HORIZONTAL LOGISTICS COLLABORATION IN AGRI-FOOD SUPPLY CHAINS: AN ANALYSIS OF MOTIVES AND ENABLERS

Behzad Behdani
USN School of Business, Department of Business, Strategy and Political Science, Univer-sity of South-Eastern Norway

ABSTRACT

Purpose: This research aims to gain insight into the motives and enablers influencing the feasibility of Horizontal Logistics Collaboration (HLC) in the agri-food industry.
Design/methodology/approach: The main methodology in this study is developing a survey –based on the theoretical framework derived from the existing literature. The survey is distributed among food logistics/SC experts (including shippers and third-party logistics companies). Additionally, statistical analysis is performed to get insight into the relevance of movies/enables for horizontal collaboration in food chains and the factors that influence that.
Findings and originality: The survey analysis shows that the "cost-oriented motives" received the strongest support, potentially caused by low-profit margins and fierce price competition in the food and logistics sectors. In contrast, the "market-oriented motives" – like access to new market areas via collaboration- had a lower evaluation. For enablers of collaboration, "Incentive alignment" has received the strongest support, which implies the necessity of designing fair incentive mechanisms for horizontal collaboration. Besides, the strong support for "compatibility" – including "product compatibility" and "logistics compatibility" - reveals the importance of partner selection for a feasible collaboration in food chains. Regarding company size, larger companies valued "decision synchronization" and "compatibility" more as enabling factors. Due to the common power asymmetry in the food industry, SMEs are forced to be flexible and adaptive in a collaborative relationship. So, they are willing to look into more possibilities for selecting partners. Also, SMEs underpinned the "size similarity" as an enabler, revealing their concerns about not being heard in a power-imbalanced relationship. Finally, larger companies prefer to make a formal setting (like a contract) as the governing mechanism, while SMEs prefer to collaborate in a more informal trust-based manner.
Research/Practical implications: The findings provide the theoretical insight and practical guideline for practitioners to understand the critical factors and achieve feasible/successful operations of HLC in the food industry.

Keywords: Horizontal Logistics Collaboration, Food Supply Chains, Enablers.

Introduction

In the past two decades, logistics has undergone significant changes due to globalization, increased competition, high customer expectations, increasing operational costs, and stricter environmental regulations (Haralambides, 2019). Particularly in the context of the food sector, the additional key logistical aims of preserving food quality and minimizing food waste put extra burdens on the food supply chains (Behdani et al., 2019). At the same time, the design and management of the food supply chain is complicated by its unique characteristics. Especially the perishability and short shelf life of food products lead to an ordering strategy of high frequency of ordering under small quantities, which may result in logistics inefficiency in Food Supply Chains (Fan et al., 2020). Examples of these inefficiencies are a high percentage of empty running and the low truck utilization factor in Europe (Cruijssen, 2012).

One possible solution to this emerging challenge is collaborating with other companies within or beyond the supply chain (Schmoltzi & Marcus Wallenburg, 2011). Collaboration is a negotiated process between independent organizations to share information, risks, and resources to improve mutual probability and reach common goals (Prakash & Deshmukh, 2010). According to the characteristics of the supply chain

structure, possible collaboration arrangements can be categorised into two primary types: vertical and horizontal collaboration (Figure 1). Vertical collaboration is defined as collaboration between the provider and user of a specific service or product. This is mostly formalized in a buyer-seller relationship (e.g., the collaboration between a manufacturing company and its suppliers or customers). Horizontal collaboration, on the other hand, includes collaboration with competitors and other supply chain actors to provide a product or service. For instance, competing companies may share manufacturing capacity – in case of disruption or to reduce the risk in developing new technologies- and logistics service providers may share the transportation capacity – to gain broader market access (Behdani et al., 2015). The collaboration among two or more companies at the same level of a supply chain who share similar or complementary logistics requirements/capabilities is called Horizontal Logistics Collaboration (HLC) (Sanchez Rodrigues et al., 2015). This collaboration can be in different logistics activities, e.g., in transportation or warehousing, aiming to optimize all involved companies' logistics efficiency. In a broader sector context, this type of collaboration can also help overcome the logistics sector's challenges like high empty truck running and low asset utilization.

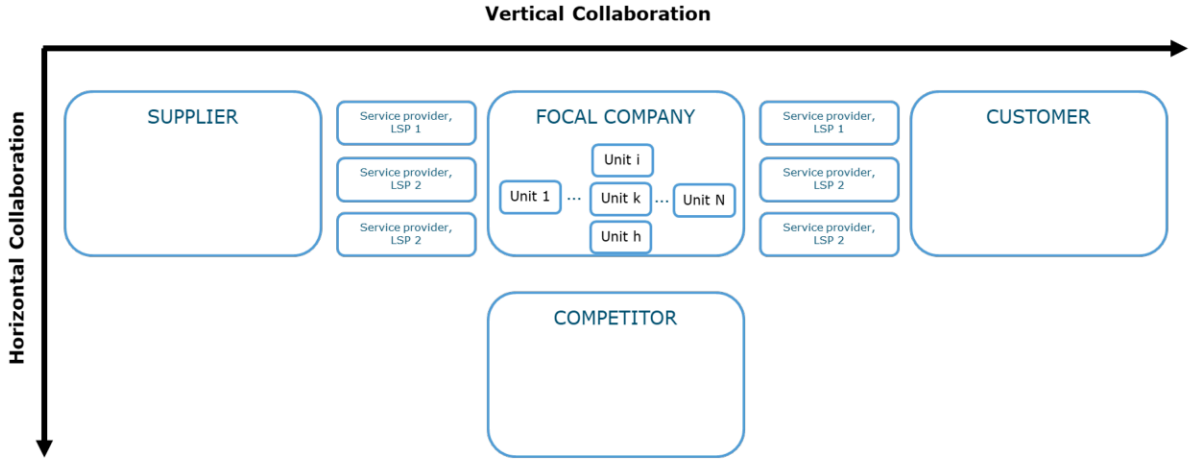

Figure 1: Vertical vs. Horizontal collaboration

In the food sector, HLC has also become a topic of growing interest (Stellingwerf et al., 2021). However, due to the unique characteristics of food products and supply chains, HLC may encounter more difficulties and specific challenges in practice. For example, there are natural (and safety) limitations on how agri-food products can be transported or stored together (to avoid undesired quality effects).

Although some practical initiatives in the food sector have been undertaken, theoretical studies on HLC in the food sector are scarce. In particular, there is limited focus on how the food industry can successfully initiate and operate HLC initiatives. This paper aims to study the enablers and motivations for Horizontal Logistics Collaboration in the food sector, formalized in a conceptual model.

Theoretical background

Agri-food supply chains

A food supply chain includes all stages of delivering food from a farm to the final consumer's tables. A typical chain consists of farmers, food manufacturing, wholesalers, retailers, and consumer, while transport and storage link the activities between each stakeholder (Behdani et al., 2019). A food supply chain has some specific characteristics and, accordingly, requires specific logistics management solutions (see Figure 2).

Figure 2: Characteristic of agri-food supply chains

A primary characteristic of the food sector is the diversity of products and logistics channels. The agri-food sector produces a wide range of products, including non-perishable (processed) food items and perishable temperature-sensitive products. Additionally, based on the temperature requirement for the cargo, we can differentiate between ambient fresh, frozen, and deep-frozen cargo (Behdani et al., 2019). As a result, one other key feature of a food chain is the perishability of agri-food products and the importance of managing product quality along the chain. To limit food quality decay, a food chain usually avoids long-term storage, employs special processing actions (drying, salting, and UV treatment), and storage and transportation conditions (such as refrigeration, freezing, or modified atmosphere). Furthermore, perishability and short shelf life of food products lead to ordering strategies involving a high frequency of ordering in small quantities to ensure food quality. Therefore, the average transportation load is relatively small and seldom fulfils a full truckload (Govindan, 2018).

Another characteristic of the agri-food chain is demand and supply variability. The production of agri-food is restricted by season and is often long and inflexible (Zhong et al., 2017). This seasonality may cause substantial fluctuations in the availability, price, and quality of agri-food products. Influenced by demographic and socio-economic characteristics, the demand for agri-food products is also highly variable (Behdani et al., 2019). Consumers are also constantly asking for year-round availability of high-quality agri-food products, which places significantly more pressure on the food logistics sector (Guiné et al., 2020).

Collaboration in the supply chain

Supply chain collaboration is defined as the mechanism by which firms within or beyond the supply chain work actively together towards common goals through exchanging information, knowledge, risks and rewards (Prakash & Deshmukh, 2010). A similar notion is discussed by Simatupang & Sridharan (2002) describing the collaboration as “more than two independent enterprises work jointly to plan and manage supply chain operation with greater achievements than act individually”.

Based on the nature of collaborating parties, we can distinguish between vertical vs. horizontal and internal vs. external collaboration (Figure 3). While external collaboration is about collaboration between multiple divisions inside one company, external collaboration is defined by the interaction of different companies. As mentioned, vertical collaboration aims to achieve beneficial partnerships and coherent linkages among entities operating at different steps of the same supply chain. The horizontal collaboration includes two

potential partners (unrelated companies or even potential competitors) being active at the same level in the market, collaborating, e.g., in managing a joint distribution or transportation process.

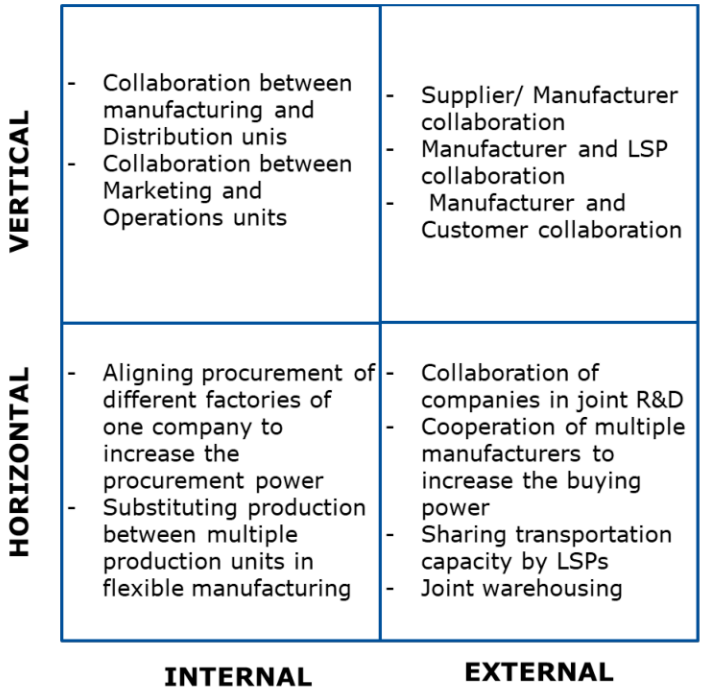

Figure 3: Different types of supply chain collaboration

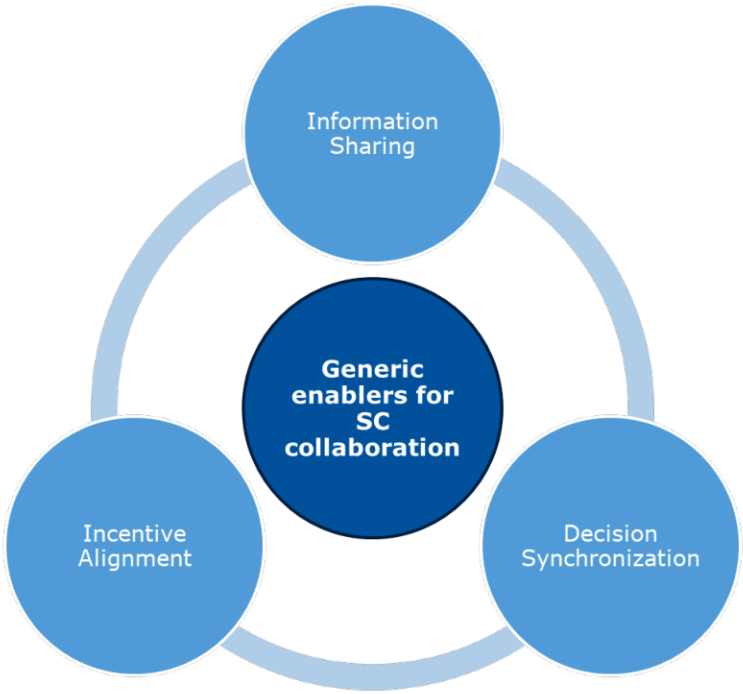

Figure 4: Key enablers for supply chain collaboration (based on Simatupang & Sridharan (2004))

Initiating supply chain collaboration (vertical or horizontal) calls for investing in a set of key capabilities or specific enablers. A well-known model in the supply chain literature, presented by Simatupang & Sridharan (2004), categorizes the enablers of supply chain collaboration into three interrelated dimensions: (1) information sharing; (2) decision synchronization; (3) and incentive alignment (Figure 4). Information sharing refers to capturing, processing, and delivering timely and relevant information for decision-makers to (jointly) plan and control supply chain operations. Decision synchronization is the second dimension and can be defined as "joint decision-making" at different managerial levels and time horizons for pursuing common goals. It includes aligning strategic objectives, tactical improvements, and synchronizing the supply chain planning and execution. The third essential enabler of collaboration is incentive alignment which refers to sharing costs, risks, and benefits of collaboration and formulating incentive schemes (Simatupang & Sridharan, 2002). According to Simatupang & Sridharan (2002), there are three strategies for developing incentive schemes: (1) Rewarding productive behaviour (rewarding observable actions which contribute to attaining the common goal); (2) Pay-for-performance (evaluating the achievements of individual participants on core objectives of the collaboration through applying performance metrics); (3) and equitable compensation (gains are allocated to the partners based on ex-ante agreed gain-sharing mechanism).

A conceptual model for Horizontal Logistics Collaboration in the agri-food supply chains

Based on the literature presented in section 2, we present a conceptual framework that is the basis for the empirical analysis in the rest of this research.

Enablers

The starting point for developing a model for enablers of HLC in the food sector is the three primary dimensions of Simatupang & Sridharan (2004) model, as discussed in section 2. Additionally, the success of horizontal logistics collaboration depends on finding the right partners and collaboration opportunities. We define this dimension as “compatibility”, referring to the possibility of planning and working together in a productive and solution-oriented manner. The first sub-dimension here is “logistics compatibility”; the potential for horizontal logistics collaboration increases if collaborating partners (1) have geographical proximity, (2) use standard/similar packaging (like pallet size); (3) have flow complementary. Flow complementary refers to the potential to combine collaborating partners' shipments to make a full truckload or combine the forward and backhaul flows. This attribute can be measured by examining the partners’ shipment quantity and intensity. Especially, Xu (2013) pointed out that companies show no interest in collaborating when there is a significant disparity in this indicator.

The second aspect of compatibility is “Product compatibility’”. For general cargo, the enablers regarding the compatibility dimension only focus on logistics aspects. However, in the context of FSC, product compatibility is also key to ensuring that the food products can be transported and stored together. Product compatibility can be summarized into the following attributes: 1) Similar environmental conditions during transportation and 2) avoiding product interferences.

Agri-food products are living organs from cultivation till final consumption. Therefore, they may keep interacting with each other and the surrounding environment. It is necessary to avoid product interferences to reduce undesired quality changes during collaborative transportation and storage (Behdani et al., 2019). For instance, bananas can produce ethylene, facilitating the ripening of other fruits like apples. Additionally, for agri-food supply chains, the processing technology (and, accordingly, the logistics requirements) can be very different. The production and processing lead time also varies between companies (Rijpkema, 2014). Take milk products as an example; the production lead times of drinking milk and cheese are significantly different. We formalize this sub-dimension as “Process compatibility” in the model.

The other essential enabling factor for collaboration in agri-food supply chains is “product suitability." It is expected that the potential for collaboration is higher for products with longer shelf life (Stellingwerf et al., 2021) and a more stable demand profile (Wang et al., 2020).

The five dimensions of enablers for Horizontal Logistics Collaboration in the food supply chains are summarized in Table 1. Each dimension has also been subdivided o some more detailed sub-factors.

Enabler	Dimension	Sub-dimension
Information sharing	Availability of key information	Availability of logistics-related information like transportation orders (Stellingwerf et al., 2021) or delivery schedule (Yuan et al., 2019)
		Availability of product-related information (Stellingwerf et al., 2021)
	Availability of ICT infrastructure	Availability of ICT infrastructure for collaborative planning like CPFR (Shi et al., 2014)
		Availability of data transfer and automated communication (Xu, 2013)
	Information consistency	Similarity of data type and information format (Chi et al., 2020)
		Similarity of ICT infrastructure (Chi et al., 2020)
	Information quality	Information accuracy (Viet et al., 2021)
		Information timeliness (Yuan et al., 2019)
Decision synchronization	Strategic fit	Common interest/ shared goal (Jepsen, 2014)
	Organizational similarity	Ccompany size/ scale similarity (Xu, 2013)
		Similarity of operational routine and managerial practices (Raue and Wallenburg, 2013)
		Top management involvement (Xu, 2013)
	Enterprise culture	Existence of cooperative culture (Kumar et al., 2016)
Incentive alignment	Relationship management	Mutual trust (Pomponi et al., 2015)
		Contract formality (Chi et al., 2020)
		Positive history of interactions (Pomponi et al., 2015)
	Sharing rules	Fair gain sharing mechanism (Stellingwerf et al., 2019)
Compatibility	Logistics compatibility	Geographical proximity (Herczeg et al., 2018)
		Logistics asset standardization (Basso et al., 2019)
		Flow complementary (Xu, 2013; Basso et al., 2019)
	Product compatibility	Similar environmental conditions (Rijpkema, 2014)
		Avoiding product interferences (Stellingwerf et al., 2021)
	Process compatibility	Similar production lead time (Rijpkema, 2014)
Suitability of product nature	Shelf life	Longer shelf life (Stellingwerf et al., 2021)
	Demand pattern	Stable demand profile (Wang et al., 2020).

Table 1: Enablers for Horizontal Logistics Collaboration in Agri-food supply chains

Motives

We further look into companies' motives for adopting HLC to complete the conceptual framework. A most often mentioned objective for HLC is ***cost reduction*** (Hernández-Espallardo *et al.,* 2010; Pomponi et al., 2015). For example, transportation costs can be reduced by sharing transportation resources (Asawasakulsorn, 2015). However, the findings of Schmoltzi & Wallenburg (2011) argued that compared to cost-oriented drivers, ***service quality improvement*** *and* ***market share enhancement*** (market-oriented drivers) are more crucial motives in HLC decision-making processes. In terms of ***service quality improvement***, Xu (2013) provides empirical evidence that collaborating with partners would result in logistics planning flexibility, thus increasing customer satisfaction. On the other hand, referring to the ***market share enhancement***, HLC can be instrumental in expanding the service options and geographic coverage (Yuan et al., 2019).

Schmoltzi & Marcus (2011) complement with one additional common-mentioned motive in the literature: i.e., ***access to additional knowledge and skills***. Similarly, Xu (2013) also emphasized this motive, elaborating that intensive communication through HLC provides access to partners' business processes, operations, and know-how. Therefore, participants can improve their competence and performance based on additional knowledge and skills gained through collaborative relationships.

Finally, ***environmental sustainability*** is another motive commonly cited in the literature (Stellingwerf et al., 2018).

All elements of the conceptual model are summarized in the conceptual model as shown in Figure 5.

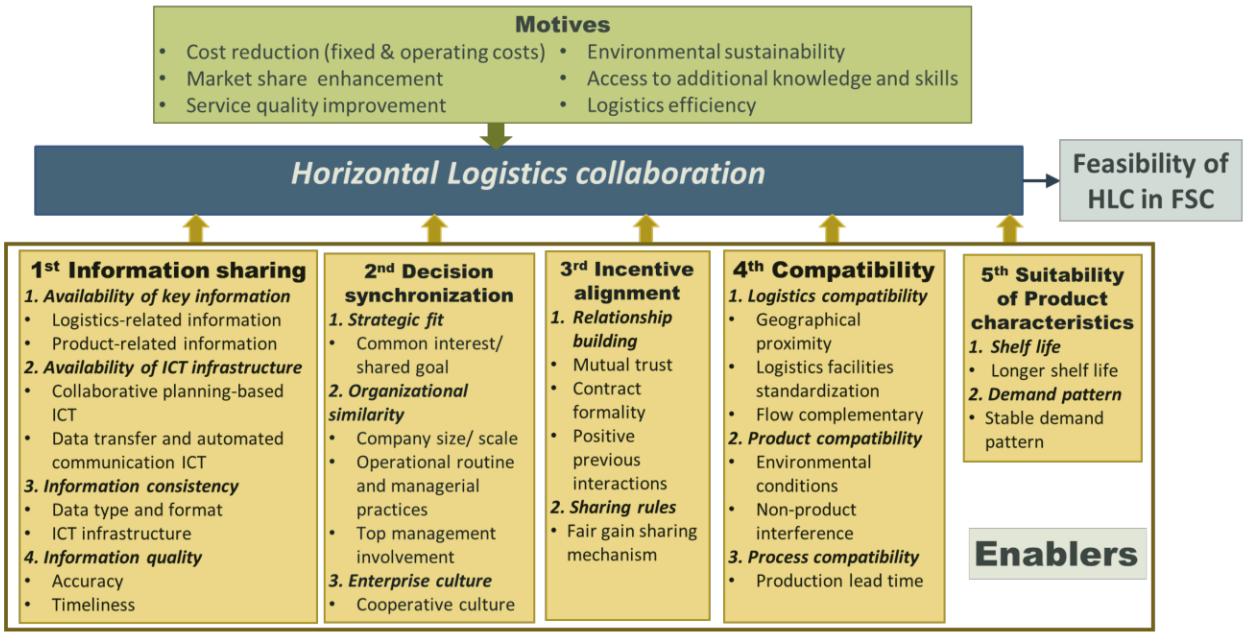

Figure 5: Conceptual model for Horizontal Logistics Collaboration in the agri-food supply chains

Concluding remarks

This paper aims to provide insight into the motives and enablers influencing the feasibility of Horizontal Logistics Collaboration (HLC) in the agri-food industry.

The food logistics sector faces distinct challenges due to the unique characteristics of the agri-food chains and the growing demand for year-round availability of agri-food products. Therefore, it is essential to

develop custom-tailored models that reflect these unique characteristics and specific food sector challenges.

This article presents a conceptual model describing the key enablers, the dimensions of each enabler, and the sub-factors influencing the horizontal logistics collaboration in the food sector. The key enablers include *information sharing*, *decision synchronization*, *incentive alignment*, *compatibility*, and *suitability of product nature*. For each leading enabler, the dimensions and sub-factors are derived from the literature and adapted with some modifications with expert views.

Using a quantitative research method, in our follow-up study, we investigate the relevance of movies/enablers for horizontal collaboration in food chains and the contextual mediating factors (like company size, type of product, and the history of collaboration).

The conceptual framework developed in this study can support top and middle management in companies to get insight and make better-informed decisions in implementing logistics collaboration initiatives in the food sectors. The model can also be used to develop a benchmarking tool to analyze the organization's readiness for horizontal logistics collaboration.

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