Development of Sustainable Food Supply Chain

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***Abstract*—In food companies, the supply chain manager has a pivotal role in the process from procurement through to managing the reverse logistics, which can be described as the process of moving goods back through the system with the purpose of finding another use for the products, or for proper disposal. This requests that food enterprises develop a sustainable supply chain to realize this process. This paper addresses the concept of the sustainable food supply chain and the methods and steps to achieve this goal for food industry.**

***Index Terms*—Sustainable supply chain, food supply chain, food industry.**

I. Introduction

Sustainability and corporate stewardship are a social ideal and a business necessity. The tension between efficiency and sustainability is vanishing now. In fact, being sustainable is now a source of competitive advantage and a matter of corporate survival rather than a costly inconvenience. Many companies and marketers, especially in the developed countries, embrace sustainability as a top-line priority. Yet the dream of doing good works and making a good profit will go unfulfilled unless orderly supply chains literally and sustainably "deliver the goods."

As a consequence, many senior executives are looking to their supply chains to deliver the breakthrough results needed to meet these expectations. In fact, supply chains in general and "green" sourcing in particular are quickly becoming the primary focal points for improving profitability while building a company's sustainable credentials. In food industry, this is more important because the food products are directly linked to the environments and the daily life of people.

II. Food Supply Chain

The food and drink supply chain has been a linear relationship involving the primary producers, or farmers, the manufactures or processors who fabricate the food for the table, and the retailers who gather a range of such products and sell them to the consumer. Food suppliers have traditionally been sourced not only from China domestic, but widely from all parts of the world.

The food supply chain can be sub-divided into a number of sectors. Agriculture, horticulture, fisheries and aquaculture are the "primary producers", the manufacturers who process the food into products ready for the table or further cooking, together with the packaging companies, are an intermediate stage, and the wholesalers, retailers and caterers are the end stages of the supply chain. At each stage in the chain the food is passed into a new ownership and value is added to allow for the costs of the journey, and also to provide a small margin of profit.

Figure 1 presents a general overview of the various activities that occur in food logistics within the food supply chain. The figure outlines a number of supply chain entities including manufacturers, third-party service providers, retailers, customers, and suppliers. Activities include those related to both products and packaging.

III. Sustainable Food Supply Chain

Sustainable supply chain has been defined as follows:

"Management of raw materials and services from suppliers to manufacturer service provider, then to customer and back with improvement of the social and environmental impacts are explicitly considered".

The sustainable supply chain considers the interactions between a business and its customers and suppliers. The greatest benefits are derived by extending the focus as far as possible upstream towards the raw materials, downstream towards the consumers and then back again as the product and wastes are recycled.

Traditionally, supply managers sought to provide necessary inputs at the lowest market prices. However, as executives and consumers move to distinguish market prices from social costs—that is, market price plus externalities and social consequences—supply is redefining and expanding its role by managing both internal and external costs. Supply managers can foster sustainability by ensuring that suppliers incorporate sustainable innovations in operations and processes. They can investigate new processes and technologies that reduce dependency on scarce and potentially expensive resources. Managing the supply chain then becomes the catalyst for triggering corporate behaviour that is truly green and socially responsible.

In order to establish a sustainable food supply chain, the food company can take the following strategy steps:

A. Devising a Sustainable strategy

A.T. Kearney's survey reveals that already 36 percent of firms have a formal sustainability strategy for managing supply chains. Such a strategy defines the values a company wants to emphasize, declares how it will enforce those values, and identifies consequences when suppliers or employees do not meet the guidelines. Deep principles inform the firm's purposes and values, which shape corporate behaviors and guidelines for engaging suppliers. By making these values, principles, and guidelines explicit, a company improves its accountability and performance.

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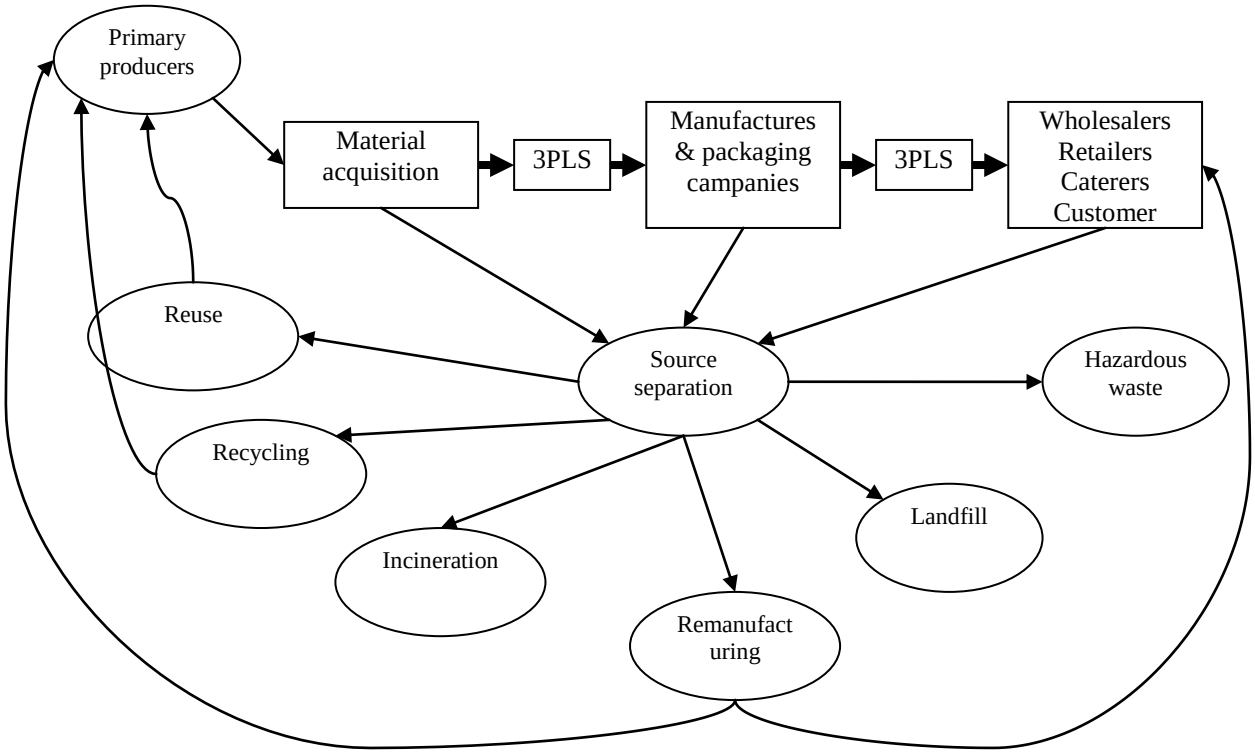

Fig. 1. Food supply chain

B. Retooling the Organization

More than one-half of companies evaluate supply management executives against some sustainability standards. As firms increase the role of sustainability in their supply management practices, they must draft specific guidelines and procedures, create training programs, and introduce sourcing tools that equip buyers to support sustainability goals. Currently, 54 percent of firms provide written sustainability guidelines to supply management staff. About 40 percent provide training on sustainability management. Twelve percent of companies offer public awards or recognition for supply management staff or for staffers meeting sustainability goals.

C. Managing Supplier Relations

Currently, 48 percent of firms reward suppliers with good sustainability practices or jointly improve processes with suppliers that do not. About 44 percent of firms measure the sustainability performance of major suppliers, and 24 percent require a third party to certify suppliers' sustainability practices.

IV. Implementation of Sustainable Supply Chain

The sustainable development of products is based on the social, environmental and economic impacts of these goods and services along the supply chain. The participating organizations may differ in product or service and are at varying stages of the supply chain. However, there are a number of consistent themes, which help drive progress and can be adopted by others.

New Zealand Business Council for Sustainable Development has provided a number of tools in its guide to help companies in planning their own supply chain impact and in implementing change.

Step1: Look at inter processes and map risks

Organizations need to recognize that they have to identify, understand and manage issues within their own organization before they start working with other organizations in their supply chain to ensure that these issues are successfully managed throughout.

TABLE I: Supply chain risks monitor

Supply chain issues			risks	examples	Rating 1-5
Procurement	Environment	Sustainable source of raw materials including all components	Chain of custody is uncertain .May result in consumer concern/NGO activity;	NGO activity relating to deforestation	
		Use of hazardous substances.	Product safeties scare.	Pesticides in produce.	
		Long-term supply	Source drying up will threaten economic viability	Hybrid vehicle is developed.	
		Short-term supply	Insufficient product to fulfill demand	Most cities in China are not able to source enough LPG vehicles.	
		Waste and packaging	Inefficient use of resources. Cost to business	Cost of landfill – levies and charges	
	o ci	Labor standards and practical conditions	Media scrutiny; boycotts; Loss of business,	Overseas labor conditions, e.g. Nike;	

		Fair pay for suppliers	Sustainability of supply base and potential adverse publicity	Fair Trade products ,e.g. Wal-Mart	
	Economic	Inventory levels	Negative impact on cash flow	Companies left with seasonal stock due to inefficient procurement	
		Escalating cost of supply	Economic viability of product or services	Increase in fuel costs; Energy costs which cannot be passed on to end consumer	
Internal operation	Environment	Water; Air or soil pollution/Contamination	Effect on reputation in local and wider community. Cost of remediation and risk of lawsuits	Potential effect of any phosphate/nitrates land pollution to 'clean.	
		Perceived health impacts from local emissions	Effect on reputation in local and wider community. Cost of remediation and lawsuits.	PCBs; Mobile phone masts; Incinerators	
		Waste management	Increased costs of disposal to landfill	Potential taxation	
	Social	Work/Life balance of employees; Unsocial hours	Potentially punitive costs for stress in the workplace or lawsuits	Impact of Occupational Health & Safety.	
		Labour standards and practices; Pay & conditions	Staff retention; Strikes; Absenteeism; Claims	Wal-Mart challenged about trade unions; Strikes	
	Economic	Increased cost of fuel; Energy; Delivery method	Economic viability of product or services	Plant closures on temporary basis due to high power costs	
		Inefficient operations/Poor productivity/Cost of overheads	Economic viability of product or services; Higher direct and indirect costs; Effect on competitiveness	Companies outsourcing or setting up lower cost operations overseas.	
Product development and stewardship	Environment	Impact and efficiency of product in use	Adverse publicity; Product boycott; Reduction in market share	Major recall of product because of Sudan red	
		Cost or suitability of raw materials increases. Need to find substitutes	Financial impact	Search for alternatives to materials such as PVC.	
		End-of-life collection and disposal	Loss of market share; Non-compliance with potential legislation in home or overseas market	Mobile phones; Car parts; White goods.	
		Product traceability; bar codes and labels	Costly recall if unable to pinpoint batches of product	E-Jiao Health products recall	
	Social	Customer demand	Loss of market share	First mover gains: Shell, Nike	
		Increased cost of product/service because of increases in raw materials; Energy; Advertising	Market viability; Loss of market share	Pulp prices effect on the paper industry –can increase the price differential between sustainable and non-sustainable pulp supplies	
	Economic	Packaging and materials: need to match packaging to product requirements	Increased costs from over packaging; Legislation in some markets relating to take back systems, e.g. bottles, cans	Returnable levies on bottles in some countries	

Step2: Identify supply chain

First identify what the supply chain means for your organization and at which point you fit within other supply chains. This is often difficult for companies with particularly complex supply chains. Such companies may find that appointing a supply chain manager with overall responsibility for purchasing and forward and reverse logistics will provide the necessary focus.

Companies may not have the resource for a dedicated supply chain manager but might give overall responsibility to an individual to identify its supply base and its relationship with its customers and position the organization within this framework. Use the table upon to identify potential issues affecting your supply chain and where they might occur in the process.

Step 3: Make sustainable development part of business strategy

KPIs are useful to measure and monitor performance whether quantitative or qualitative, e.g. cost reduction from improved waste management; deliveries in full, on time; staff satisfaction rating for companies as good employers; and energy savings. Some organizations including Shell have appointed a Sustainable Development Manager. Whilst this can appear to place responsibility in one person's hands, there are clear benefits.

Make Sustainable Development a Key Performance Indicator (KPI) for your Organization at all levels from the Board to junior management.

Step 4: Adopt measurement tools which work for organization

These include written policies and communications materials, prequalification of suppliers (using social, environmental and economic criteria), purchasing guidelines and supplier Managers often lack appropriate decision-making tools to help them assess the risks and benefits associated with managing their suppliers. For many companies there is a process to achieve regulatory compliance, through risk management, to long-term sustainable development strategies:

Step 5: Identify initiatives throughout the organization which can get everyone involved internally and externally

These may range from a zero waste policy to energy efficiency .The initiative needs to be driven from the top but will only succeed if everyone is involved. Use your relationship with suppliers or customers to progress sustainable development thinking across the supply chain. Suppliers: include sustainable development criteria in setting Supplier Code of Conduct. Start with a handful of suppliers and some easily defined principles. Customers: influence customers to reward sustainable suppliers.

V. TECHNOLOGY FOR SUSTAINABLE FOOD SUPPLY CHAIN

Food supply chain safety and sustainability are not only in the news and on the minds of consumers; they are rapidly becoming strategic issues for all participants in the food supply chain. Strengthening the "chain of custody" related to food production is becoming the ante for successful participation in the industry.

Recent advances in systems and tools are helping push full traceability right back to the "first mile" of the food supply chain—to the farms, orchards, ranches, and first-stage processors.

The common ground among many of these protocols is a prescribed set of best practices, documentations that the practices are being followed, and retention of the source of origin and identity of food products across the supply chain—that is, establishment of the chain of custody. As a result, participants in the food supply chain are facing the twin challenges of (1) how to effectively meet these requirements so they have access to important geographic markets and retailers and (2) how to efficiently meet these requirements so they can run profitable businesses. The fundamentals of the processes and systems required to achieve the risk mitigation sought by consumers, regulators, and the industry are the same as those required to achieve the next phase of business improvement across the first mile of the food supply chain.

The basic building blocks of first mile chain-of-custody solutions include the following:

Data Collection. The idea is to collect the necessary data at the lowest possible cost, via any reasonable and available means. "Low tech" or "no tech" often works best. If there are auto ID devices, in-field sensors, data collection devices on mobile equipment, or data that can be integrated from scale or receiving systems; so much the better. Applications running on ruggedized personal digital assistants (PDAs) are a practical and flexible way to plug critical data gaps and are a step up from paper and pencil for data capture, validation, and storage.

Data Services. Chain of custody data need to be validated, aggregated, sometimes mapped to another data standard or format, and ultimately passed to systems downstream in the chain. There are many available off-the-shelf products that can reliably perform these services.

Standards. While solutions need to be open and flexible, a few strict standards are needed to ensure that useful information can be moved successfully downstream. Market research firm Gartner has determined that companies that are succeeding at cross-enterprise data sharing (regardless of industry or application) have adopted simple sets of core standards that are rigorously enforced. These standards manifest themselves in terms of "events" to which inbound data are translated and which are subsequently stored in repositories and feed data marts. A low-tech example of the establishment of helpful "standards" is the three-point hitch on farm equipment that allows inter-operation of implements made by different manufacturers.

Event Repositories. These provide ways to capture, organize, and store the information associated with standard events— data associated with planting, irrigating, and harvesting crops, for example.

Data Marts/Operational Databases. These construct relevant aggregations of events to serve specific business needs for specific companies (for example, product trace-back/track-forward reporting, compliance reporting).

Applications. The further downstream in the food supply chain you go the more likely you are to encounter ERP, financial, process control, and quality control applications. In keeping with the guiding principles above, it would be difficult, if not impossible, to convince these participants to abandon their investments in these applications and invest in new applications just to establish and maintain the chain of custody for the products that they are processing or selling. It is critically important to integrate the accumulating stream of chain of custody information into established downstream applications.

Decision Support. The motivation for complete chain of custody information is to support a business decision or event— a customer audit or continuous improvement program, say. Decision support can be valuable anywhere from analyses performed with spreadsheets to the use of sophisticated online analytical processing (OLAP) tools.

Chain of custody is a huge issue facing the food and allied supply chains, where products are often viewed as commodities and profit margins are paper-thin. But the gains being made to date by leading supply chain participants are impressive. Companies in other complex industries could do well to look at some of the first-mile solutions being implemented by food producers today.

VI. DISCUSSIONS

This paper presents the methods and steps to develop a sustainable food supply chain. Having a sustainable food supply chain can help the food industry not only contributing more to the environment protection and improving the markets, but also increasing the safety of the food they can produce and provide. This is becoming more and more important in China domestic food market.

While there are many processes that play important roles in building a sustainable food supply chain, the food logistics is one of the most important aspects to be improved. This introduces another interesting and complex topic for us to study and discuss.

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