SUPPLIER RELATIONSHIP MODEL ENHANCING THE FOOD SAFETY IN THE AGRICULTURE SUPPLY CHAIN

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Agriculture Supply Chain, Food Safety, Supplier Relationship

Abstract - In recent years, the supplier relationship aspects of the supply chain management, has observed many attentions in academia and literature. However, in terms of the agribusiness, there are limited number of scientific studies focusing on importance of supplier relationships and the essential of stronger integration between the buyer and suppliers and its effect on the food safety. This study contributes to the food safety science by developing a semi-qualitative and practical model for supplier-buyer relationship in the food industry, aiming to improve food safety and quality at upstream supply network.

Index Terms - Agriculture Supply Chain, Food Safety, Supplier Relationship

I. INTRODUCTION

During the last decades, supply networks have been expanded in a fast rate due to the trend in globalization, specialization and customization of the production process. This growth in the networks demand for more collaboration and management of the involving parties, from suppliers to the retailers, that is a critical aspect of Supply Chain Management (SCM). Among all, the SCM of food product or Food Supply Chain Management (FSCM) has more complex structure as compare to other SCMs. This is due to its perishable nature of products, high demand and price fluctuations, long distance between point of origin and consumption, and growth in customers’ concerns for food safety [1]. The globalization of food market and production has led to greater distance between producers and consumers, which cause more risk for foodborne illness and public health. Besides, increasing urbanization results in more demand for transportation, storage and distribution of food products, therefore, any single source of failure in food safety can cause worldwide consequences.

Food supply chain is a critical part of the logistics networks in national and international concepts. The nourishment division assumes a huge part in economy, being one of the principle contributors to the Gross National Product (GNP) of numerous countries, especially in developing countries. As indicated by the European Commission [2], the nourishment and beverage industry is one of Europe's most critical, second largest and elemental modern segments comprising 14.5% of total manufacturing turnover (€917bn). One of the main concerns in the agri-supply chain is the safety of the product for the end consumers. Ensuring availability and access to sufficient safe and nutritious food is a key priority that impacts all people and needs to be ensured today and in the future [3]-[4].

The review of the current pattern in the food safety and quality chain by [5] reveals three main trends in the FSCM:

A. More prominent centralization of farms, food production risks, and wholesalers into littler number with substantial sizes;
B. The development of incorporated supply chains connecting producers and different partners;
C. Growth of customers’ interest for food safety, quality, nutritious product and animal welfare.

Nonetheless, to date, the linkage among different parties in the food supply chain has a slower rate compare to the other industries. This connection demands for more collaboration and joint venture of the firms within the supply chain, in order to improve the efficiency and productivity of the network. Quality and safety of raw materials, ingredients and packaging are essential in food safety and quality. So choosing a right supplier and establishing a good relationship is a critical business decision.

II. THE NEED FOR THE INTEGRATED FOOD SUPPLY CHAIN

The globalization of food market and production has led to greater distance between producers and consumers that cause more risk for foodborne illness and public health. Besides, this trend results in more demand for transportation, storage and distribution of food products, therefore, any single source of failure in food safety can cause worldwide consequences. In consequence of this evolution in food supply chain, food safety has observed more attentions, for public, policy makers, companies, researchers in an international level. Following this changes, a significant increase in public and private standards has emerged which has affected on food production, distribution and business [3]. Nevertheless, food safety standards represent significant differences around the world. These standards are in both public level (i.e. Codex Alignments, regional countries, and individual nations) and private level (firms and supply chain demands and customers requirement), which both have different level of protections [6]. Among all, ISO 22000 is a quality management framework aiming to food safety issues in food production and can be connected to a wide range of...
association in the food supply chain. As it is mentioned by [7], ISO 22000:2005, Food safety management outlines: "...aims to guarantee that there are no fail connections in the food supply chain." Food safety and quality are best guaranteed by an incorporated, multidisciplinary methodology, considering the entire food chain. In order to have an overall quality and safety management in entire food chain, the first step is to establish collaboration among the parties within the agri-supply chain, and develop more integrated relationship between the business partners. With high involvement relationship, suppliers have more incentives and obligations to satisfy the buyers’ demands regarding product safety and quality [8].

In the agriculture literature, most of discussion in relationship management focuses on its constructs, such as power, trust and dependency among partners [9]-[10]-[11]. Vertical integration among parties and degree of collaboration is discussed by [12], the effect of trust in supply network is revealed in [13]-[10]. Reference [14] studied the relationship between grape growers and wine producers in Indonesia, and [15] evaluated supplier relationships in Zimbabwean horticulture focusing on behavioral approach and broad model of relationship constructs, in terms of dependency, commitment, satisfaction, conflict, long-term orientation, and social bonding. Reference [16] analyzed the relationship in New Zealand red meat industry, among farmers, livestock buyers and slaughterhouses. They found that buyers have closer relationship with farmer-suppliers than both groups have with slaughterhouses.

However, as stated by many authors [17]-[18]-[19] managing the supply chain relationships need further investigation, as suppliers and producers have expanded around the world. A challenging issue here is the selection of the suppliers based on defined safety enhancing criteria and the development of the relationships with strategic suppliers, together with the coordination and monitoring of their behavior with respect to the product safety. In previous researches the characteristics and the construction of current relationship have been analyzed, while presenting a model for selecting the right supplier, developing a relationship further and increasing the collaboration in food industry is lacking. This study introduces the strategies for supplier-relationship management within the food industry in order to improve the integration and cooperation among suppliers and producers and ultimately facilitate the safety management along the entire network.

III. SUPPLIER RELATIONSHIP MODEL

Supplier relationships have changed substantially and become more complex than ever before. Each party aims to maximize the profit and minimize the costs, due to higher competition among firms and it also may change the relationship concept. Reference [20] argues that using a total sourcing model, rather than the traditional cost-based models, may make sense for product safety. She argues that a more comprehensive sourcing model would also consider the costs of risk management if the products became contaminated or unsafe. The high costs associated with supply disruption, product liability and potential recall might indicate that some low-cost suppliers are really high-cost suppliers when the expected costs of safety risk are considered. It is essential to have a mutual commitment in terms of objectives and goals to achieve supply chain success and prosperity. Recently, the policy of mutually beneficial relations is becoming more accepted and some firms have come to accepting that the success of one can contribute to the success of the other [21]. This trend causes large producer companies to pay specific attention for developing their relationships with suppliers and establishing partnerships, working closer together [22].

Reference [23] described a “partner” as “a firm with whom your company has an on-going buyer-seller relationship, involving commitment over an extended period of time, a mutual sharing of information and a sharing of risks and rewards resulting from the relationships”.

In this respect, there has been a trend moving from short-term contracting with several suppliers towards more commitment with fewer suppliers and aiming on a longer perspective. There have been companies trying for partnership collaboration, but the outcome was only conflicts, resentment and not successful [24]. The main barrier for closer integration with suppliers was the fact that in many firms the organizational structure interfered with effective collaboration. Besides, choice of the desired type of relationship usually depends on the requirements and needs of the companies involved.

Placement of suppliers in the matrix presented in Fig.1 will help facilitate a transparent view on where the current suppliers are positioned, as well as where they should be positioned in an optimal state. This perspective provides a broader vision of opportunities and risks, and allows companies to see the pros and cons of a certain supplier more easily. If the analysis reveals a supplier as being Routine (lower left part), it means that this particular supplier would not be of any significant importance, hence close collaboration should not be prioritized and instead reducing the amount of suppliers might be a solution. If the supplier is depicted as Leverage (upper left part), the financial impact shows that it might be necessary to have several suppliers. This can help the negotiating-aspect with lower prices, as it is a buyer’s market on these particular products. Bottleneck Suppliers (lower right part), have the technology specialists and are few to be selected, and Strategic Suppliers (upper right part), have specific know-how, with high risk of both supply side and financial impact.
IV. DEGREE OF INVOLVEMENT BETWEEN THE SUPPLIER AND BUYER

With respect to the supplier-buyer relationship, [25] define different types of relationships regarding high and low involvement. They present four classes of relationships (Fig. 2), depending on level of involvement and the aspect of continuity, in order to explain four different methods suggested in each cell. As presented in the Fig. 2 there are four major types of relationships, short term arm’s length relationship, long term arm length relationship, short term intense relationship, long term intense relationship.

High involvement relationship leads to efficiency improvement and more resource adoptions among firms and beneficial over time, however, it is resource demanding and leads to more resource bound (e.g. IT system) and only limited number of suppliers could be of interest of the buying company [25]. For the high involvement-high continuity relation, both mutual trusts are fundamental in order to collaborate and maintain the relationship. Reference [27] has also mentioned the importance of communication and interaction in a dyadic collaboration and partnership among firms.

V. DEVELOPING DEEPER RELATIONSHIPS

References [28] and [29] claimed that developing deeper relationship and collaboration with suppliers is recommended to obtain competitive advantages. They refer deeper relationship to “lean” and “Kaizen” philosophy of the Japanese car manufacturing (Toyota, Honda) as a successful example of business culture and ability to select and develop collaboration with their strategic suppliers. “Mutual trust “has also been identified as a foundation to build a dipper relationship [28]. They defined the steps in relationship development in a hierarchy framework (Fig. 3).

1. Understanding the supplier management and operation system
2. Turning supplier competition into opportunity and collaboration
3. Supervising the suppliers
4. Developing compatible technical capabilities
5. Sharing information intensively, but selectively
6. Performing joint improvement activities
7. Continues improvement and learning

This hierarchy model could be adopted in the food business as well; however, the relation of producers in agribusiness is different from those in other sectors as they usually buy from a large number of more or less small suppliers (farmers) who all deliver almost the same product.
develop strategies to improve the relationship. In terms of food supply chain, as mentioned by [30] vertical integration of buyer-supplier relationships brings value into entire supply chain by several forms of cooperation and agreement, licensing, R&D and quality levels. More cooperation and collaboration in the relationship increase the organizational resources and capabilities, and could lead to improve product quality and safety [31].

VI. STRATEGIC SUPPLIER RELATIONSHIP MODEL

The buyer-supplier relationship in the food industry used to be based on price, location and availability, however, putting a stronger emphasis on the food safety and quality by government and consumers, assessing and selecting the right supplier relationship today has become much more critical and complex. While choosing a more simplistic supplier selection procedure could be useful for some smaller supply chains, a more involved procedure of right buyer-suppliers relationship could help food companies drive regulatory standards, meet customer requirement and form a strong brand reputation of quality products. Accordingly, the model developed in this study (fig 4) follows a systematic procedure to select the right suppliers with high degree of the safety and develop strategic relationship with those suppliers. Therefore, two main priorities of the supplier partnership in this model are the food safety and degree of buyer-supplier involvements, which are measurable based on related KPIs that are defined in follow. Firstly, we need to categorize our current suppliers (using models in fig.1 and fig.2) to identify the potential strategic suppliers or partners. The next step is defining the key performance measurements (KPIs) to have the criteria for the selection process (table 1).

The KPIs developed in this study is based on experts' opinion, including safety experts and researchers, production and quality assurance of a food producer that touches the supplier selection process.

<table>
<thead>
<tr>
<th>Table1. KPIs for the Supplier Selection</th>
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<tbody>
<tr>
<td>S1</td>
</tr>
<tr>
<td>S2</td>
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<tr>
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<td>S4</td>
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In the table 1 there are 5 KPIs that are mainly focused on the food safety as Regulation, Quality Control, Standards, Order Fulfillment, and Traceability. Each KPI is measured by Liker Scale method from very low (1) to very high (5). The average of the five KPIs (S1-S5) results, will be compare to a Threshold which is defined as 4 in this study (the definition of Threshold is a subjective decision of food safety team based on criteria such as food safety objectives, food process, purchasing process and product characteristics) X = Avg KPI (S1-S5) Xt= 4 If X ≥ Xt the selection of the supplier process continues to the next step. In the next step we assess the supplier relationship and measure the degree of involvement in the supplier-buyer relationship. Using the KPIs model in table 2, which is semi-quantitative measurement and based on Liker Scale method similar to table 1, we will have:
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Table2. KPIs for the Relationship Assessment

<table>
<thead>
<tr>
<th>R1</th>
<th>Joint regulation or standards</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>R2</td>
<td>Percentage of Products that Undergo Quality Testing after purchase</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>R3</td>
<td>IT integration</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>R4</td>
<td>Information Sharing</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>R5</td>
<td>Joint Traceability and control System</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

The average of the five KPIs (R1-R5) will be compared to a Threshold 4, 

\[ Y_t = \frac{\sum \text{KPI}}{5} \]

If the \( Y_t \leq 4 \) then we need to develop the relationship with this supplier further, using the 7 steps in the model (figure 3), adopting to the food industry, (i.e. joint standards, regulation, information sharing, controlling system, etc). And if \( Y_t > 4 \) then our supplier is our strategic supplier (partner), however, we need a periodic control procedure (e.g. each six months) to assess the safety and the ongoing relationship with partners. Therefore, the entire procedure perform in a loop for continues improvement.

A validation of this model is actually undergoing in a dairy company.

CONCLUSION

Having the safe raw material is the first step of the high quality food supply chain process. Accordingly, selection of the right supplier is a challenging task for the decision makers and it needs more systematic procedure for obtains the better results. Furthermore, having high degree of involvement with the strategic suppliers or partners could facilitate the food safety due to sharing information, control system and other collaborative activities that improve the process.

This study introduces the strategies for supplier-relationship management within the food industry in order to improve the integration and cooperation among suppliers and producers and ultimately facilitate the safety management along the entire network. This is achieved by introducing a novel model to obtain two aims mentioned above (supplier selection and relationship development). The model follows a procedure loop, using KPIs as main tool in the decision-making process. This approach helps to select the right supplier based on the safety KPIs and to assess the degree of buyer-supplier involvement using the KPIs related to the supplier relationship. This semi-quantitative and systematic procedure supports decision makers to have a better tool in selecting their business partners and developing their partnership further, building a control and managing system for continuous improvement. However, the model needs to be evaluated and tested in different case studies and to be validated in the practical environment that is our next step in the further studies.

REFERENCES

[2] Key indicators, food and beverage service activities (NACE Division 56), EU-27, 2012 - Source: Eurostat (sbs_na_1a_se_r2)

Corresponding author: Mohsen Shirani, works as a Marie Curie research fellow at Politecnico di Torino, Italy. This study is a part of InnHF – (Innovation through human factors in risk analysis and management) Marie Curie Actions Initial Training Networks. The INNHF main objective is to formalize an approach and make it possible to integrate the current and developing assessment methods recommended or required by recognized industrial standards and methodologies, with an easy to use but complete human factors and system health management approach.

The author PhD research focus is on the Food Safety Supply Chain; the main objective is introducing new model and approach in Risk Assessment of the entire food supply chain (farm to table) with integration of HOF (Human Organization Factor). The result would be in interest of Food Regulation and Standards authorities as well as Food Business Industries and Stakeholders.

Assistant Prof. Michaela Demichela is with Politecnico di Torino. Research activities in the field of process safety and safety and health in the work environment. Her research activity was developed not only at the Department, but also among petrochemical companies and foreign research centers, and it concerned several aspects of the safety in processing industry, both in the field of fine chemistry and in the field of basis chemistry.

Scientific Responsible for several projects and agreements; the active ones actually are:
• Marie Curie ITN: INNHF—INNOVATION THROUGH HUMAN FACTORS IN RISK ANALYSIS AND MANAGEMENT (2011-2015) – Coordinator
• FP7 SME: TOSCA - TOTAL OPERATION MANAGEMENT FOR SAFETY CRITICAL ACTIVITIES (2013-2016)
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