Benchmarking Supply Chain Collaboration: An Empirical Study[*]

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Abstract

Supply chain collaboration enables firms to achieve better performance. It requires close arrangements of collaborative practices among the participating members. Searching for better practices and ideas that lead to superior performance means that the chain members also need to benchmark their current collaborative practices to other collaborative supply chains. Benchmarking enables them to identify the highest standards of excellence in customer services and processes and implement necessary improvements to match or exceed these standards. This article reports a benchmarking study on supply chain collaboration between retailers and suppliers, which incorporates collaborative practices in information sharing, decision synchronisation, and incentive alignment. An empirical study was carried out to benchmark the profile of collaborative practices and operational performance. The study also compared differences in the use of collaborative practices from retailer and supplier perspectives.

Introduction

Supply chain collaboration has become a new imperative strategy for companies to create competitive advantage (Horvath, 2001; Spekman *et al.*, 1998). A closer relationship enables the participating companies to achieve cost reductions and revenue enhancements as well as flexibility in dealing with supply and demand uncertainties (Bowersox, 1990; Lee *et al.*, 1997). Hewlett-Packard (HP), for instance, initiated collaboration with one of its major resellers (Callioni and Billington, 2001). These collaborative efforts, which focused on co-managed inventory by considering different levels of demand uncertainty, enabled both parties to improve fill rate, increase inventory turnover, and enhance sales. Similarly, Wal-Mart collaborated in demand planning and replenishment with its major suppliers to increase inventory turns, reduce inventory costs, reduce storage and handling costs, and improve retail sales (Parks, 1999).

Supply chain collaboration requires a reasonable amount of effort from all participating members to ensure the attainment of potential benefits (Barratt and Oliveira, 2001; Corbett *et al.*, 1999). The chain members also search for better practices and ideas through benchmarking their current collaborative practices to other collaborative supply chains. Benchmarking provides them with opportunities to identify excellent standards in processes and performance and make necessary improvements to match or exceed these standards. However, previous study on supply chain collaboration has paid little attention to conceptualising prominent collaborative practices that help the chain members to understand performance drivers. The focus is usually on internal business practices from a single company's perspective (Basnet *et al.*, 2003; Knuckey *et al.*, 2002). A novel type of benchmarking is required for supply chain collaboration because the chain members are

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concerned with both performance drivers and targets (Gunasekaran, 2002). As a consequence, it is crucial to carry out a benchmarking study that identifies collaborative practices that contribute to performance improvements. This makes it relevant to study benchmarking in supply chain collaboration.

Given the importance of sharing the best practices, the objective of this research is to compare the collaborative practices between suppliers and retailers. The concept of collaboration consists of three dimensions, namely information sharing, decision synchronisation, and incentive alignment (Simatupang and Sridharan, 2004a). Research instruments were developed around this conceptualisation. Data were sought from a sample of New Zealand companies. The survey results provide benchmarking data on the profile of collaborative practices and operational performance. This research promotes interorganisational benchmarking rather than a focus on a single company and thereby provides a significant contribution to the study of benchmarking in supply chains.

The study is organised as follows. First, a literature review is presented as the foundation of this research. The next section proposes a conceptual model that characterises three dimensions of supply chain collaboration, namely information sharing, decision synchronisation, and incentive alignment. After that, the research method that consists of data collection and development of measures is given. Findings are presented and discussed. Finally, the paper provides concluding remarks and recommendations for future research.

Literature Review

This section summarises previous benchmarking studies on supply chain collaboration relevant to this study. Benchmarking may be defined as the process of analysing the best products or processes of leading competitors in the same industry or leading companies in other industries (Camp, 1995). The focal company then gains an understanding of the appropriate performance level and drivers behind the success (Zairi, 1996). This process provides ideas to the company to identify and implement the most effective solutions for realising breakthroughs in performance. In this sense, benchmarking provides both motivation and learning in performance improvements. As the team in the company compares its internal practice with the best practice, benchmarking feedback reveals plenty of room for improvements and suggests how to imitate strategies which have the potential to achieve better performance. Besides this motivational aspect, the team also becomes involved in the learning process of implementation. They engage in planning, controlling, and evaluating the life cycle of the improvement project.

Previous benchmarking studies in supply chain management covered types of performance or practice including its achievable performance levels for comparison, how to set performance targets, and possible methods to implement improvement solutions (Boyson *et al.*, 1999). However, most of this previous research relates mainly to benchmarking schemes for a specific single company as a part of the supply chain. Hanman (1997) employed the leaders-laggers analysis to compare a firm's performance to best practice. Gilmour (1999) proposed a set of benchmark measures based on a set of capabilities, which consists of process, information technology, and organisation. Bowersox *et al.* (2000) found that best practice in supply chain management resulted in better performance compared to companies with less integrated supply chain practices. Van Landeghem and Persoons (2001) developed a causal model as a means for identifying possible initiatives to bridge the performance gap between a company and best-in-class performers. Recently, Basnet *et al.* (2003) empirically provided a benchmarking study on supply chain practices in New Zealand companies.

The advent of supply chain collaboration shifts the focus of benchmarking from a single company level to an interorganisational level (Simatupang and Sridharan, 2004a). Several research surveys have shown, for example, that the core of supply chain

management is the improvement process at the interorganisational level (Boyson *et al.*, 1999; Kopczak, 1997; Stank *et al.*, 1999). According to Stewart (1995), a best-in-class supply chain was characterised by the best achievement of both internal-facing measures and customer-facing measures. Christopher (1998) also argued that supply chain benchmarking includes joint practices and achievements of the chain members in the supply chain. Stewart (1997) provided the development of the supply chain operations reference (SCOR) model as the first cross-industry framework for evaluating and improving extended supply chain performance. Geary and Zonnenberg (2000) employed the SCOR model to show that the best-in-class performers gained considerable financial and operating advantages over the rest of the respective groups. By using system-wide revenues and costs, Ramdas and Spekman (2000) also examined collaborative practices between high performers among innovative-product supply chains and high performers among functional-product supply chains.

As companies move toward closer arrangements with their partners, they become involved in the progressive process of collaboration (Mentzer *et al.*, 2000). Poirier (1999) proposed a progressive framework consisting of four levels of supply chain optimisation. The first two levels of progress are internally focused, namely "sourcing and logistics" and "internal excellence". The last two levels, "network construction" and "industry leadership", reflect the collaborative efforts amongst participating members that improve their value chain constellation in which the effectiveness is measured by the ultimate customers in terms of their purchases and continued loyalty. In a similar vein, Polese (2002) developed a supply chain maturity model that reflects how companies progress in terms of operational capability. There are four stages in the supply chain maturity model. The first two levels are functional focus and internal integration. Collaboration is the key ingredient to reach stages three (i.e., external integration) and four (i.e., cross-enterprise collaboration). In conjunction with the SCOR model, the maturity model can be used to measure fact-based benchmarking for determining best-in-class performance opportunities. Most recently, Simatupang and Sridharan (2004a) have recommended an integrated benchmarking scheme for supply chain collaboration that consists of enabling practices and a collaborative performance system. This current research focuses on the empirical evidence for benchmarking supply chain collaborative practices.

Conceptual Model

Supply chain collaboration implies that the chain members become involved in coordinating activities that span boundaries of their organisations in order to fulfil end customer needs (Bowersox, 1990). This collaboration shifts the focus of supply chain management away from simply looking at the four walls of the individual member to how the chain members interact with each other to create an agile supply chain which contributes to competitive advantage. There are three key assumptions underlying the study of supply chain collaboration. First, the supply chain performance is explained by how the chain members manage across their boundaries. Previous studies provide empirical evidence that support this first assumption (Bowersox, 1990; Lee *et al.*, 1997; Spekman *et al.*, 1998; Stank *et al.*, 1999). Second, the key to effective supply chain collaboration depends on the careful selection of the levels of coordination structure that drive supply chain performance (Simatupang and Sridharan, 2004b). The chain members need to choose interorganisational design variables that mostly contribute to overall performance. Previous literature recommends that the chain members need to design the supply chain strategy that fits to various levels of demand uncertainties (Fisher, 1997; Lee *et al.*, 1997). Third, interorganisational settings across boundaries of the chain members change over time because of competitive and environmental changes.

Based on these assumptions, this research thus attempts to explore the relationship between drivers of collaboration and supply chain performance. The primary task prior to

data collection is to develop a conceptual model (Cavana *et al.*, 2001). The conceptual model offered in this paper was developed in two stages. The first stage is a theoretical development, which is drawn upon the interorganisational economics view (Simatupang and Sridharan, 2004b). The result of this stage indicates that supply chain collaboration can be characterised by five elements including appropriate performance system, information sharing, decision synchronisation, incentive alignment, and streamlined intercompany business processes (see Figure 1). The three elements of information sharing, decision synchronisation, and incentive alignment constitute the structure of coordination that can be designed at different levels by the participating members. The second stage is to incorporate the conceptualisation of collaboration into the benchmarking study (Simatupang and Sridharan, 2004a). This stage provides a comprehensive view of linking collaborative enablers to supply chain performance. It is hypothesised that the three enablers of collaboration, namely information sharing, decision synchronisation, and incentive alignment, are required to facilitate the chain members engaging in a cross-organisational cooperation that enables them to realise better overall performance. Figure 1 shows that the three dimensions of supply chain collaboration are related to supply chain performance. The remaining section presents the three dimensions of supply chain collaboration.
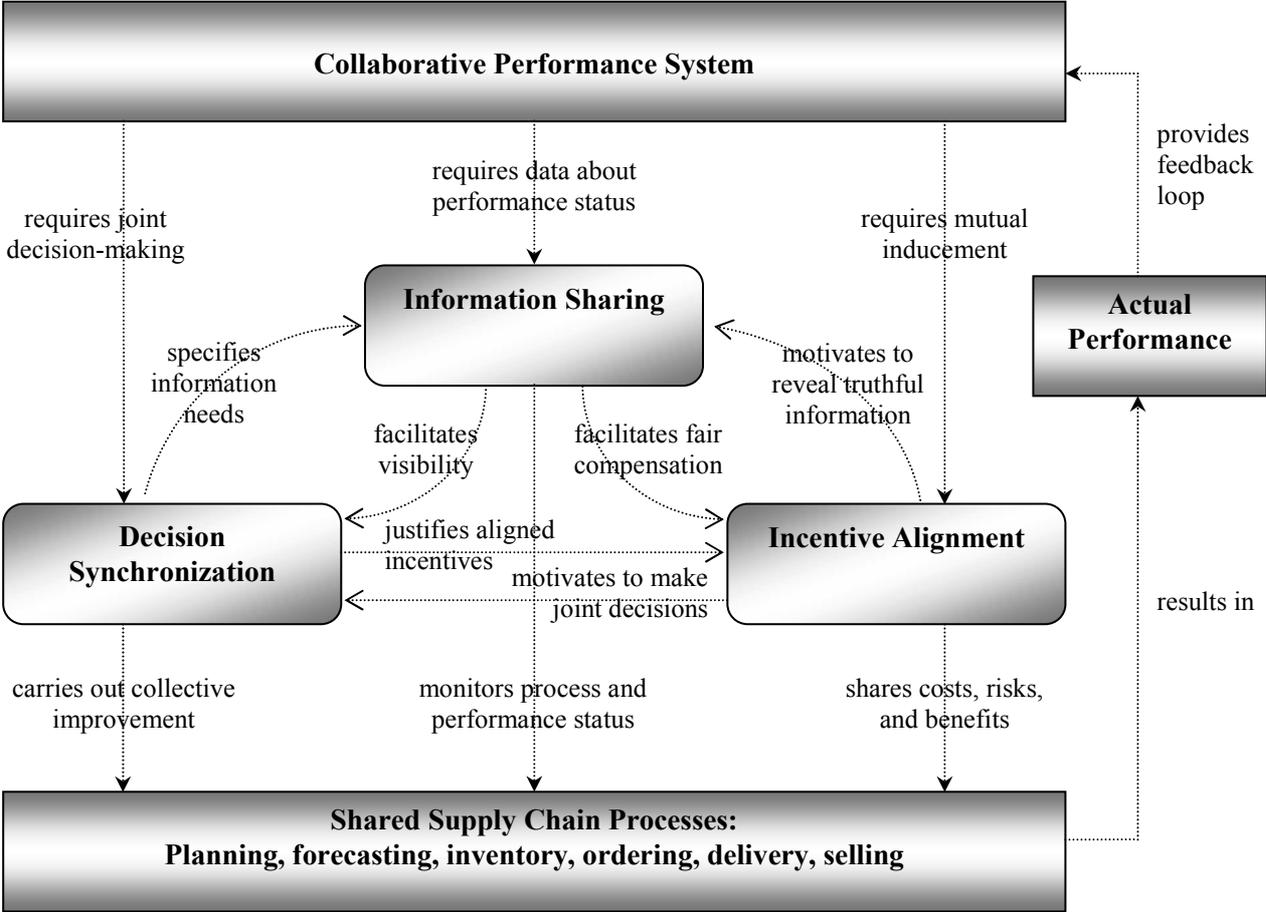

Figure 1. A conceptual model for supply chain collaboration

Information Sharing
The starting point of supply chain collaboration is information sharing. Information sharing aims to capture and disseminate timely and relevant information to enable decision makers to plan and control supply chain operations. Effective information

sharing provides a shared basis for concerted actions by different functions across interdependent firms (Whipple *et al.*, 2002). Examples of shared data include points of sale (POS) data, demand forecasts, inventory levels, delivery schedules, and inventory costs (Lee and Whang, 2000). Information sharing also facilitates clarity about demand, the fulfilment process, and common performance. Fisher (1997) indicates that supply chain collaboration leads to cohesive market focus, better coordination of sales and demand fulfilment, and minimum risks associated with demand uncertainty. Information sharing thus appears to enable the chain members to create better performance (Lee *et al.*, 1997; Whipple *et al.*, 2002).

Decision Synchronisation
Decision synchronisation refers to joint decision making at planning and operational contexts. These joint decisions are used to guide logistics processes inside an individual chain member firm. The planning context integrates decisions about long-term planning and measures such as selecting target markets, product assortments, customer service level, promotion, and forecasting. The operational context integrates order generation and delivery process that can be in the forms of shipping schedule and replenishment of the products to the stores. Decision synchronisation encourages the chain members to have a sense of belonging in which all decisions work toward a common goal of serving end customers. It reduces the gap between delivery requirements and actual delivery, thereby improving customers' perceptions of fulfilment performance (Ramdas and Spekman, 2000). Customers are satisfied as they find products suited to their preferences and tastes at the right time and at the right price. Decision synchronisation thus contributes to a reputation of on-time delivery and consistent product availability (Bowersox *et al.*, 2000).

Incentive Alignment
Incentive alignment refers to the degree to which chain members share costs, risks, and benefits. The costs such as administration and technology need to be shared fairly amongst the chain members in order to maintain the commitment of each party to the collaborative efforts. Moreover, chain members commit to the collaborative efforts if they can realise and capture relevant benefits that contribute to their future survival (Kaplan and Narayanan, 2001). Benefits of collaboration include both commercial gains - such as increased sales - and performance improvement - such as lowered inventory costs (Corbett *et al.*, 1999). Incentive alignment also involves risk sharing among the chain members in managing demand, supply, and price uncertainties (Fisher, 1997). Setting and applying appropriate incentives – such as rewarding responsiveness and sharing the costs of markdowns – motivate the chain members to take decisions that align with the achievement of supply chain profitability (Simatupang and Sridharan, 2002).

Research Method
A survey was conducted to assess the level of collaboration practice and its impact on performance. The rationale of the survey was to obtain adequate data for generalisation of the findings (Pinsonneault and Kraemer, 1993). The survey instrument was developed and tested by following the framework suggested by Churchill (1979). It included conceptualisation, itemisation, pilot test, purification, and validation. The conceptualisation phase identified key areas of collaboration practices that incorporate information sharing, decision synchronisation, and incentive alignment (Simatupang *et al.*, 2002; Simatupang and Sridharan, 2004a). To develop a scale, recent literature was used to itemise the domains of a variable into a set of activities (Cavana *et al.*, 2001).

A number of practitioners and academics were asked to review, drop, and change the questions presented in the questionnaire. They modified where necessary, and confirmed that the items reflected the concept of collaboration. Furthermore, a panel of

practitioners was asked to identify ambiguous items, poorly worded questions, and poor instructions to answer the questionnaire. Several items were rewritten after evaluation by the panel. The panel found no major problems with the response format, directions, or other survey procedures. Additional evaluation was made to ensure consistency with the measures used in prior research. Several items were modified slightly after this evaluation. The final questionnaire reflected the changes.

The sample was drawn from extensive trade databases such as *The New Zealand Business Directory*, *The New Zealand Business Who's Who*, and *Kompass*. A total of 400 respondents were selected from those sources, which comprised 200 retail and 200 supplier companies. Since the unit of analysis is at the retailer-supplier link, two versions of the questionnaire were developed. The retailing version was sent to retailers represented by a purchasing professional or logistics manager. The supplying version was sent to suppliers represented by a sales manager or logistics manager. Respondents were asked about their perceptions of actual collaborative practices with their immediate upstream or downstream supply chain members. Specifically, the retailer respondents were asked to assess their collaborative practice with their suppliers and the suppliers were asked corresponding questions about their relationship with retailers. From these two perspectives, it is believed that the research captured the essence of the overall view of each chain member that reflects key dimensions of current practices (Kopczak, 1997).

Several techniques were used to motivate respondents to participate in this research (Dillman, 1978). First, the survey was accompanied by a covering letter that described the objectives of the study and the contributions it makes to supplier-retailer collaboration. Second, the covering letter stated that the Massey University Human Ethics Committee (MUHEC) had approved the survey with PN Protocol 02/107, which increased the legitimacy of the survey. Third, all respondents were guaranteed anonymity and offered a summary report of the results in exchange for their participation. Fourth, a pre-addressed stamped envelope was provided to encourage the respondent to return the completed questionnaire. Finally, respondents who did not respond in four weeks were mailed a reminder letter and another copy of the questionnaire.

The final questionnaire was sent to 400 respondents comprising retailing and supplying companies. Within five weeks from the dispatching date, 73 of the managers had responded. A reminder letter was sent four weeks after the due date of the first mailing. The second mailing resulted in 67 additional responses. A total of 140 questionnaires were returned. However, 8 responses from the first wave and 20 from the second wave chose to decline to participate in the study on the basis of company policy. Around 14 responses from the first wave and 7 from the second wave were returned due to non-existing addresses. Four respondents from the first wave and eight from the second wave stated that their firms have inappropriate supply chain structures, and are, therefore, irrelevant to this study. There were 2 returned questionnaires from the first wave and 1 from the second wave with excessive missing data. A final usable sample of 76 completed questionnaires out of 367 representative samples was used in the study, which gave an overall response rate of 21%. Given the length of the survey and the high level of manager targeted, the response rate is in line with those reported by other researchers who study supply chain management (Basnet *et al.*, 2003).

The non-response bias was tested through an extrapolation method by comparing the early wave (first two-thirds) and late wave (last third) (Armstrong and Overton, 1977). The basic rationale is that late respondents are more similar to non-respondents than are early respondents. The test showed no significant differences ($p > .10$) in the means responses between early and late respondents for all the included variables. This finding provides reasonable evidence that non-response bias was not a problem in these data.

Across the sample, the respondents varied in terms of company types, annual sales, number of employees, and product types as shown in Table 1. Fifty percent of the

respondents were retailers and 50% of suppliers comprising manufacturers (38%) and distributors (12%). The average annual sales of the respondents were between NZ$ 25-50 million. The average number of employees was about 250 people. The respondents were from six broad product categories: clothing and footwear comprised 22.37 percent; food and beverages 21.05 percent; home improvement, building supplies, tools, and furniture 19.74 percent; electronics and appliances 18.42 percent; stationery and toys 10.53 percent; and health products 7.89 percent of the sample. The respondents had been involved in supplier-retailer collaboration for an average of two years. Given the broad industry groups represented, the results can reasonably be generalised to a larger base of companies.

Table 1. Descriptive statistics of respondents

Employees:	n	%	Firm type:	n	%
< 50	19	25%			
51-100	17	22%	Manufacturers	29	38%
101-200	9	12%	Distributors	9	12%
201-500	24	32%	Retailer	38	50%
> 500	7	9%	Total frequency	76	100%
Total frequency	76	100%			

Sales (millions):	n	%	Product types:	n	%
< 9	13	17%	Apparel, footwear, clothing	17	22%
10-24	20	26%	Electronics, appliances	14	18%
25-49	15	20%	Food, beverages, soft drink	16	21%
50-99	10	13%	Stationery, books, toys	8	11%
100-500	9	12%	Home improvement, tools	15	20%
> 500	9	12%	Health products	6	8%
Total frequency	76	100%	Total frequency	76	100%

Statistical tests were conducted to confirm the reliability and validity of the measurements (Churchill, 1979). Consistent with the conceptualisation, information sharing, decision synchronisation, and incentive alignment were specified as three separate factors. The measurement items were examined by item-to-total correlations in order to purify the scale. Two items from the information sharing scale, three items from the decision synchronisation scale, and six items from the incentive alignment scale were dropped because of significant improvement in item-to-total correlation after deleting those items. Construct reliability of the scale was estimated through the Cronbach coefficient alphas. Table 2 lists the scale items, the item-total correlations, the means, standard deviations, and coefficient alphas. Reliability analyses in Table 2 showed a high degree of internal consistency among research variables (Nunnally, 1978).

The measurement items for each variable were developed as follows. The practice of information sharing refers to the extent to which the chain members shared their private information about supply chain operations over time. Twelve items of information sharing were identified through review of previous studies (Lee and Whang, 2000) and a panel of experts. The level of usage of each item was assessed on a five-point Likert scale. Cues of the scale were never, seldom, sometimes, often, and always. Ten items remained on the scale after checking item-total correlation. Factor analysis confirmed that the ten items formed the information sharing scale. The reliability coefficient for information sharing was 0.86.

Decision synchronisation was operationalised as the degree to which the chain members become involved in joint decision making at the planning and operational levels. Twelve items of decision synchronisation were identified through review of previous studies and reviewed by a panel of experts. Each item was assessed on a five-point format.

The scale ranged from *never* to *always*. Nine items remained after checking item-total correlation. Factor analysis confirmed that the nine items formed the decision synchronization scale. The reliability coefficient for decision synchronisation was 0.88.

Table 2. Measurement for the three dimensions of collaboration

Items of the scale	Mean	Standard deviation	Item-total correlation	Alpha
The information sharing scale:	2.89	.75		
1. On promotional events.	3.69	1.02	.33	
2. On demand forecast.	2.91	1.12	.62	
3. On point-of-sales (POS) data.	2.55	1.27	.70	
4. On price changes.	2.04	1.17	.60	
5. On inventory holding costs.	1.88	1.09	.56	0.86
6. On on-hand inventory levels.	2.50	1.21	.67	
7. On inventory policy.	2.84	1.08	.72	
8. On supply disruptions.	3.46	.94	.66	
9. On order status or order tracking	3.37	1.22	.48	
10. On delivery schedules.	3.66	1.19	.36	
The decision synchronisation scale:	2.58	.80		
1. Joint plan on product assortment.	3.00	1.06	.45	
2. Joint plan on promotional events.	3.34	1.16	.58	
3. Joint development of demand forecast.	2.61	1.07	.73	
4. Joint resolution on forecast exceptions.	2.44	1.08	.66	0.88
5. Consultation on pricing policy.	1.93	1.17	.66	
6. Joint decision on availability level.	2.37	1.12	.67	
7. Joint decision on inventory requirements.	1.98	1.11	.75	
8. Joint decision on optimal order quantity.	2.51	1.19	.59	
9. Joint resolution on order exceptions.	3.01	1.05	.61	
The incentive alignment scale:	2.57	.79		
1. Joint frequent shopper programs.	2.25	1.32	.56	
2. Shared saving on reduced inventory costs.	2.19	1.19	.41	
3. Delivery guarantee for a peak demand.	3.65	1.03	.31	0.72
4. Allowance for product defects.	3.08	1.44	.45	
5. Subsidies for retail price markdowns.	2.38	1.34	.62	
6. Agreements on order changes.	1.84	.93	.38	

Incentive alignment was operationalised as the degree to which the chain members share costs, benefits, and risks of collaboration. There were twelve items of incentive alignment identified in this study based on the literature review and input from a panel of experts. A five-point Likert scale was used to assess the level of usage of incentive alignment. The scale ranged from *never* to *always*. Six items remained after checking item-total correlation. Factor analysis confirmed that the ten items formed the information sharing scale. The reliability coefficient for incentive alignment was 0.72.

Performance criteria were operationalised as the degree to which the chain members achieve better order fulfilment, inventory, and responsiveness as a result of collaboration. All responses were ranked from 1 to 5, 1 representing *poor performance* and 5 representing *excellent performance*. The scores on the core questions were used to construct indices measuring different performance levels. Fulfilment measures the extent to which the collaborative practice affects the ability of the chain members to achieve consumer delivery dates. The scale includes on-time delivery (i.e., the percent of all orders sent on or before the promised delivery date), accuracy (i.e., the percentage of the order which is correct), and fill rate (i.e., amount of an order that is filled as compared to the amount that is requested). The reliability coefficient for fulfilment was 0.77. Inventory measures the extent to which the collaborative practice affects inventory levels. This includes merchandise inventory turnaround, a decrease in inventory days-of-supply, and a decrease in inventory carrying cost. The reliability coefficient for inventory was 0.83.

Responsiveness measures the extent to which the collaborative practice affects lead-time and flexibility to accommodate demand changes. The reliability coefficient for responsiveness was 0.71.

Findings

This section presents findings from the survey that can be summarised into reasons for collaboration, patterns of collaborative achievement, and comparisons of collaborative practices between low and high performers.

Reasons for Collaboration

Respondents varied in reasons for collaboration. There were ten top reasons for respondents to establish close supplier-retailer relationships, in order of importance: increasing sales (80%), ensuring on-time delivery (76%), lowering inventory costs (74%), reducing out-of-stock (72%), creating accurate forecasts (53%), better return-on-investment (ROI) (50%), reducing obsolete inventory (49%), reducing lost sales (49%), cutting order cycle time (42%), increasing market shares (34%), and reducing markdowns (32%). Retailers were more concerned with out-of-stock, on-time delivery, sales, and inventory. On the other hand, suppliers focused on sales, on-time delivery, inventory, and accurate forecast. It appears that sales, on-time delivery, and inventory costs were the three top reasons for respondents to initiate collaboration.

Patterns of Collaborative Achievement

The achievement of collaborative relationship refers to the extent to which the chain members implement the collaborative practice that contributes to better performance. The distribution profile of the collaborative practice versus performance indicates to what extent the chain members realise the benefits of collaboration. To assess the position of each respondent in the profile, a collaboration index was developed as an average of the scores of three dimensions of collaboration (Simatupang and Sridharan, 2003). Similarly, the performance index represents the average of fulfilment, inventory, and responsiveness. The profile of collaboration index versus performance index shows how the collaborative practice contributes to the achievement of performance.

Figure 2 indicates a distribution of results on the collaboration index and performance index (a scatter graph). Interestingly, the correlation between the collaboration index and the performance index was 0.85 and significant at the 1% level. The coefficient of determination was 0.736, which indicates that the collaboration index accounted for 74% in the variation of performance index. The correlations between the three dimensions of collaboration and performance criteria showed similar results. Information sharing correlated with fulfilment at 0.83, inventory at 0.58, and responsiveness at 0.56. Decision synchronisation had a 0.66 coefficient correlation with fulfilment, 0.66 with inventory, and 0.52 with responsiveness. Incentive alignment correlated with fulfilment at 0.56, inventory at 0.71, and responsiveness at 0.64. All correlations were significant at the 1% level. Furthermore, the result of analysis of variance showed that respondents who had a high collaboration index (more than 3) outperformed respondents with a lower collaboration index in terms of their performance index. This finding confirmed that respondents who have a higher degree of the collaboration practice were able to attain better performance.
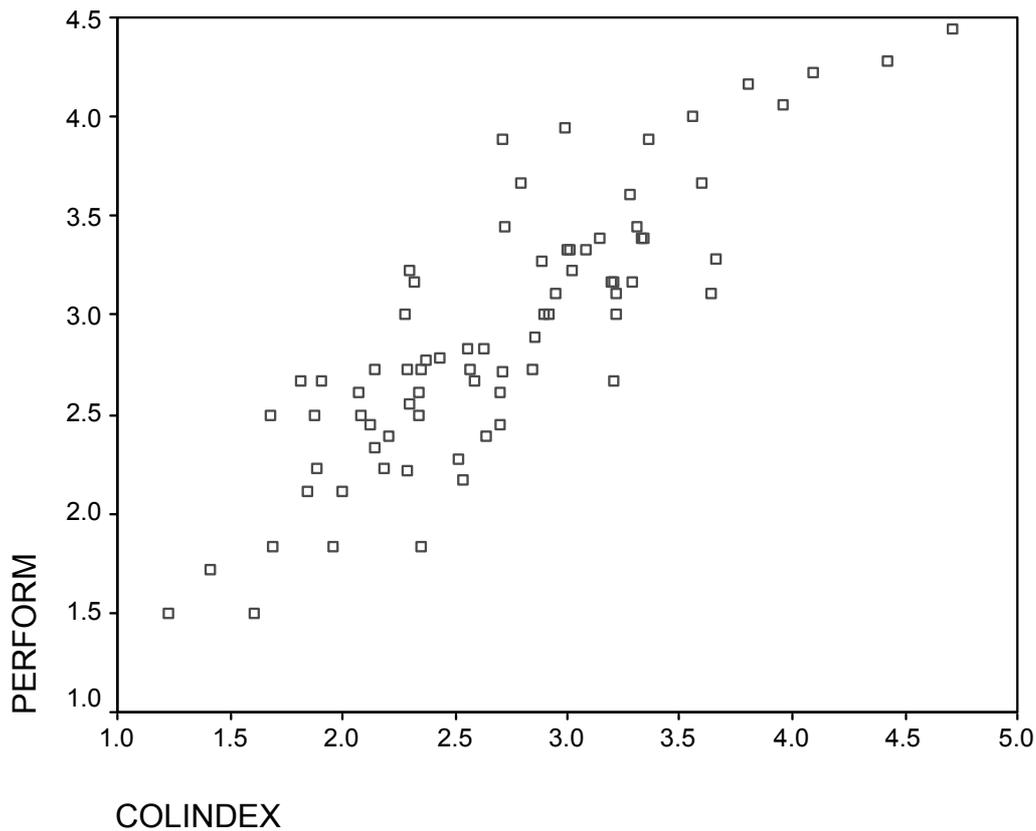
Figure 2. A scatter plot of collaboration index versus performance index

Based on the collaboration index and performance index, four types of collaboration can be identified as shown in Figure 3, namely synergistic, efficient, prospective, and underrating. A relatively large number of respondents truly achieved synergistic collaboration, a very small number had the potential to achieve this status, a small number had developed efficient collaboration, and another large group lagged behind in the race to achieve synergistic collaboration. This profile suggests that a large number of companies are attempting to develop their collaboration relationship and those who developed a high degree of collaboration were successful in attaining a higher level of performance.

		Collaboration Index	
		Low	*High*
Performance Index	*High*	Efficient Collaboration (maintain and extend)	Synergistic Collaboration (harvest and sustain)
	Low	Underrating Collaboration (develop and reengineer)	Prospective Collaboration (improve and leverage)

Figure 3. The collaboration-performance profiles

Synergistic collaboration: 23 respondents or about 30% from the survey reached the high mark on both the collaboration index and performance index (i.e. the score of 3 for

both indexes is a cut-off point for the high mark). These companies have adopted a range of best collaborative practices, resulting in a high level of operational performance.

Efficient collaboration: The results for this category were more disappointing: 14% or 11 companies reached a high level of performance with respect to collaboration. These respondents seem to have strong performance scores, but are vulnerable because they have achieved these without having established strong collaborative practices. This suggests that these respondents will be able to move into the synergistic collaboration category with some maintenance and extensions.

Prospective collaboration: In this group, only 3% of the sample have developed a strong set of collaborative practices, but are not yet attaining better operational performance. These respondents could expect to improve their performance in the future. They need to transfer the high level attained on the collaborative index into better operational results through learning acceleration and continuous improvement.

Underrating collaboration: 53% of respondents occupy the lowest position on both the collaboration index and the performance index compared to other respondents. These companies seem to be in an unfavourable position, but they have the potential to identify their shortcomings and develop collaborative practices to move to the category of synergistic collaboration.

Comparisons of Low and High performers
This section attempts to benchmark the collaborative practices that drive high performance. The responses were listed in ascending order according to their ranking on the performance index. The respondents with an index of more than 3 were classified as high performers and those with an index below 3 as low performers. Statistical tests showed that the score 3 was a significant cut-off value for differentiating low and high performers ($p < .01$). This classification enabled one to compare the collaborative practices of high performers with those of low performers. Collaborative practices in the areas of information sharing, decision synchronisation, and incentive alignment were compared between low and high operational performers as follows.

Mean differences in the practices of information sharing, decision synchronisation, and incentive alignment between high and low performers are shown in Tables 3 to 5. The mean difference of collaborative practice appearing in the first column was the mean of high performers minus low performers under different operational performance criteria. The *t*-test of equality of means was used to check the significance of the mean differences of collaborative practices between low and high performers.

As shown in Table 3, the high performers practised all types of data sharing compared to low performers in attaining fulfilment performance, except on order status. This indicated that the sample shared data on order status with mean 3.37 evenly regardless of low or high fulfilment performance. Order status appeared as a common requirement for respondents in order fulfilment. Both suppliers and retailers placed similar importance on data exchanges concerning promotional events, demand forecasts, POS, price changes, inventory costs, inventory levels, inventory policy, supply disruptions, and delivery schedules.

In the case of inventory performance, high performers had greater reliance on sharing data about promotional events, demand forecasts, POS, price changes, inventory costs, and inventory levels. Among these practices, high performing suppliers placed more importance on sharing promotional plans, demand forecasts, and POS. This indicated that suppliers needed these data to enable them to deploy inventory. Furthermore, retailers with high inventory performance exchanged more data on inventory costs and inventory policy. These two data are important for determining ordering decisions, which minimised inventory levels. Finally, both suppliers and retailers with high performance exchanged more data on price changes and inventory levels compared to low performers. Both types

of respondents appeared to agree on the importance of data on price and inventory levels in managing inventory.

Table 3. Differences in the use of information sharing practices between high and low performers

| Information Sharing Practices | Performance Criteria | | | | | | | | |
| | Fulfilment | | | Inventory | | | Responsiveness | | |
	S	R	A	S	R	A	S	R	A
1. On promotional events.	1.35 ***	1.07 ***	1.13 ***	1.22 ***	.47 -	.91 ***	.87 **	.86 ***	.88 ***
2. On demand forecasts.	1.64 ***	1.39 ***	1.60 ***	.58 *	-.17 -	.55 **	.49 -	.68 **	.65 **
3. On points-of-sale (POS).	1.25 **	1.61 ***	1.46 ***	1.07 **	.05 -	.86 ***	1.32 **	1.04 ***	1.23 ***
4. On price changes.	1.34 **	1.02 ***	.98 ***	1.01 **	1.05 **	.87 ***	1.28 **	.53 -	.88 ***
5. On inventory costs.	.87 ***	.99 **	1.13 ***	.42 -	1.08 **	.91 ***	.84 **	.75 *	.86 ***
6. On inventory levels.	1.56 ***	.67 *	1.26 ***	.86 **	1.03 **	1.06 ***	.69 *	.38 -	.59 **
7. On inventory policy.	1.06 ***	.87 **	.95 ***	-.24 -	.87 *	.27 -	.59 -	.86 **	.76 ***
8. On supply disruptions.	.78 **	.68 **	.76 ***	.51 -	.42 -	.54 -	.72 **	.20 -	.48 **
9. On order status.	.47 -	-.08 -	.38 -	.17 -	-.31 -	.17 -	.50 -	.47 -	.52 *
10. On delivery schedules.	.73 *	.62 *	.79 ***	.64 -	.45 -	-.30 -	.45 -	.46 -	.49 *

Note: S = supplier, R = retailer, A = aggregate, * $p < .10$, two-tailed test; ** $p < .05$, two-tailed test, *** $p < .01$, two-tailed test, - Not statistically significant.

In terms of responsiveness, the sample with high responsiveness significantly carried out all information sharing practices (see the responsiveness column in Table 3). Table 3 also shows that retailers with high responsiveness emphasised exchanges on demand forecasts and inventory policy to create better responsiveness. Suppliers with high responsiveness relied on data about price changes and supply disruptions. Both types of respondents with high responsiveness seemed to practise data exchanges on promotional events, POS, and inventory costs in order to enable them to improve responsiveness.

Table 4 shows mean differences in the practices of decision synchronisation between high performers and low performers. The respondents with high fulfilment performance conducted all decision synchronisation practices significantly compared to low performers. Suppliers with high fulfilment performance were keen to practise joint decisions on product planning, safety stock requirements, and resolution on order exceptions. This indicated that upstream members were more concerned with cooperating on the supply side to ensure reliable fulfilment. On the other hand, retailers with high fulfilment performance carried out joint decisions on order quantity, which help them to attain better fulfilment. Both types of respondents agreed on the importance of joint decisions on promotional events, demand forecasts, forecast exceptions, pricing policy, and availability targets.

In the case of inventory performance, high performers conducted all decision synchronisation practices significantly compared to low performers except for joint planning on product assortment. Suppliers with high inventory performance placed more emphasis on co-promotional plans and consultation on pricing policy, whereas retailers with high inventory performance significantly made joint decisions on availability target

to reduce inventory levels. It appeared that retailers were interested in serving end customers better with respect to availability. Joint development of demand forecasts, joint resolution on forecast exceptions, joint decisions on safety stock requirements, joint decisions on optimal order quantity, and joint resolutions on order exceptions were outlined as most important for both types of respondents.

Table 4. Mean differences in the use of decision synchronisation practices between high and low performers

Decision Synchronisation Practices	Performance Criteria								
	Fulfilment			Inventory			Responsiveness		
	S	R	A	S	R	A	S	R	A
1. Joint plan on product assortment.	1.44 ***	.31 -	.85 ***	.62 -	-.28 -	.28 -	.43 -	.21 -	.22 -
2. Joint plan on promotional events.	1.04 ***	.68 *	.81 ***	1.14 ***	.59 -	.82 ***	1.00 **	.68 *	.73 ***
3. Joint development of demand forecast.	1.17 ***	.73 **	1.17 ***	.56 *	.98 **	.88 ***	.76 **	.84 ***	.86 ***
4. Joint resolution on forecast exceptions.	.88 ***	.94 ***	1.05 ***	.54 *	.72 *	.75 ***	.81 **	.95 ***	.95 ***
5. Consultation on pricing policy.	.84 *	.68 *	.58 **	1.15 ***	.66 -	.87 ***	.62 -	.26 -	.44 -
6. Joint decision on availability level.	1.01 **	.68 *	.92 ***	.40 -	.89 *	.57 **	1.08 ***	1.00 ***	1.08 ***
7. Joint decision on safety stock requirements.	.91 **	.42 -	.78 ***	.86 ***	1.37 ***	1.13 ***	.91 **	.31 -	.57 **
8. Joint decision on optimal order quantity.	.45 -	.73 *	.58 **	.71 **	1.42 ***	1.03 ***	.49 -	.42 -	.34 -
9. Joint resolution on order exceptions.	.68 *	.42 -	.82 ***	.65 *	.73 *	.82 ***	1.14 ***	.31 -	.65 ***

Note: S denotes supplier, R denotes retailer, A denotes aggregate, * $p < .10$, two-tailed test; ** $p < .05$, two-tailed test, *** $p < .01$, two-tailed test, - Not statistically significant.

In terms of responsiveness, there were significant differences between high and low performers on promotional plans, demand forecasts, demand exceptions, availability targets, safety stock requirements, and order exceptions for creating a high level of responsiveness. However, the sample had no preferences on joint decisions on product planning, pricing policy, and optimal order quantity. Suppliers with a high level of responsiveness were seen to be more cooperative with regard to safety stock requirements and resolution on order exceptions. These practices appeared to enable suppliers to improve responsiveness because they knew the target service level and how to handle order exceptions. Both types of respondents appeared to agree on the importance of joint decisions on promotional events, demand forecasts, forecast exceptions, and availability targets.

Table 5 shows mean differences in the practices of incentive alignment between high performers and low performers. Overall, respondents emphasised the importance of joint promotional efforts, shared saving on lowered inventory costs, allowance for product defects, subsidies for markdowns, and order flexibility in their efforts to improve fulfilment. Retailers placed more emphasis on subsidies for markdowns. It appeared that retailers need risk sharing due to the decline in retail prices. On the other hand, suppliers were more concerned about shared savings from lowered inventory, delivery guarantee for a peak demand, and allowance for product defects. This indicated that suppliers carefully developed their supply capability for creating better fulfilment.

High performers carried out all incentive alignment practices significantly to attain better inventory performance. Similarly to the case of fulfilment performance, suppliers

significantly conducted arrangements on shared savings of lowered inventory costs, delivery guarantee on peak demand, and allowance for product defects to improve inventory performance. According to both suppliers and retailers, more importance was placed on joint promotional efforts, subsidies for markdowns, and order flexibility in their efforts to reduce inventory.

Table 5. Differences in the use of incentive alignment practices between high and low performers

Incentive Alignment Practices	Performance Criteria								
	Fulfilment			Inventory			Responsiveness		
	S	R	A	S	R	A	S	R	A
1. Joint frequent shopper programs (co-promotions).	1.78 ***	1.46 ***	1.45 ***	1.17 ***	1.64 ***	1.24 ***	1.28 **	.92 **	1.10 ***
2. Shared saving on reduced inventory costs.	1.28 ***	.11 -	.83 ***	.89 **	.69 -	.88 ***	1.56 ***	.35 -	.96 ***
3. Delivery guarantee for a peak demand.	.53 *	.28 -	.28 -	1.02 ***	.15 -	.54 **	.75 **	-.09 -	.29 -
4. Substitution for product defects.	.96 **	.36 -	.56 *	1.28 ***	.58 -	.86 **	1.12 **	.66 -	.87 ***
5. Subsidies for retail price markdowns.	.76 -	.71 *	.57 *	1.57 ***	.91 *	1.11 ***	1.19 **	.53 -	.83 **
6. Agreements on order changes.	.88 **	.76 **	.85 ***	.54 **	.56 *	.62 ***	.52 -	1.03 ***	.81 ***

Note: S = supplier, R = retailer, A = aggregate, * $p < .10$, two-tailed test; ** $p < .05$, two-tailed test, *** $p < .01$, two-tailed test, - Not statistically significant.

In terms of responsiveness, high performers significantly carried out all incentive alignment practices to attain high responsiveness - except for delivery guarantee. However, suppliers significantly conducted arrangements on shared savings of lowered inventory costs, delivery guarantee on peak demand, allowance for product defects, and subsidies for retail price markdowns to improve responsiveness. It appeared that suppliers considered markdowns in their efforts to improve responsiveness in reacting to demand changes. Retailers put emphasis on order flexibility for increasing responsiveness. This indicated that they required flexibility to respond to demand changes.

Managerial Implications
Supply chain collaboration has increasingly gained popularity in recent years as companies have sought new ways to improve operational performance. It appears that suppliers and retailers will continue to actively develop close collaborative efforts to effectively meet customer needs. This research confirmed that supply chain collaboration enables the chain members to attain better performance. It thus has important managerial implications. First, the concept of supply chain collaboration helps to explain how chain members with strong collaboration are often able to gain better performance than their competitors. These chain members are quite willing to develop collaborative practices in information sharing, decision synchronisation, and incentive alignment to improve fulfilment, inventory, and responsiveness. However, the chain members need to modify and tailor the items of collaborative practices that suit their unique circumstances and to conduct regular surveys to provide up-to-date benchmarking data.

Second, the scatter plot shows that companies differed in their relative position both in the collaboration index and in the performance index. Four collaboration-performance profiles were identified: efficient, underrating, prospective, and synergistic. This finding implies that the use of a scatter plot enables the chain members to recognise their profile and assess the performance of their collaborative efforts. They need to

respond to an unfavourable profile by finding ways to reach a favourable position such as identifying which practices need attention for further improvement.

Third, the research highlights the items of collaborative practices that drive operational performance. Suppliers and retailers differed in the degrees of importance which they accorded to collaborative practices that differentiate between high and low performance. For example, suppliers were more concerned with the upstream side of the supply chain. This implies that a company needs to understand the differing priorities of the various members of the supply chain. The reality is that collaborative efforts add costs and bring benefits differently to the chain members. Therefore, benchmarking data enables the chain members to understand each others' concerns and find effective solutions that benefit all parties.

Finally, the research emphasises the importance of collaborative efforts in attaining better performance. This benchmarking study showed that there are different expectations from collaborative practices amongst the chain members. To increase the probability of acceptance, suppliers do not create collaborative efforts in isolation but only after intimate discussion with their retailers. They need to share concerns in order to clearly set objectives and devise plans to achieve those objectives. Management from both parties must put together an integrated strategy in order to initiate improvement in specific collaborative practices. Improving collaborative practices would lead to better performance in fulfilment, lowered inventory, and responsiveness.

Conclusions

This paper provided a benchmarking study on supply chain collaboration that incorporated conceptualisation of supply chain collaboration and survey results. Supply chain collaboration was characterised into three dimensions, namely information sharing, decision synchronisation, and incentive alignment. It is argued that the three dimensions contribute to the attainment of better operational performance. Survey instruments were developed based on this concept and sent to a sample of New Zealand companies. There were 76 valid responses, which provided a 21% response rate. The survey results indicated that sales, on-time delivery, and inventory reductions were the top three reasons for establishing collaboration.

A collaboration index was introduced to represent the level of collaborative practices in information sharing, decision synchronization, and incentive alignment. A correlation analysis confirmed that a higher level of collaboration index means a higher level of operational performance. This suggests that respondents who had a higher collaboration index were able to achieve better operational performance. Furthermore, based on the collaboration index and performance index, this study identified four profiles of collaboration: efficient, underrating, prospective, and synergistic. This profile provides benchmark data for practitioners to identify their collaboration positions on the scatter plot.

The paper also empirically shows the benchmarking data on the collaborative practices that differentiate between high and low performers. These practices can be seen as enablers for creating better operational performance. Overall, respondents perceived the importance of information sharing with regards to promotions, demand forecasts, POS, price changes, inventory costs, inventory levels, inventory policy, supply disruptions, order status, and delivery schedules to improve responsiveness. When becoming involved in decision synchronisation, suppliers were more concerned with the supply side of the chain such as product assortment, joint plan on promotional events, safety stock requirements, and order exceptions. A similar conclusion also occurred with suppliers who placed emphasis on shared incentives, were more concerned with upstream improvements of the chain such as reduced inventory costs, reduced product defects, and delivery guarantee during peak demand. This finding demonstrates that the best practices

of collaboration have different degrees of importance perceived by suppliers and retailers in attaining better operational performance. There is plenty of room for improving opportunities if the chain members share concerns and see the complementary effect of the three dimensions of collaboration. It therefore makes more sense to consider all three dimensions when creating a collaborative relationship.

This study contributes to the benchmarking of joint practices among chain members in improving their operational performance. Three contributions to the literature on supply chain collaboration result from this study. First, the study proposed and tested the three dimensions of supply chain collaboration: information sharing, decision synchronization, and incentive alignment. Second, the study showed that there is a significant correlation between a collaborative index and a performance index. Therefore, it is recommended that collaborative efforts amongst the chain members should be encouraged in order to improve operational performance. Third, as the chain members varied in their perception of the importance of collaborative practices that differentiate between high and low performers, it is recommended that the chain members should create a dialogue mechanism that encourages discussion on improving the most important practices that support the achievement of better performance. The contribution of this study thus provides useful managerial insights into the improvement of collaborative practices in the supply chain.

Although multiple items were used in this study, the operationalisation of the three dimensions and performance criteria can be expanded based on focus groups or case studies. For example, information sharing in this study was limited to operational data. New items can be generated to include exchanges of financial data, market data, and other costs related data. Performance criteria can also be extended to incorporate the financial impacts of collaboration. Some of these issues will be addressed in the future research on supply chain collaboration.

Acknowledgement

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