance has been well documented (Fugate et al. 2009; Senge 1990; Sinkula 1994; Wang 2008).

Data and Methods

Data for this study were collected via a mail survey of the food processing industry. A group of 4,341 food companies from across the United States was randomly drawn from a national database maintained by Dun and Bradstreet. To be included in the study, the respondent had to be in a knowledgeable management position such as CEO or owner (Floyd and Wooldridge 1994). The Salant and Dillman (1994) recommended approach for data collection for mail surveys was implemented through two waves of mailings. After removing 461 respondents due to reasons such as an incorrect address, the respondent asking to be removed from our mailing list owing to company policy, or did not meet the top management team position criterion, 360 surveys were received for a response rate of 9.3%. Of those, 324 responses completed all the relevant questions. The response rate is comparable to "…10 to 12 percent typical for mailed surveys to top executives…" (Hambrick et al. 1993), and is favorably comparable to other food industry oriented surveys (Kinsey et al. 2007).

Because of Armstrong and Overton's (1977) finding that late respondents often possess firm characteristics which were similar to those of non-respondents, non-response bias was tested by comparing a random sub-sample of fifty firms from the early respondents (Survey Wave 1) versus a random sub-sample of fifty firms from the late respondents (Survey Wave 2). No statistically significant differences were found between the two sub-samples on the studied constructs. Thus, all 324 responses were included in the analysis.

The survey was constructed to obtain respondents' answers to multiple questions per construct or latent variable. These constructs include: planning intensity (PLAN), three measures of competitive strategy (overall least cost (OLC), product differentiation (PROD), customer satisfaction (CUST)), strategic flexibility (FLEX), dynamism (DYN), strategic emphasis on innovation (STINOV), innovation (INOV), and three measures of firm performance (PERF, GROWTH, PROFIT). In addition, number of employees (EMP) and firm age (AGE) were measured as proxies for size and experience. The relevant parts of the questionnaire are presented in the Appendix. Where appropriate, the language of each established scale was modified to fit the food industry. Select statistics for each of the scales are provided in Table 1.

Table 1. Descriptive Statistic and Cronbach's Alpha (n = 324)

Scale	Mean[a]	S.D.	Alpha
PLAN	2.98	.79	0.85
OLC	2.82	.89	0.70
PROD	3.42	.82	0.75
CUST	3.84	.73	0.66
FLEX	3.62	.73	0.86
DYN	2.84	.76	0.82
STINOV	3.07	.74	0.78
INOV	3.13	.99	0.74
PERF	2.46	.81	0.84
GROWTH	2.88	1.00	0.76
PROFIT	2.99	1.14	0.95

[a]Measures were summated and then divided by the number of items for each respective measure.

The group-defining criteria scales are both a five-point scale anchored by "Not at All" and "To an Extreme Extent." A foundational study in measuring a firm's planning effort is Brews and Hunt (1999). The current study, for reasons of parsimony and multicollinearity, condensed the Brews and Hunt's (1999) Likert scales down to a four item scale that collectively measured the formality of the planning objectives (ends) and processes (means). The reduction of scale items did not hinder the reliability of this scale ($\alpha>0.65$). Generic strategy, the second set of group-defining criteria, is measured by a 15 item scale that was adapted from Dess and Davis (1984) by Davis, Dibrell and Janz (2002).

The scales used to measure the other factors noted in the literature review are also well established scales. Planning flexibility (FLEX), which measures how smoothly a firm's strategic plan reacts to changes in the environment, was a six item scale adopted from Barringer and Bluedorn (1999). A six item scale from Zahra, Neubaum, and Huse (1997) was used to measure perceived industry-wide changes in advertising, manufacturing, product, and technological innovations – or dynamism (DYN). The level of strategic emphasis on innovation (STINOV) was measured by a scale formulated by Dess and Davis (1984). This scale is made up of a subset of the competitive strategies scale. It was chosen as it focuses on a firm's strategic emphasis on innovation and does not delineate between product and process innovations. Finally, a three item scale measuring a firm's R&D, product, and marketing innovations compared to industry norms (INOV) was taken from Miller and Friesen (1982).

Proxies were used to represent the size of the firm and its experience set. As the food industry is a fairly labor intensive industry, the number of full-time employees (EMP) was selected to represent the size of a firm. The number of employees was identified on a 6-point scale ranging from less than 5 to greater than 500. Using firm age as a proxy for experience, the number of years the firm has been in operation (AGE) was assessed on a 6-point scale ranging from less than 3 years to more than 30 years.

Although it is not the objective of this study to determine the causation of performance but rather profile strategic groups of firms, it is imperative to note if the groups of firms differ with respect to performance. As publicly available financial performance data (archival or secondary forms) do not exist for the privately held firms, the approach recommended by Dess and Robinson (1984) and other scholars in this area (e.g. Davis et al. 2002; Matsuno and Mentzer 2000) was executed. Dess and Robinson (1984) found that self-reported data is comparable to archival sources of financial results and suggest this method is appropriate for studies of firms for which archival sources of financial data are unavailable. Firms in this study identified how their financial performance compared to competitors in the industry using quintiles. This five item scale is a broad measure of overall firm performance (PERF); and then two sub-constructs with two and three items, respectively, were used to measure growth (GROWTH) and profit (PROFIT) of the firm.

The items associated with a construct were averaged for each respondent to obtain a single score. This was done for each of the multi-item scales and these mean scales were used in the analysis. The two-step clustering method in SPSS 17 was utilized for the cluster analysis because it allows for mixed variable types and a larger dataset (Norušis 2008). The method gets its name from the use of two distinct steps. The first step is developing preclusters and the second is the

hierarchical clustering of the preclusters. Despite checking for outliers using bi-variate and multivariate methods, the procedure was allowed to identify outliers in the clustering process. In addition, the Schwarz Bayesian Criterion was used for the information criterion, the continuous variables were standardized, and the number of clusters was not fixed. The log-likelihood estimation process was used to calculate the clusters.

When possible, an ANOVA was used to test for homogeneity between groups for a given variable. However, when the assumption of variance homogeneity is violated, which was tested for by using the Levene Statistic, the Welch F was used to compare groups of means for homogeneity. When homogeneity between groups failed, paired comparisons were done using one of two methods: Tukey's test when variances were homogeneous and Tamhane's T2 test when they were not.

Results

Table 2 shows the dispersion of cases based on the cluster analysis. The analysis identified two outliers and 38 cases were omitted due to list wise deletion of missing data. Cluster 1 has the largest percentage of observations (41%) with the remaining two clusters being of similar size.

Table 2. Cluster Descriptive Statistics

		Total Observations	Percentage of Combined	Percentage of Total
Cluster	1	148	46.00%	41.10%
	2	91	28.30%	25.30%
	3	81	25.20%	22.50%
	Outliers	2	0.60%	0.60%
	Combined	322	100.00%	89.40%
	Excluded Cases	38		10.60%
	Total	**360**		**100.00%**

For each of the three clusters –descriptive statistics for the mean scales of interest in this study, including the variables used in determining the clusters –are provided in Table 3. Given the nature of the scales, an interpretation of the absolute score is not meaningful, but rather a relative comparison is the focus. A casual observation shows that all three clusters have similar emphasis on customers, and that variable has the highest mean of the competitive strategy scales for all three clusters. Beyond this similarity, there are substantial differences between clusters in the way they plan and the competitive strategies emphasized. Cluster 2 predominantly has the lowest average of the three clusters. Between Clusters 1 and 3, Cluster 3 conducts more planning and focuses more on providing products at a low cost, whereas Cluster 1 has a stronger emphasis on product differentiation.

The clusters also fall into similar patterns with the other variables of interest. Cluster 2 again has the lowest scores with respect to flexibility, strategic innovation, and innovation, as well as all the performance variables. While Cluster 3 has the highest score for flexibility and performance,

Cluster 1 has the highest for strategic innovation and innovation. All three clusters have similar results for how tumultuous they see their industry (dynamism).

Table 3. Mean and Standard Deviation of Strategy and Performance Variables

	Cluster		
	1	2	3
PLAN	2.97	2.72	3.30
	(0.78)	(0.76)	(0.73)
OLC	2.83	2.50	3.17
	(0.87)	(0.79)	0.92)
PROD	3.67	3.02	3.40
	(0.68)	(0.94)	(0.76)
CUST	3.88	3.71	3.89
	(0.76)	(0.66)	(0.75)
FLEX	3.66	3.44	3.75
	(0.73)	(0.79)	(0.63)
DYN	2.81	2.86	2.86
	(0.75)	(0.78)	(0.78)
STINOV	3.24	2.73	3.15
	(0.63)	(0.74)	(0.79)
INOV	3.37	2.71	3.15
	(0.94)	(0.94)	(1.01)
PERF	2.41	2.23	2.79
	(0.79)	(0.75)	(0.79)
GROWTH	2.86	2.46	3.36
	(0.97)	(0.86)	(0.98)
PROFIT	2.93	2.78	3.31
	(1.15)	(1.10)	(1.12)

In addition to the scales, the employee size classification, age and main sales channel (e.g. selling into retail, restaurants, and industrial distribution channels) are compared between clusters. Figure 1 shows how the makeup of these clusters differs with respect to the number of employees. Although clusters 1 and 2 are very similar, Cluster 1 does have firms with 50-99 employees and Cluster 2 has none. Cluster 3 clearly is comprised of the larger firms. Figure 2 depicts the distribution of firm ages. Cluster 1 is clearly the youngest group and Cluster 2 the oldest. However, Cluster 3 tends toward the older category. Table 4 shows how the average percentage of sales by market channel compares across clusters. The means are quite similar between clusters across the various market channels of retail, food service, industrial and other. Statistical tests (ANOVA, Welch, Tamhane), indicate that there is no statistical difference of mean sales percentage by market channel across the clusters.

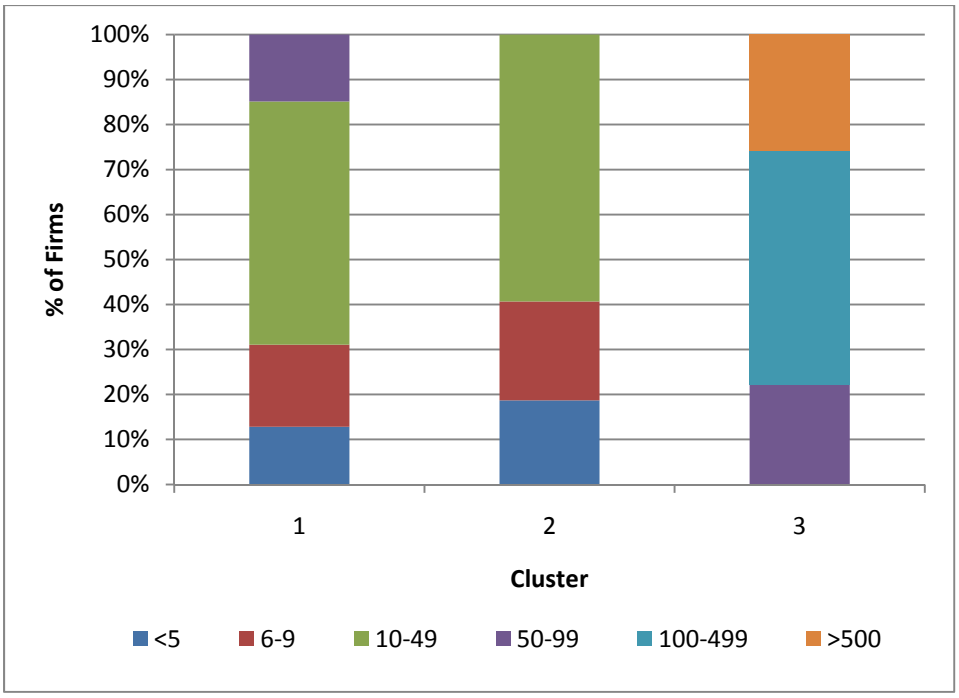

Figure 1. Number of Employees by Cluster

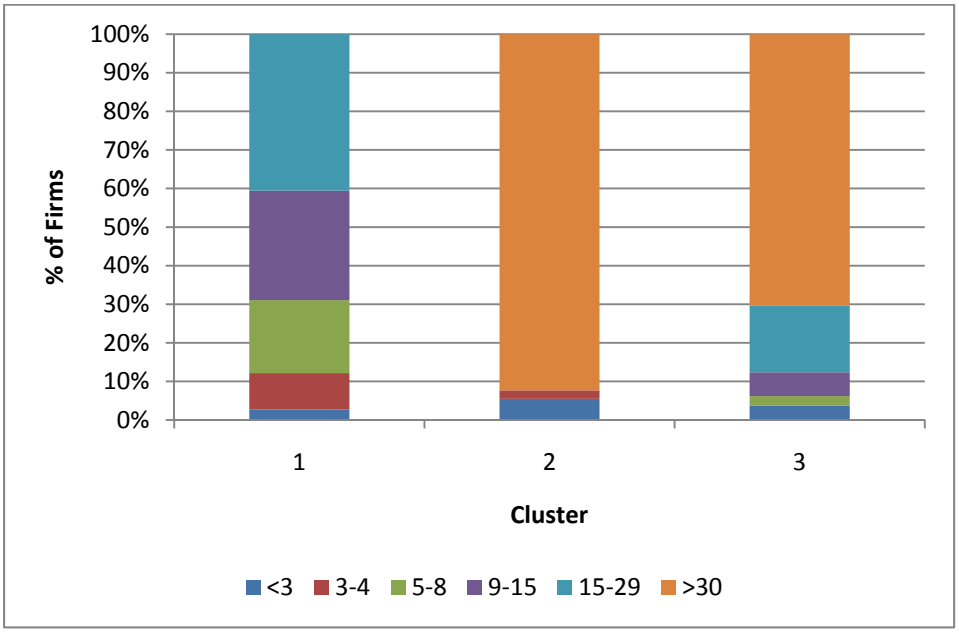

Figure 2. Firm Age Cluster Profile

Table 4. Average Percentage of Sales: Market Channel by Cluster

Cluster	Retail	Food Service	Industrial	Other
1	45.1	26.7	12.9	15.3
2	56.1	20.4	14.5	9.0
3	45.2	26.6	18.7	9.5

The differences noted above between clusters are made by comparing the relative values. For more meaningful comparisons, the mean scales are tested for statistical differences to validate the preliminary results about each cluster's primary strategic focus, planning effort and other factors. In order to utilize an ANOVA test, the variances must be homogeneous between clusters. The Levene Statistic Test indicated PROD and STINOV did not have homogeneous variances across clusters. For these variables, the Welch Test statistic was utilized. These tests revealed that statistical differences in means do exist between clusters for PLAN, OLC, PROD, FLEX, STINOV, INOV, PERF, GROWTH, and PROFIT (Table 5). The two variables that had no statistical differences were CUST and DYN, meaning the firms view customer orientation and the dynamic nature of their industry identically across clusters.

Table 5. ANOVA and Welch Test Results for Mean Scales

		ANOVA				
		Sum of Squares	df	Mean Square	F	Sig.
PLAN	Between Groups	14.29	2	7.15	12.32	0.000
	Within Groups	183.82	317	0.58		
	Total	**198.12**	**319**			
OLC	Between Groups	19.31	2	9.65	12.99	0.000
	Within Groups	235.55	317	0.74		
	Total	**254.85**	**319**			
CUST	Between Groups	1.99	2	0.99	1.88	0.155
	Within Groups	167.79	317	0.53		
	Total	**169.78**	**319**			
FLEX	Between Groups	4.51	2	2.25	4.31	0.014
	Within Groups	163.29	312	0.52		
	Total	**167.80**	**314**			
DYN	Between Groups	0.21	2	0.10	0.18	0.838
	Within Groups	180.75	308	0.59		
	Total	**180.96**	**310**			
INOV	Between Groups	23.59	2	11.80	12.88	0.000
	Within Groups	272.97	298	0.92		
	Total	**296.56**	**300**			
PERF	Between Groups	13.50	2	6.75	11.09	0.000
	Within Groups	178.40	293	0.61		
	Total	**191.90**	**295**			
GROWTH	Between Groups	33.17	2	16.59	18.68	0.000
	Within Groups	264.61	298	0.89		
	Total	**297.79**	**300**			
PROFIT	Between Groups	12.34	2	6.17	4.85	0.008
	Within Groups	375.13	295	1.27		
	Total	**387.47**	**297**			

	Welch Robust Tests of Equality of Means				
	Test	Statistic[a]	df1	df2	Sig.
PROD	Welch	16.85	2	169.81	0.000
STINOV	Welch	14.90	2	170.07	0.000

To determine which clusters have statistically different means per variable, two post hoc tests are used. Tukey is a post hoc test that uses pairwise comparisons of the means and t-tests to identify significant differences. Tamhane is another post hoc test similar to the Tukey test that is used when group variances or sample sizes are unequal. The results of these tests at a 5% significance

level are presented in Table 6 (CUST and DYN were omitted from this table as the previous results showed there was no significant difference between clusters).

Table 6. Pairwise Comparisons between Clusters for Mean Scales

	Cluster Comparison*			
	1 vs. 2	1 vs. 3	2 vs. 3	Test
PLAN	>	<	<	Tukey
OLC	>	<	<	Tukey
PROD	>	>	<	Tamhane
FLEX			<	Tukey
STINOV	>		<	Tamhane
INOV	>		<	Tukey
PERF		<	<	Tukey
GROWTH	>	<	<	Tukey
PROFIT		<	<	Tukey

*Inequalities within the table indicate relative size of means between cluster means and only appear when the pair is statistically different at a 5% level.

The respective mean values of planning, overall least cost, and product differentiation strategies are statistically significantly different across the three clusters. The values for the three decision criteria (planning, overall least cost, product differentiation) have statistically the lowest mean values in Cluster 2. This indicates that firms in this cluster do not have an outstanding competitive strategy (i.e. beyond the minimum competency indicated by the consistent score for customer focus – CUST), nor as intensive a planning focus compared to the other clusters. The primary strategic focus of Cluster 1 is on product development; Cluster 3 has strategic foci on planning and overall least cost (OLC). In reporting these differences, it is important to note that each of the three clusters has a strong customer strategic focus (see Table 1).

The other factors considered in this study but not used in determining clusters include dynamism, flexibility and innovation. All three are measurably different between clusters. Cluster 2 had the lowest means for flexibility, dynamism, strategic innovation, and innovation. The differences between Cluster 2 and the other two clusters proved to be statistically significant for strategic innovation and innovation. In addition, Cluster 2 had a statistically significantly lower score for flexibility than Cluster 3. The two variables of STINOV and INOV are significantly different between Clusters 1 and 2. In other words, Cluster 1 has a greater degree of strategic innovation and innovation than Cluster 2.

These findings indicate that cluster analysis has stratified the data into three distinct arrays. The measures of statistically significant variables are summarized below and depicted graphically in Figure 3. Cluster 3's high performance levels coincide with larger, older firms that pay the most attention to business strategy planning, are most committed to overall least cost competitive strategy, and have the greatest flexibility of all the clusters. This cluster group could be classified as older, larger, aggressive firms. Cluster 2's low performance levels on the other hand relate to smaller firms that pay little attention to strategic planning, have the lowest focus on any competitive strategy, and have the lowest flexibility and innovation scores. This cluster of firms is most aptly classified as lifestyle firms. Lifestyle firms focus on maintaining their quality of life, looking to grow only to keep ahead of inflation, and subsequently putting the minimum

required effort into strategic planning. Finally, Cluster 1 firms, although presenting mediocre performance levels relative to Cluster 3 firms, are younger firms that pay moderate attention to planning and are oriented the most to product differentiation and innovation. They can be classified as young, dynamic, up and coming firms with novel products.

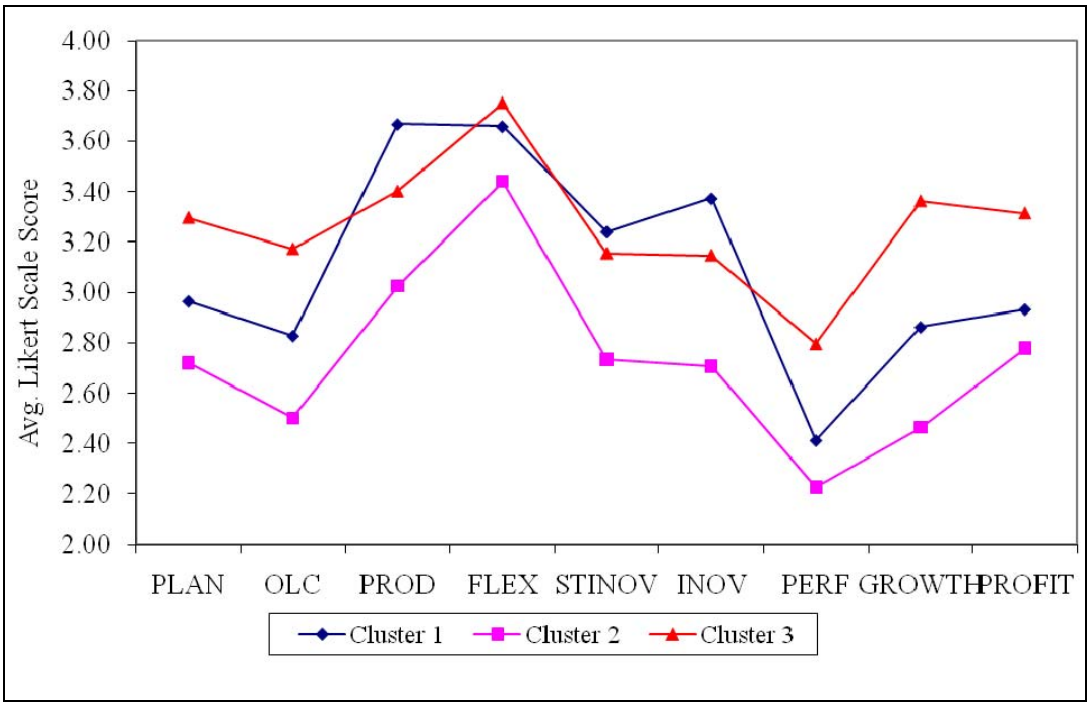

Figure 3. Cluster Profiles for Statistically Different Measures

Discussion and Conclusions

Given the focus of this study is on food manufacturers, generalization to all manufacturing is not possible. However, the findings from this study provide insight into the competitive landscape of the food manufacturing industry, and these lessons may be applicable to other mature industries like the food processing industry. Our specific results indicate that all of the firms offer a minimum level of customer service, leading to the conclusion that some level of focus on customer needs and desires is a necessary strategy for success – and is a minimum competency for competition in the industry.

Further analysis separated the food businesses into three distinct groups which we describe as a.) Differentiators (Cluster 1) – smaller firms with a differentiated but good focus and attention to strategy and planning – "slow and steady wins their race"; b.) Lifestylers (Cluster 2) – firms along for the ride, tending to "do as we always have"; and, c.) High performers (Cluster 3) – larger, more aggressive firms which focus on low costs and have the most formal planning among firms in the study.
Management implications that follow from the findings of this study are: a.) smaller, newer food companies, may find it productive to differentiate and "dig-in for the long haul;" b.) larger food firms, many "firing on all cylinders" (from a growth and profitability standpoint), may find their

greatest threat comes from within their group; c.) Lifestyler food companies should not expect much from overall growth, performance and profit, but can expect to be content with the "status quo."

"One size fits all" does not apply when it comes to the planning and strategic choice of food businesses. The analysis in this study found three distinct types of firms. First, there is the Lifestyler firm (Cluster 2) that is focused on making a modest "living," usually by focusing on a fringe market. Second, there is the High Performer firm. These are companies that tend to be larger and focus on multiple objectives. Finally, there is the Differentiator firm, the one that can match the High Performers in some categories, but which lack the economies of scale usually associated with the High Performers. What sets them apart is their ability to differentiate their products and services. For these firms, there arises the potential for an exit strategy to sell their proven differentiated product to a High Performer.

Each type of company has their strength, but they also face unique challenges. For example, the High Performer's approach of multiple foci can lead to greater performance as measured by GROWTH and PROFIT; however, this approach requires sufficient size and access to resources to be successful. Even with access to resources, these multiple foci can result in being distracted and subsequently being leapfrogged by other High-Performers. While the Differentiator can match the larger High Performer with respect to capabilities of flexibility, strategic innovation and innovation, if the company wants to pursue growth they must rely on a differentiation strategy. Finally, while the Lifestyler can make a modest "living," they are always at risk. Depending on the loyalty of their customer base, they could be displaced by the more aggressive High Performers or Differentiators.

As a result of this study, managers of food companies better understand their competitive environment, and thus are more informed when they themselves conduct planning and choose their strategy. Managers in other industries could also take lessons in how to consider their industry's competitive environment based on the process presented in this study. Of course, an explicit study within their industry would be needed for exact knowledge, but at the very least the process laid out here is food for thought.

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Appendix

STRATEGIC PLANNING (PLAN) – Brews and Hunt (1999)

1. When formulating strategy **in your business**, how many OBJECTIVES are usually specified?
___None ___Very few ___Some ___Quite a few ___A large number

Please indicate the extent your business emphasizes these activities as part of your *planning process*.	**Not at all**				**To an extreme extent**
2. To what degree are the objectives that result from the strategy formation process formalized and documented?	1	2	3	4	5
3. To what degree are strategy implementation plans developed as a result of the strategy formation process?	1	2	3	4	5
4. How closely are your business' strategy implementation plans followed as your company attempts to implement the strategy objectives?	1	2	3	4	5

STRATEGY (OLC, PROD, CUST)* Davis, Dibrell and Janz (2002)

Please indicate the extent your business emphasizes these activities as part of your *competitive strategy*.	**Not at all**				**To an extreme extent**
1. Developing new products	1	2	3	4	5
2. Upgrading existing products' appearance and performance	1	2	3	4	5
3. Producing specialty products	1	2	3	4	5
4. Emphasizing products for high price market segments	1	2	3	4	5
5. Higher production efficiency than competitors	1	2	3	4	5
6. Maintaining low levels of inventory	1	2	3	4	5
7. Investing in new R&D facilities to gain a competitive advantage	1	2	3	4	5
8. Customer service (including after sales support)	1	2	3	4	5
9. Effective control of channels of distribution	1	2	3	4	5
10. Quick delivery and immediate response to customer orders	1	2	3	4	5
11. Tight control of selling/general/administrative expenses	1	2	3	4	5
12. Innovation in marketing techniques	1	2	3	4	5
13. Innovation in production processes	1	2	3	4	5
14. Procurement of raw materials	1	2	3	4	5
15. Higher quality standards than competitors	1	2	3	4	5

* OLC – items 5, 7, & 13; PROD – items 1, 2, 3, & 4; CUST – items 8, 9, & 10
items 6, 11, 12, 14, & 15 failed to load properly using confirmatory factor analysis

STRATEGIC FLEXIBILITY (FLEX) – Barringer and Bluedorn (1999)

Please indicate your evaluation of how flexible your business's strategic planning process could be in response to the following events.	**Not at All Flexible**				**Very Flexible**
1. The emergence of a new technology that adversely affects your existing business.	1	2	3	4	5
2. Opportunistic shifts in economic conditions.	1	2	3	4	5
3. The market entry of new competition.	1	2	3	4	5
4. Adverse changes in government regulations.	1	2	3	4	5
5. Opportunistic shifts in customer needs and preferences.	1	2	3	4	5
6. The emergence of an unexpected market opportunity.	1	2	3	4	5

DYNAMISM (DYN) – Zahra, Neubaum and Huse (1997)

Please indicate your evaluation of CHANGE in your industry for each of the following.	**Very Little**		**Moderate**		**Very High**
1. Extent of industry-wide spending on advertising has been	1	2	3	4	5
2. Extent of industry-wide promotional activities has been	1	2	3	4	5
3. Extent of overall innovations has been	1	2	3	4	5
4. Extent of manufacturing innovations in your industry has been	1	2	3	4	5
5. Extent of product innovations has been	1	2	3	4	5
6. Extent of technological innovations has been	1	2	3	4	5

INNOVATION (INOV) – Miller and Friesen (1982)

Please indicate the choice that best approximates how your business compares with other companies in your industry in relation to innovation.

1.	There exists a very strong emphasis on marketing of tried and true product/services	1	2	3	4	5	There exists a very strong emphasis on R&D, technological leadership, and innovations
2.	No new lines of products, services, or programs were introduced during the past three years	1	2	3	4	5	More than half of our product lines or services were introduced during the past three years
3.	Changes in product lines have been minor over the last three years	1	2	3	4	5	Changes in product lines have been major over the last three years

STRATEGIC INNOVATION (STINOV) – Dess and Davis (1984)

Please indicate the extent your business emphasizes these activities as part of your *competitive strategy*.	Not at all		To a moderate extent		To an extreme extent
1. Developing new products	1	2	3	4	5
2. Upgrading existing products' appearance and performance	1	2	3	4	5
3. Producing specialty products	1	2	3	4	5
4. Investing in new R&D facilities to gain a competitive advantage	1	2	3	4	5
5. Innovation in marketing techniques	1	2	3	4	5
6. Innovation in production processes	1	2	3	4	5

PERFORMANCE (PERF, GROWTH, PROFIT)* – Dess and Robinson (1984)

Please indicate the category that in your opinion best approximates how your business compares with other competitors in your industry over the most recent year.	Bottom 20%	Next Lowest 20%	Middle 20%	Next Highest 20%	Top 20%
1. Total sales growth	1	2	3	4	5
2. R&D as a percentage of sales	1	2	3	4	5
3. Total market share growth	1	2	3	4	5
4. After-tax return on total sales	1	2	3	4	5
5. After-tax return on total assets	1	2	3	4	5

* PERF – items 1 – 5; GROWTH – items 1 – 3; PROFIT – items 4 & 5

FIRM SIZE - EMPLOYEE NUMBERS (EMP)

How many full-time employees does your business employ?

___ <5 ___ 6-9 ___ 10-49 ___ 50-99 ___ 100-499 ___ >500

EXPERIENCE - FIRM AGE (AGE)

How many years has your business been in operation?

___ <3 years ___ 3-4 years ___ 5-8 years ___ 9-15 years ___ 15-29 years ___ >30 years

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Determinants of Willingness to Purchase Organic Food: An Exploratory Study Using Structural Equation Modeling

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Abstract

The global organic food market has grown tremendously over the past decade. The present study investigated the determinants of willingness to purchase organic food among consumers in a Malaysian city, using a questionnaire survey. The Theory of Planned Behavior informed the research framework and hypotheses. Using structural equation modeling, attitude, subjective norms and affordability (behavioral control) were modeled to impact intention or willingness to pay (WTP) for organic food. WTP in turn predicted actual purchase. Attitude and subjective norms exerted significant positive effects on WTP while the effect of affordability was not significant. Attitude further impacted subjective norms and affordability, thus indicating that efforts to promote consumption growth should focus on influencing consumer attitudes.

Keywords: organic food, management, SEM

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Introduction

The consumption of organic food has grown remarkably, both in developed and developing countries. Food and Agricultural Organization (2009) estimated that the value of global market for organic food has reached $45 billion (USD) in 2007. Although organic food comprises only a small fraction of the food market, its rapid growth has generated much interest among consumers, businesses as well as researchers. In Asia, the demand for organic food grew by 15 to 20 percent annually during the last decade (Helga and Lukas 2009). Its growth can be traced, *inter alia*, to concerns over the negative environmental impact of conventional agricultural practices, as well as the potential long-term effects of consuming genetically modified food (e.g. Zepeda and Leviten-Reid 2004; Zepeda and Li 2007).

At present, the term organic food remains loosely defined along dimensions such as *biological, naturally produced, green, environmentally friendly, sustainable* and *limited use of artificial chemicals* (Klonsky and Tourte 1998; Goldman and Hylton 1972; Torjusen et al. 1999). Organically produced food is generally regarded as healthier, safer, better tasting and more nutritious than conventionally produced food (Perrini et al. 2009; Krystallis and Chryssohoidis 2005). In spite of these, the relatively higher prices of organic food, together with lack of availability, lack of awareness of the organic concept and uncertainty over the truthfulness of organic food claims are hindering more widespread consumption (Krystallis and Chryssohoidis 2005).

Previous studies on organic food consumption concentrated primarily in the United States and the European continent. Relatively little is known of consumers' perception of organic food in Asia (Roitner-Schobesberger et al. 2008). In particular, there is a paucity of studies on consumption trends in South-East Asian countries (i.e. Singapore, Thailand, Indonesia, Malaysia, Vietnam, etc.) even though the region represents some of the most promising markets for organic food.

Malaysia for instance, offers valuable case studies on how consumers in emerging economies are embracing the organic lifestyle. Although the country has a small population of 27.4 million, it is considered an upper-middle income country by the World Bank and viewed as among the most developed of the world's emerging economies. EIU (2010) estimated that annual private consumption per head in the country has risen by 43.3 percent between 2005 and 2009, to 3,395USD. The aspirations of the middle-income Malaysian consumers reflect those in other developed economies. However, differences in their purchase behaviors are likely to persist due to cultural influences.

The characteristics of the Malaysian culture offer insight into their purchasing behaviors in relation to organic food products. Hofstede (1991) described Malaysia as a collectivist society that is characterized by high uncertainty avoidance and high power distance. Consumers from a high uncertainty avoidance culture are more likely to be uncomfortable with trying unfamiliar products and deviating from established consumption habits. Due to the credence nature of organic food, Malaysians are likely to be more cautious and skeptical of the genuineness of organic food labels as well as their benefits. With a lower average spending power as compared

to consumers in more developed countries, Malaysians are less likely to take risks in consuming organic food products if they are not assured of the benefits and genuineness of these products.

As a society with high power distance, Malaysians are also very conscious of their social ranks and tend to accord higher regard for individuals with higher social status or possessing expert knowledge in a domain. This implies that they may be more likely to consume organic food if they are advised to do so by experts or significant others. Likewise, they also tend to place higher trust on the quality of products that are accredited by agencies from more developed countries such as the United States, Australia and Japan.

The cultural traits of Malaysian consumers suggest that demand for organic food products may be more sustained and predictable. This is because the bulk of consumption are expected to be by consumers who are already convinced of the benefits and genuineness of organic food and are 'committed' to the organic lifestyle. They are also less likely to switch products due to their risk avoidance.

The Malaysian Agricultural Research and Development Institute which spearheads efforts to modernize the country's agricultural sector noted that the local organic food industry is still very small. More than sixty percent of organic food products are imported and these are required to carry a reliable label of "certified organic" from the exporting countries. Perception and understanding of organic production revolve mainly on the non-use of synthetic fertilizers and pesticides. In general, there is a lack of awareness among producers, retailers and consumers of the wider extent of organic production and processing standards in both local and international markets.

The primary objective of the present study was to investigate the main factors that influence the consumption of organic food among Malaysian consumers. Currently, little is known of the psychosocial and psychological factors that are associated with organic food purchase behavior. The results of the study can therefore provide insights for marketers on the key variables that could be used for promoting more widespread consumption in the country.

Theory and Hypotheses

A major theory that informs studies on consumer behavior is the Theory of Planned Behavior (Ajzen 1991). The theory argues that an individual's intention to perform a behavior is influenced by a combination of behavioral attitudes (i.e. a person's beliefs about the desirability of behaviors); subjective norms (i.e. a person's perceived relevance and importance of opinions of significant others); and behavioral control (i.e. a person's sense of control over behavior) (Ajzen 1991). These are elaborated as follows.

Attitude

An individual's attitude towards consuming a product is one of the most important antecedents for predicting and explaining consumers' choices across products and services, including food products (Honkanen et al. 2006). Jung (1971) defines attitude as a psychological construct which represents an individual's readiness to act or react in a certain way. It is a relatively enduring

evaluation of an object against alternatives, and is based on an individual's thoughts (cognition), beliefs (values) and emotions (affection) towards the object (Hoyer and Maclnis 2004; Rokeach 1973; Dossey and Keegan 2009).

Previous studies have associated organic food consumption with behavioral attitudes such as health consciousness, environmental consciousness, trust of organic food claims and desirability of organic food attributes such as taste, texture, freshness (Hughner et al. 2007; Gil and Soder 2006; Thogersen 2006; Aryal et al. 2009).

A person who has strong health values is likely to accept the importance of exercise, maintain a healthy diet, refrain from smoking and consume moderate amounts of alcohol (Bephage 2000). As organic food is generally regarded as more nutritious and safer than conventionally-produced food, health-conscious individuals are more likely to develop positive attitudes towards the health enhancing attributes of organic food (Michaelidou and Hasson 2008). In First and Brozina's (2009) study on the impact of cultural differences on organic food consumption among consumers in West European countries, the researchers reported that while the impact of cultural dimensions varied among the consumers, all exclusively considered health as the prime motive for consumption. Likewise, Roitner-Schobesberger et al. (2008) found that health consciousness was a main motive to purchase organic food in Thailand, particularly when consumers are concerned with residues from synthetic chemicals used in agriculture. Environmental consciousness was a key determinant in a study (Honkanen et al. 2006) on Norwegian consumers. They investigated the ethical motives in consumers' choice of organic food and found that environmental and animal rights issues had a strong influence over attitudes towards organic food. Specifically, the more concerned consumers are about these issues, the more positive their attitudes will be and the more likely they will consume organic food.

Luhmann (1979) defines trust as confidence in one's expectations, where desirable conducts are viewed as certain while undesirable conducts are removed from consideration. Trust of organic food claims is a strong determinant of intention to consume due to the credence nature of organic food. Credence products are those for which consumers are not able to evaluate effectively as the benefits of consumption cannot be directly or immediately observed. Consequently, consumers may rely on product labeling, advertisements and certifications as signals of the trustworthiness of product claims. The extent that these engender consumer trust will therefore influence the intention to consume organic food. Perrini et al. (2009) found that Italian consumers were more likely to trust retailers of organic products if they believe the retailer is committed to respecting their rights and the environment.

In sum, a favorable attitude towards organic food is likely to strengthen an individual's intention to purchase or consume. It is therefore hypothesized that:

H1: Health & environmental concerns, trust on organic food claims and perceptions of organic food attributes together form the attitude towards organic food.

H2: A positive attitude towards organic food positively impacts willingness to purchase organic food.

Subjective Norms

Subjective norms concern the perceived social pressures to undertake or not undertake a behavior (Ajzen 1991; O'Neal 2007). Individuals' subjective norms reflect their beliefs about how others, who are important to them, would view them engaging in a particular behavior. McClelland's (1987) theory of needs suggest that individuals tend to perform behavior that is deemed desirable by loved ones or referent group, due to their need for affiliation and group identification. In this vein, individuals' intention to consume organic food are likely to be strengthened if they believe that their loved ones expect them to do so, or they wish to be identified with other individuals who are consuming organic food (Chen 2007). It is therefore hypothesized that:

H3: Subjective norms will positively influence willingness to purchase organic food.

Behavioral Control

Perceived behavioral control concerns individuals' perceptions on the extent they are able to perform a given behavior (Ajzen 1991). Underlying such perceptions is their beliefs about the relative ease or difficulty in performing the behavior and the extent that performance is up to them (Ajzen, 2002, cited in Tarkiainen and Sundqvist, 2005). Where performance of a behavior is deemed to be relatively easy and within the means of the individual, intention to perform the behavior will be strengthened. A number of studies have operationalized affordability as a subset of behavioral control, in influencing behavioral intention (Thompson and Thompson 1996; Notani 1997; Oh and Hsu 2001). Affordability by conventional definition concerns the ability to bear the cost without serious detriment to the capacity for action. For consumers, affordability is intimately associated with monetary and search (convenience) costs. ACNielsen (2005) reported that higher monetary cost was perceived as the main barrier to organic food consumption for one third of respondents in Asia Pacific and over 40 percent of European and North American consumers. Likewise, limitations in supplies and distribution channels were seen as factors that increase the cost of sourcing for organic food. Cost and convenience are therefore, hypothesized as constituting the affordability construct in this study which may impact intention to purchase organic food.

H4: Cost and convenience form perception of affordability of organic food.

H5: High affordability positively impacts willingness to purchase organic food.

Methodology

A questionnaire survey was undertaken to gather data from a sample population of consumers in Kuching, the capital city of largest state in Malaysia. Target respondents were identified using the following criteria: (a) they are at least 18 years old; (b) are engaged in full-time employment or tertiary education; (c) are able to respond comprehensively to an English-language survey questionnaire and (d) have consumed organic food products for at least one year. An initial fieldwork had shown that English proficiency among consumers who made actual purchases of household groceries and organic food is low to moderate. Hence, to ensure the accuracy of

responses, target respondents were selected using purposive sampling method where field assistants approached potential respondents and verified that the latter meet the sampling criteria before distributing a survey questionnaire.

Over a five-week period, 570 questionnaires were distributed and 421 responses were collected. A high response rate of 74 percent was achieved as most targeted respondents were requested to complete the questionnaire on the spot, aided by field assistants. A sample of 406 was retained for data analysis after deleting datasets with large missing values and for ensuring normality of distribution.

The survey questionnaire measures (1) demographic characteristics of respondents; (2) grocery purchasing behavior; (3) attitudes toward organic food; (4) perceived social expectations of organic food consumption; (5) perceived consumption cost and convenience while purchasing organic food; (6) concerns toward health and environment, and (7) willingness to pay (WTP) for organic food. These items are presented in Table 2 (see Appendix). Items were measured on a 5-point Likert scale where 1 is "strongly disagree" and 5 is "strongly agree". A pilot questionnaire was tested on 30 academic staff of a university, after which a final questionnaire consisting of 44 items was developed.

The demographics of the sample are presented in Table 1 (see Appendix). Majority of the respondents are female (60.1 percent) and most are between the ages of 25 to 44 (55.2 percent). They have obtained tertiary education qualifications at diploma, certificate or degree-levels (67.9 percent). The respondents are mainly medium sized households with three to six members (74.2 percent). Most of the respondents reported a combined household income of between Malaysian Ringgit (RM) 2,501 and RM5,000 (36.7 percent) and RM5,001 and RM7,500 (24.6 percent).

Data Analysis

Exploratory factor analysis (EFA) was undertaken to identify and confirm the factors under each construct. The results of EFA are shown in Table 2 (see Appendix). Oblique rotation was used due to high correlations between factors. Items with loadings smaller than 0.4 were dropped from further analysis. Likewise, an item that loaded on more than one factor was assigned to the factor where it achieved the highest factor loading. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy has a value of 0.963 while the Bartlett's test of Sphericity was significant, indicating that the data was suitable for factor analysis. Eight factors with eigenvalues greater than one were extracted. While several items were dropped due to low factor loadings, it is noted that most of the remainder items that were expected to measure a similar construct did indeed load on the same factor.

The Cronbach's alpha value for each factor was then computed in order to assess the reliability of the items in measuring the factor (see Table 2 in Appendix). Reliability was assured as the Cronbach's alpha values which ranged from 0.73 to 0.96 were higher than the minimum threshold of 0.70 (Nunally 1978). In addition, correlations among the factors ranged from 0.152 to 0.761, indicating that multicollinearity was not a problem (see Table 3).

Table 3. Correlations of first order observed variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Trust of organic food claims	1.00							
Cost concerns	.552**	1.00						
Convenience concerns	.562**	.647**	1.00					
Subjective norms	.649**	.463**	.514**	1.00				
Health and environmental concerns	.719**	.506**	.518**	.684**	1.00			
Actual purchase	.184**	.284**	.257**	.339**	.152**	1.00		
Perception towards organic food attributes	.746**	.545**	.577**	.691**	.628**	.233**	1.00	
Willingness to pay	.742**	.583**	.581**	.761**	.616**	.340**	.628**	1.00

Note: ** Correlation is significant at 0.01 level

Testing the Latent Constructs

Structural equation modeling was used for exploring the impact of exogenous constructs on purchase intention. It allows for simultaneous testing of an entire model that consists of multiple separate hypothetical relationships (Hair et al. 1998). A two-stage approach was used, where a measurement model that comprised of latent constructs was assessed first, followed by a structural model that consists of all constructs and hypothesized relations (Anderson and Gerbing 1988).

Consistent with hypotheses H_1 and H_4, two latent constructs were formed from five observed variables (i.e. factors). The first latent construct attitude was formed based on three attitudinal variables, namely, health and environmental concerns; trust of organic food claims; and perceptions of organic food attributes. The second latent construct affordability was formed by two variables, namely, cost and convenience concerns. A measurement model which comprised of the two latent constructs was developed in order to test the validity and reliability of the latent constructs (see Figure 1).

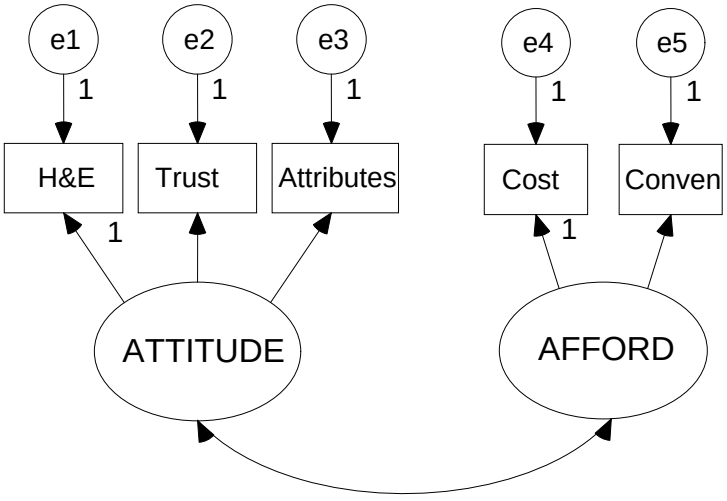

Figure 1. CFA Model: Testing the latent constructs
Note: H&E: Health & environmental concerns; Trust: Trust of organic food claims; Attributes: Perceived desirability of observable organic food attributes; Cost: Cost concerns; Conven: Convenience concerns; ATTITUDE: Attitude towards organic food; AFFORD: Affordability of organic food.

Factor loadings for the latent constructs ranged from 0.787 to 0.926, indicating strong support for construct validity (see Table 4) (Hair, Anderson, Tatham and Black, 1998). Likewise, the average variance extracted (AVE) values for attitude (0.78) and affordability (0.65) were higher than Fornell and Larcker (1981)'s recommended benchmark of 0.50. Composite reliability coefficients for Attitude (0.91) and Affordability (0.79) were higher than 0.60, suggesting high internal reliability (Fornell and Larcker 1981). Goodness of fit statistics of the measurement model further demonstrated a good fit with the data (χ^2/df = 2.157; GFI = 0.984; NFI = 0.751; RFI = 0.621; IFI = 0.749; TLI = 0.629; RMSEA = 0.053).

Table 4. Results of confirmatory factor analysis of latent constructs attitude and affordability

Latent Constructs and Variables	Factor Loadings
Attitude (CR:0.913, AVE:0.778)	
Trust	0.824
Perceptions	0.926
Health & Environment	0.894
Affordability (CR:0.785, AVE:0.646)	
Convenience	0.821
Cost	0.787
Goodness-of-Fit (benchmarked values)	**Fit statistics**
χ^2/DF (1 to 4)	2.157
GFI (>0.90)	0.984
AGFI (>0.80)	0.940
NFI (>0.90)	0.963
RFI (>0.90)	0.908
IFI (>0.90)	0.980
TLI (>0.90)	0.948
RMSEA (<0.08)	0.053

Note: CR: Composite Reliability, AVE: Average Variance Extracted

Structural Model

A hypothesized structural model M1 was developed to test the impact of attitude, subjective norms and affordability on willingness to pay (WTP) and actual purchase (see Figure 2). Relationships among the constructs were depicted in Figure 2. Consistent with the TPB theory, the exogenous constructs were modeled to impact WTP directly, and actual purchase indirectly through WTP. Evaluation of model M1 indicated a poor fit as the indices were below the benchmarked levels (χ^2/df = 31.747; GFI = 0.751; NFI = 0.743; RFI = 0.621; IFI = 0.749; TLI = 0.629; RMSEA = 0.276). In order to improve model fit, model M^1 was recalcuated based on modification indices that were computed by AMOS. The resulting model M^2 (see Figure 3) consisted of two additional regression paths that linked attitude to subjective norms and affordability. A covariance path linking the error terms of health & environmental concerns and actual purchase were also added to further enhance model fit.

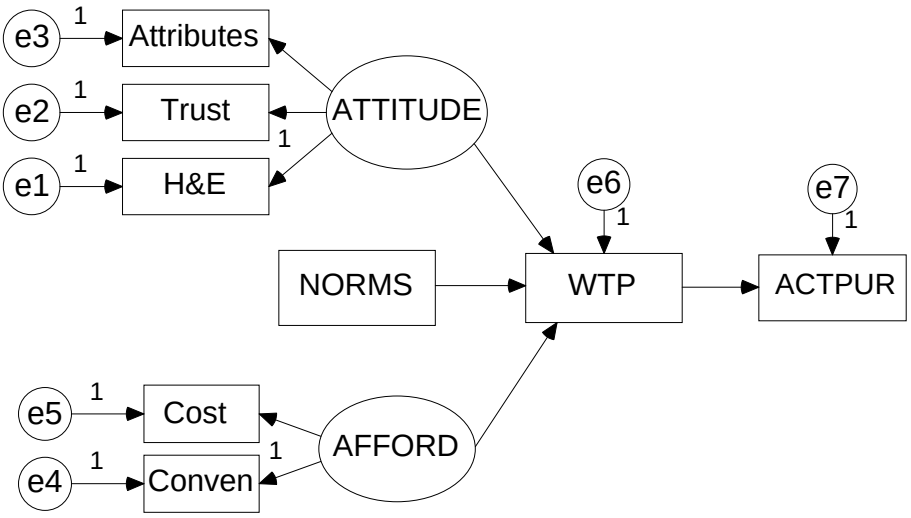

Figure 2. Structural Model M^1
Note: H&E: Health & environmental concerns; Trust: Trust of organic food claims; Attributes: Perceived desirability of observable organic food attributes; Cost: Cost concerns; Conven: Convenience concerns; ATTITUDE: Attitude towards organic food; AFFORD: Affordability of organic food; WTP: Willingness to pay; ACTPUR: Actual purchase

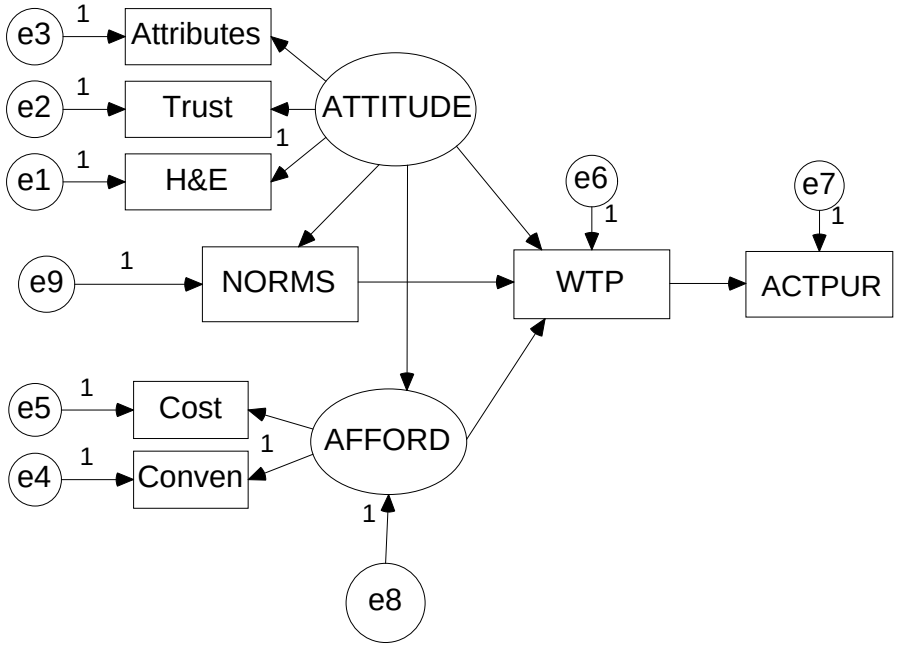

Figure 3. Revised Structural Model M^2
Note: H&E: Health & environmental concerns; Trust: Trust of organic food claims; Attributes: Perceived desirability of observable organic food attributes; Cost: Cost concerns; Conven: Convenience concerns; ATTITUDE: Attitude towards organic food; AFFORD: Affordability of organic food; WTP: Willingness to pay; ACTPUR: Actual purchase

Model M^2 achieved significant improvements in terms of its goodness-of-fit indices as all suggested values were met (χ^2/df = 3.113; GFI = 0.971; NFI = 0.963; RFI = 0.979; IFI = 0.986; TLI = 0.974; RMSEA = 0.072). The model accounted for 83.8 percent of variance in WTP and 11.7 percent of variance in Actual Purchase. Results of structural equation analysis of model M^2 are reported in Table 5.

Table 5. Parameter estimates and goodness-of-fit statistics of Model M^2

Standardized Regression Weights			
NORMS	←	ATTITUDE	0.773***
AFFORD	←	ATTITUDE	0.768***
WTP	←	NORMS	0.141***
WTP	←	ATTITUDE	0.761***
WTP	←	AFFORD	0.52
TRUST	←	ATTITUDE	0.817
H&E	←	ATTITUDE	0.892***
Attributes	←	ATTITUDE	0.913***
Cost	←	AFFORD	0.796
Conven	←	AFFORD	0.813***
Actpur	←	WTP	0.343***
Correlations			
e1	↔	e7	-0.260***
Goodness-of-Fit (benchmarked values)			
χ^2/DF (1 to 4)			3.113
GFI (>0.90)			0.971
AGFI (>0.80)			0.936
NFI (>0.90)			0.979
RFI (>0.90)			0.963
IFI (>0.90)			0.986
TLI (>0.90)			0.974
RMSEA (<0.08)			0.072

Note: *** Coefficient values are significant at 5% level.

Attitude has a significant direct positive effect on WTP (0.761***). Hypothesis H_2 which proposed that a positive attitude towards organic food would positively impact willingness to pay could not be rejected. Subjective norms has a significant albeit weaker direct positive effect on WTP (0.141***). Therefore, hypothesis H_3 which proposed that subjective norms will influence willingness to pay for organic food could not be rejected. In contrast, the regression coefficient of the relationship between affordability and WTP is not significant (0.052). Therefore, hypothesis H_5 which proposed that high affordability will positively impact willingness to pay for organic food is rejected. WTP exerts a significant direct positive effect on Actual Purchase (0.343***). This is consistent with the TPB theory which proposes behavioral intention as an antecedent of actual behavior.

Structural analysis of model M^2 provided additional information on the nature of the relationships between the exogenous and endogenous constructs. Attitude not only affects WTP directly, but also indirectly through a direct positive effect on subjective norms (0.773***). The

standardized total effect of attitude on WTP reported by AMOS is 0.911. Attitude also exerts a strong significant effect on affordability (0.768***) as positive attitudes are likely to reduce the perceived cost of sourcing for organic food. Attitude also impacts actual purchase indirectly through significant effects on subjective norms and WTP. The standardized total effect of attitude on actual purchase reported by AMOS is 0.312. Lastly, analysis of structural model M^2 revealed a significant negative correlation between the error terms of health & environmental concerns and actual purchase (-0.260***).

Conclusions and Implications

The present study validated a model that predicts the willingness to pay and actual purchase of organic food among Malaysian consumers. Consistent with the Theory of Planned Behavior, attitude and subjective norms were found to exert significant positive effect on willingness to pay, which positively affects actual purchase.

Health and environmental concerns together with trust of organic food claims and desirability of organic food attributes form Malaysian consumers' attitude towards organic food. The importance of health and environmental concerns reflect the growing affluence of Malaysian consumers. The rising educational levels of the middle-income consumers coupled with better access to worldwide communication and information channels have raised their awareness of health and environmental issues. These have driven strong demand for health-related products (Euromonitor 2009) and greater willingness to adopt more environmental-friendly lifestyles. The importance of trust of organic food claims and desirability of organic food attributes reflect the high uncertainty avoidance of Malaysian consumers. Although trust and observable organic food attributes are important factors affecting consumers in other countries, the greater tendency of Malaysian consumers in avoiding uncertainties is likely to strengthen the effect of these factors when making purchase decisions. Consumers are expected to rely heavily on product labeling, the media, reputation of producers and other observable attributes of organic food as measures of trustworthiness and quality.

The significant impact of subjective norms on willingness to pay reflects the high power distance culture that characterizes Malaysians. Consumers are therefore likely to be influenced by the advice or opinions of significant others, particularly those whom that they hold high regard for. Furthermore, as Malaysia is a highly collectivist society, consumers tend to conform to the consumption choices of significant others. This implies that those whom consumers hold high regard for, are able to influence the consumers both actively through their advice or opinions, as well as passively, through their own behaviors.

Contrary to the TPB theory, the impact of affordability as a subset of behavioral control on willingness to purchase was not significant. This raises questions about how behavioral control impacts the intention of Malaysian consumers. Hughner et al. (2007) offered insights on the relationship between cost and organic food consumption. They cautioned that consumers are likely to perceive cheaper organic food products as of lower quality and containing fewer benefits. Consequently, organic food may lose its differentiating feature and appeal among consumers. Affordability may be a concern for consumers who consume organic food occasionally or who are yet convinced of the benefits. For them, cost of consumption is likely to

have a major influence over decisions to consume either higher priced organic food or cheaper conventional alternatives. However, consumers who have been convinced of the benefits of organic food and have adopted the organic lifestyle may be less likely to be deterred by the high cost. They seem to be able to accept a higher price tag on organic food.

Results from structural equation analysis further show that attitude impacts subjective norms and affordability. These suggest that a strong positive attitude towards organic food consumption will influence consumers' perceptions of subjective norms. Where the expectations of significant others are consistent with consumers' own attitudes toward organic food, they are more likely to comply with the expectations as doing so positively reinforces their own attitudes. In similar vein, a strong positive attitude increases perception of affordability. This is because consumers are likely to rationalize the high cost of consumption as a premium paid for the benefits and desirable attributes of organic food.

The negative correlations between health and environment concerns and actual purchase suggest that consumers' concern for health & environment decreases after consuming organic food. This implies that when consuming organic food, consumers are assuring themselves that they are making a 'difference' or 'doing their part' by 'acting responsibly'. Consequently, concerns about the impact of food consumption habits on health and the environment would decrease.

The findings from the study offer insights on promoting more widespread organic food consumption. Cost of consumption may need to be lowered in order to attract new consumers. At the same time, there is a need for differentiation through other means in order to sustain or increase consumption among existing consumers. Producers and marketers may extend their influence over contextual factors that shape consumer attitudes towards organic food. These factors include consumers' concerns over their health and environment, their perceived trustworthiness of organic food claims and observable attributes of organic food which were deemed desirable. A successful effort in these directions can impact consumers' affordability concerns and their readiness to comply with subjective norms. These inevitably contribute towards enhancing intention to consume.

South-East Asian countries such as Malaysia offer significant market potentials for organic food. Nevertheless, although consumers in emerging markets are becoming more affluent and more conscious about their consumption patterns, they tend to be less informed about organic food classification. When evaluating product options, their judgment is based mainly on product labels and the mainstream media, rather than on formal organic certifications. Both sources of information are subjected to manipulation by parties which attempt to exploit consumers' knowledge gap.

In Malaysia, the use of terms such as 'organic' and 'organically produced' are not strictly regulated, particularly among imported food products. Hence, a producer or importer can label a food product as organic even if it is not. Consumer vulnerability is further compounded by the fact that the health-promoting claims of organic food are difficult to validate in the short-term. Any well-publicized incident that calls into question the integrity of product labels is therefore likely to create distrust among consumers across all organic product categories (e.g. fresh, dried, frozen).

Research Limitations and Future Directions

The absence of studies related to organic food attitude, purchase and consumption in Malaysia implies some inherent limitations in the present study. The findings from the present study need to be validated or compared with similar studies in order to enhance the generalizability of the findings.

Another limitation concerns the measurement of latent construct Attitude. Literature on consumer behavior research suggests three components of attitude, namely, cognitive, affective and conative. Most of the studies related to organic food are limited to studying only affective and cognitive components of attitude. This study faces a similar limitation as it has not measured the conative—"feelings and emotions" component of attitude.

Future researchers can aim to explore mediating variables between the present exogenous constructs and willingness to pay. Likewise, the relationship between willingness to pay (intention) and actual purchase may be further investigated. The TPB theory considers intention as a predictor of actual behavior. Researchers may focus on identifying factors that moderate and/or mediate the impact of intention on actual behavior.

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Appendix 1

Table 1. Sample Demographics

Gender	Frequency	Percent
Male	162	39.9
Female	244	60.1
Age		
18-24	75	18.5
25-34	130	32.0
35-44	94	23.2
45-54	68	16.7
55 or over	39	9.6
Education		
Others	2	0.5
Primary schooling	21	5.2
Secondary schooling	107	26.4
Diploma, certificate	98	24.1
Degree	178	43.8
Household members		
1-2	45	11.1
3-4	161	39.7
5-6	140	34.5
7-8	47	11.6
9 or more	13	3.2
Monthly Household Income		
RM1,000-2,500	89	21.9
RM2,501-5,000	149	36.7
RM5,001-7,500	100	24.6
RM7,501-10,000	30	7.4
RM10,001 or above	38	9.4

[1]RM denotes Malaysia Ringgit, the official currency of Malaysia.

Table 2. Questionnaire items, factor loadings and Cronbach's Alpha

Factors and Questionnaire items	Cronbach's Alpha & Factor Loadings
Actual Purchase	**0.73**
How much have you spent on organic food in the past 7 days?	.809
RM0-25, RM26-50, RM51-75, RM76-100, More than RM100	
How much more are you willing to pay for organic food, compared to conventional alternatives?	.732
0-25%, 26-50%, 51-75%, 76-100%, More than 100%	
How many times have you consumed organic food in the past 7 days?	.825
0-1 time, 2-3 times, 4-5 times, 6-7 times, More than 7 times	
Trust	**0.944**
I trust that those selling organic food are honest about the organic nature of their products	0.936
I trust that local producers of organic food are practicing organic farming	.851
I trust the organic certification logo on organic food labels	.872
I trust the information on organic food labels	.817
Cost perceptions	**0.838**
Organic food is too expensive*	NA
Only consumers with higher income can afford organic food	.894
Organic food is beyond my budget	.862
Convenience Perceptions	**0.825**
Buying organic food is highly inconvenient	.534
Organic food is only available in limited stores/ markets	.777
The stores that I frequently shop do not sell a variety of organic food	.850
Subjective Norms	**0.862**
My close friends and family consume organic food	.699
Nowadays, organic food is widely regarded as a better alternative to conventional food*	NA
My loved ones expect me to purchase more organic food for them	.508
Health and Environment Concerns	**0.964**
I am concerned about the type and amount of nutrition in the food that I consume daily	.766
I am concerned about the presence of food additives	.789
I care about cholesterol and fat	.822
I keep a strict diet*	NA
I am concerned about how food is processed	.884
It frightens me to think that much of the food I eat is contaminated with pesticides	.820
The government is not doing enough to help control pollution of the environment	.807
I am greatly concerned about the harm being done to plant and animal life by pollution	.904
Environmental pollution is not a serious issue*	NA
Organic food tastes better*	NA
Organic food is more environmentally friendly*	NA
Organic food is good for health	.473

Table 2. *Cont.* Questionnaire items, factor loadings and Cronbach's Alpha

Factors and Questionnaire items	Cronbach's Alpha & Factor Loadings
Attributes' Perception	**0.938**
Organic food is free from genetic modifications	.463
Organic food does not contain additives and artificial flavoring	.458
Organic food is free from pesticides	.545
Willingness to Pay	**0.955**
I'm willing to buy organic food even though choices are limited	.523
I'm willing to buy organic food because the benefits outweigh the cost	.512
Buying organic food is the right thing to do even if they cost more	.612
I don't mind spending more time sourcing for organic food	.627
I would still buy organic food even though conventional alternatives are on sale	.562

* Reverse coded items

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Consumer Preferences for Fruit and Vegetables with Credence-Based Attributes: A Review

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Abstract

The food marketing sector is responding to an increased level of interest to consumer demand for products with an increasingly wide array of attributes. As evidence, there has been double digit proliferation of offerings in the produce section of retailers on an annual basis. Differentiation claims include factors related to experiential eating quality as well as credence attributes related to environmental and other social outcomes. To establish the overall importance and willingness to purchase and/or to pay for such foods, a summary of selected studies on such credence attributes and a critique of the research methodologies encountered in those studies may be informative. This study aims to identify and rank a number of attributes, focusing on how their statistical significance across consumer studies of fresh produce buying decisions.

Keywords: credence goods, consumer preferences and attitudes, sustainable fruit and vegetables, consumer research.

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Introduction

Over the past two decades, consumer demand for niche products (including organic and locally grown foods) has grown substantially. Various sources suggest that both of these niche food sectors have seen double-digit annual growth (even though local foods were vaguely defined until the United State Department of Agriculture's (USDA) 2010 definition[1] in various grant and agency programs). While some studies suggest that the motivation to purchase organic and local products derives from environmental concerns, other production and quality concerns (nutrition, support for family or small farms, and treatment of animals) are increasingly reported as issues guiding consumer choices (Thilmany et al. 2008). In response, private industries have invested more in branding programs, while various international NGOs and national governments develop and oversee public certification programs meant to address asymmetric information in consumer product markets.

Consumers' perception of quality is influenced by the product's intrinsic attributes as well as by extrinsic indicators and cues provided by the seller of the product (Caswell et al. 2002). Food as a good can be classified into search, experience and credence goods according to the level of quality that can be discovered by the consumer at different stages (Nelson 1970; Darby and Karni 1973). A good is identified as a search good when consumers can evaluate relevant attribute information before the purchase (e.g., price, dimension, size, color), while it is defined as an experience good when relevant attribute information can be determined only after consumption (e.g. experiential eating quality such as taste and convenience) (Nelson, 1970 and 1974). Credence products are those whose relevant attribute information is difficult to ascertain directly by consumers at any stage of purchase, even after consumption of the food (Darby and Karni 1973; Torjusen et al. 2001; Grunert et al. 2004). For this reason, credence goods require a judgment or a certification by an authority figure such as a governmental agency, or organizations that consumers trust to lend information on credence attributes (Caswell and Mojduszka 1996; Becker 1999). Many agro-food goods fall into this category (Caswell and Mojduska 1996).

While experience and search good involves usually private good characteristics, credence good provides private benefits to those who consume the good, while its production often has "affiliated public dimensions" (Lusk et al. 2007). The credence good category incorporates a wide range of fairly intangible and often interrelated characteristics such as outcomes related to public health, environmental conservation, origin, creation of employment, supporting small-scale agriculture and local rural communities, farmers living and producing in marginal and/or disadvantaged conditions and workers' rights. All these attributes fully or partially fall under the realm of public goods (non-excludable, non-rivalrous) (Becker 1999; Midmore et al. 2005; Darby et al. 2006). An example is food produced according to organic or low impact environmental production systems (such as Integrated Pest Management (IPM)) because they not only are perceived by some as safer for consumption, but also reduce the impact on environment, may protect biodiversity and/or reduce greenhouse gas emissions.

[1]According to the definition adopted by the U.S. Congress in the 2008 Food, Conservation, and Energy Act, the total distance that a product can be transported and still be considered a "locally or regionally produced agricultural food product" is less than 400 miles from its origin, or within the State in which it is produced (Martinez et al. 2010).

Credence attributes play an increasingly important role in consumer preference formation (Zanoli 2003; Heuvel et al. 2007). Subsequently, the 'bundle of attributes' which constitute a good is evolving in the food system (Arunachalam et al. 2009) as evidenced by the emerging set of new certifications trying to establish themselves as market standards (Food Alliance, Ocean Trust Fish, Fair Trade). Thus, many agribusiness stakeholders could benefit from understanding patterns, consistencies and conflicting research on consumer values for these credence attributes (Travisi and Nijkamp 2008).

In recent decades, efforts to understand consumer attitudes, or overall buying behavior and the relative importance of various attributes in purchasing food have been widely explored (Kiesel and Villas Boas 2007), primarily with stated preference techniques such as Contingent Valuation (CV) and Choice Experiments (CE). Stated preference methods are grounded in consumer utility theory and, by employing econometric models, they allow one to measure the amount people would be willing to pay (WTP amount) for a good or for a specific attribute. But, there may be reasons to compare and contrast approaches that use the two. Both CV and CE methods ask people to express their preferences by choosing between a base case and another alternative in a hypothetical situation (Mitchell and Carson 1989; Naidoo and Adamowicz 2005). CV is more suitable to evaluate a good in its wholeness, while CE focuses on the 'bundle of attributes' which constitute a good, according to Lancaster's theory (1991). CE involves constructing multiple scenarios, presenting a choice set and asking respondents to choose the preferred option among different alternatives described by various attributes and prices (Naidoo and Adamowicz 2005). In short, it allows researchers to specifically investigate trade-offs between several competing product attributes and to determine the relative importance of various attributes in consumers' choice process (Hanemann and Kanninen 1998). More recently, the experimental approach has also been used by employing auction and lab experiments (Lusk and Shogren 2007; Combris et al. 2009). Finally, general information on consumer preferences and purchasing behavior can be collected through quantitative and qualitative (focus group or in depth interviews) surveys employing rating or ranking questions[2] and Likert scales.

Regardless of the approach, to conduct an effective study, correctly identifying the relevant attributes is key. The chosen attributes should be relevant for respondents, since the conclusions drawn about consumer choice would change if we ignore the existence of important factors (Lancaster 1991, 56). Moreover, the presence of either too many or irrelevant attributes may lead to an overly complex decision for respondents, and therefore, may result in more inconsistent and random choices (Bennett and Blamey 2001).

With this study we would like to contribute to the field by summarizing the existing research. Previous studies focus on understanding the cues between quality and credence aspects and investigating the role of specific labels or certifications (Marchesini et al. 2007). The choice to focus only on fruits and vegetables is driven by the fact that, as Gil et al. (2000) suggested, environmental attributes are more important in fresh and perishable products, (or at least it is easier to directly identify them in such products), and also, consumers are willing to pay a higher premium for organic fruits and vegetables. The contribution of this study is: 1) to identify and rank the attributes that have been shown to be relevant and decisive in purchasing and

[2] Rating questions ask respondent to compare different items using a common scale, while ranking questions ask respondent to compare different items directly to one another ordering them in order of preference.

willingness to pay (WTP) for IPM and organically grown fruits and vegetables (F&V); 2) to improve understanding of the differences and similarities across the USA, European and Asian regions; and 3) to inform future consumer research in this market sector.

The paper is divided into five sections following this introduction. The first section describes the data gathered and analytical methodologies used, followed by a summary of important attributes of consumers buying behavior of F&V as inferred from their significance. The next section compares preferences across countries, followed by a discussion of the relevance of credence goods in WTP and WTBuy decision processes. We conclude by drawing implications for sustainable food industry managers and noting limitations and methodological issues that could inform future research.

Data and Methodology

To explore consumer preferences for F&V, we focus on studies that try to understand the consumer-based key factors in purchasing sustainably produced fruit and vegetables including those that focus on methodological issues and that report these details within their empirical results.

The literature review conducted for this study relies on web-based scientific community databases. Different sources were considered ranging from scientific to popular studies written between 1998 and 2007, but more recent studies were used to motivate and draw conclusions on how the field is evolving. Since the aim of the review was to identify and rank attributes which affect buying decision and WTP on sustainable F&V, relevant studies include those reporting any evaluation, ranking, rating or estimates of attribute coefficients employing econometric or statistical models. This includes 13 studies based on CV, 9 on CE, 2 on experimental auctions and 16 based on quantitative (12) and qualitative (2) surveys.

The actual size of the database (40 publications) was determined by certain practical limitations – possibly excluding studies difficult to obtain or written in languages other than English and Italian – as well as by the usual budget and time constraints.

Our summary of final rankings was organized according to the food attribute's relevance in influencing consumer buying decisions, frequency of occurrence in the literature and absolute values reported for the attribute. Then the reviewed studies have been classified according to the geographic context to allow for comparative analysis.

Factors Influencing the Willingness to Purchase and to Pay Sustainable F&V

According to the database of 40 studies, numerous specific attributes were found to influence consumer buying behavior and the willingness to pay for IPM, organically grown and other sustainably produced F&V. In categorizing attributes, experience related attributes that are clearly present in all foods are common, as are credence attributes. Table 1 lists all attributes described in details in the next paragraphs. Moreover, it reports how many studies have considered a particular attribute, how many have employed an econometric model and how many found that attribute significant at 5% level (or higher). In general, results show that the

significance of attributes does not change using different evaluation techniques (quantitative methods, CV, CE). It seems that methodology affects the magnitude of these attributes, but not their significance.

Table 1. List of attributes, including credence subset, and frequency of inclusion

Attributes List	Studies that considered attribute	Studies with econometric model	Studies reporting attribute significant at 5% level
Visual, smell and taste	24	3	1
Quality	6	1	1
Credence attributes			
Health	27	11	8
Pesticide free	14	2	2
Organic	16	6	3
Environment	17	9	5
Support to farmers	5	1	-
Job creation	2	1	1
Origin	8	1	1
Local	9	-	-
Certification	11	8	6
Price	16	5	5
Brand	10	1	1
Packaging	2	1	-

Before spelling out the role of these attributes, it is important to keep in mind that consumer buying behavior and price sensitivity are also affected by other types of variables such as demographics (age, education, place of residence, income, marital status), neuro-sensory systems (Jacoby 2002) and habits and life style (Govindasamy and Italia 1998; Lohr 2000; Cranfield and Magnusson 2003; Magnusson and Cranfield 2005; Midmore et al. 2005; Darby 2006). As example, focusing on an important attribute, the organic one, some differences in WTP emerge according to whether the respondent buys organic F&V regularly or occasionally. In general, regular organic consumers are willing to pay a premium price that ranges from 17 to 67% for organic fruit, and from 13 to 37% for organic vegetables, while occasional or unlikely consumers accept premiums ranging from 3 to16% for organic fruit and vegetables. So, the segmentation of customers appears to be warranted.

Visual, Smell and Taste Components

A review of results shows that, among the full set of factors, perceptions about eating experience components are clearly among the most relevant and valued reasons for buying and being willing to pay more for sustainable F&V. Experiential eating quality of a product is made up of a composite of attributes whose relative importance varies with the product. The main components are flavor – defined as being made up of taste (sweetness, acidity, astringency, bitterness) and aroma – texture (defined as firmness, juiciness, succulence) and color and shape (Tan 2000). Visual, smell and aroma components were often top rated among attributes listed, which is

logical since they represent the basic components of eating pleasure (Zanoli et al. 2003; Ernst et al. 2006). These experiential attributes are more important, but less of a challenge for marketing professionals, since information is obtained and updated by consumers at each time of purchase. So, we chose to focus on the subset of credence attributes in this study.

However, there are some clear linkages across attribute types; organic and low environmental impact F&V are commonly bought since they are thought to be superior in terms of "flavor", better, intensive, and authentic taste, good texture, and freshness. Moreover, these components were commonly used as indicators about the overall product quality (Ness et al. 2010). The definition of "quality" is difficult to interpret as it involves various attributes that are closely interrelated with each other but go beyond taste, smell, color, size, firmness, and freshness. Only a few studies consider and define quality in all its meanings (Lohr 2000; Mabiso et al. 2005; Darby 2006; Akgüngör et al. 2007; Ghorbani et al. 2007; Lili and Tong 2007), while others introduce quality without defining it. Most researchers delineate a few specific aspects, but how these experience attributes are controlled for varies significantly across studies, and a more standardized approach may be warranted.

Credence Attributes

Health Related Components

Together with visual, smell and aroma components, health related attributes are perceived by consumers as the most significant reasons to buy sustainable food. According to this literature review, perceived personal health related differences in F&V can be linked to specific food components (artificial additives, genetically modified organisms), to the presence of nutritional components (rich in vitamins), and to the perceived risk associated with the use of agrochemicals. According to a large number of the studies, consumers perceive sustainable F&V as being natural, with higher vitamin and nutrient content, and containing fewer or no pesticides and additives compared to conventional F&V.

Overall, it seems that people are especially concerned with the potential harm that conventional food production practices may cause to their personal health, or to public health concerns (children, ill and elderly people; development of allergies in youth) (Midmore et al. 2005). Therefore, they are willing to pay a higher price to reduce the perceived direct and societal risk associated with the use of pesticides, GMOs and additives. According to Florax et al. (2005, 457), who conducted a meta-analysis, WTP for reduced risk exposure increases by approximately 15% and 80% in going from low to medium and high risk-exposure levels, respectively.

Related to risk concerns, "pesticide free" is perceived as another important attribute in consumer buying behavior as respondents were willing to pay a premium averaging 15% above the regular price to buy pesticide-free fresh F&V (Boccaletti and Nardella 2000; Onozaka et al. 2006). Yet, consumers seem to be unconcerned whether the risk source concerns just one or a multitude of pesticides (Florax et al. 2005).

Production Methods Related Attributes

Attributes related to production method differentially impact purchase decisions across consumer studies. Production methods evoke a bundle of attributes related to environment, risk concerns, and certification criteria, and in many cases, related to other attributes. For example, "organic" production appears to be similar, yet more far-reaching, to the pesticide free attribute since, by legal definition, no synthetic pesticides can be used in organic production. Yet, it was found to be less significant to the buying decision. One possible rationale for why the organic attribute seems to be less important in the consumer's eyes (compared to the less restrictive claim of pesticide free) may be the complexity surrounding organic certification processes (Rizzardi 1997). Past studies also concluded that consumer's perceptions that organic products are only food for babies or sick people (Piraccini 2000), or that poor product availability in supermarkets limited information and the consumption experiences at the time of studies (Boccaletti and Nardella 2000, 298). According to the latter study, consumers often doubt the existence of "truly organic" F&V.

Evidence on F&V produced with IPM is mixed. Some studies show that consumers who have knowledge of sustainable practices and have made previous purchases of such products are more likely to buy IPM grown F&V, and are willing to pay a premium of six percent or higher (Govindasamy and Italia 1998; Richter et al. 2000; Cranfield and Magnusson 2003); while others found that having prior familiarity with IPM concepts decreases the probability of buying IPM products (Blend and Van Ravenswaay 1999).

Environmental and Socially Oriented Attributes

A significant number of studies have specifically analyzed the relevance of environmentally related attributes (increased biodiversity, ecosystem protection and natural system conservation). They range from somewhat important to important across consumer studies. Louriero et al. (2001) - who studied the WTP for sustainable and organic apples versus conventional ones - found that consumers with strong environmental attitudes have the largest demand for food grown by producers with a strong commitment to environmentally friendly practices. However, other studies suggest that the coefficient on environmental concern is the least important (Scarpa and Spalatro 2001) or insignificant in the WTP regression, after controlling for consumption behavior and demographic characteristics (Hamilton et al. 2003).

Socially oriented attributes of production systems, such as job creation or support for farms, do not seem to affect the consumer decision in a significant way. Although consumers appear concerned with sustainability of local or small farmers and the creation of employment in rural areas, those who are more likely to pay a higher premium for sustainable products may not prioritize such claims. Across the findings reviewed, the magnitudes of the marginal effect of such factors are small (Cranfield and Magnusson 2003; Akgüngör 2007) or insignificant (Magnusson and Cranfield 2005). As one exception, when consumers are solicited about buying decisions and willingness to pay for local (Darby 2006; Henseleit et al. 2007), "help local farmers" was an important factor (Richter et al. 2000). In short, it appears that the support for farms may be nested into other product claims.

Local and Origin Related Attributes

Attributes referring to the products' origin was found to be either important, or somewhat important in a majority of the studies. Production origin (as made in USA, Italy, etc.) is generally ranked, rated or estimated among the somewhat or less relevant factors to the buying or paying decision (Zanoli et al. 2003; Campbell et al. 2004; Midmore et al. 2005; Darby 2006; Poole and Martínez-Carrasco 2007). Mabiso et al. (2005) found that origin labels garner a premium, while Scarpa et al. (2005) found that the WTP for origin depends on the product under question.

The attribute "local" involves a bundle of aspects, private and public, which a consumer may perceive to be interrelated with each other, such as aroma components, environmental concerns and the intention to support the local economy of the home region. According to our analysis, the attribute local generally seems to be relevant to the decision to buy fresh F&V. Local products are assumed to be fresher and better tasting and, most importantly, they may enhance the trust of consumers who personally know the producers of their fruit and vegetables (Midmore et al. 2005; Rodriguez-Ibeas 2007; Thilmany et al. 2008). Moreover, according to Marchesini et al. (2007, 7), the shorter the distance between producer and consumer (geographically and culturally speaking), the higher the effectiveness of local geographical indicators.

Certification and Other Labels

Consumers often use 3rd party certification and labels as safety and quality cues for attributes that require oversight by knowledgeable experts (Lohr 2000). Several studies suggest that the lesser importance placed on certification process could be due to the lack of clear procedures that implicitly guarantee the credence attribute, such as safety (Boccaletti and Nardella 2000; Midmore et al. 2005; Zanoli et al. 2007). For example, most Italian consumers do not trust labels because they do not perceive the existence of standardized certification procedures (Pirani and Re 1999). Also, due to past food scandals (BSE, dioxin contamination of Belgian food), labeling products to certify organic or low input production is no longer a guarantee in and of itself (Lohr 2000). In a broader context, the complexity and ambiguity behind a certification process may also be part of the rationale for this consumer response.

However, among different labels, eco-labels seem to provide the most effective market signal (Loureiro et al. 2001; Mabiso et al. 2005; Marchesini et al. 2007; Rodriguez-Ibeas 2007). Eco-labels for fresh apples and tomatoes showed a price premium of between $0.10 and $0.50 per pound (Loureiro et al. 2002; Mabiso et al. 2005).

Regarding production origin designation, Bureau and Valceschini (2003) report an interesting finding: higher demand for certification is requested by consumers who live further from the production site than those living closer (Marchesini et al. 2007). In short, 3rd parties may be more essential when distance makes information gathering more difficult. In contrast, proximity may support other credence attributes. Bond et al. (2007) note that intended support for farmland preservation is significantly linked to those who pay a premium for local produce, and one might believe that this preservation is more valued by buyers who are near protected lands.

Moreover, Marchesini et al. (2007) found that the appreciation of geographical labels varies significantly between countries: the premia attached to Geographical Indicators ranges from 10-30% and 10-50% (up to +100%), respectively. They report that the deciding factor explaining increased levels in WTP appears to center around a perceived increase in food safety and quality, especially for fresh and perishable products.

Other Attributes

Branding seems to be less important in determining consumer buying decisions given insignificant results for this attribute (Mellor et al. 2002; Darby 2006; Thilmany et al. 2006; Poole and Martínez-Carrasco 2007). Packaging is considered in only two studies with insignificant results.

Finally, price does still matter. According to the review's results presented in Table 1, although people do not mention price directly as an obstacle to purchases, the price of sustainable products might be a barrier (Roitner-Schobesberger et al. 2008), even if a higher prices could be seen as a signal of the higher quality given the relative importance of value in several studies (Zanoli et al. 2003).

Relevant Attributes and Countries

After the identification of the key factors of consumers buying and WTP for sustainable F&V, we analyze similarities and differences in attribute relevance that occur in different countries where studies have been done. All mentioned attributes were grouped into three categories - strongly determinant, somewhat determinant, and less determinant - according to the statistical relevance of the attribute in different types of survey, to the frequency of inclusion and when estimated, to the reported coefficient of the attribute.

Three different macro regions have been identified: USA, Europe (plus some countries of the Middle East) and Eastern Asia/Pacific Rim, including China and Thailand. According to our study, only the health-related attributes are found to be an important factor common to all the three areas. Otherwise, the relevance of attributes seems to be differentially valued depending on the area studied.

Most studies investigated US consumers' purchase and payment behavior, especially for apples, berries and vegetables. In the USA and Canada, willingness to buy and pay seems to be determined by both private (health and food) characteristics, and credence attributes (environment and support farmers) that, more or less, have the same weight. The organic seal, price, and 3rd party certification are somewhat important, while brand and origin are the attributes that least affect the WTB and WTP. A few things are interesting to note. First, US consumers perceive pesticide free and organic differently, and second, organic claims are only somewhat important (Table 2). This may suggest that organics are still not well understood by consumers.

Table 2. Relevance of attributes according the country where the study has been done.

Country	USA, Canada, Argentina, Australia	Europe	East Asia/ Pacific Rim (China, Thailand)
Attribute relevance[a]			
Strongly determinant	Health Visual & Smell Environment Pesticide free Local Farmers' support Quality	Health Visual & Smell	Health Environment
Somewhat determinant	Organic Price Certification	Environment Pesticide free Certification Origin Quality	Visual & Smell Pesticide free
Less determinant	Brand Origin	Local Organic Brand Farmers' support Price	Price
Not investigated	Creation of employment Packaging Availability	Creation of employment Packaging Availability	Certification Origin and Local Support farmers Creation of employment Brand Availability

[a] in decreasing order of importance

In Europe, greater significance is given to experience features and to health related components, while credence attributes (environment and support farmers, origin, local, organic) are of somewhat limited or little importance. This result is quite unexpected given the effort of European Union's Common Agricultural Policy (CAP) to introduce sustainable practices among growers and to increase people sensitivity to environmental and social issues linked to agricultural practices in rural areas.

Regarding the third region (Eastern Asia/Pacific Rim region), health and environment attributes constitute the key factors, followed by visual & smell components and the pesticide free attribute. It is worth noting that only a few attributes (6) are even taken into consideration by studies in this area when compared to the US (13) and European (12) areas, possibly signaling that developing countries with broader food security issues may consider credence attributes less essential than sufficient quantities and dietary needs.

Besides these macro regions differences, other differences exist inside each region, nevertheless a direct comparison is challenging to interpret given that these differences depend not only on the product evaluated - but also, on the diversity of attributes investigated and cultural and socio-characteristic of the sample. This latter aspect is particularly true for Europe, where each country has a unique food culture and tradition.

Implications for Sustainable Food Industry Managers

Assessing the Role of Private vs. Public Attributes

The review shows that, even if consumers assign a high value to credence attributes that are at least indirect related to public goods (environment and biodiversity conservation, economic support of local or small farmers, job creation in rural areas), their choice to buy and WTP for fresh F&V is primarily driven by attributes involving private good features associated with own health issues or food as enjoyment (Michelsen et al. 1999; Louriero et al. 2001; Cranfield and Magnusson 2003; Hamilton 2003; Canavari et al. 2005; Magnusson and Cranfield 2005; Midmore et al. 2005; Bond et al. 2007).

This result could be due to the fact that consumers are less familiar with credence public attributes, or uncertain that their buying choices will affect outcomes in the public realm. This uncertainty surrounding some product attributes at the time of purchase can lead to a mismatch between purchase and consumption preferences (Poole and Baron 1996; Poole et al. 2007). In addition, besides public good aspects being extremely difficult to evaluate, they are bound by highly subjective and often relatively vague consumer attitudes towards lifestyle and *raison d'etre*, including less explicit needs and wishes (Midmore et al. 2005, 8).

Marketing Challenges for Products with Credence Attributes

Credence attributes are characterized by a higher dependency on 3rd party information (Röhr et al. 2005) but this summary of findings suggests that the average consumer does not highly value the quality and safety certification processes (Blend and van Ravenswaay 1999; Zanoli et al. 2007; Roitner-Schobesberger et al. 2008).

Among credence features, "local" is always ranked higher than organic, certification, origin, even with no clear definitions or regulating body in place to monitor such claims. This result suggests that the attribute local might be interpreted by consumers as an implicit guarantee or direct assurance which they view as better than a 3rd party certification. For now, a personal assurance from the producers of fruit and vegetables appears to enhance the consumers trust in this type of food (Midmore et al. 2005; Rodriguez-Ibeas 2007; Thilmany et al. 2006) more than a certification. Therefore, improving the contact between the producer/seller and the consumer, for example, through marketing foods at the farm gate, at direct markets or specialty stores where consumers and producers may interact (Midmore et al. 2005; Thilmany et al. 2006) could be an effective strategy for small firms. Finally, comparing WTP motivations for organic food vs. local food, Bond et al. (2007) found that supporting local farmers is a more powerful motivator than supporting natural systems. The challenge associated with the attribute local is to better communicate interrelated aspects such as health nutrition, environmental concerns and the willingness to support the local economy of the home region that could indirectly increase a local claim's relevance in buying decision.

Mistrust in certification is reported by Röhr et al. (2005, 652) who found that German consumers perceive information provided by consumer or environmental organizations, nutritionists or physicians as more trustworthy than information from the Ag Ministry, food producers or the

media. It may due to recent food scandals that fueled a certain degree of uncertainty about the oversight of the food marketing system (Midmore et al. 2005).

Solutions to increase the value of certifications may include providing more reliable information about the certification processes' connection to sustainable outcomes (Hamilton et al. 2003; Röhr et al. 2005; Zanoli et al. 2007). Local could be viewed as a threat to more structured food certification programs that are based on scientific standards, production plans and regulatory oversight. But, marketing these new generations of grades and standards effectively may be challenging given what consumer research signals about current interest in these programs.

Lessons for Future Consumer Research

From the lessons drawn from this literature review, we can provide some guidance for future research. Preferences for organic food have been widely studied, while research into consumer response towards IPM or other sustainable practices is scarce in the literature (Govindasamy and Italia, 1998; Louriero et al. 2001, Scarpa et al. 2005). IPM agricultural practices are often neglected compared to the more commonly known organic standards, but in many circumstances, it remains the only feasible option for some producers[3], and may be more attractive to consumers given the clarity of its intended outcome. Similarly, given the literature's indication that clear outcomes may matter to consumers and growing interest in climate change, research on consumer valuation of products providing assurances about practices that result in low greenhouse gases emissions, or more generally, on consumers' perception and willingness to pay for carbon offsets seems warranted.

No direct attention has been devoted in the reviewed studies to the distinction between tangible and intangible attributes, especially in revealed vs. state preference studies; a shortcoming that could be addressed as auctions become more prevalent. As demonstrated by Horsky et al. (2004) in relation to wine preferences, tangible attributes (price and performance in their study) are weighted relatively more than intangible attributes (such as the prestige) in actual choice vs. stated preferences. When you ask people what they would like, they answer ideally by pointing to the label of high-price or high-prestige option, but in reality, they will proceed to do what makes most sense for their wallet (Horsky et al. 2004, 138). Choice experiments rather than contingent valuation methods may also make such comparisons of individual attributes possible.

Besides these research areas, the review identifies some limitations and methodological issues encountered in the analyzed studies, with particular attention devoted to CE (Adamowicz et al. 1998; Bennett and Blamey 2001). The following is a list of limitations and methodological issues noted in the studies.

[3] In Michigan, for example, most blueberry production is undertaken with conventional pest management, while organic production is around 0.1-0.4% of total production. Due to Michigan's specific climatic characteristics, it is impossible to adopt organic production without incurring huge losses and low quality. Thus, Michigan State University undertook a project, RAMP, designed to measure the changes in blueberry pest management systems when broad-spectrum insecticides are replaced by an IPM scouting program and reduced-risk insecticides (Mark Longstroth, Isaacs Rufus, Dave Trinka, June 2007, personal interviews).

1. Comprehension of environmental and social attributes by respondents depends on the definitions (or not) provided in the survey. Information does matter and should be as objective as possible. Varying definitions of credence attributes make comparative analysis difficult.

2. When designing any survey, and in particular a CE, this effect should be vetted in focus group processes to develop research instruments since WTP estimates highly depend on the amount of information presented to respondents in the survey. Wier (2007) highlighted that studies about sustainable food provide information about the sustainable practice before the CE is carried out, but they rarely measure the effect of the provision of this additional information.

3. Many attributes investigated in the studies interact with each other and might even overlap: (e.g. origin, production type, and taste). As these attributes are not separable in a controllable way, it becomes important to clearly present the attribute description and control for interactions in the statistical design. For example, a clearer definition of Local is needed in order to avoid some inferences that respondents could make and to improve efficiency of WTP values. Darby et al. (2008) addressed this issue by decomposing the local attribute into two degrees of distance and by distinguishing factors that are often associated with Local, such as farm size and freshness, and found that demand for locally produced food is independent of these attributes.

4. In specifying attributes in a CE, it also important to select appropriate levels, since they may capture hidden information and influence credibility in the eye of the respondents.

5. None of the reviewed studies, and in particular, those that employed a CE, addressed the role of processing information within consumers' food choices. However, it appears to be crucial to account for differences in attribute processing strategies, both across respondents and across choice tasks, since failure to account for such heterogeneity can lead to biased WTP estimates (Hensher 2006a, 2006b).

6. Quite surprisingly, few studies in the literature review examined the existence of lexicographic preferences[4]. In evaluating WTP for a credence good through a CE, lexicographic preferences should be taken into account, given the amount of evidence supporting their existence for public attributes such as environment and biodiversity conservation, or economic support of local or small farmers (DeShazo and Fermo 2002). Failure to account for lexicographic preference, will cause a violation of the continuity axiom for environmental goods (Rosenberg et al. 2003) and a departure from the use of compensatory decision-making, ultimately leading to biased WTP estimates (Campbell et al. 2006). One strategy to deal with lexicographic behavior is to use debriefing questions, probing further if respondents focused on only one or two of the attributes in the choice experiment (Alpizar et al. 2001; Rosenberg et al. 2003).

[4] According to Rosenberger et al. (2003), a person who has lexicographic preferences bases her response according to a hierarchy of values and she is generally unwilling to trade or accept compensation for changes in a good or for a specific attribute at all. That is, for this person there is not a reservation price at which he/she is willing to trade the good.

7. Stated preference techniques are likely to have some "hypothetical bias". Using a mixed approach that investigates both stated and revealed preferences could be very helpful in understanding actual consumer preferences for food and to test choice consistency.

Conclusions

This review provides a discussion on important consumer research questions and draws some implications useful for agribusiness researchers. Among 40 selected studies, this research provides a summary of attributes which likely drive consumers buying behavior of sustainable fruit and vegetables. The review confirms that the choice to buy and WTP for fresh F&V is primarily driven by privately-oriented attributes such as personal health or experiential eating quality. Analyzing differences across countries led us to conclude that only health related aspects are similarly valued across regions, while the importance of others attributes varies considerably by consumers' place.

Future research should be devoted to understanding the claims used for credence attributes, perceptions about the expected outcomes and marketing strategies that enhance trust and loyalty toward sustainable products. In short, targeting motivated consumers, positioning brands and communication strategies for organic and low environmental impact food should focus on convincing consumers that these attributes confer a value added to the consumer, even if the value relates to a broader public good aspect of the food and its production system.

Currently, direct marketing in localized food systems is "winning" this challenge in the eyes of consumers, but such direct marketing channels represent just a small share of the overall fruit and vegetables distribution. Interestingly, results show that the attribute "local" is increasing in relevance when compared to organic, certification, and origin. This may indicate that consumers interpret the attribute local as an implicit quality guarantee, or they have relatively greater confidence in a local than a 3rd party certification. As local claims become more common, and possible more challenged, new marketing efforts to communicate aspects that may relate to local sourcing, such as nutrition, environmental benefits and the willingness to support the local economy of the home region will be needed.

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The Nature of Agribusiness Management Research

Executive Commentary

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Abstract

What do we do, when we do agribusiness management research? Who do we serve and how is it different than research in other management fields? What disciplines influence our work? Is there a unique body of agribusiness theory? In an attempt to answer these questions I conducted a very pedestrian exploratory study.

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Introduction

After 20 years of a fruitful IFAMA membership, and academic work, a couple of questions keep catching my attention. What do we do, when we do Agribusiness Management (AgB Mgmt) Research? Who do we serve? How is it different than research in other management fields? What disciplines influence our work? Is there a unique body of agribusiness theory? In an attempt to answer these questions I conducted a very pedestrian exploratory study. I first looked at all the titles of the work presented at symposiums and published in the IFAMR during the last 20 years. Then I analyzed all the articles published in 1998 and 2007. I used those years because 1998 was the first one available online and 2007 was the last one available while exploring the question. I checked that the titles of those two years were not at odds with the norm at both ends of the decade. My understanding of the work published in the general management literature comes from four years of readings (2007-2010) for my doctoral thesis titled "Organizing science based innovation".

Exercises of self-criticism are frequent in the fields of management and strategy, as they are deemed healthy for the progress of an academic field. Self-reflection helps to identify one's field unique contribution and provide a sense of identity for its community. Recently, members of the relatively new strategic management field have voiced a range of somehow divergent concerns about the direction of their work, such as lack of paradigmatic development, premature paradigmatic convergence, moving away from its eclectic and pluralistic origins, lack of adequate testing and replication to consolidate knowledge, and distancing from the 'integrative capstone' nature of strategy teaching. The fact that one such self-reflective studies was awarded with the Academy of Management Best Conference Paper in 2004 is an indication of the importance that the Academy of Management places in these types of discussions.

Problems

How do our problems compare with those of other management fields? Where do problems come from in science is a highly contentious question. In the more fundamental and mature sciences, research problems emerge from the community of scientists itself as mature sciences work mostly in a 'normal science' mode. In the less mature sciences, as in the social sciences, most questions and problems emerge from the environment and from society itself – how do we cure cancer? How do we feed a growing population? Applied fields such as management in general and agribusiness management are performance oriented. The field of management emerged as a result of the need to coordinate work in increasingly complex organizations and corporations. The strategic management field emerged as result of increasing corporate competition.

In agribusiness our problems originate from society's needs. In 1957 Goldberg and Davies stated that the overall mission of agribusiness as a profession was to …" inform private and public policy and strategic decision making with the ultimate purpose of providing food in an efficient, nutritionally acceptable, and socially desirable manner." For Goldberg, the research problems of interest were related to understanding and informing how agents – private and public – could advance their strategic position and how such moves could affect performance at the various levels–agency (firm), value chain, industry, commodity system, and the wider food system.

Sonka and Hudson argued that the uniqueness of agribusiness management challenges were due to (1) the unique cultural, institutional, and political aspects of food, domestically and internationally; (2) the uncertainty arising from the underlying biological basis of crops and livestock production; (3) the alternative goals and forms of political intervention across subsectors and among nations in an increasingly global industry; (4) the institutional framework leading to significant portions of the technology development process being performed in the public sector; and (5) the variety of competitive structures existing within and among the subsectors of the food and agribusiness sector.

Variables of Interest

In the management literature, managing is mostly about interventions at the level of the work environment. When they talk management they talk mostly about people at work and how it affects performance of groups and the organization. The independent variables of interest in the generic management literature are mostly factors and entities inside the firm – individuals, groups and their behavior, the organization, the work environment, culture, incentives, routines, governance (the board room), and leadership.

A look at our literature shows that although we do have an interest in the performance of the firm, we have a broader performance interest spanning beyond the boundaries of the firm. We have an interest in the value chain, the industry, the commodity system, and the food system. Our research shows that our independent variables of interest reside mostly outside the firm - markets, prices, technologies, consumer preferences, institutions (outside the firm), regulations, natural environment, industrial organizations. When we talk about agribusiness management we mean managing the resources in general and managing the organization – the firm, the value chain- with respect to the environment. When we talk management we mean interventions at various levels–the firm, the value chain, market institutions (governance), policies and regulations.

Theories

What are the theories that inform research in the general field of management and how do they compare with agribusiness management? Management research is informed by disciplines such as sociology, psychology and social psychology. The field of strategic management was built around disciplines such as organization theory, industrial organization, organizational economics, institutional economics and agency theory. As fields of study become more applied or solution driven, they tend to make use of a broader base of supporting disciplines; they somehow become more eclectic. Vigorous epistemological debates are frequent in the management sciences, with one camp arguing for paradigmatic convergence and theoretical consolidation and another for theoretical eclecticism and diversity of scholarly work.

Agribusiness management research draws on a wide range of disciplines, which is consistent with the applied nature of the field and the diversity of levels of analysis and problems that are of interest to the profession. Goldberg's Agribusiness Commodity System approach is an example of the multidisciplinary nature of the profession. For him, no problem at any functional level of

the value added food and fiber chain could be understood, evaluated, researched, or acted upon without looking at the total agribusiness system. A complementary view of the multi-theoretical nature of the problems that our profession is required to address was offered by Cook and Chaddad who explained about the diversity of theories required for getting all the levels of the agri-food system right. They concluded that the competence and governance literature underpin agribusiness management research.

Methods

How do our research methods compare to research in general management? The choice of methods of enquiry depends of course on the nature of the problem, but also depends on how well a problem can be defined in terms of extant theory. In the mature sciences, because research problems emerge from inside the science itself, hypotheses are well grounded on accepted theories, and the methods are mostly aimed at testing hypotheses in quantitative terms. A more frequent use of exploratory and qualitative methods is observed in the less mature social and applied fields, due to the complexity and dynamics of the phenomena of interest. It has been recognized though, that problems coming to science vary in terms of equivocality. Some problems fall in the domain of the knowable (normal science) other in more complex and more uncertain domains. While the natural fundamental sciences may ignore problems coming from society as non-scientific or not amenable to their science, the more applied sciences may not have that luxury. A look at the general management literature shows that they are making increasing use of qualitative methods, longitudinal studies, case study research, due to their interest in understanding complex processes of change. Surprisingly, a look at the sources of citations in our literature shows that there are almost no references to the mainstream management journals and very little to the strategic management literature. Our path dependency in terms of research approaches from agriculture economics is very much evident from the journals cited in our work. Hypothetico-deductive approaches and quantitative methods are still very much the norm.

Summary and Implications

The similarities with the generic management field are 1) we share an interest in the performance of organizations; 2) we aim to inform managerial action 3) we share some of the disciplines underpinning our research with the economics strand of the strategic management literature. The differences are (1) we define the boundaries of organizational interest more broadly (2) accordingly, our interest in performance as main dependent variable of interest extends beyond the boundaries of the firm; (3) our independent variables of interest reside mostly outside the firm (4) the disciplines underpinning our work are different than in the general management research, (5) we make less use of qualitative methods to explore complex and dynamic socially embedded processes.

The uniqueness of AgB management research is defined by the uniqueness of its context, by the diversity of agencies and levels of interest in the food system, and by the applied nature of the profession. Although context free research is perceived by some as more scientific and rigorous, both forms of enquiry serve different and useful goals to inform managerial action. The diversity of levels of analysis and the complexity of contexts require a diverse set of support theories and

methods of research. There are no reasons to believe that the AgB management profession would be better served by a theory pushed than by a problem pulled research agenda.

My review of the citations from those two selected years revealed a paucity of exploratory research, and of citations supporting the practice of exploratory research. The global dynamics of the agri-food and bionenergy system present many new and remarkable phenomena for study. Waiting for secondary or thick data sets to emerge may cause the academy to miss important researchable events. A need for scientifically rigorous exploratory research is required to open up new agribusiness management theoretical developments.

The implications for education are quite significant. Masters students should be familiar with a repertoire of analytical frameworks, emphasizing competence and governance, and be able to exercise those frameworks in diverse contextual settings. Intensive use of teaching case studies would serve this second requirement. AgB PhD education should be able to balance the tension between disciplinary focus and rigor as required by theory driven studies, and the skills required to tackle complex and context specific managerial research problems.

Management education, while fundamental for providing analytical frameworks and tools leaves practitioners with little understanding of the nexus and interdependency between the biology of production system, social science, engineering, and markets, which underlie the field of agribusiness. This reality not only justifies AgB education, but calls for a greater integration from the fields of business and agricultural colleges.

AgB management research is a heterogeneous research space ... it is our nature.

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