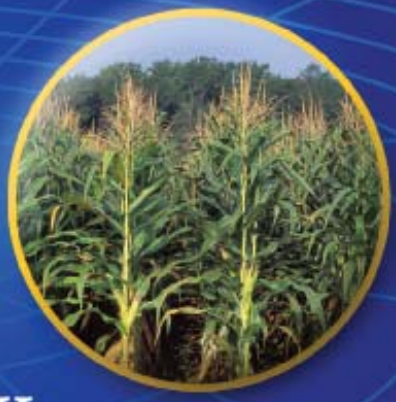

Food Traceability & Assurance in the Global Food System

Farm Foundation's Traceability and Assurance Panel Report, July 2004

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Preface

For more than 70 years, Farm Foundation has worked to help private and public decision makers identify and understand the forces shaping the economic viability of agriculture and rural North America. Traceability and assurance is one such issue, particularly since these protocols are more prevalent in several markets of the world, particularly the European Union, than in the United States.

The expanding volume of global agricultural production and trade, food safety concerns, genetically modified organisms, and food industry biosecurity has focused attention on the viability of tracing food products from retail to farm, and the need to assure specific food ingredient attributes.

Because food traceability and assurance represent a fundamental change in the relationships that exist among market participants, it is inevitable that important questions be raised about the motivations, constraints and appropriate locations of responsibility in implementing these protocols in the United States.

Farm Foundation brought together a panel of industry leaders from most segments of the grain and meat supply chains, and representatives from various agencies of USDA. The charge to the Panel was to define the forces—both pro and con—motivating the adoption of traceability and assurance protocols, and to explore the implications for the various sectors of the United States food system. Over the last 18 months, the Panel members have discussed the issues of traceability and assurance on the U.S. food system. This report is based on that dialogue.

Farm Foundation's intent is for this report to aid informed decision-making in both the public and private sector.

We extend our thanks to DeeVon Bailey of Utah State University, and Eluned Jones of Texas A&M University, for their leadership in coordinating this project. But this project would not have been possible without the experience, knowledge and thoughtful input of the Panel members. We deeply appreciate their time and contribution to this project.

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Any opinions, findings, conclusions or recommendations expressed in this publication are those of the Panel collectively, and do not necessarily reflect the personal views of each member of the Panel or of the institutions with which they are affiliated.

Executive Summary

Because food traceability and assurance represent a fundamental change in the relationships among market participants, it is inevitable that important questions will be raised about the motivations, constraints and appropriate location of responsibility in implementing these protocols in the United States (US).

Farm Foundation's Traceability and Assurance Panel debated many approaches to the challenges facing US food and ingredient supply chains in dynamic global markets. On one issue, however there was clear consensus: One size does not fit all.

Key issues identified by the Panel include:

- USDA agencies have, historically, provided market facilitation and oversight through regulatory protocols, consistent with legislative authority, that do not recognize differences in firm size or strategic objectives, i.e. one size fits all. Thus, the difference between facilitation and constraint of markets may place the private and public sectors in opposition in a dynamically changing global market.

- Traceability and assurance protocols that incorporate existing food safety and assurance elements, such as HACCP and ISO 9000, have the potential to provide an umbrella framework for the diversity of public and private market facilitation needs in the food system. They may address such issues as,
  - food safety contaminations,
  - intentional biosecurity contamination,
  - requirements established for market entry by country or firm,
  - opportunities to address inefficiencies in the supply chain, such as non-safety contaminations that violate contractual specifications,
  - opportunities to identify extrinsic characteristics such as animal welfare, environmental and social responsibility, and
  - opportunities for gaining consumer, and internal supply chain customer, brand or private label equity through implied system integrity.

- The timeline of implementation of traceability and assurance protocols across global markets varies widely as a result of cultural differences, and legislation that emphasizes protection of either the consumer or industry, and with experience of past food safety incidences. Substantial differences exist in the level of consumer trust in public oversight—the strongest example may be the market responses in the EU and the US to their respective discoveries of *BSE*. US market participants believe government regulation and industry compliance provide good control over the safety of the food system. In contrast, consumer confidence in the ability of government to effectively regulate food safety has been shaken across Western Europe by *BSE* incidences, dioxin contamination of poultry feed and contamination of bottled beverages. The EU approach to new food introductions, such as genetically modified (GM) ingredients and nutriceuticals, employs strict interpretation of the precautionary principle. In the US, once the regulatory system designates a product as safe, it is considered to be so until proven otherwise.

- Increasingly, market participants, rather than government agencies, are influencing the determination of acceptable levels of health and food safety. The leading global food retail chains establish acceptable thresholds based on their home nation's legal standards and cultural experience, as well as those pertaining to the country within which they are operating. For example, Tesco responds to the consumer market of the United Kingdom (UK), Ahold to the Netherlands, and Carrefour to France, and to some extent transfer the associated strategies to the international markets within which they operate. Processors and manufacturers supplying these retail chains must meet the public and private standards established for procurement, even though they may differ significantly from those prevailing in the country of origin. A significant question is whether US multinational food corporations are adopting this model, and if such action diminishes or retains the public's role as a third-party certifier.

- Globally, there is consensus that sound science should underlie oversight of food markets. However, increasing consumer awareness and knowledge of the limits and continual evolution of science is increasing the emotional response—rather than cognitive acceptance—to food products. This is particularly true in mature and emerging economies. It is the emotional response that activist minorities can sway, that corporate advertisers target in developing brand allegiance, and that retailers target to gain competitive advantage.

- Both the public and private sectors use dramatic events to motivate paradigm changes. If, for example, government response to a life-threatening contamination of foods is a funded mandate to implement new oversight protocols, it is unlikely to be rejected by consuming taxpayers, demonstrating an indirect willingness-to-pay. Consequently, events dramatized in the media gain political support, even if the probability of a negative event is very low. In contrast, less dramatic but more probable negative events gain less political support but are no less critical to the overall integrity of the food system.

- Public policy, by definition, must address the needs of the general population and establish acceptable minimum food safety and market facilitation guidelines. However, the mandate should also encourage and enable firm level entrepreneurial activity and innovation.

- Biosecurity concerns increase the complexity of the traceability and assurance debate. To some extent, however, biosecurity may bring clarity to the division between the objectives of prevention versus containment. Decision makers must consider the financial and technical trade-offs in assessing the probability of a negative event occurring, leading to the strategic objective of preventing the event versus rapidly containing the outcome. Prevention should be the objective if the probability is high, measurable and the technology exists to prevent the event. Containment should be the objective if the probability of an event is low, and there is no viable way to prevent it. Traceability and assurance protocols provide a paradigm for prevention, where technically and financially feasible, as well as for rapid containment.

- Even with consensus of the need to implement traceability and assurance protocols, there is still a need to address the public-private interface. Exploration is needed of ways to significantly reduce the biosecurity and life-threatening contamination without initially extending the protocols from retail to farm. This would allow time for technology innovation and costs to become more economically, as well as technically, feasible.

One size does not fit all. The greatest challenge to implementing traceability and assurance systems may be adjusting a century-old public-private partnership that has been extremely successful using a "one size fits all" paradigm.

#

Introduction

In the dynamic, global marketplace the rate of innovation has increased to meet the growing influence of consumer purchasing power. Technological innovation has revolutionized what we consume, whether we consume at-home or away-from-home, and the form of consumption—from the traditional meat and two vegetables to meal-replacement shakes or energy bars. There is considerable pressure on the food and agribusiness supply chain to meet this demand in mature[1] and emerging[2] market economies without increasing the percentage of disposable income consumers are spending on food.

As food production, processing, and manufacture have evolved to efficiently meet this demand[3], consumers have become sufficiently aware and knowledgeable to start questioning these processes and request more information about the food they are purchasing. In a totalitarian culture, information would be provided on a need-to-know basis. In a free society, participants are provided with a different and potentially powerful set of expectations. The discord between the corporate need for rapid innovation, to sustain competitiveness in a global market, and the protection of consumer expectations is at the center of the debate of how to meet the needs of both. An inability to resolve this debate increases the probability of market failure in one or more sectors of the supply chain.

The evolving trend toward implementing traceability and assurance protocols is motivated by the need for greater transparency throughout the food supply chain—from retail and restaurant to the producer—in response to consumer demands. The extent of traceability required depends on the level of assurance needed to ensure market facilitation, sustainability and possibly competitiveness. Moreover, the need to use process verification, rather than inspection, to certify some food product attributes may be motivated by the lack of technology to test for an attribute, or the lack of a testable indicator to ensure required management practices occurred.

Increased movement of food ingredients and products in global supply chains increases corporate exposure to different interpretations of due diligence and accountability. The need to track accountability and recall contaminated products provides strong financial motivation to incorporate information needed for traceability with the supply chain management processes implemented to discover efficiencies. Consequently, the greatest concern and recent focus of debate is associated with the handling and production levels of the supply chain where the economic signals to implement traceability and assurance protocols have been the weakest.

The December 2003 discovery of a cow with *Bovine Spongiform Encephalopathy* (*BSE* or mad-cow disease) in the state of Washington has prioritized traceability and assurance issues in the United States (US) food policy debate, and places greater urgency on establishment of a national animal identification system. While food systems in Western Europe and elsewhere[4] have incorporated traceability and assurance protocols, the US has generally lagged other global

[1] US, EU.
[2] India, China.
[3] Including the development of confinement animal production, industrial scale disassembly of animal carcasses and the introduction of genetically modified crops.
[4] Particularly countries where European food retailers such as Ahold, Carrefour and Tesco have a strong presence.

competitors and customers in the implementation of these protocols. Consequently, dichotomous systems have developed across global markets, resulting in significant divisions between countries, and across industry sectors within countries, relating to traceability and assurance issues. Without question, the most significant drivers for implementing these protocols have been *BSE,* in the case of livestock, and genetically-modified organisms (GMOs) in the case of grain, where both are perceived to be food safety events.

There are several possible definitions for traceability. European Union (EU) General Food Law Reg. EC No. 178/2002 defines traceability as: "The ability to trace and follow a food, feed, food-producing animal or substance intended to be or expected to be incorporated into a food or feed, through all stages of production, processing and distribution."

US agribusiness firms and producers are uncomfortable with the European definition for traceability, considering it to be broader than needed to achieve specific food safety or assurance goals. For the purposes of this paper, traceability is defined as: "The efficient and rapid tracking of physical product and traits from and to critical points of origin or destination in the food chain necessary to achieve specific food safety and, or, assurance goals." Of greater concern to the Panel, than strictly defining traceability and assurance was emphasizing that "one size does not fit all", and that different food supply chains require different levels of traceability and assurance for both food safety and assurance.

Structure of the Traceability and Assurance Panel's Work

At their first meeting, Panel members identified five principal questions, which provided the context for subsequent meetings and discussions. The questions are:

I. How do traceability and assurance contribute to the value and cost of food products?
II. What are the responsibilities of the public and private sectors regarding the implementation of traceability and assurance across food systems?
III. How does traceability and assurance affect the risks and potential liability faced by participants in the food marketing chain?
IV. What technical issues and emerging technologies facilitate, or are barriers to, traceability and assurance?
V. How might traceability and assurance affect the structure of the US food industry?

The debate regarding traceability and assurance is an integral part of the dynamic changes that have buffeted the global food system from farm to fork in just over a decade. The rate of change, and the ability to keep up with the economic and business forces impelling change, understandably creates discord[5]. The major forces of change in the food sector are also those proposed by the Panel as underlying the traceability and assurance debate.

Outlined below are the four principal forces underlying the Panel's five questions, together with specific issue areas relating to the traceability and assurance debate.

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[5] Kinsey, Jean "The New Food Economy: Consumer, Farms, Pharms, and Science*." American J. of Agricultural Economics*, 83 (No.5: 2001) 1113-1130. Given as the Presidential Address at the American Agricultural Economics Association, Chicago, IL, August 2001.
Sporleder, T.L. and P.D. Goldsmith. "Alternative Firm Strategies for Signaling Quality in the Food System. *Canadian J. of Agricultural Economics* 49(4)(2001): 591-604.

1. Macroeconomic and government influences
    a. Globalization and trade liberalization
    b. Legal constructs - risk and liability (due diligence, consumer versus industry focus.)
    c. Public/private relationship - collaboration versus confrontation
    d. Geographic and industry structure - diversification versus dependency

2. Corporate and Business Management
    a. Structural and strategic change in the supply chain
    b. Location of consumption – geographic location (US, EU, Asia)
    c. Resource allocations (infrastructure assets/investments, human/intellectual capital, financial capital)

3. Consumer driven food system
    a. Inter-continental demographics
    b. Consumer sophistication/knowledge – including perceived expectations
    c. Concerned consumer – public versus private (food safety, assurance, source, social and environmental responsibility)
    d. Methods of risk assessment – sound science versus the precautionary principle

4. Technology change and innovation
    a. Measurement technology
    b. Innovation - Pharming

The powerful forces for increased traceability and assurance in global food systems demonstrate the evolutionary and revolutionary changes occurring at both the macro and micro levels in the world food economy. Panelists believe these forces are fundamental drivers of change, and that the public and private sectors each have roles to play in addressing the issues and opportunities posed by this new environment. An understanding of these forces provides an essential backdrop to how the food system has arrived at this critical juncture.

I. Macroeconomic and Government Influences

a. Globalization and trade liberalization

At the end of the 20th century the institutions and infrastructure, within which the US food system functions, remain essentially unchanged from their original design in the 1920s. At that time, the focus of US commerce was to simplify the allocation and use of resources to fuel economic growth. The subsequent guiding legislation for facilitating agricultural markets focused on supporting market exchange processes for fungible commodities that could encourage mass handling and production across the geographic extent of the US. During this same period, the states of Europe focused on exploiting their colonial linkages to provide their own food security. These distinctly different strategic approaches led to half a century of divergent economic growth. The strategic shift initiated by the formation of the EU in the mid-1970s did not begin to clearly exercise its affect on global food industry leadership until the last

few years of the 20th century. The effect of this change is only now becoming apparent in the global retail food sector (Table 1).

International institutions with jurisdiction over trade, food safety and assurance, and human health were promulgated in the context of fungible markets, and prior to emergence of biotechnology in the form of GM grains and oilseeds, and the emergence of life-threatening diseases such as *BSE*. For example, the Codex Alimentarius Commission (Codex), founded in 1963 by the United Nation's (UN) Food and Agriculture Organization (FAO) and the World Health Organization (WHO), has a mandate to protect human health and to ensure fair trade practices in the food sector.[6] However, despite the work of an *ad hoc* Codex task force to draft guidelines on food safety and biotech labeling, no consensus has yet been reached. Consensus on Codex guidelines is not binding on UN member nations, but they have typically been adopted in World Trade Organization (WTO) arbitration of trade disputes.

The January 2000 Cartagena protocol on bio-diversity, an amendment to the 1992 UN Convention on Biological Diversity, was intended to provide guidelines for the regulation of trade in GM crops. The main provisions of the Cartagena protocol, in force as of September 11, 2003, allow a country to require information on imported GM products and ingredients prior to entry, and to reaffirm that country's rights to regulate imports. Segregation of GM products is not explicitly required under the protocol. However, since the US did not ratify the Biodiversity Convention, it was not a participant in the subsequent Cartagena negotiations.

b. Legal constructs

The absence of consensus among international institutions placed emphasis back on national legislations as the apparent governing bodies, and, at the same time, magnified the differences in the interpretation of legal constructs. The result has been a distinctly different response to the issue of traceability and assurance between the EU and the US[7]. The United States' greater reliance on legal redress, compared with the EU emphasis on a regulatory regime, results from the legal and institutional environments from which the societies have evolved. For example, in the area of consumer protection, the US relies on a highly active tort system that has emerged from a strong constitutional commitment to individual rights[8]. A comparable tort system does not exist in the EU. The differential evolution of consumer protection laws globally will have implication for the strategic management of multi-national firms with respect to intra-country actions, and international trade where the law of the importing country prevails.

For example, unique to the experiences of the UK, the interpretation of due diligence evolved during the 1990s in concert with the emergence of bio-engineered ingredients[9] and, particularly, the prolonged incidence of *BSE* contamination of the beef supply chain[10]. The 1994

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[6] Jones, Eluned and Stephanie Mercier "The Power of Biotechnology to Impel Change in the Grain and Oilseed Sector" unpublished paper, Texas A&M University, February 2004.

[7] Goldsmith, P.D., N. Turan, and H. Gow. "Food Safety in the Meat Industry: A Regulatory Quagmire." *International Food and Agribusiness Management Review*. Volume 6, July 2003.

[8] Jones, Eluned. "Entity Preservation and Passport Agriculture: EU vs. USA." Drake Journal of Agricultural Law, Vol. 7, No. 2, 2002, pp. 381-406.

[9] The main legislation on GMO's in the EU is Directive 90/220/EEC. Products derived from GMO's are covered by vertical, sectoral legislation, e.g. the Regulation on Novel Foods and Novel Food Ingredients, January 27, 1997, under Regulation EC 258/97. An updated Directive 2001/18/EC was adopted on the deliberate release of GMO's.

[10] EC Regulation 2081/92 and 2082/92.

General Product Safety Regulations redefined civil and criminal liability to place the responsibility for safety on food ingredient suppliers, including producers, manufacturers and importers.[11] This directive was amended in 1999 to remove the exemption for primary agricultural products, and to require that consumers be provided sufficient information to assess inherent product risks.

Starting in October 1998, the EU placed a *de facto* moratorium on GM products and ingredients following demands by Denmark, Greece, France, Italy and Luxembourg for the suspension of trade pending a review of rules and the creation of authorizations specifically to address labeling and traceability of GMOs and GMO-derived products. Prior to this moratorium four corn varieties, one soybean variety and one rapeseed variety had been admitted to EU markets[12]. EU merchants were able to use the novel foods act interpretation of the precautionary principle[13] to restrict entry of GM grains that were not already admitted until guidelines were established covering pre-market evaluation, product tracing for recall and post-market monitoring[14]. Corporate interpretation of the EU food safety laws provided considerable motivation to implement internal and external controls in order to minimize liability exposure. Much of this was accomplished in the private sector through a focus on process control, rather than inspection, and by developing and implementing protocols that combined principles of both Hazard Analysis of Critical Control Points (HACCP) and the International Organization for Standardization (ISO).[15]

Further incentive to control liability exposure was provided by EU General Food Law Reg. EC No. 178/2002, in which the extent of the traceable system comprised the food chain from retail to farm[16]. Article 18 of this regulation specifies: "Food and feed business operators shall be able to identify any person from whom they have been supplied with a food, a feed, a food-producing animal, or any substance intended to be, or expected to be, incorporated into a food or feed. To this end, such operators shall have in place systems and procedures which allow for this information to be made available to the competent authorities on demand."

In March 2003, the EU Council of Ministers announced that the approval process for GMOs would likely resume later in the year. In July 2003, EC regulation 1830/2003 was passed establishing the basis of labeling and traceability of GM food and feed according to the origin of the GM content rather than the actual presence of GM content, and also establishing a threshold of <= 0.9% presence of adventitious GM material. The intent of this legislation was to remove the moratorium on GM products and ingredients and to address the US complaint to the WTO of

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[11] Jones, Eluned See note 5.

[12] Corn: Bt 176, Bt 11, Mon 810 and T 25, Round-Up Ready Soybean, and herbicide resistant Rapeseed.

[13] The intent of the precautionary principle was originally to enable protective action of the environment to take place when a potential negative event occurred, such as an oil spill, without waiting for scientific evidence of direct harm.

[14] Jones, see note 5.

[15] Baines, Richard, Paul Davies and Paul Ryan "Reducing Risks in the Agri-Food Supply Chain – Co-Recognition of Food Safety Systems of a Global Scheme." Presented at the 10th IAMA World Food Congress, Chicago, June 2000.

Jones, Eluned. See note 5.

Bailey, DeeVon, Eluned Jones and David L. Dickinson. "Knowledge Management and Comparative International Strategies on Vertical Information Flow in the Global Food System." *American. J. Agricultural Economics* 84 (No. 5, 2002): 1337-1344.

[16] See Introduction, page 3, for definitions.

barriers to trade in the grain and oilseed markets. Concurrent with the EU legislation was a *Codex Alimentarius*[17] release of guidelines that would provide a uniform approach to analysis and risk management related to GM derived foods and food ingredients across the 169 member countries. These broad principles concerned both food and environmental risk and endorsed the concept of traceability, which is a central tenet of the EU legislation.

c. Public/private relationships

The public mandate through the activities of USDA agencies is to facilitate market exchange and to ensure that food and food ingredients are safe and wholesome[18]. Where legislative change is proposed at the production level of the supply chain, the economic impact is complicated by the diversity of existing business structures—from lifestyle and part-time, to full-time or multi-national. Use of best practices and sound management techniques result in any or none of these structures being economically efficient. However, the democratic process gives all market participants the opportunity to voice their opinion and concerns. Reconciliation through the legislative process is at best a compromise and, in a market economy, will likely lag private industry innovation.

The delay in connecting *BSE* as a causal agent of vCJD in humans was a significant contributor to UK consumers losing confidence in the scientific community and in public oversight by government agencies, particularly the Ministry of Agriculture, Fisheries and Food[19]. As a consequence, the private sector took the leading role in implementing "passport" protocols that minimized market failure potential in the short run, i.e. in the first 2-3 years after *BSE* was accepted as the causal agent of vCJD. This led to a myriad of assurance schemes, particularly in the meats sector[20]. Longer term, public agencies partnered with industry to develop a sustainable umbrella protocol that could translate from retail to consumer.[21] The almost simultaneous impact on consumers of verifying the incidence of vCJD and the introduction of GM ingredients into retail food products was a sea-change in UK market governance.[22] Consumers' perceptions of their vulnerability to oversight failure, and the dramatic results of failure to control for *BSE*, *E. coli* and dioxin[23], provided impetus to retail leadership of the food supply chain in the UK and, to a increasing extent, in the EU[24].

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[17] www.fao.org

[18] This includes but is not limited to the Agricultural Marketing Service, the Grain Inspection and Packers and Stockyards Administration, the Food Safety and Inspection Service, and the Animal and Plant Health Inspection Service of the U.S. Department of Agriculture.

[19] The EU Food Standard Agency is an outcome of the need to re-establish credibility.

[20] Jones, Eluned. See note 5.

[21] Jones, Eluned. See note 5.

[22] Fearne, Andrew. Sainsbury's partnered with the National Farmers Union to generate the "little red tractor" mark to indicate that products complied with one of the certification protocols meeting the standards of this "umbrella" structure.

[23] Dioxin (2,3,7,8-tetrachlorodibenzo-p-dioxin) was found to be prevalent in the Belgian poultry and animal feed supply chain in 1999. Dioxin is stable in the environment and resists degradation and metabolism in organisms. Dioxin accumulates in fatty tissues rather than being excreted and has a half-life of approximately 7 years in humans. As a result biomagnification occurs, i.e. there is increasing concentration up the food chain. All domestic poultry and eggs were ordered removed from all stores in May 1999. In June 1999, the EU agricultural commissioner F. Fischler announced legal action against Belgium for its delayed notification of dioxin related events.

[24] CIES – The Food Business Forum "Implementing Traceability in the Food Supply Chain." March 2004. www.ciesnet.com, last accessed April 16, 2004.

US government agencies observed the loss of consumer confidence in public oversight in several European countries, initially in conjunction with the peak of the UK *BSE* epidemic in 1992/93.[25] However, in November 2000 two cases of *BSE* were diagnosed in German-born cattle and, subsequently, cases were diagnosed in cattle born in all other EU countries, except Luxembourg. In September 2001, the first native-born diagnosis of *BSE* was made in Japan indicating that this disease was not confined to the European continent. Although a Canadian victim died of vCJD in August 2002, the source was determined to be from the UK. In May 2003 a case of *BSE* was confirmed in Canada and in December 2003 in the US, though the source was from a Canadian-born animal[26]. While the probability of a human contracting vCJD is extremely low, based on current incidence, the need for more extensive oversight protocols, than the product inspection system in place, has become a global market consideration through the perception of risk associated with this life-threatening disease.

d. Geographic and industry structure

Competitive advantage relates to the allocation of available assets, such as land or facilities, technology, markets, and even proximity and access to customers. Asset specificity, and the allocation of those assets, based on economic signals from the prevailing public institution, leads to unique strategic decision paths that allow market participants to identify opportunities based on geographic, economic, cultural, and supply or market channel differences[27]. Competitive advantage accrues not only from innovation and strategic use of assets, but also from decisions in the course of a firm or industry's development. A commodity association, region or government may decide to promote a technological innovation. For example, upstream participants in the food chain engaged in pilot field trials of GM crops with life science companies in the early 1990s. Once the investment of resources has occurred, the subsequent path of competitiveness and associated positive or negative opportunities may be irreversibly determined. The first-mover advantage in reaching the market with a new innovation is a critical strategic decision. The need to recover the costs of innovation to provide financial fuel for the next generation of research should not be underestimated in analyzing decision incentives. Future revenues and global market position depend on correctly forecasting government, business and consumer response to future innovations.

Panel Summary on Macroeconomic and Government Influences

The EU definition of traceability has been a source of concern for US agribusiness firms and policy makers, who generally consider the definition to be unnecessarily broad. Although a continuing debate is taking place, most US agribusinesses generally believe a narrower or more targeted definition of traceability could still accomplish food safety and assurance goals at lower costs than tracking each input from farm to retail. These differences of opinion on what is

[25] Between 1996 and 2000, approximately 4.5 million cattle were slaughtered in the UK to prevent the spread of the disease at a cost in excess of £1.4 billion in compensation to producers and a further £575 million to dispose of the carcasses. Since vCJD was identified in 1995, 120 people have died of the disease and others have been identified. (L. Frewer, University of Wageningen).

[26] APHIS-USDA announcements on *BSE* at http://cofcs66.aphis.usda.gov/lpa/issues/bse/bse.html, January 6, 2004 announcement that the dairy cow in Washington originated in Canada. http://cofcs66.aphis.usda.gov/lpa/issues/bse/updates/bse_update01-06-04.html.

[27] Wright, G. "Towards a More Historical Approach to Technological Change." *The Economic Journal*, 107 (September): 1560-66, 1997.

actually needed to assure a safe and high-quality food supply remain a source of friction in trade, especially between the EU and the US.

The desire for flexibility in developing traceability and assurance systems is an overriding message from Panel members: One size does not fit all. This is at the core of divergence in the government (public) versus industry (private) oversight debate since the motivations of firms are neither equivalent to, nor synchronous with, each other in any industry sector. Consequently, a crucial part of this debate is whether public intervention is necessary to ensure that markets are facilitated (the mandate of public oversight) without pre-empting the role of the private sector, which has the economic incentive and can respond more dynamically to change. Corporate strategists are proponents of the need to customize traceability and assurance requirements to specific industries, so that specific sector goals can be effectively achieved[28]. For example, greater traceability capability between production and processing currently exists in pork and poultry than in beef. Consequently, flexibility needs to exist for the different industries to effectively and efficiently meet specific industry sector goals.

The grain industry offers an example of where protocols tailored to meet specific food safety or quality assurance goals are preferable to blanket protocols. Grain and oilseed products are routinely tracked by lot after initial processing, but are typically co-mingled at the first assembly point at the country elevator. Segregation is used in the grain industry to assure characteristics prior to processing, but this is not traceability *per se* since manufacturing and end-use product attributes are tracked rather than a chain of possession. Of greater concern with grains is the non-uniformity of record-keeping systems across firms, and whether protocols should be standardized to facilitate recalls. The direct economic benefits of using traceability to maintain the integrity of attributes within the chain are limited, except for high-value food chains such as soybeans for tofu products. Indirect benefits accruing to better management practices have been documented for several ISO certified grain elevators in the mid-West. However, the cost-benefit relationship for a broader segment of the grains and oilseeds markets changed in the mid-1990s associated with the jeopardy of export market loss from rejected GM grains and oilseeds ingredients.

Should the government compete with or even preempt the private sector in providing oversight of traceability and assurance certifications? There is a clear role for the public sector in ensuring food safety, including both unintentional and intentional (bioterrorism) contamination of the food supply. The private sector also has a role in overseeing efforts to prevent plant and animal diseases from proliferating. For example, the *BSE* crisis provides adequate justification for government intervention to address public health concerns. However, animal identification is needed primarily as a means for tracking animal disease, including *BSE*, and, potentially, bio-terrorist threats.

While some characteristics certified by the use of process verification protocols are clearly public goods, such as with enhanced food safety, other characteristics that could be generated by the use of traceability and assurance protocols appear to be solely proprietary, or private goods, that are intended to enhance the market position and/or price of a product. However, because

[28] Effectiveness may not necessarily be efficient in the short run. Gaining market access or increasing market share are measures of effectiveness, but these might be achieved at significant, and less-than efficient cost. In the long run, efficiency is also necessary to sustain competitiveness.

government enjoys a high degree of trust with US consumers, it is often asked to certify processes used to produce food, even though they may not be directly related to food safety[29].

II. **Corporate and Business Management**

a. Structural and strategic change in the supply chain

Diversification of national and multinational corporations in the early 1990s brought the food and agribusiness sectors in contact with decision-makers in the manufacturing sectors, such as textile and steel products, who were implementing the protocols of Total Quality Management (TQM) and Continuous Improvement (CI) (Figure 1). Through application of these protocols, decision-makers increased their understanding of the potential to gain market power, economic efficiencies and competitive advantage by implementing statistical process control of identified performance criteria. The dynamic growth of, and access to, computing power and information sharing in the early 1990s contributed to the increased rate of change. Coordination within the supply chain—from input/ingredient sourcing to final product—evolved from early relationship-building, in the form of sole source supply of ingredients, to strategic alliances as alternatives to vertical integration of the supply chain. The application of electronic data interchange (EDI) in supply chain management (SCM) has demonstrated the potential for cost savings and efficiency gains through coordination of the procurement process between the buyer and seller, inventory and turnover management, and shrink reduction for downstream market participants. Many of these management protocols involve the same information collection and knowledge management as required by traceability and assurance protocols, such as ISO 9001 and SQF 2000[30], enabling relatively low-cost implementation.

In contrast, the upstream agri-food system continues to rely, in part for practical reasons, on the commodity structure. When contemplating procurement systems, the challenge is to weigh the benefits of continuing with the commodity procurement model--and its flexibility, fungibility, price transparency and low transactions cost--versus engaging in an alternative model that delivers traceability and assurance but with uncertain net results. Are there sufficient risk mitigation or market uplift[31] benefits to justify greater investment in procurement of raw agricultural inputs?[32]

In the early 1990s, closer attention to upstream production management practices illustrated the potential efficiency gains and market uplift possibilities. Cargill trained their workforce in TQM protocols, and the results motivated the National Cattlemen's Association to offer

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[29] Christensen, Bryan J., DeeVon Bailey, Lynn Hunnicutt, and Ruby Ward . "Consumer Preferences for Public and Private Sector Certifications for Beef Products in the United States and the United Kingdom." *International Food and Agribusiness Management Review* 6(2003). Ifama.org/members/IFAMR/v6:3.htm. This article presents evidence supporting the notion that US consumers trust government to make these types of certifications.

[30] ISO 9001 and SQF 2000 (Safe Quality Food) a combination of ISO and HACCP protocols.

[31] Uplift – gains associated with increased market access, increased market share, market power.

[32] Sporleder, T.L. and P.D. Goldsmith. "Differentiation Within the Grain and Oilseeds Sectors: The Evolution and Reengineering of Supply Chains." Presented at the ERS-Farm Foundation Symposium on Product Differentiation and Market Segmentation in Grains and Oilseeds: Implications for an Industry in Transition. Washington D.C., January 27-28, 2003.

workshops for their members and feed suppliers[33]. Similarly, the uplift potential in the food grains and oilseeds supply chains were apparent in the adoption of intensive wheat management practices in soft red winter wheat, in the designation of specific corn varieties for the tortilla chip and breakfast cereals markets, and the export market potential for tofu-destined soybean varieties[34] [35].

b. Geographic Location of Consumption

The influence of the leading European retail supermarket chains on the global market is apparent not only in the activities of Carrefour, Ahold, Metro and Tesco, but also in the changing management practices and protocols that Wal-Mart has adopted in its Europe-based operations. Transference of these practices to the US is increasingly apparent, reflecting coordination of corporate procurement protocols and practices.

The emerging economies of India, China and Eastern Europe are providing strong investment and expansion incentives for global leaders in retail and food service. Eastern Europe and Asia are considered the primary global regions for immediate retail development based on economic and political risk, the level of retail saturation, and the difference between GDP and retail growth[36].

c. Resource allocations (assets/investments, human/intellectual capital, financial capital)

The UK and EU paradigm shift to process-driven oversight challenged the century-old business and institutional infrastructure of the US food ingredient supply chain. How US multi-national corporations respond to this shift depends to a great extent on corporate location in the supply chain—farm/agri-input, commodity handling, processing/manufacturing, or retail/service—and the geographical extent of corporate business—regional, national or global.

i. Farm and Agri-input

The market introduction of GM corn and soybeans in 1996 was a result of a decade of investment and strategic corporate direction change of the agri-chemical companies to become life-science based. The financial and intellectual capital fueling the research and development of bio-engineering during the 1990s was generated through mergers and acquisitions that changed the structure of the agri-input sector (Tables 2 and 3). The strategic decision-making leading to these supply-side products (pesticide resistant crops) was predicated on the prevailing US farm policy of the mid-1980s and the scientific reasoning that the final consumable products were not substantively different from their non-GM counterparts. In the decade-long pipeline from inception to market of these early generation products, corporate strategists could not have

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[33] Jones, Eluned. "Total Quality Management: A Fad or a Necessary Paradigm for Agribusiness--A Symposium." Journal of Agricultural and Applied Economics. 25:1 (July 1993): 300. Presented at the Southern Agricultural Economics Meetings, Tulsa, OK. February, 1993.
"Quality: Believe It!" Stories of Success in the Quality Improvement Process. 1993. Cargill Corporate Quality Dept. Video. Cargill, Minneapolis, MN.

[34] Jones, Eluned, and Lowell D. Hill. "Reengineering Agricultural Market Policies: Issues and Alternatives for Grain Grades and Standards." In Reengineering Marketing Policies in Food and Agriculture: Proceedings of the Agricultural and Food Marketing Consortium. College Station, TX: Texas A&M University. Presented at the Agricultural and Food Marketing Conference, Alexandria, VA, January 1994.

[35] Jones, Eluned. "The Role of Information in the United State Grain and Oilseed Markets." Review of Agricultural Economics, Vol. 21(1999) 237-255.

[36] A.T. Kearney, 2003. Emerging Market Priorities for Food Retailers. http://www.atkearney.com/main.taf?p=5,3,1,61.

foreseen the revolutionary change to consumer-driven markets through the power of disposable income and access to information[37].

Export market response to the commercialization of supply-side GM seeds was unexpected; the grain handling industry was unprepared for the rejection of these grain and oilseeds products and the requirements for documentation of GM-free status from European and Asian importers. In this market environment, the Association of Official Seed Certifying Agencies (AOSCA) was in position to provide a documented trail of registered seed governed by Federal Seed Laws in conjunction with state regulations and state Crop Improvement Associations for registered and certified seed[38]. The template for meeting due diligence requirements was already established in the record management systems required for seed production, including production, field inspections, inventories, transportation, cleaning and certification tags. Using these protocols in conjunction with certified seed, that has already been produced within this management framework, in addition to documentation of all stages from breeder to foundation seed, provides full traceability and assurance of the production process.

ii. Handling and Processing

The leading national and multi-national grain handlers were strategically structured to gain cost-leadership based competitive advantage through the mid-1990s. The introduction of production-oriented GM crops in 1996 raised concerns with export clients that threatened to constrain market access and significantly impact export market share. There was minimal visibility in the consumer market of many of the leading US corporate names, such as Cargill, ConAgra Foods Inc., Archer Daniels Midland (ADM), and Bunge Ltd, as ingredient suppliers. Consequently, buyer allegiance to these multi-national suppliers was service, rather than product oriented.

To sustain competitive position, the major grain and oilseed handling and processing multi-nationals had to address the changing export market climate. Not only did the EU invoke the precautionary principle with respect to GM grains and oilseeds, initially requiring zero tolerance, but many key Asian export markets for the US established tight specifications of less than 0.5%-1.0% tolerance. Moreover, the Tokyo exchange established a futures contract for GM-free soybeans to enable price discovery for the GM-free Asian market[39].

The threat to already-established corporate feed and food grain supply chains between the US and processing facilities overseas, as well as client facilities, necessitated a rapid reaction to ensure continuity. Cargill created InnovaSure as a branded process to deliver dry corn products to its key customers. One of the specific attributes of InnovaSure product lines was non-GM assurance, but the long-term real value of the system comes from customers having a high confidence level in the delivery of products through the InnovaSure supply chain. When the StarLink crisis occurred, InnovaSure customers had confidence that their dry corn products were StarLink free. The continued movement toward branding is part of a continued strategic effort by Cargill, and other multi-nationals, to differentiate capabilities and products for the discerning

[37] Jones and Mercier. See note 3.
[38] Association of Official Seed Certification Agencies ftp://www.aosca.org/opandcs.pdf. Last accessed May 5, 2004.
[39] Non-GM soybean futures are traded on the Tokyo Grain Exchange, http://www.tge.or.jp/english/et611.html. Last accessed May 10, 2004.

supply chain customer, and to prevent the market from commoditizing specific high-value products and processes[40].

Consolidated Grain and Barge, a major grain-handling company, justified costs associated with implementing ISO certification based on the needs of their Japanese clients. As a management strategy, this was extremely successful in the aftermath of the StarLink incident, since Consolidated Grain and Barge could document and certify non-contaminated supplies of corn.[41]

The start of the 21st century brought corporate restructuring in the leading food sector corporations of a similar order of magnitude to that seen in the creation of the life-science companies half a decade earlier. Differentiation and brand-name recognition became the focus of business strategy but, more importantly, corporate strategy moved towards internal structures that focused on "customer solutions" for health, nutrition and food applications[42].

Of concern to early implementers was the need to cover the costs of both traceability and assurance protocols and USDA inspection, where the former were considered by the market participants to be more stringent. A significant difficulty in overcoming the cost impact was the dynamics of changing government oversight. Without an acceptable third party to verify or certify that the protocols met the required standards, and were implemented correctly, the USDA was required to provide oversight. The USDA's Agricultural Marketing Service (AMS) initiated a program to provide oversight of third-party certifiers, a system that was already taking place with the privatization of much of the grain inspection system[43]. The AMS initiated this program with the development of protocols designed for use with branded beef products, which have evolved from this program to cover grains, oilseeds and other agri-ingredients. This evolution is occurring within the current mandate of the agencies, and while still providing the parallel service of product inspection.

With the diagnosis of a *BSE* case in the US, corporate strategic decision-makers are faced with the dilemma of either supporting a mandatory animal identification system to enable full and rapid source verification, or maintaining that current US government oversight is adequate. Mandatory animal ID would necessitate public funding and both federal and state government support to enable a fully participated system. However, this would undermine the corporate investment already made in implementing animal ID systems for those industry leaders who considered the implementation cost an investment. Any added costs of meeting the proposed animal ID legislation are minimal for those industry leaders who have already made the investment in traceability and assurance systems, but prohibitive for those who are not already using detailed record management and best management practices (BMP), TQM or similar management and business practices. Hence, Panel members' underlying concern that "one size

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[40] Communication with Ruth Kimmelshue, Cargill.

[41] Lin, William, Gregory K. Price, and Edward Allen. "Starlink: Where no Cry9C corn should have gone before." Choices, Winter 2001-2002.
Personal interview with J. Stitzlien, Consolidated Grain and Barge, October 2001.
Bender, K. and R. Westgren, 2001. "Constructing the Market(s) for Genetically Modified and Non-modified Crops", *American Behavioral Scientist*, 44(8): 1350-1370.

[42] Personal interviews with Glen Weaver, ConAgra, and Keith Ehmke, Cargill, September-December, 2001.

[43] The Grain Inspection and Packers and Stockyards Administration provide 3rd party oversight of the independent inspector members of the American Association of Grain Inspection and Weighing Agencies.

does not fit all." An industry-level assessment of implementation costs would overestimate the costs to most corporate leaders on a per animal basis, and severely underestimate the costs to the lifestyle producer who has had less economic incentive to tag and monitor animals[44]. Unfortunately, agricultural and food policy formation rarely differentiates decision-making or management consequences at the firm level.

Traceability and assurance systems are not costless, and upstream market participants claim that larger firms will be able to implement such protocols at a lower cost than smaller firms due to economies of scale thereby further increasing their market advantage. The initial investment of implementing traceability and assurance protocols can be expensive. One study suggests that, for a single meat marketing chain in the EU, the cost was $10 million to $12 million[45]. However, once implemented, there may be long-run niche-marketing opportunities for small production and, or, processing firms because of the associated ability to gather and certify data about production inputs and processes that creates management knowledge and can lead to the identification of cost efficiencies or market opportunities[46].

The necessity to meet retail protocols for traceability and assurance of food ingredients changes the processor and manufacturer perception of branding, giving rise to the use of branding within the supply chain. Branding downstream consumer products has been a universal practice to gain consumer loyalty, but does not come without risk exposure and has different strategic uses. Smithfield Foods has retained the diversity of brand labels specifically to spread the risk of liability and brand label damage should a recall be necessary for food safety reasons[47]. Conversely, Nestle pursues a strategic approach of investing in their corporate name[48]. The divergence in strategic approach highlights the differences between the US and European food systems. European retailers have long used private label brands to indicate quality and service differentiation, leading to considerable control over the manufacturing and processing sectors of the supply chain. In contrast, the US retail sector has lagged in leveraging the private brand as a market tool. Assurance occurs through double branding—the retailer, acting as the buyer for the consumer, is not only protective of its store's reputation, but actively evaluates the quality of the brands it permits on its shelves[49].

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[44] Hayes. D. J., and S. R. Meyer. "Impact of Mandatory Country of Origin Labeling on U. S. Pork Exports." White Paper. Iowa State University. Spring 2003.
VanSickle, J., R. McEowen, C. R. Taylor, N. Harl, and J. Connor. "Country of Origin Labeling: A Legal and Economic Analysis." International Agricultural Trade and Policy Center Paper PBTC 03-5, University of Florida. May 2003.
Sparks Companies, Inc. "COOL Cost Assessment." April 2003.
[45] Buhr, Brian. Presentation to National Pork Board, Denver, CO. February 28, 2002.
[46] For example, Creekstone Farms, KS, and Kobe America, OR.
[47] Smithfield Foods. "History of Smithfield Foods," [On-line].
http://www.smithfieldfoods.com/Understand/History/. Last accessed May 10, 2004.
[48] Harvard Business Case: Nestle
[49] Goldsmith, Peter D., Nesve Turan, and Hamish Gow. See note 4.

iii. Manufacturing

Although the initial response to supply-side GM ingredients[50] was not positive in the mature and growth market economies, the multi-nationals viewed implementation of traceability and assurance protocols as a strategic necessity, providing a vehicle to capture value in the supply chain for ingredients with scientifically supportable health and nutrition benefits. Where a multi-national or national company had a market presence in both grains and animal products the shift to process verification, and away from product inspection, was easier to justify at the corporate level given the double exposure to these forces of change.

The investment in implementing traceability and assurance protocols could be viewed as the option value, or premium, on ensuring future revenues from second tier, demand-side GM products. The second round of strategic positioning for competitive advantage can be illustrated by Cargill's Cerestar acquisition to take advantage of core competencies in cereal foods manufacturing; the alliance between Bunge Ltd. and DuPont to create Solae Company in 2003 to strategically benefit from DuPont's protein technology businesses and Bunge's ingredient assets to further develop consumer oriented Solae-brand soy protein products[51]; a joint venture between ADM and Kao Corporation to create the infrastructure necessary to meet Japan's strict standards of identity preservation and to build on ADM's NutriSoy brand of soy protein[52]; and a venture between ADM and Volkswagon to further develop opportunities for innovation in biofuels; a joint venture between Tate & Lyle, p.l.c., and DuPont, DuPont Tate & Lyle BioProducts, L.L.C., that aligns proprietary fermentation and purification core competencies with DuPont's strategic objective of reducing dependency on petrochemicals in the production of textile fibers.

iv. Retail/Service

A critical trend in the US, and one being watched closely in the emerging market economies, is the inexorable move towards spending more per capita on food consumed away-from-home than on food purchased for consumption at home. The associated growth of the food service sector has been supported by dynamic innovation in food processing and manufacturing technology. New technologies in food product preparation, packaging and shelf-life extension are used in conjunction with branding and private labeling to gain competitive advantage in attracting the share of consumer food expenditures.

However, in the past decade the greatest competitive advantage has come from the use of information technology in managing the logistics of the food system. Competitive advantage in retail, wholesale and food service distribution is driven by supply consistency and cost efficiency. Wal-Mart's use of information technology to provide efficient consumer response (ECR) through electronic data interchange (EDI) with their suppliers has revolutionized logistics management at retail, and set a retail industry standard for every-day-low-price (EDLP) marketing. This management structure relies on efficient and extensive use of data collection, information analysis, and effective use of the resulting knowledge. The technology used to support this systems approach parallels that required for traceability and assurance protocols.

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[50] Initial GM seeds commercially released included pest resistant varieties such as Bt corn, and herbicide resistant varieties such as RoundUp Ready corn and soybeans. These are considered as supply-side traits since the producer is a primary beneficiary of the technology. Demand-side traits would reflect benefits to the consumer, although possibly to the manufacturer downstream in the supply chain.

[51] *See generally* The Solae Company, http://www.solae.com/. Last visited April 4, 2004.

[52] Effective July 2003, Japan implemented the Food Hygiene Law and Feed Security Legislation, which established strict requirements with respect to identity preservation, as well as food and feed safety.

Having information on the critical control points in the system to minimize costs and maximize profits requires knowledge of the locations of greatest risk and uncertainty—many of which relate to food safety, assurance and biosecurity.

Corporate focus on capturing consumer disposable income in mature and emerging economies is evident in any retail, wholesale, procurement and food service industry conference agenda. The practice of using brands and private labels, to capture consumer attention is translating into an increased use of this strategy within the supply chain and in retail and food service. A consequence is that ensuring the integrity of the supply chain is paramount in protecting brand or private label reputation.

Whether for retail or for food service, the weakest segment in maintaining the integrity of the food chain is at the initial handling stages upstream. Thus, few developments have had greater potential for changing market infrastructure structure than the emergence of traceability and assurance protocols as a management tool. Processors and manufacturers in the middle of the supply chain, between retailers and producers, have traditionally dominated the US food system. Because intermediate ingredient tracking quality was difficult, retailers and consumers relied on manufacturers and manufacturer brand names to signal quality in the system. Traceability and assurance protocols provide the ability for retailers to influence upstream management decisions through specifications that control all aspects of production and processing (Table 4). The increasing influence of retailers in global markets, including the US, and the emergence of consumer interest in extrinsic characteristics relating to production processes and inputs (e.g., animal welfare, environment impacts, social welfare of workers), will likely propel the need to document all management practices in a future driven primarily by retail and food service specifications. A recent example is McDonalds' requirement that larger cages be provided for laying hens in their egg supply system.

Panel Summary of Corporate and Business Management Influences

Public policy regarding market oversight needs to reflect the changing nature of the food and agribusiness industry globally, and the associated different needs of this sector to engage competitively at all levels of the supply chain. Public policy can have dramatic effects in either facilitating or constraining the ability of firms to compete within their industry sector and across global markets. For example, many believe that environmental laws were one of the driving forces in the consolidation of the swine industry because small farmers were unable to make the investments in infrastructure needed to comply with these laws. If compliance with traceability and assurance system requirements exhibits economies of size then one could argue they will disadvantage small farmers. However, it should also be recognized that these management protocols may enable new opportunities to capture value from new products and new product characteristics, thereby enabling the firm not hampered by an unwieldy fixed infrastructure to be more innovative and flexible to a dynamic market. An example of this might be the small acreages required for green manufacturing of monoclonal antibodies for the pharmaceutical industry[53].

Traceability and assurance essentially provides the possibility for a completely new set of dimensions for food products. Private industry has clearly recognized these opportunities and

[53] Zavon, Juliet A. and James E. Flinn, *Future of Pharming Involves Look at Big Picture*, 75 Feedstuffs, No. 25, June 23, 2003, at A11.

the time-sensitive opportunities for exploitation of short-term financial benefits that will accrue to first movers. Global corporate leaders have estimated the real (option) value of investing now, versus later, in traceability and assurance protocols in order to sustain competitive advantage[54] [55] [56].

III. **Consumer Driven Food System**

a. Inter-continental demographics

In the mature and growth economies, the rate of increased disposable personal income in the past decade has provided consumers with considerable market power and influence. The competition to gain share of consumer spending isn't only at retail and in food service, but reaches upstream from product development to the management of ingredients. In today's global market, consumer studies increasingly reflect the influence of inter-cultural differences, changing age demographics, the location and perceived level of market power in the food chain, and perception of risk or benefit from the purchase.[57]

b. Consumer sophistication/knowledge

European studies on consumer concerns about food risk issues indicate that labeling is perceived as a means of correcting for lack of transparency in the regulatory systems, and for concealing the truth about risks in order to protect the vested interests of scientists, regulators and food industry participants[58]. Marks and Spencer discovered the power of perception when they were targeted by Friends of the Earth for having the highest level of residue on fresh fruit and vegetables of any supermarket studied[59]. The pesticide residues were within legal limits, but far from the zero tolerance demanded by Friends of the Earth. Marks and Spencer researched soon-to-be-banned chemicals and excluded use in their supply chain. The strategy eventually paid off—Marks and Spencer regained market share but were unable to pass on the costs.

The economic debate underlying this example is one of whether freedom from pesticides is a public or private good. Removing the pesticides from the supply chain is not cost-less, but if consumers are unwilling to pay, or do not have sufficient disposable income to have the luxury of choice, do they vote by taking their purchasing power elsewhere[60]? Ensuring that scientifically determined maximum levels of pesticide residue are not exceeded is a public good, in that all consumers are entitled to protection regardless of income. In a competitive market environment, private industry may choose to further differentiate their products and services by

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[54] Salin, Victoria. 2000. "A Real Option Approach to Valuing Food Safety Risks," Proceedings of the 1998 Conference on Economics of HACCP, NE-165, June 15-16, chapter 14 in The Economics of HACCP: Costs and Benefits, L. J. Unnevehr, (ed.), St. Paul: Eagan Press.

[55] Cargill, Bunge, ConAgra have restructured, or are in the process of restructuring through reinvestment, away from commodity to customer solutions (health, nutrition, and food applications).

[56] Booz, Allen, and Hamilton 2001 "Managing Procurement Through a Merger: Capturing the Value of the Deal." 17pp.

[57] Frewer, L., Miles, S., and March, R. (2002) "The media and genetically modified foods: Evidence in support of social amplifications of risk." *Risk Analysis*, 22(4), 701-711.
Frewer, L., Scholderer, J., and Lambert, N. (2003). "Consumer acceptance of functional foods: Issues for the future." T*he British Food Journal*.

[58] Ibid.

[59] Maitland, Alison. *An Ethical Answer to Consumers' Fears*, FINANCIAL TIMES, December 3, 2003.

[60] Hamilton, Stephen F., David L. Sunding and David Zilberman. "Public Goods and the Value of Product Quality Regulations: the Case of Food Safety." J. of Public Economics, 87 (2003) 700-817.

meeting exo-legislated standards, regardless of whether they are able to recover their added costs.

c. Concerned consumer

In the United States, consumers' willingness-to-pay for extrinsic characteristics has been at the center of most discussions regarding implementation of traceability and assurance protocols[61]. Considerable debate has ensued in academia, government and industry about whether or not firms should implement such protocols, and the scientific and economic justification for so doing. Most economic studies examining willingness-to-pay have revealed only small, positive premiums for traceability and assurance, indicating consumers perceive that many of the attributes being studied are public goods, or have insignificant additional value[62]. In reality, it is almost certain that assuring traceability, source verification and origination in US markets cannot be justified solely on willingness-to-pay. However, characteristics related to nutrition and health could possibly generate premiums that would justify the costs of traceability and assurance.

Willingness-to-pay discussions also focus on how potential premiums would be shared between participants in the marketing channel. Implementation of traceability and assurance systems may not result in the explicit financial enrichment of those participating in these systems. Retail prices are likely to be very similar to those being received in traditional markets. However, while firms and producers in EU-based marketing chains, where traceability and assurance certifications have become relatively standard practice, may not be receiving premiums, those outside of these systems have become regarded as residual suppliers and their products receive discounted prices as a result. Examples abound in the EU and elsewhere where small or non-existent premiums are actually realized, a further indication that in the EU traceability and assurance certification is seen, post-*BSE*, as a public good. In lieu of consumer confidence in government oversight, private industry oversight has replaced the public good, but without the public compensation from consumer taxes.

In the end, the willingness-to-pay argument may simply be misguided. The question is not whether a marketing chain can receive more as a result of pursuing a traceability and assurance system, but rather whether the marketing chain is willing to risk losing market share and market position if they do not implement traceability and assurance. In some marketing chains there will likely be no choice regarding the implementation of traceability. To maintain consumer confidence in the meat system, mandatory animal identification and tracking will be implemented as the only current means of reducing the risk of not identifying another case of *BSE*.

Panel Summary Regarding the Influences of the Concerned Consumer

The loss of consumer trust in government food system oversight has been a significant force driving changes in the western European markets. The US experiences underlying loss of consumer confidence have been less dramatic than those experienced in the western European

[61] Goldsmith, Peter D., A. Salvador, D. Knipe and E. Kendall. "Structural Chain or Logical Incrementalism? Turbulence in the Global Meat System." J. of Chain and Network Science. Volume 2, Number 2, 2002:101-115.

markets[63]. Continued consumer confidence in US public oversight indicates the public-private partnership is effective.

The precedent is well established that, once lost, consumer confidence is not easily regained and translates to economic sectors beyond the food system. With consumer confidence in the public sector undermined, the European supermarket food chains have assumed the role, in coordination with third-party certifying private agencies, of providing economic signals on quality, safety, and environmental and social responsibility through retail private brand labels (Figure 2).

At retail, traceability and assurance protocols and certifications are addressing:
1. Real food safety concerns and potential breakdowns in public oversight,
2. Requirements established for market entry, by country or firm,
3. Opportunities to address inefficiencies in the supply chain,
4. Opportunities to identify extrinsic characteristics, such as animal welfare, and environmental and social responsibility,
5. Opportunities for gaining consumer, and internal supply chain customer, brand or private label equity through implied system integrity, and
6. Management of liability exposure and insurance costs.

All six reasons can be considered as consumer or customer-driven, but only #1 and possibly #2, if this is a trade requirement, define traceability and assurance as a public good. Implementing traceability and assurance protocols for the remaining reasons clearly involves competitive advantage and strategic decision-making.

The problem of separating the public and private justifications for traceability and assurance comprises much of the debate's complexity since the different motivations are neither clearly visible at retail nor within the supply chain from retail back to the farm. The record keeping requirements and knowledge acquired are similarly derived for either set of reasons, but for public reasons the costs can be justifiably subsidized by federal[64] and state funds. Thus, where the justification is determined to constitute a public good the costs should not be passed on the consumer. Where private motivations underlie implementing traceability and assurance protocols, there may be financial benefits accruing to efficiencies gained (reason #3), value attached to extrinsic and intrinsic characteristics (reason #4), reduced insurance premia and liability costs due to decreased claims (reason #6),or competitive advantage gained that justifies costs.

IV. **Technology Change and Innovation**

a. Measurement technology

The evolution of measurement technology to meet the information needs of exchange processes has lagged where the need involved non-life threatening attributes (process attributes also known as credence attributes), or significant markets (exports) were not threatened.

[63] The US experiences include the co-mingling of StarLink corn in the food chain; the commingling of adventitious pharmaceutical grain in soybeans that was caught upstream at the country elevator; and most recently, the December 2003 verification of *BSE* in a non-US bred animal.
[64] Ultimately, consumer taxes.

Innovative measurement technology is typically uneconomic for general market use. The exception is where use supports contractual agreements that specify attribute levels with the potential for significant cost efficiencies or added value[65] [66]. The potential for significant export market loss at the introduction of GM seeds prompted rapid development of quick-test kits to detect specific modifications[67].

The limitation to the development of specific tests for intrinsic and extrinsic attributes, and food safety contaminants is that these are based on sample analysis. The sampling techniques proscribed by the USDA are established to provide accurate and repeatable results. However, as the number of extrinsic attributes demanded in the market and the number of detectable microbiological contaminants increases, the sheer volume of sampling and testing has the potential to undermine the market exchange process. While the implementation of HACCP and ISO process protocols is not a perfect substitute, the combination of product inspection and process verification is most likely to facilitate efficient markets. Process verification has the added benefit of requiring traceability and assurance as part of the protocols, providing a framework for recall in the case of both unintended and intended biosecurity contamination[68].

Information technology (IT) can provide the means for gathering the intelligence both the public and private sectors need to achieve objectives related to food safety and quality. The UK *BSE* crisis in the early 1990s occurred during an earlier technological generation of IT, and their "passport" system first implemented was mostly a paper trail[69]. In 1997, the UK government computerized the system to trace more than 24 million animal movements each year. The management of the intelligence necessary to cover unintentional contamination due to a breakdown in the traceability and assurance process is daunting to those considering the costs. However, the potential outcome of either a life-threatening unintentional contamination, or of an intended biosecurity contamination, shifts the assignment of implementation cost to risk and liability management.

In response to the continued failure of inspection systems to confine contaminations,[70] many national and multinational corporations have implemented traceability and assurance protocols as an internal risk and liability management measure. This is done to protect their access to markets, particularly export markets, and in some instances to gain competitive market advantage by associating brand reputation with these changes.

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[65] Jones, Eluned. See note 19.
Jones, Eluned and Stephanie Mercier. "Policy Implications of New Grain and Oilseed Market Structures for Quality." *Review of Agricultural Economics*, Vol. 21 (1999) 256-263.

[66] For example, the use of Near Infra-Red Technology (NIRT) to measure oil and protein content in soybeans, corn and wheat. The initial cost of $80,000 in the late 1980s was prohibitive to general use in the country elevator. A decade later the cost of an NIRT system was $40,000, enough to encourage more widespread use and the needed demand driven cost efficiencies to make this technology more accessible to all participants in the market.

[67] Measurement technology companies such as Neogen and Strategic Diagnostics are responsive to market needs for microbiological contaminants and specific genetic modifications.

[68] GIPSA, www.usda.gov/gipsa/lawsandregs/lawsregs.htm. Last accessed February 1, 2004.

[69] Fearne, Andrew. "The Evolution of Partnerships in the Meat Supply Chain: Insights from the British Beef Industry." Supply Chain Management, Vol. 3 No. 4, 1998.

[70] *BSE* in European countries, Dioxin in Belgium, *BSE* in Japan, Canada, and the U.S., StarLink and Prodigene in the US.

A critical need in using IT innovations is to provide a common nomenclature digital the collected intelligence to be extracted and exchanged within the target elapsed time from food safety related contamination diagnosis to establishing the method for containment. The US National Animal ID Task Force brought together all the participants of the beef sector to address the opportunities in, and constraints to, a national animal ID system that would meet a target of 48-hour elapsed time. Task force members were able to describe the digital capability to create a national premises ID, based on a seven-digit unique code, and a national digital animal ID that uses the ISO 11784 code structure for Radio Frequency Identification (RFID) to create a unique animal code that can be transmitted by ear tag or implant[71].

The timely emergence of RFID as a next generation, and allied, technology to the bar code has enabled the technical feasibility of considering animal ID on the scale of the US beef industry. Service providers with expertise in computer architecture, software and systems analysis, and scientists with industry knowledge have emerged in the past five years to meet the need for traceability and assurance, not only for food safety and biosecurity reasons, but to meet the demand for:

1. Market uplift opportunities,
2. Input and product consistency,
3. Segregating defective ingredients,
4. Lowering the cost per unit of production by extracting inefficiencies and reduce waste
5. Justifying brand claims of value added attributes, and
6. New performance measures imposed to meet management accountability[72].

The packaged goods industries are rapidly adopting tracking technology in the context of improving logistics efficiency. The coordination of RFID tags with electronic product codes is the basis of industry collaborations such as EPCglobal Inc., and UCCnet GLOBAL registry, which are being pilot tested. While these systems are still considered costly to set up for most small and medium-sized enterprises, Wal-Mart has already indicated intent to introduce RFID management systems with mandated use by its top 100 suppliers by early 2005. The shipping industry has adopted RFID as a more cost-efficient solution to meet the Homeland Security mandates on tracking shipping containers. Application upstream is likely to be slower, but the evolution of partnerships and alliances between IT providers, consulting services, and equipment and input dealers indicates that innovation and competitive positioning provide opportunities for larger producer enterprises to meet market requirements[73].

b. Innovation - Pharming

Corporate incentive to invest in a traceability and assurance infrastructure that can retain the integrity of high-value traits, such as nutriceuticals, is associated with the ability to meet the legal due diligence requirements when using crops as 'green-manufacturing' plants. The total acreage involved in 'pharming' is unlikely to extend to more than a few thousand acres, but the risk and liability of inadvertently contaminating commodity grain supplies was exhibited with

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[71] John F. Wiemers, APHIS, National Animal ID Task Force presentation at the Farm Foundation Panel Animal ID workshop, November 2003.

[72] Among these providers are AgInfoLink, eMerge Interactive, Global Animal Management, Clarkston Canada, and VeriPrime.

[73] John Deere's partnership with CropVerifeye and VantagePoint data warehousing systems provides the capability of meeting ISO 9000 certification protocols at the farm level. See http://www.deere.com/en_US/ag/feature/croptracer.html. Last accessed May 10, 2004.

both StarLink, and with Prodigene's corn crop. The financial exposure associated with StarLink was limited compared with that of a similar contamination if the supply could not be redirected into the feed market, as would be the case in a 'pharmed' crop. Despite the risks associated with the use of 'green-manufacturing', there is considerable private-sector interest and investment due to the overall economic incentives offered by plant-based manufacture of monoclonal antibodies[74] (Tables 5 and 6).

c. Certifications and Protocols

A critical question is whether the public sector can respond with sufficient speed and detail in providing third-party certification and assurance, primarily using product inspection, without compromising the private sector's competitive ability to respond to the expectations of domestic and global consumers. If the public sector cannot meet these demands, or the taxpayer is unwilling to support the cost of the public sector meeting these demands, is the US consumer willing to accept an alternative autonomous or third–party certifier?

The USDA is already moving toward an alternative structure with certification of independent inspection agencies for grains and oilseeds[75]. How will the US respond to oversight by a global private entity, such as that being created by CIES[76], a consortium or forum of the leading 200 global food retailers and manufacturers, which plans to approve process certification protocols that incorporate both food safety and quality assurance protocols[77]? In the EU, this voluntary approach has evolved because of consumer lack of confidence in the public sector. In the US, a voluntary private-sector approach may be needed to meet the competitive pace of the industry, and to meet consumer's expectations in the context of sustaining their confidence in the US food system. However, given the litigious environment in the US, the private sector may not be able to afford the risk exposure of not having a mandatory system in place.

The evolution of process verification protocols from an oversight structure based on product inspection has been slow. Although both the meats and grains and oilseeds sectors have protocols in place that enable some combination of food safety as well as quality assurance oversight, there are few firms that have embraced the level of integration of food safety and assurance provided in the SQF 2000 protocols (Figure 2).

Where sustained competitiveness indicates, multi-national firms will differentiate products and product specifications based on traceability and assurance requirements established by the private sector further downstream in the US and by clients in importing countries. In the absence of consensus, these dichotomous systems will constrain opportunities for increased efficiency and are likely to add costs in the trade sector. Standardization of certification requirements for varying levels of completeness of the traceability and assurance protocol, i.e. one-step-forward, one-step-back versus the complete supply chain, would be an improvement on the current status,

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[74] "The capital cost for a facility to produce 1000-2000 kg per year of Monoclonal antibodies (Mabs) can range up to $600 million, of which half is need for the upstream production facility (in this case agricultural). Steiner estimates that using green plants could cut this initial investment from $300 million to $3 million. The remaining investment in recovery and purification would still be required." Juliet A. Zavon and James E. Flynn. "Future of pharming involves look at big picture." Feedstuffs, June 23, 2003, Vol. 75, No. 25.

[75] Association of American Grain Inspection and Weighing Agencies.

[76] CIES http://www.ciesnet.com/index.htm. Last accessed March 27, 2004.

[77] For example, SQF 2000 and BRS (British Retail Standards).

yet recognize the economic and technical limitations associated with setting a target of 100 percent traceability and assurance.

Panel Summary Regarding Technology Change and Innovation Influences

The gap in maintaining identification of product flow between commodity assembly and product distribution after processing originates in the evolution of the US food supply infrastructure. Tracking from farm to assembly point is relatively easy, as is tracking processed product from plant to retail. However, high-speed US processing plants are not well-suited to maintaining the link between the farm and retail. These plants were designed to assemble and process large volumes of commodities with minimal specific identity of the producer and handler being maintained prior to the manufacturing level. This suggests achieving traceability and assurance from farm-to-fork will require substantial redesign in standard handling and processing practices.

The structural impediments to maintaining identification are considerable, particularly within the grains and oilseeds sectors, representing a significant technical barrier to the implementation of traceability and assurance systems in the US for the purposes of enhanced food safety and assurance. This is why a two-stage traceability system is preferred by many agribusiness firms--provide traceability from the farm to the plant where the safety of the commodity is established by testing, and then track the product from plant to retail but without a direct link back to the farm. The issue is whether a two-stage traceability system will be adequate to establish enhanced food safety and address bio-terrorism issues. This is important from a public policy perspective because enhanced food safety and safeguards against bio-terrorism are the public sector's main interest in traceability and assurance systems.

Ownership and access to the intelligence generated in a traceability and assurance system, such as an animal identification system, remains a concern. Information gathered by the USDA is considered a "critical infrastructure" and, as such, is supposedly protected from public disclosure. However, depending on the level of government involvement and the nature of the system, litigants, the private sector and government could all, without sufficient safeguards, access the information through a variety of methods, including the Freedom of Information Act and a court's subpoena power. Since the public objective of traceability and assurance systems is to mitigate life-threatening situations, a public system should keep information as narrow as possible to address public needs. At the same time, the system needs broad enough capabilities to capture proprietary information that market participants choose to gather, record and track for private-sector competitive advantage.

Incentives for innovation of measurement technologies may be associated as much with public as with private oversight through traceability and assurance protocols and certifications, if the technologies serve a dual purpose. For example, in the delineation of information required to support public good objectives versus proprietary (private) information that can yield competitive advantage, the same technology can be used.

Summary

Each member of the Farm Foundation Traceability and Assurance Panel represented different levels of the supply chain, and brought different perspectives of the grains and animal products sectors to the debate. The review below highlights common issues between the two sectors, and within the supply chains.

I. ***How does traceability and assurance contribute to the value and cost of food products?***

The differentiation of costs and benefits to implementing traceability and assurance inter- and intra-supply chain indicates that "one size does not fit all." Strategic response, external to regulatory conditions, indicates that each firm has different motivations and different timelines for technical and economic implementation. For those firms facing competitive advantage issues of market access and market share due to cultural responses to GM ingredients in the mid-1990s, the motivation depended on whether the firm was engaged in the export market directly or indirectly. Firms engaged with other participants in pursuing cost efficiencies through supply chain or category management have also implemented traceability and assurance protocols to some extent. While the risk and liability exposure is greater in the animal industry in relation to microbiological and disease contamination, the move to mandate HACCP protocols mitigated the need to implement traceability and assurance to the extent of animal ID until the threat of *BSE* became proximal to the US industry. In part, the lower dependence of the US beef industry on export markets contributed to this response.

There is significant producer resistance to mandatory animal ID, although some resistance exists at all levels of most marketing chains. It has taken a major negative event, the *BSE* crisis, costing the US beef industry $10 million per day in lost exports, to achieve support for a national animal identification system[78]. Resistance to implementing mandatory traceability systems stems from the producers' uncertainty regarding the costs and benefits they will bear. They are also concerned with potential exposure to liability if their actions are made visible in the marketing channel via certified traceability and assurance protocols.

One difficulty in policy formation is how to reconcile the disparity of existing investments--some firms have taken few, if any, steps towards implementation of traceability and assurance protocols, while others are fully ISO and HACCP certified. If traceability and assurance implementation is mandated and costs subsidized, the potential for financial benefits accruing to first movers is diminished, effectively creating a welfare transfer. However, if traceability and assurance is considered necessary to meet the public mandate for food safety, and the government provides 100 percent oversight, then the industry can reasonably expect government subsidies to support the fixed costs of implementing the protocols and possibly continued subsidy indirectly through certification of the protocols and service providers. The government is already providing an indirect subsidy through certification systems supported by the USDA's Agriculture Marketing Service[79]. Supra-mandatory support of certification of traceability and assurance protocols provided by the public sector, for private industry, should be limited to the need for oversight of common nomenclature and exchange of information necessary for market

[78] Federation of Animal Science Societies. "*BSE* Regulations Have Economic Impact on US Beef Industry." Available on line March 3, 2004, at http://osl.fass.org/thenews2.asp?news_id=229.

[79] AMS-USDA Quality System Assessment Program. http://www.ams.usda.gov/lsg/arc/qsap.htm Last accessed May 5, 2004.

facilitation. Certain services associated with traceability and assurance certifications could be provided by the USDA, as currently done, but the private sector has economic incentive to innovate and meet the market's needs more cost efficiently.

II. *What are the responsibilities of the public and private sectors regarding implementation of traceability and assurance in food systems?*

Life threatening unintentional and intentional contamination

Government involvement in designing, facilitating, or covering all or part of the costs of traceability and assurance is based on the argument that traceability is a public good[80]. In the context of biosecurity and life-threatening food safety, there is an expanded responsibility and role for government oversight in rapid crisis management of unintentional, as well as intentional contamination. The level of intelligence gathering, exchange and redistribution under extreme time pressure is only possible with coordination of public and private capture and coordination of data and records.

An integral part of this debate is the extent of access to proprietary information, what is defined as proprietary, and what limits can be placed on data gathering without compromising the effectiveness of the system. Establishing and supporting such an effort, external to functioning market exchange processes, would be technically feasible, but inefficient. The data gathered and knowledge gained has economic benefits to all the participants in the supply chain only if access can be transformed into useful management decision-making. While there is a clear public good in oversight and establishing a common nomenclature for extraction and exchange of data, the private sector has the ability and economic incentive to affect this exchange most efficiently. However, a national intelligence grid would require jurisdiction over both interstate and intrastate commerce. Currently, federal agencies have jurisdiction over interstate movements only, thereby requiring the public role to incorporate a partnership of both federal and state agencies.

Non-life threatening contamination

If life-threatening events are not the underlying reason for traceability and assurance implementation, then the role of government is significantly different. Modern food marketing chains operate in an environment where market or internal transactions can no longer rely solely on trust and simple contracts to assure quality. Corporate incentives and strategic decisions are driven by supply stoppages and volume constraints, and market access where risk and liability are not involved. Consequently, intelligence on a broad range of input attributes is valuable to firms trying to gain competitive advantage, while maintaining brand equity and integrity.

Resistance to mandatory traceability and assurance is, in part, associated with concern that the location of competitive advantage will change. There are concerns that the limits of public and private intelligence exchange are not clearly defined, and that public access would be unlimited under the Freedom of Information Act. Furthermore, under current liability laws, the location of liability in the supply chain would move upstream to the farm and first handler level, which is likely to have the least ability to document practices to meet due diligence requirements.

[80] Where "public good" is an economic term meaning goods or characteristics which consumers cannot or should not be excluded from consuming.

These concerns have lead to contracts in the grains and oilseeds sectors being tied to documented management practices, and even to premia paid to cover the cost of required crop consultant services[81].

Major US manufacturer and retail competitors are moving inexorably toward establishing certification protocols that incorporate food safety (HACCP) and assurance (ISO) protocols. This suggests that the US public and private sectors need to be exploring methods for effectively and efficiently achieving appropriate traceability and assurance standards as a strategy for maintaining global market competitiveness. In this context, there needs to be cooperative government-to-government interchange, in addition to business-to-business.

III. *How does traceability and assurance affect the risks and potential liability faced by participants in the food marketing chain?*

There is often a disconnection between consumer demands and technical realities. An example would be policy that reflects a balance between risks, or probability of a negative event occurring, and the costs of achieving given levels of traceability and assurance in the food system. To be effective, public policy must reflect technical realities. Determining what is technically and economically feasible can be discovered through cooperation between the public and the private sectors. Some efforts have taken place to coordinate public and private interests in traceability systems, e.g. the US Animal Identification Plan.

Risk assessment remains a critical issue. It has become politicized as a debate between sound science and the precautionary principle as applied by the EU[82]. Risk assessment has become a focus of international trade disputes, as a new method for erecting trade barriers.

Implementation of traceability and assurance protocols may not eliminate the overall risk in a marketing chain, since traceability does not guarantee that system breakdowns will not occur. However, these protocols provide an effective means of managing risk containment once a negative event is identified, since the problem can be located efficiently and the impact minimized. For example, food recalls could be targeted and less market disruption would occur if a traceability and assurance system were in place rather than the conventional marketing chain. This suggests that a public interest exists in traceability and assurance systems—food safety breakdowns can be efficiently tracked and the consequences minimized. Use of these protocols can also help minimize damage to private brand equity, suggesting that private interests also benefit. For example, traceability can substantiate private standards used to determine if there has been a breach of contract or other type of agreement.

In a system employing traceability and assurance protocols agricultural producers are no longer anonymous participants in the marketing chain. Because of this, there will be a re-

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[81] For example, intensive wheat management programs that are partnered with crop management consulting companies. See Siemer Milling Company at http://www.siemermilling.com/Grain/Programs/programs.html. Last accessed May 5 2004.
Interview with Ron Olson, Vice President for Grain Operations, General Mills, September 21, 2001.

[82] The precautionary principle (PP) is applied where lack of full scientific certainty of an outcome exists. In food policy, the PP basically states that short-run food policy decisions may have long-run consequences but are often made without conclusive scientific evidence of the absence of any long-run harm (Bailey, Jones, and Dickinson. See note 9).

allocation of risk and liability. A particular concern to some producers is that under the principles of strict liability, a producer may be strictly liable for introducing a defective product into the stream of commerce[83]. Thus, producers are concerned that efforts, such as animal identification, will increase their liability exposure. Some livestock organizations have publicly called for limits on liability. One possible alternative is to pass legislation that would offer some protection to market participants who follow the rules, so that if breakdowns in the system occur, litigation does not devolve into attempts to pass responsibility upstream in the marketing chain. Traceability can provide proof that appropriate processes and remedies have been followed in the production process, but it does not define the extent of liability. This is a fundamental disincentive to the implementation of traceability and assurance systems, and highlights the differences in the food safety laws in the US and Europe.

IV. *What technical issues and emerging technologies facilitate or are barriers to implementing traceability and assurance protocols?*

Technical issues are important, but not the primary, reasons blocking implementation of traceability and assurance in most marketing chains, or segments of the supply chain. Effective technology exists for tracking animals from birth to carcass as they move through the marketing chain, but cost-effective technology does not exist for tracking meat cuts from high-speed meat-cutting plants to retail Animals can be tracked from the feedlot to slaughterhouse door; then in an opportunity window within the slaughter process by lot; and finally from packaged product to retail. There is a discontinuous traceability and assurance process across the whole chain, but complete between specified points. Technical issues relating to information sharing within and across chains, appropriate testing methods, and reducing or eliminating human error need to be addressed.

Efforts are needed to determine globally accepted, scientifically-based standards for measurement technology and for the digital nomenclature intended for data extraction and exchange in order to provide a platform for trade and government-to-government as well as business-to-business discussions.

V. *How might traceability and assurance affect the structure of the US food industry?*

Payment of royalties in exchange for the right of access to the intellectual property, e.g. GM seed is an example of the changing relationship between producers and input suppliers. The use of traceability and assurance protocols upstream has the potential to provide clarity to revenue generation from intellectual property royalties applied to seed purchases. Incentives to use or buy black market, or saved brown bag, seed should be significantly diminished if the process is more transparent though documentation[84] [85]. Discomfort with changing business relationships upstream at the farm level is more acute than downstream, since many of these relationships

[83] Where the defect is attributable to the producer and the defect causes injury, regardless of whether the producer employed due care.

[84] Monsanto has lost significant revenues in the black market use of Round-Up Ready soybeans in Brazil. In part, this contributed to the debate and subsequent interim legislation to allow the planting of GM soybeans in Brazil for the 2003/2004 crop season.

[85] Monsanto has sued producers for saving seed that was covered by a technology use agreement and planting this seed in the subsequent crop year. Monsanto claims patent infringement and piracy of intellectual property. (New York Times, November 2, 2003.)

have been in place for several generations. In contrast, many of the supply chain participants, and certainly the technology, downstream didn't exist one or more generations back.

Increasing coordination in the food supply chain through supply chain management, and particularly category management, has raised questions of antitrust behavior in the courts[86]. A challenge by producers to Tyson Foods coordinated procurement of beef cattle claimed the marketing activities precluded certain producers from participating in that market. The court determined Tyson's actions were consistent with cost-efficiency objectives. However, other courts have concluded that coordination closer to the retail end of the supply chain, and incorporating prior knowledge of contractual specifications as would be standard practice in category management protocols, constitutes antitrust behavior. The US Security and Exchange Commission has considered the activities of Wal-Mart several times, but has been challenged to justify antitrust and monopolistic behavior since Wal-Mart mark-up and prices are lower than its competitors.

[86] Larson, Philip C. and Richard S. Silverman. "Sixth Circuit Decision in *Conwood Co. v. United States Tobacco Co.* Addresses Category Management." *Hogan & Hartson L.L.P. Update* (July 2002).

Key Issues

Because food traceability and assurance represent a fundamental change in the relationships among market participants, it is inevitable that important questions will be raised about the motivations, constraints and appropriate locations of responsibility in implementing these protocols in the US.

Farm Foundation's Traceability and Assurance Panel debated many approaches to the challenges facing US food and ingredient supply chains in dynamic global markets. On one issue, however there was clear consensus: One size does not fit all.

Issues identified by the Panel include:

- USDA agencies have, historically, provided market facilitation and oversight through regulatory protocols, consistent with legislative authority, that do not recognize differences in firm size or strategic objectives, i.e. one size fits all. Thus, the difference between facilitation and constraint of markets may place the private and public sectors in opposition in a dynamically changing global market.

- Traceability and assurance protocols that incorporate existing food safety and assurance elements, such as HACCP and ISO 9000, have the potential to provide an umbrella framework for the diversity of public and private market facilitation needs in the food system. They may address such issues as:
  - food safety contaminations,
  - intentional biosecurity contamination,
  - requirements established for market entry by country or firm,
  - opportunities to address inefficiencies in the supply chain, such as non-safety contaminations that violate contractual specifications,
  - opportunities to identify extrinsic characteristics such as animal welfare, environmental and social responsibility, and
  - opportunities for gaining consumer, and internal supply chain customer, brand or private label equity through implied system integrity.

- The timeline of implementation of traceability and assurance protocols across global markets varies widely as a result of cultural differences, and legislation that emphasizes protection of either the consumer or industry, and with experience of past food safety incidences. Substantial differences exist in the level of consumer trust in public oversight—the strongest example may be the market responses in the EU and the US to their respective discoveries of *BSE*. US market participants believe government regulation and industry compliance provide good control over the safety of the food system. In contrast, consumer confidence in the ability of government to effectively regulate food safety has been shaken across Western Europe by *BSE* incidences, dioxin contamination of poultry feed and contamination of bottled beverages. The EU approach to new food introductions, such as genetically modified (GM) ingredients and nutriceuticals, employs strict interpretation of the precautionary principle. In the US, once the regulatory system designates a product as safe, it is considered to be so until proven otherwise.

- Increasingly, market participants, rather than government agencies, are influencing the determination of acceptable levels of health and food safety. The leading global food retail chains establish acceptable thresholds based on their home nation's legal standards and cultural experience, as well as those pertaining to the country within which they are operating. For example, Tesco responds to the consumer market of the United Kingdom (UK), Ahold to the Netherlands, and Carrefour to France, and to some extent transfer the associated strategies to the international markets within which they operate. Processors and manufacturers supplying these retail chains must meet the public and private standards established for procurement, even though they may differ significantly from those prevailing in the country of origin. A significant question is whether US multinational food corporations are adopting this model, and if such action diminishes or retains the public's role as a third-party certifier.

- Globally, there is consensus that sound science should underlie oversight of food markets. However, increasing consumer awareness and knowledge of the limits and continual evolution of science is increasing the emotional response—rather than cognitive acceptance—to food products. This is particularly true in mature and emerging economies. It is the emotional response that activist minorities can sway, that corporate advertisers target in developing brand allegiance, and that retailers target to gain competitive advantage.

- Both the public and private sectors use dramatic events to motivate paradigm changes. If, for example, government response to a life-threatening contamination of foods is a funded mandate to implement new oversight protocols, it is unlikely to be rejected by consuming taxpayers, demonstrating an indirect willingness-to-pay. Consequently, events dramatized in the media gain political support, even if the probability of a negative event is very low. In contrast, less dramatic but more probable negative events gain less political support but are no less critical to the overall integrity of the food system.

- Public policy, by definition, must address the needs of the general population and establish acceptable minimum food safety and market facilitation guidelines. However, the mandate should also encourage and enable firm level entrepreneurial activity and innovation.

- Biosecurity concerns increase the complexity of the traceability and assurance debate. To some extent, however, biosecurity may bring clarity to the division between the objectives of prevention versus containment. Decision makers must consider the financial and technical trade-offs in assessing the probability of a negative event occurring, leading to the strategic objective of preventing the event versus rapidly containing the outcome. Prevention should be the objective if the probability is high, measurable and the technology exists to prevent the event. Containment should be the objective if the probability of an event is low, and there is no viable way to prevent it. Traceability and assurance protocols provide a paradigm for prevention, where technically and financially feasible, as well as for rapid containment.

- Even with consensus of the need to implement traceability and assurance protocols, there is still a need to address the public-private interface. Exploration is needed of ways to significantly reduce the biosecurity and life-threatening contamination without initially extending the protocols from retail to farm. This would allow time for technology innovation and costs to become more economically, as well as technically, feasible.

One size does not fit all. The greatest challenge to implementing traceability and assurance systems may be adjusting a century-old public-private partnership that has been extremely successful using a "one size fits all" paradigm.

Table 1: Top Global Supermarket Companies[87]

Company	Stores Owned	Sales ($ Bill.)	Countries of Operation
Wal-Mart (United States)	5,164	244	Argentina, Brazil, Canada, China, Germany, Japan, Mexico, Singapore, South Korea, United Kingdom, United States, Vietnam
Carrefour (France)	10,704	65	Argentina, Belgium, Brazil, Chile, China, Columbia, Czech Republic, Dominican Rep., Egypt, France, Greece, Indonesia, Italy, Japan, Malaysia, Mexico, Oman, Poland, Portugal, Qatar, Romania, Singapore, Slovakia, South Korea, Spain, Switzerland, Taiwan, Thailand, Tunisia, Turkey, United States
Ahold (Netherlands)	9,407	59	Argentina, Brazil, Chile, Costa Rica, Czech Republic, Denmark, Ecuador, El Salvador, Estonia, Honduras, Indonesia, Latvia, Lithuania, Malaysia, Netherlands, Nicaragua, Norway, Paraguay, Peru, Poland, Portugal, Slovakia, Spain, Sweden, Thailand, United States
Kroger (United States)	3,667	52	United States
Metro (Germany)	2,411	49	Austria, Belgium, Bulgaria, China, Croatia, Czech Republic, Denmark, France, Germany, Greece, Hungary, India, Italy, Japan, Luxembourg, Morocco, Netherlands, Poland, Portugal, Romania, Russia, Slovakia, Spain, Switzerland, Turkey, United Kingdom, Ukraine, Vietnam
Tesco (United Kingdom)	2,294	40	Czech Rep., Hungary, Ireland, Malaysia, Poland, Slovakia, South Korea, Taiwan, Thailand, United Kingdom, United States
Costco (United States)	400	38	Canada, Japan, Mexico, South Korea, Taiwan, United Kingdom, United States
Albertsons (United States)	1,688	36	United States
Rewe Zentrale (Germany)			Germany, Austria, Italy, France, Poland, Hungary, Czech Republic, Slovakia, Croatia, Romania, Ukraine, Bulgaria

[87] Source: Supermarket News, September 2003

Figure 1: Evolution of Strategic Management Protocols in the Context of Significant Events in the Food Chain

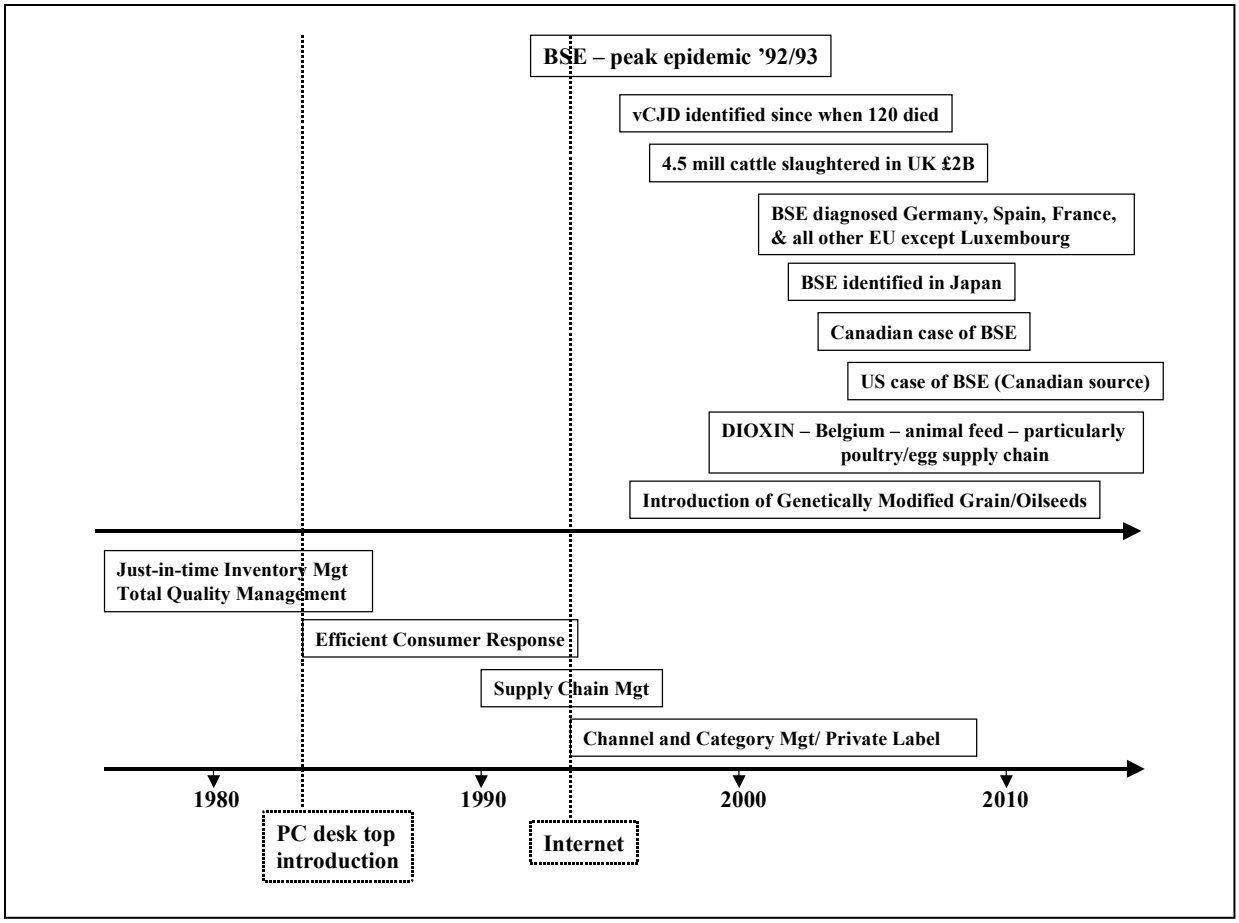

Table 2: Consolidation Activity for the Ten Most Active Biotechnology Firms, 1998[88]

Company	Mergers	Acquisitions	Joint Ventures	Other	Total
Monsanto	1	15	4	17	37
AgriBiotech	1	30	0	5	36
Novartis	3	21	1	0	25
AgrEvo/Aventis	2	15	3	2	22
AstraZeneca	0	14	1	1	16
Limagrain	0	15	0	1	16
Empressa La Moderna	1	10	0	5	16
Rhone-Poulenc	3	6	2	2	13
DuPont	0	3	2	8	13
DeKalb Genetics	0	11	0	0	11

Table 3: Selected Acquisitions in Crop Biotechnology and Seed Industries, 1993-1998[89]

Parent Company	Acquired Companies	Total Cost ($ billion)
DuPont	Pioneer Protein Technologies International Dalgerty Hybrinova Cereals Innovation	10.9 for Pioneer and PTI
Monsanto	DeKalb Delta and Pine Land Cargill Seed International Holdens Asgrow Agronomics Agroceres Agracetus	8.56
AgrEvo	PGS	.77
Dow	Mycogen (United AgriSeeds, Dinamilho)	.62 (.04)
Zeneca	Mogen	.07

[88] From "Impact of Industry Concentration on Innovation in the US Plant Biotech Industry." By M.F. Brennan, C.E. Pray, and A. Courtmanche, 2000, in Transitions in AgBiotech: Economics of Strategy and Policy, W. H. Lesser (Ed.) Storrs, CT: University of Connecticut.

[89] From Kalaitzandonakis and Hayenga, University of Missouri Agrobiotechnology database.

Table 4: EU Actions with respect to Meat Quality and GMOs[90]

Distributor	Action relative to meat	Action relative to GMO	Labeling policy
Auchan (F)		GM free own brands, also propose to eliminate GM from additives.	Information provision to consumers
Carrefour (F)	Traceability	Guaranteed by TTA, grain suppliers GM-free-Brazil.	Filliere Qualite Certificate
Leclerc (F)	Traceability	Guaranteed by TTA.	Marque Repere Brand
M&S (F)	Removed all meat from animal feed with GM crops	All own brands are GM free.	
Asda/WalMart (UK)	All beef or milk are free of GM based feed	All own brands GM free. Link with Brazilian SB growers, UK distributors & labs to create a quality network.	
Iceland (UK)		All producers are GM free since 1998. Investments to support farmers to develop environmentally responsible practices.	
Marks & Spencer (UK)	Traceability on beef products sold under own brand. Will eliminate all animal products fed with GMO.	Eliminated all GM ingredients from own brands.	Labels over 100 products containing GM derivatives
Safeway (UK)	Consortium with Sainsbury, Marks & Spencer and Northern Foods to eliminate GM feed		Labels all own products containing GM ingredients
Sainsbury (UK)	Contract with Anglo Beef Producers- last 60 days no GM feed	Eliminated all GM ingredients from own brand. Efforts to establish reliable sources of non-GM.	Products not labeled
Tesco (UK)	Eliminated all animal products fed with GM feed		Identifies products containing GM ingredients

[90] Extracted from Belik, Walter, Roseli R. dos Santos, and Raul Green. "Food Retailing, Quality Signals and the Customer Defense." Presented at the International Agribusiness Management Association Conference in Sidney, Australia, June 2001.

Table 5: Input, Processing, and Consumer-level Traits of Bioengineered Food Crops in Field Testing or Commercialization[91]

Crop	Input	Processing	Consumer
Barley	F	F	F
Corn	F, P, A		
Cotton	F, A	F	F
Oat	F		
Rapeseed	F, P, A	A	A
Rice	F, P, A	F	F
Russian wildrye	F		
Sorghum	F		
Soybean	F, A	A	A
Sunflower	F	F	
Wheat	F	F	F

Note: F = field testing, P=pending petition for deregulation, A=approved for commercialization

Table 6: Bioengineered Crops, Engineered Protein Products and North American Companies Working Toward their Commercialization[92]

Crop	Protein Products	Company
Alfalfa	Interferon and other medical proteins	Medicago, Sainte-Foy, Quebec
Corn	Blood protein, enzymes, vaccine Monoclonal antibodies for delivering anti-cancer toxins	Prodigene, College Station, Texas
Corn	Monoclonal antibodies for delivering anti-cancer toxins	Monsanto Integrated Protein Technologies, St. Louis, MO
Corn, Rice	Medical monoclonal antibodies	Epicyte Pharmaceutical, San Diego, CA
Corn	Vaccines and monoclonal antibodies	Dow AgroSciences, Indianapolis, IN
Corn, soybean	Phytase enzymes	Novozymes Biotech, Davis, CA
Rice	Milk proteins, blood proteins	Ventria Bioscience, Sacramento, CA
Safflower, canola	Anticoagulant, peptides, monoclonal antibodies	SemBioSys Genetics, Calgary, Alberta
Tobacco	Antibodies for oral and topical application	Planet Biotechnology, Hayward, CA
Tobacco	Peptides, monoclonal antibodies	LSBC (Large Scale Biology Corp.), Vacaville, CA
Tobacco	Therapeutic enzymes, HIV vaccine	CropTech Corp., Blacksburg, VA

[91] Extracted from Table 1 in "US Food Manufacturer Assessment of and Responses to Bioengineered Foods." AgBioForum, 5(3): 90-100, 2002 by Mary Muth, Dominic Mancini, and Catherine Viator.

[92] Juliet A. Zavon and James E. Flinn. "Future of pharming involves look at big picture." Feedstuffs, June 23, 2003, Vol. 75, No. 25.

Figure 2: Traceability and Assurance Certification Protocols