THAMMASAT REVIEW
PRINT ISSN: 0859-5747 ONLINE ISSN: 2630-0303
Volume 22 No 1 (January-June) 2019 [Page 46-63]

Supply Chain Collaborative (SCC) Measures Cases of Food Manufacturing Firms in Thailand

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Received 27 October 2018; Received in revised form 10 February 2019
Accepted 18 February 2019; Available online 26 June 2019

Abstract

Many academics and practitioners have attempted to investigate supply chain performance, which mainly revolves around financial and non-financial (delivery, flexibility, and quality) performance measures along the chain. Some studies have extended the research scope to explore how supply chain collaboration impacts a supply chain's or a firm's performance. However, the inter-firm collaborative measures within supply chains, which can result in a poor supply chain, have received very little attention, despite the fact that supply chain collaboration (SCC) has been widely accepted and researched as a key to improve a firm's and supply chain's performance as a whole. Performance measurement of SCC is still a challenging task because the objective of each player in the chain can be different and misaligned. Therefore, this paper seeks to explore the collaborative performance measures of firms in both upstream and downstream supply chains through case study investigations. Six leading food manufacturing firms along with their key suppliers and key customers in Thailand were interviewed to explore their inter-firm collaborative measures that help improve supply chain performance as a whole. The case studies were conducted in the food manufacturing industry. This industry has several unique characteristics such as product perishability, temperature-control and safety requirements in the chain. The findings offer new insights into supply chain collaborative measures. Both upstream and downstream collaborative measures should be different and customized instead of using a general set of inter-firm collaborative measures, particularly in the food industry where supplies can be varied.

Keywords

Food supply chain, Performance measurement, Supply chain performance measurement

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Research Background

The old cliché "What gets measured, gets done. What gets measured, gets improved" reflects the importance of performance measurement, particularly when it comes to supply chain collaboration (SCC). SCC has been widely accepted as a key to improve supply chain performance (Ataseven & Nair, 2017; Flynn et al., 2010; Maestrini et al., 2017; Ramanathan & Gunasekaran, 2014). Examples of SCC practices that help improve a supply chain through information sharing and joint decision making are VMI (Vendor-Managed Inventory), ECR (Electronic Consumer Response), and CPFR (Collaborative Planning, Forecasting, and Replenishment) (Hill et al., 2018). Despite the increase in popularity of these practices, supply chain collaboration is still a challenging task, partly because the objective of each player in the chain can be different and misaligned (Fawcett et al., 2015; Gopal & Thakka, 2012), resulting in misalignment of performance measures amongst players in the chain and poor supply chain collaborative performance (Fawcett et al., 2015).

Many academics and practitioners have attempted to investigate supply chain performance measures, which mainly are around financial and non-financial (delivery, flexibility, and quality) performance measures across different dimensions of a supply chain, i.e., internal performance measures, supplier performance measures, and customer performance measures (Ataseven & Nair, 2017; Maestrini et al., 2017). In addition, some studies extended the research scope to explore how supply chain collaboration impacts a supply chain's or a firm's performance (Ataseven & Nair, 2017; Flynn et al., 2010). However, the measures on how well each firm collaborates within supply chains, which could result in a poor supply chain or hurt a firm's performance, have received very little attention (Fawcett et al., 2015; Soosay & Hyland, 2015).

Examples of research in supply chain collaborative performance measures are three collaborative measures and several sub-measures of supply chain under those three key measures (Simatupang & Sridharan, 2005), seven dimensions of SCC (Gimenez et al., 2012), and three collaborative processes for SCC success (Ramanathan & Gunasekaran, 2014). Some research only included SCC as part of an overall picture of, e.g., operational integration, strategic alignment, etc. (Flynn et al., 2010; Soosay & Hyland, 2015; Wu et al., 2014). Designing appropriate and effective collaboration activities was also recently studied to help improve a firm's supply chain performance as a whole (Um & Kim, 2018). Yet, the literature on supply chain collaborative performance measures is still in its infancy and there is room for further empirical studies (Gopal & Thakka, 2012; Sillanpää, 2015; Soosay & Hyland, 2015). In addition, a study of multi-tier supply chains, which is beyond the dyadic relationship of a supply chain, is still required (Soosay & Hyland, 2015). Therefore, this paper seeks to explore the collaborative performance measures of supply chains in both upstream

and downstream chains through case studies in the food manufacturing industry where the industry characteristics are highly unique such as product perishability, seasonality, and temperature-controlled and safety requirements in the chain.

This research begins with a research background to highlight the research gap, followed by research methodology to explain how itwas conducted. Then, the literature on supply chains and their collaborative performance measures, and food supply chains and their characteristics, respectively, is reviewed in order to identify the literature gaps and also to draw a conceptual framework. Later, data from case studies are briefly presented, followed by empirical studies *and* analysis across cases which enrich the conceptual understandings from the literature. This paper ends with a discussion and conclusion indicating the key research findings and limitations.

Literature Review

This section aims to lay the theoretical foundation for conceptual framework development in supply chain collaborative measures in a food supply chain, as well as identifying the theoretical gaps in the existing literature. It reviews the literature on performance measurement in supply chains, supply chain collaborative performance measures, and food supply chains.

Performance Measurement in Supply Chain

Gopal and Thakkar (2012) argued that the concept of performance measurement in supply chains first appeared in Chow et al. (1994) through the measure of logistics performance. At that time, the definition of logistics and supply chain were still unclear. The supply chain definition has evolved over time through the emerging issues that companies have faced during the past two decades, such as the development of advanced technologies, the increase in outsourcing activities, the increased challenges of globalization, and the increased requirements for supply chain collaboration and integration (Meixell & Gargeya, 2005; Neilson et al., 2014).

Through the past 20 years, the research in supply chain performance measurement has improved dramatically (Gopal &Thakkar, 2012; Maestrini et al., 2017). For example, the balanced scorecard (Kaplan & Norton, 1992) and its application with the SCOR (Supply Chain Operations Reference) model has been one of the most cited topics in supply chain performance measurement. This is because the tool is practical, and it considers both financial and non-financial factors, which provides a holistic view of an organization and its supply chain. The tool focuses on cost, quality, time, flexibility, and qualitative versus quantitative factors in relation to the SCOR process stages (Gopal & Thakkar, 2012). Meanwhile, several other tools have also been developed to help measure supply chain performance systematically such as activity-based costing (Anderson & Young, 1999) and

performance prism (Neely et al., 2002). However, with the growth and improvement of research in supply chain performance measurement, the absence of collaborative performance measurement in supply chains is still observed (Busi & Bititci, 2006; Papakiriakopoulos & Pramatari, 2010; Soosay & Hyland, 2015) despite the fact that supply chain collaboration evidently improves supply chain performance as a whole (Hill et al., 2018; Ramanathan & Gunasekaran, 2014).

Most of the research in performance measures of supply chain collaboration (SCC) focuses on the financial and non-financial (delivery, flexibility, and quality) performance measures within an organization's supply chain. In addition, some studies extended the research scope to explore how supply chain collaboration impacts a supply chain's or a firm's performance (Ataseven & Nair, 2017; Flynn et al., 2010). However, the inter-firm collaborative measures within supply chains, which could result in a poor supply chain, have received very little attention (Fawcett et al., 2015; Soosay & Hyland, 2015). Hence, there is a need to further investigate the collaborative performance measures in a supply chain, which will be reviewed in the next section.

Supply Chain Collaborative (SCC) Measures

The research into collaborative performance measurement in supply chains began when supply chain players saw the potential benefits of working together (Speakman et al., 1998). As performance measures affect decision making of companies (Papakiriakopoulos & Pramatari, 2010), Simatupang and Sridharan (2003) suggested that supply chain members should jointly agree on performance measures in order to encourage supply chain collaboration.

Examples of research into supply chain collaborative performance measures include the three collaborative measures and several sub-measures of supply chain under those three key measures (Simatupang & Sridharan, 2005), seven dimensions of SCC (Gimenez et al., 2012), and three collaborative processes for SCC success (Ramanathan & Gunasekaran, 2014). Some research only include SCC measures in an overall pictureof operational integration, strategic alignment, etc. (Flynn et al., 2010; Soosay & Hyland, 2015; Wu et al., 2014). However, whether detailed measures or overall measures, most SCC measures can still be categorized into three key dimensions as suggested by Simatupang and Sridharan (2005) in their three-collaborative index: information sharing, decision synchronization, and incentive alignment.

Information sharing is the most popular dimension for researchers and practitioners pay attention to. It is argued that sharing information, such as demand information and its forecast, production schedule, marketing activities and changes from demand and supply sides, product price changes and increased costs of inventory as well as inventory policy or delivery schedule, helps in supply chain performance improvement because this information

improves the flexibility and responsiveness in a supply chain as a whole (Papakiriakopoulos & Pramatari, 2010; Ramanathan & Gunasekaran, 2014; Simatupang & Sridharan, 2005; Wu et al., 2014). Information visibility, mainly on the demand side, is strongly emphasized as a key to supply chain performance improvement (Hill et al., 2018; Wu et al., 2014), however, on the upstream chain collaboration, information sharing has received less attention in the literature (Soosay & Hyland, 2015). Perhaps most academia assumes that supply chain collaboration in both upstream and downstream would be similar as very little research focuses on multi-tier chain collaboration (ibid.).

Decision synchronization is another step towards SCC after information is shared between supply chain players. This dimension mainly involves joint activities amongst supply chain players that help to improve supply chain performance as a whole, for example joint planning on marketing activities, joint development of demand forecast, joint development of new product assortment, joint decisions on delivery order quantity or inventory policy (Flynn et al., 2010; Ramanathan & Gunasekaran, 2014; Simatupang & Sridharan, 2005; Wu et al., 2014). This dimension significantly increases SCC performance as it integrates the information sharing with action plans between two or more parties in the supply chains.

Incentive alignment is considered to be an indirect factor that motivates supply chain collaboration, though little research has paid much attention to this factor (Hill et al., 2018; Ramanathan et al., 2011). This dimension includes joint activities, such as shared savings on reduced inventory costs or improved quality level, or shared costs when problems arise (Simatupang & Sridharan, 2005; Wu et al., 2014). This dimension is difficult to achieve as it requires supply chain players to first have a close relationship and trust before they start having such joint activities and joint financial measures.

The three dimensions of collaboration aim to improve supply chain performance in terms of order fulfillment, inventory management, which reflect supply chain efficiency, and responsiveness (Fawcett et al., 2015; Flynn et al., 2010; Hill et al., 2018; Simatupang & Sridharan, 2005; Soosay & Hyland, 2015; Wu et al., 2014;). In this research, these three key dimensions of supply chain collaborative performance measurement, information sharing, decision synchronization, and incentive alignment, serve as the key foundation of the *conceptual framework* which will be developed in the next section.

Food Supply Chain (FSC)

The food industry is one of the most important industries in the world as it impacts everyone's daily life. It is particularly important in Thailand. Food exports from Thailand are now ranked 4th in the world by revenue (NFI, 2017). Supply chain collaboration performance with both suppliers and customers continues to be imperative as the country's GDP is closely tied to this industry.

Despite its long history and evolution, SCM research in the food industry is still yet to grow as "most of the literature is fragmented and is in silos" (Shukla & Jharkharia, 2013). The literature is still lacking in several senses, for example, demand and supply mismatch, and a less integrated approach to research are still the key concerns in FSC literature (ibid.). Hence, this research aims to fill this gap by investigating both demand and supply food chains (upstream and downstream).

The specific characteristics of food supply chains such as product perishability, long product life cycle (PLC), non-modular product structure, product safety and traceability, product temperature sensitivity, and seasonality, etc. (Aramyan et al., 2007; Entrup, 2005; Fuller, 1994; Karkkainen, 2003; Shukla & Jharkharia, 2013; Soman et al., 2004; van Hoek, 1999; van der Vorst & Beulens, 2002) place specific requirements and performance measures on FSC.

In a food supply chain in general, several performance measures are proposed:, such as efficiency, flexibility, responsiveness, food quality and safety, and sustainability, etc. (Aramyan et al., 2007; Dania et al., 2016; Shukla & Jharkharia, 2013). To improve supply chain performance, collaboration is often seen in the food industry due to the specific characteristics that require close relationship amongst supply chain members, such as shelf life constraint of raw materials and finished products, seasonality in production, and natural conditions that affect product quality and quantity (Dania et al., 2016; Kittipanya-ngam et al., 2010, 2011; Lorentz et al., 2013; Mena & Stevens, 2010; Shukla & Jharkharia, 2013), though its performance measures, as well as collaboration measures, are difficult to draw because these characteristics set them apart from other types of supply chain (Aramyan et al., 2007; Dania et al., 2016; Shukla & Jharkharia, 2013). In this research, we hence incorporate these characteristics to enrich the conceptual framework, which is based on the three dimensions of collaborative performance measures.

The Conceptual Framework on Supply Chain Collaborative (SCC) Measures

Emerging from the literature discussed above, this research primarily focuses on the development of supply chain collaborative measures in a food supply chain, given the lack of knowledge in this field. A conceptual framework investigating supply chain collaborative measures in a supply chain is then developed from the literature review as shown in Table 1. This framework is not yet specific to a food supply chain and it serves as a data collection tool for the case study research method, which will be elaborated on in the next section.

Table 1 The conceptual framework on supply chain collaborative measures in FSC

1. Information sharing	**Key literature**
1.1 promotional/marketing events	Flynn et al. (2010), Hill et al. (2018), Simatupang and Sridharan (2005), Wu et al. (2014)
1.2 demand forecast	Flynn et al. (2010), Hill et al. (2018), Simatupang and Sridharan (2005), Wu et al. (2014)
1.3 point of sales	Flynn et al. (2010), Hill et al. (2018), Simatupang and Sridharan (2005), Wu et al. (2014)
1.4 price changes	Ataseven and Nair (2017), Simatupang and Sridharan (2005)
1.5 inventory holding costs	Ataseven and Nair (2017), Simatupang and Sridharan (2005)
1.6 inventory level	Flynn et al. (2010), Hill et al. (2018), Simatupang and Sridharan (2005), Wu et al. (2014)
1.7 supply disruption	Hill et al. (2018), Simatupang and Sridharan (2005)
1.8 order status/tracking	Flynn et al. (2010), Hill et al. (2018), Wu et al. (2014)
1.9 delivery schedule	Flynn et al. (2010), Hill et al. (2018), Simatupang and Sridharan (2005), Wu et al. (2014)
1.10 Production schedule	Hill et al. (2018), Wu et al. (2014)
1.11 Performance metrics	Wu et al. (2014)
2. Joint discussion	**Key literature**
2.1 joint planning on prod assortment	Flynn et al. (2010), Wu et al. (2014), Simatupang and Sridharan (2005)
2.2 joint planning on promotion	Flynn et al. (2010), Wu et al. (2014), Simatupang and Sridharan (2005)
2.3 joint development of customer demand forecast	Flynn et al. (2010), Hill et al. (2018), Simatupang and Sridharan (2005), Wu et al. (2014)
2.4 joint resolution on demand forecast exceptions	Flynn et al. (2010), Hill et al. (2018), Simatupang and Sridharan (2005)
2.5 joint consultation on pricing policy	Flynn et al. (2010), Simatupang and Sridharan (2005)
2.6 joint decision on availability level	Hill et al. (2018), Simatupang and Sridharan (2005)
2.7 joint decision on inventory requirements	Flynn et al. (2010), Hill et al. (2018), Simatupang and Sridharan (2005)
2.8 joint decision on optimal order quantity	Flynn et al. (2010), Hill et al. (2018), Simatupang and Sridharan (2005)
2.9 joint resolution on order exceptions	Flynn et al. (2010), Hill et al. (2018), Simatupang and Sridharan (2005)
2.10 joint development of new market and customer response	Flynn et al. (2010), Wu et al. (2014)
2.11 joint new product development	Flynn et al. (2010), Wu et al. (2014)
3. Incentive alignment	**Key literature**
3.1 joint marketing/promotional events to boost sales	Flynn et al. (2010), Simatupang and Sridharan (2005), Wu et al. (2014)
3.2 shared saving on reduced inventory costs & other costs	Flynn et al. (2010), Simatupang and Sridharan (2005), Wu et al. (2014)
3.3 delivery guarantee for a peak demand	Flynn et al. (2010), Hill et al. (2018), Simatupang and Sridharan (2005), Wu et al. (2014)
3.4 allowance for product defects	Flynn et al. (2010), Hill et al. (2018), Simatupang and Sridharan (2005), Wu et al. (2014)
3.5 subsidies for retail price markdowns	Flynn et al. (2010), Hill et al. (2018), Simatupang and Sridharan (2005), Wu et al. (2014)
3.6 shared assets (i.e. materials, labours, infrastructure, facilities, equipment)	Dania et al. (2016)

The conceptual framework in Table 1 comprises three collaborative dimensions: information sharing, decision synchronization, and incentive alignment. Each dimension includes several sub-dimensions drawn from the literature both in the food and non-food industries. It is assumed that supply chain collaborative performance measures are similar in both upstream and downstream chains of a food manufacturer as most literature does not distinguish them yet.

Research Methodology

This research aims to explore the collaborative performance measures of a firm's supply chain. The research itself is exploratory in nature, using a multiple case study method (Yin, 2009). The case studies were used to collect and analyse the case data on collaborative performance measures in both the upstream and downstream food supply chains. A manufacturing firm's supply chain collaboration, as a *unit of analysis*, includes a collaboration in the upstream with one key supplier in the first tier and a collaboration in the downstream with one key customer in the first tier. This unit of analysis only focuses on one product in each case's supply chain.

A case study method allows for richness of the data despite a small number of cases (Eisenhardt, 1989). Triangulation of data collected through semi-structured interviews, direct observations, and documentation increase the validity and reliability of the research (Yin, 2009). Figure 1 presents the three main stages and key activities of this research. To begin with, the literature on supply chains and their collaborative performance measures, as well as the literature on food supply chains and their characteristics were reviewed to identify the key collaborative performance measures in supply chain๗. Based on the literature review, three key areas of performance measures in the conceptual framework were: (1) information sharing, (2) decision synchronization, and (3) incentive alignment. The sub-measures were also drawn from the literature review.

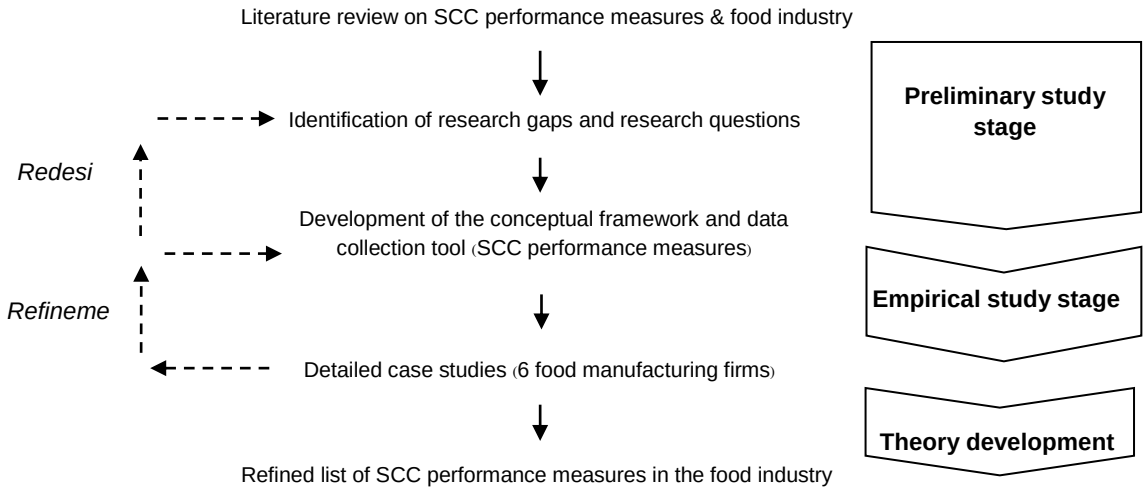

Figure 1 Three main stages and key activities of the research

The research demonstrates different cases of supply chain collaboration in both upstream and downstream in six food manufacturing firms in Thailand. Case selection relies on replication rather than logic sampling (Yin, 2003). The selection criteria are based on: (i) leading business performance of the case companies, and (ii) a broad range of food product and raw materials' characteristics as well as various types of customers, which could result in different degrees and performance measures of supply chain collaboration. The first criterion allows internal validity whereas the second criteria increases generalizability. As a result, the size of food manufacturing firms ranges from SMEs to leading agro-industrial and food conglomerates in the Asia Pacific region. Case products cover a wide range of product perishability levels such as frozen ready meals and chilled foods, as well as ambient goods. Semi-structured interviews are conducted in order to identify the key collaborative performance measures which influence thesupply chain performance of the firms. Finally, the conceptual framework on collaborative performance measures in food supply chain is refined.

Additionally, there is still a need for empirical studies, e.g., a case study based approach in this area to provide practical guidelines for companies (Papakiriakopoulos & Pramatari, 2010). Hence, there is a need to further investigate the collaborative performance measures in a supply chain through empirical studies.

Table 2 Details of in-depth case studies

No.	Company	Revenue (USD)	No. of employees	Product	Key suppliers	Key customers
1	A	N/A	100	Frozen ready meal	rice, meat, vegetables	owned restaurants
2	B	128 million	1,700	Canned tuna	tuna	overseas distributors
3	C	45 million	1,800	Crab sticks	Surimi	food processors, fresh markets, Japanese distributors
4	D	58 million	900	Dim sum	shrimp, flour	local restaurants, Japanese distributors
5	E	N/A	2,500	Chicken burger ready meal	Chicken meat, bread	owned outlets (retailers)
6	F	43 million	1,050	Canned peanuts	raw peanuts	local retailers

Table 3 List of 10 cases in the upstream collaboration with key suppliers

Case No.	Company	Key supplier
1A	A	rice
2A		meat
3A		vegetables
4A	B	tuna
5A	C	surimi
6A	D	shrimp
7A		flour
8A	E	chicken meat
9A		bread
10A	F	raw peanuts

Table 4 List of 9 cases in the downstream collaboration with key customers

Case No.	Company	Key customer
1B	A	owned restaurants
2B	B	overseas distributors
3B	C	food processors
4B		fresh markets
5B		Japanese distributors
6B	D	local restaurants
7B		Japanese distributors
8B	E	owned outlets
9B	F	local retailers

Tables 2-4 demonstrate the case studies conducted with six leading Thai food manufacturing firms, comprising of 10 cases of upstream collaboration with one of the key suppliers and nine cases of downstream collaboration with one of the key customers. Table 2 shows the details of the companies, their products, their key supplies and key customers, whereas Tables 3 and 4 show the case numbers for each upstream and downstream case.

Empirical Studies & Analysis

Tables 5 and 6 show the cross-case analysis of the upstream collaboration and downstream collaboration, respectively. The key supply chain collaboration indicators, which are drawn from the cases, are also compared with those from the conceptual framework drawn from the literature.

Table 5 Cross-case analysis of 10 cases in the upstream collaboration with key suppliers

Company No.	A			B	C	D		E		F	literature
Activities with key suppliers	**1A**	**2A**	**3A**	**4A**	**5A**	**6A**	**7A**	**8A**	**9A**	**10A**	
1 information sharing											
1.1 promotional/marketing events	×	×	✓	✓	×	×	×	✓	×	✓	✓
1.2 demand forecast	×	×	×	×	×	×	✓	✓	✓	✓	✓
1.3 point of sales	×	×	×	×	×	×	×	✓	×	×	✓
1.4 price changes	×	×	✓	✓	×	×	×	✓	✓	✓	✓
1.5 inventory holding costs	×	×	×	×	×	×	×	✓	×	✓	✓
1.6 inventory level	×	×	×	✓	×	×	×	✓	×	✓	✓
1.7 supply disruption	×	×	✓	✓	×		×	×	✓	✓	✓
1.8 order status/tracking	✓	×	×	✓	×	×	×	×	×	×	✓
1.9 delivery schedule	✓	×	×	×	×	×	×	×	✓	✓	✓
1.10 Production schedule	×	×	×	×	×	×	×	×	×	✓	✓
1.11 Performance metrics	×	×	×	×	×	×	×	✓	×	✓	✓
1.12 supply cost and volume forecast	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓	×
2 joint decision											
2.1 joint planning on prod assortment	×	×	×	×	×	×	✓	✓	✓	×	✓
2.2 joint planning on promotion	×	×	✓	×	×	×	×	✓	×	✓	✓
2.3 joint development of customer demand forecast	×	×	×	×	×	×	×	×	×	×	✓
2.4 joint resolution on demand forecast exceptions	×	×	×	×	×	×	×	✓	✓	✓	✓
2.5 joint consultation on pricing policy	×	×	×	×	×	×	×	✓	×	✓	✓
2.6 joint decision on availability level	×	×	×	×	×	×	×	✓	×	✓	✓
2.7 joint decision on inventory requirements	×	×	×	×	×	×	×	×	×	✓	✓
2.8 joint decision on optimal order quantity	✓	×	✓	✓	×	×	✓	✓	×	✓	✓
2.9 joint resolution on order exceptions	×	×	×	×	×	×	×	×	×	✓	✓
2.10 joint development of new market and customer response	×	×	×	×	×	×	×	×	×	×	✓
2.11 joint new product development	×	×	×	×	×	×	×	×	×	✓	✓
3 incentive alignment											
3.1 joint marketing/promotional events to boost sales	×	×	×	×	×	×	×	✓	×	×	×
3.2 shared saving on reduced inventory costs & other costs	×	×	×	✓	×	×	✓	✓	×	✓	×
3.3 joint programs to improve supply value & quality	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓	×	✓	×
3.4 delivery guarantee for a peak demand	×	×	×	×	×	×	×	×	×	✓	✓
3.5 allowance for product defects	×	×	×	✓	×	×	×	×	×	✓	✓
3.6 shared assets (i.e. materials, labours, infrastructure, facilities, equipment)	×	×	×	×	×	×	×	✓	×	✓	✓
3.7 subsidies for retail price markdowns	×	×	×	×	×	×	×	×	×	×	✓
3.8 agreements on order changes	×	×	×	×	×	×	×	✓	×	✓	✓

Table 6 Cross-case analysis of 9 cases in the downstream collaboration with key customers

Company No.	A	B	C			D		E	F	literature
Activities with key customers	**1B**	**2B**	**3B**	**4B**	**5B**	**6B**	**7B**	**8B**	**9B**	
1 information sharing										
1.1 promotional/marketing events	✓	×	×	×	✓	✓	✓	✓	×	✓
1.2 demand forecast	✓	×	✓	×	✓	×		✓		✓
1.3 point of sales	✓	×	×	×	×	×	×	✓	×	✓
1.4 price changes	✓	✓	×	×	×	×	×	✓	×	✓
1.5 inventory holding costs	✓	×	×	×	×	×	×	✓	×	✓
1.6 inventory level	✓	×	×	×	×	×	×	✓	×	✓
1.7 supply disruption	✓	✓	×	×	×	×	×	✓	×	✓
1.8 order status/tracking	✓	✓	×	×	×	×	×	✓	✓	✓
1.9 delivery schedule	✓	✓	×	×	✓	×	×	✓	×	✓
1.10 production schedule	✓	×	×	×	×	×	×	✓	×	✓
1.11 performance metrics	✓	×	×	×	×	×	×	✓	×	✓
1.11 information on product & its usage	×	N/A	N/A	N/A	N/A	N/A	N/A	✓	×	×
2 joint decision										
2.1 joint planning on prod assortment	✓	✓	✓	×	✓	✓	✓	✓	×	✓
2.2 joint planning on promotion	✓	×	×	×	✓	✓	✓	✓	✓	✓
2.3 joint development of customer demand forecast	✓	×	×	×	×	×	×	✓	×	✓
2.4 joint resolution on demand forecast exceptions	✓	×	×	×	✓	×	×	✓	✓	✓
2.5 joint consultation on pricing policy	✓	×	×	×	×	×	×	✓	×	✓
2.6 joint decision on availability level	✓	×	×	×	×	×	×	×	×	✓
2.7 joint decision on inventory requirements	✓	×	×	×	×	×	×	×	×	✓
2.8 joint decision on optimal order quantity	✓	×	×	×	✓	×	✓	×	✓	✓
2.9 joint resolution on order exceptions	×	×	×	×	×	×	×	×	×	✓
2.10 joint development of new market and customer response	✓	×	×	×	×	×	×	✓	×	✓
2.11 joint new product development	✓	×	×	×	×	×	×	✓	×	✓
3 incentive alignment										
3.1 joint marketing/promotional events to boost sales	✓	×	×	×	✓	×	✓	✓	✓	×
3.2 shared saving on reduced inventory costs & other costs	✓	×	×	×	×	×	×	✓	×	×
3.3 joint programs to improve product value & quality	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓	×	×
3.4 delivery guarantee for a peak demand	✓	×	×	×	×	×	×	✓	×	✓
3.5 allowance for product defects	✓	×	×	×	×	×	×	✓	×	✓
3.6 shared assets (i.e. materials, labours, infrastructure, facilities, equipment)	×	×	×	×	×	×	×	✓	×	✓
3.7 subsidies for retail price markdowns	×	×	×	×	×	×	×	✓	×	✓
3.8 agreements on order changes	×	×	×	×	×	×	×	×	×	✓
3.9 educating sale staff on product spec & usage	×	N/A	N/A	N/A	N/A	N/A	N/A	✓	×	×

In the upstream collaboration depicted in Table 5, each case shows a different degree of collaboration in all three dimensions. For example, Cases 1A and 2A (rice and meat as key supplies to frozen ready meal products) do not show much collaboration between the suppliers and the focal firm in terms of information sharing, joint decisions, and incentive alignment. To be specific, only the delivery schedule is being shared in Case 1A's (rice) chain. This is partly because rice can be easily sourced and suppliers can be easily found; hence Company A has many choices for its supplies. Low-cost basis has been applied in sourcing decisions in both Cases 1A and 2A; as a result, the degree of supply chain collaboration is low in their chains.

On the other hand, for example, Case 10A's (raw peanuts) supplier demonstrates a high collaboration with Company F through several sets of information sharing as well as joint decisions and incentive alignment activities. Initially, the company faced difficulties of supply uncertainty in terms of *price and volume fluctuation* all year round. Once the price of raw peanuts fell, farmers stopped farming raw peanuts and switched to a new product that had a higher price in the market. Therefore, the company collaborated with a supplier who had peanut farms in China. This allowed the company to secure raw peanuts at a predictable price with higher control of the raw material's quality. As a result, the collaboration between the company and its supplier included information sharing on demand information, demand forecast, price changes, inventory levels and costs, supply disruption, as well as the supply price and volume forecast, which depended on the weather conditions. In addition, the company also helped to educate farmers on good peanut farming practices to improve *supply quality* and supplier capability. This allowed the company's supply chain to perform better as a whole. In case 3A (vegetables), during the *high season*, there would be too many vegetables in the market, hence, the price would be low. However, given the *high perishability*, the supplier wanted to clear the stock before the vegetables went bad. Therefore, the company and the supplier shared more information on supply disruption and price changes so that the supplier's stock was cleared and the company could buy vegetables at a good price.

Similarly, Case 8A (chicken meat) also demonstrates a high degree of upstream chain collaboration in all dimensions as the focal firm has a high stake in the suppliers' shares and bargaining power over the suppliers (contracted farms).

In the downstream collaboration depicted in Table 6, each case also shows a different degree of collaboration in all three dimensions. Case 1B (frozen ready meals being sold to a company owned restaurant), for example, has a high degree of collaboration because the company and the customers were within the same conglomerate group. However, information or activity which did not help with supply chain performance improvement was not shared or jointly developed as it would incur additional cost. Similarly,

Case 8B (chicken burger ready meals being sold to a company owned retail outlet) has high collaboration because the company and the customers are within the same company group. The company helps the customers (owned retail outlets) to train the outlets' staff on how to heat up and pack the product correctly.

Additionally, the conceptual framework is already refined through cross-case analysis. The sub-dimensions of each collaborative index in the supply chains are enriched on both upstream and downstream sides, as shown in Tables 5 and6. For example, from the upstream side, information sharing on supply cost and volume forecast emerged from Case 10A (raw peanuts) due to the *high uncertainty of supply availability*, whereas from the downstream side, information sharing and training on how to use the product correctly appeared in Case 1B (frozen ready meals being sold to the company owned restaurant). This reflects that the performance measures for supply chain collaboration in the upstream and downstream should be different and customized, which is an area still lacking in the literature. These measures would help guide companies to improve the performance of their supply chains as a whole.

Conclusion & Recommendations

Most of the research in performance measures of SCC focuses on the financial and non-financial (delivery, flexibility, and quality) performance measures within a supply chain. However, the inter-firm collaborative measures within supply chains, which could result in a poor supply chain, have received very little attention (Fawcett et al., 2015; Soosay & Hyland, 2015). This research offers new insights into collaborative performance measures in a food supply chain through the refinement of the sub-dimensions of a collaborative index in both upstream and downstream chains, which is still lacking in the literature (Soosay & Hyland, 2015).

According to the case studies, these inter-firm collaborative measures and their sub-dimensions in the upstream and downstream chains appear to be slightly different. Interestingly, most research into supply chain collaboration and its performance measures were conducted in the downstream chain (product supplier – retailer relationship) and not in the upstream, which should not be any different from the downstream. However, the results from this research suggest that the upstream chain requires a different set of collaborative performance measures due to the different characteristics and requirements of raw materials such as seasonality, quality consistency, perishability, and supply availability. Indirectly, the research results suggested that food firms should manage inter-firm collaboration differently in both upstream and downstream chains due to the different collaborative measures.

The findings from this research can help guide food firms to better measure their inter-firm collaborative performance both in the upstream and downstream chains in a more customised manner. The proposed list of collaborative measurements for both upstream and

downstream in this research would indeed help food firms to have a more holistic picture of their supply chain and how to manage both upstream and downstream chains accordingly.

Given the exploratory nature of this research, the sub-dimensions of collaborative index in food supply chains, both upstream and downstream, from the case findings still require more case evidence from a broader range of food product characteristics and various types/sizes of manufacturing firms, particularly the ones that might have significantly different extensions of the framework.

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