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The impact of information sharing in supply chains on organisational performance: an empirical study

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Information sharing has been cited as one of the major means to enhance supply chain performance. It allows companies to better coordinate their activities with their supply chain partners that lead to increased performance. This study conceptualises and assesses several factors that influence the degree of information sharing in supply chains, namely integrated information technologies, internal integration, information quality and costs–benefits sharing. The relationship between the degree of information sharing and organisational performance is then tested. Data from 150 manufacturing companies were collected and proposed relationships are examined using structural equation modelling. The results show that integrated information technologies and information quality have positive influence on the intensity of information sharing. However, internal integration and costs–benefits sharing do not relate to the intensity of information sharing. This study finds that information sharing does not directly relate to organisational performance. Its relationship is mediated by collaboration practices with supply chain partners. This suggests that information sharing is essential but insufficient by itself to bring significant performance improvements.

Keywords: information sharing; supply chain management; factor analysis; path analysis; structural equation modelling

1. Introduction

Supply chain management (SCM) theory suggests that close coordination between supply chain partners is required to sustain competitiveness. Companies cannot survive alone; they need to operate closely with their partners and leverage their partners' capabilities to secure cost reductions, increase quality (Fisher 1997, Handfield and Nichols 2002) and develop a sustainable competitive advantage for the whole supply chain (Lewis 1995, Ross 2002, Taylor 2003).

Growing demand for ever higher level of service and quality requires companies to be more responsive and flexible (Christopher 1992) while still maintaining competitive costs. This can best be achieved through close and effective coordination with all members of supply chains (Mentzer 2004). The basic foundation for close coordination and collaboration in supply chains is information sharing amongst supply chain members (Lee 2000). Rashed *et al.*'s (2010, p. 61) research shows that 'information sharing is a prerequisite for knowledge sharing and the close buyer-supplier relationship is a vital factor for

escalating the supplier's operational performance'. Information provides linkages amongst members of a supply chain that can be used to synchronise all activities across the supply chain. For example, information sharing can increase supply chain efficiency by reducing inventories and smoothing production. A study by Lewis (2006) examined how information sharing affects outsourcing performance in a supply chain. She finds a significant relationship between information sharing and outsourcing performance.

Advances in information technology (IT) provide many opportunities for companies to achieve seamless integration with their supply chain partners at relatively low cost (Huang *et al.* 2003, Siau and Tian 2004). A wide range technologies are now available (e.g. radio frequency identification, electronic data interchange (EDI), the Internet, wireless application protocol, mobile computing and extensible mark-up language) to all members of a supply chain however, the major challenge for many companies along the supply chain relates to the integration of the technologies and information sharing. The real question is deciding what

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information to share, appropriate mechanisms for sharing, and how to better exploit information to stay competitive.

Although anecdotal evidence supports the benefits of information sharing in supply chains (Lee *et al.* 2000, Yu *et al.* 2001), empirical research establishing the relationship between information sharing and performance is scarce. Especially lacking is research on how information sharing relates to firm performance and what factors affect the degree of information sharing in supply chain. Hence, the overall research question addressed in this research is: 'What is the impact of information sharing on organisational performance?'

More specifically, we are interested in the following research questions:

(a) What is the relationship between the intensity of information sharing and supply chain collaboration practices?
(b) What is the relationship between supply chain collaboration practices and organisational performance?
(c) What is the relationship between the intensity of information sharing and organisational performance?
(d) What is the relationship between integrated information technologies (IITs), internal integration practices, costs and benefits sharing, and information quality and information sharing?
(e) What is the relationship between internal integration practices and IITs and supply chain integration?

Relevant literature relating to the above questions is reviewed in Section 2 which presents the conceptual framework for our study and the development of the detailed research hypotheses. Section 3 presents the empirical research design and the development of the survey instrument. Section 4 presents the data analysis including data reduction, measurement validation and the analysis of the results of the structural model, followed by Section 5 which presents the discussion of the findings. Section 6 concludes this article with several major conclusions drawn from the research, some general practical implications and suggestions for future research.

2. Literature review: development of the conceptual framework and hypotheses

In this section, the relevant literature is reviewed in developing the detailed research hypotheses relating to the research questions outlined in the previous section. A conceptual framework is first proposed that posits a relationship between the intensity of information sharing and organisational and supply chain factors and its impact on organisational performance (Figure 1). This conceptual framework identifies several variables that predict the intensity of information sharing including IITs, internal integration practices, costs and benefits sharing, and information quality. It also posits the relationship between the intensity of information sharing and organisational performance. The collaboration practice is hypothesised to mediate the relationship between information sharing and organisational performance.

This study is unique in that it differentiates itself from previous studies by simultaneously examining the factors influencing the intensity of information sharing and how information sharing impact on organisational performance.

The following subsections describe each of the variables or constructs in the research framework, followed by the development of hypotheses.

2.1. *Information intensity and information quality*

Information intensity refers to the extent to which firms share a number of distinct types of information with their partners (Barut *et al.* 2002, Cai *et al.* 2006). Chopra and Meindl (2004) categorised information that flow across a supply chain into supplier information, manufacturer information, distributor and retailer information and demand or customer information. Huang *et al.* (2003) sort information into six categories pertaining to product, process, resource, inventory, order and planning. Lee and Whang (2000) discuss various types of shared information and their potential benefits. For example, sharing order status can improve the quality of customer service, reduce payment cycles and reduce labour cost. Sharing retail sales data can mitigate the bullwhip effect.

Following Barut *et al.* (2002), this research measures information sharing with suppliers and customers. Information sharing with suppliers consists of two flows of information: information that a company receives from its suppliers and information that a company provides to its suppliers. Similarly, information sharing with customers comprises two flows: information that a company receives from its customers and information that a company provides to its customers.

The quality of information is critical in information sharing. While the benefits of information sharing have been well documented, its value can only be realised if
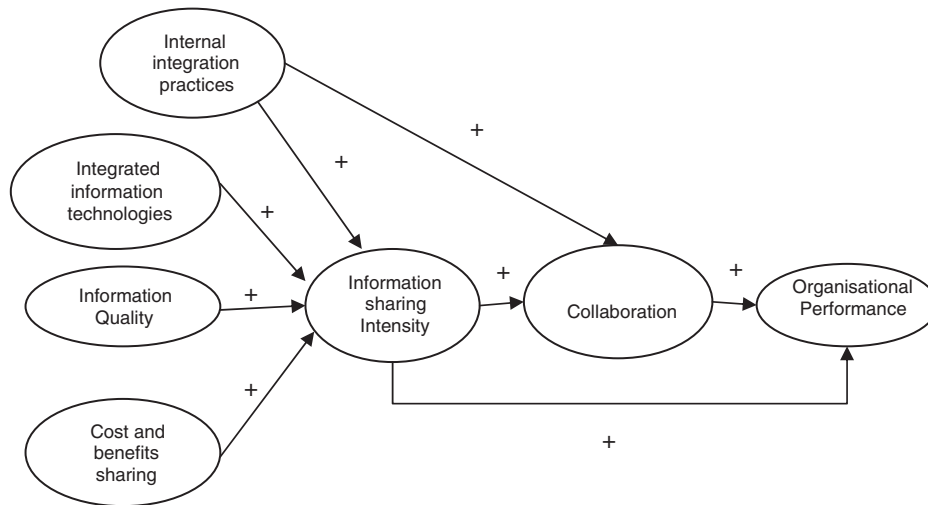
Figure 1. Research framework.

the shared information is of good quality (Moberg *et al.* 2002). The real power of information only becomes evident when the information can be used throughout supply chains (Mason-Jones and Towill 1997). Information quality refers to the degree to which the shared information meets the need of organisations (Petersen 1999). This encompasses several aspects including accuracy, timeliness, adequacy and reliability of information (Li and Lin 2006).

Several studies have provided empirical evidence about the importance of information quality in SCM. Extant research in supply chain has proved that delayed and distorted information creates severe problems in supply chains (Forrester 1958, Lee *et al.* 1997, Childerhouse *et al.* 2003). This distorted information can be damagingly propagated when it moves up the supply chain. Kulp (2002) examined the effect of information precision on the buyer–supplier relationship based on vendor managed inventory and found that the benefits of information sharing depend on the accuracy, precision and reliability of shared information. Larson and Kulchitsky (2000) empirically tested that timely and accurate information makes for closer buyer–supplier relationship and information quality has a direct impact on performance. Petersen *et al.* (2005) found that information quality has a direct impact on collaborative planning. Moberg *et al.* (2002) and Li and Lin (2006) found that increased quality of shared information increases the degree of information sharing between companies. Perceived quality of information will increase partners' willingness to share more information (Whipple *et al.* 2002), as providing the right information is often seen as a sign

of trustworthiness (Dyer 1997). Thus, the above arguments lead to our first hypothesis:

Hypothesis 1: There is a positive relationship between information sharing quality and the intensity of information sharing.

2.2. *Costs and benefits sharing*

Costs and benefits sharing refer to ensuring that all members of the supply chain share costs and benefits appropriately. Studies on information sharing have reported that the costs and benefits of information sharing are not enjoyed equally by all partners. Yu *et al.* (2001) found that manufacturers gained more benefits than their retail partners. Similar observations were made by Bourland *et al.* (1996), Simchi-Levi and Zhao (2003) and Småros *et al.* (2003). Clark and Hammond (1997, p. 250) reported that 'Retailers generally acknowledged that providing this additional information to manufacturers would offer some savings to the manufacturers, but many retailers were sceptical about the benefits for their firms in sharing information with manufacturers'. Unbalanced distribution of benefits will obviously discourage some partners to share information.

Information sharing entails costs of implementing the required technology and acquiring the necessary resources. Corsten and Kumar (2003) reported that some companies perceived that their partners did not spend as much as they did. This perception often leads to perceived inequality in the return from information sharing partnerships (Corsten and Kumar 2005). Frohlich (2002) found that costs are significant

impediments for integration, both for buyers and suppliers. Companies need to devise clear agreements on how to cope with costs and risks of information sharing. These observations suggest the following hypothesis:

Hypothesis 2: There is a positive relationship between costs and benefits sharing and the intensity of information sharing.

2.3. *Integrated information technologies*

Following Vickery *et al*. (2003), IITs comprise technologies that facilitate seamless flow of relevant information within a company and with its partners. These include computerised production systems (Perry and Sohal 2000), integrated information systems (Kelle and Akbulut 2005) and EDI or the Internet (Li *et al*. 2005).

The rapid development of IT has been widely acknowledged as a driver of SCM (Spekman *et al*. 1998, Simchi-Levi *et al*. 2003). IT enables many organisations to integrate with their supply chain partners (Li *et al*. 2006) and may facilitate the establishment of a virtual integrated supply chain as has been exemplified by Dell (Magretta 1998). IT has enabled real-time, online communication that links all member of a supply chain from suppliers, manufacturers, distributors, retailer and ultimately the customers, regardless of the location (Handfield and Nichols 2002). The central theme in SCM is collaboration amongst members that requires a large amount of data/information exchange. IT allows companies to improve the information processing capabilities required to share information with their partners. IT serves as the backbone of the supply chain business structure which is used to acquire, process and transmit information amongst supply chain members for better decision-making (Sanders and Premus 2002).

In the context of information sharing, integrated IT is essential to achieving effective information sharing (Lee and Whang 2000). Integrated IT can help companies provide accurate information in a timely manner, and exploit the shared information in effective decision-making (Whipple *et al*. 2002). This enables companies to better coordinate their supply chain activities with their partners (Garcia-Dastugue and Lambert 2003). Lack of integrated IT can inhibit companies' participation in information sharing partnerships (Stefansson 2002). Inadequate and fragmented IT makes it difficult for companies to exploit knowledge of shared information from their

partners (Siau and Tian 2004). Based on the above discussion, the following hypothesis is proposed:

Hypothesis 3: There is a positive relationship between IITs and the intensity of information sharing.

2.4. *Internal integration practices*

Bowersox *et al*. (2003) define internal integration as linking internally performed work into a seamless process to support customer requirements. Kahn and Mentzer (1996, p. 9) define internal integration as 'a process of interdepartmental interaction and interdepartmental collaboration that brings departments together into a cohesive organization'. Internal integration goes beyond just formal interaction between departments; instead it should be based on collaboration characterised by mutual understanding and a common vision, sharing resources and achieving common goals. Internal integration is characterised by the use of cross-functional teams, high degrees of information sharing and knowledge transfer amongst functions (Mentzer 2004, Gimenez and Ventura 2005). A study of multi-national enterprises based in Malaysia by Sambasivan and Jacob (2008) shows that amongst other practices, improving the efficiency of operations has a significant impact on the competitive position of the company.

To achieve internal integration, the right culture for collaboration needs to be established. Performance management system should be aligned with a common goal in order to encourage collaborative work and avoid conflicting objectives amongst departments (Stank *et al*. 1999). Standardisation of all management procedures and activities is also required to facilitate synchronisation of operations, avoid redundancy and eliminate islands of analysis (Bowersox *et al*. 2003, Droge *et al*. 2004).

Internal integration is as critical in SCM as the basic tenet of SCM philosophy in achieving business process integration both internally across each company and across the whole supply chain (Cooper *et al*. 1997). Internal integration must be well-established before companies integrate with external parties (Stevens 1989, Handfield and Nichols 2002). Successful SCM presumes internal integration and external integration to be in place, but neither of them is sufficient in itself to having a successful supply chain (Min 2001). Lack of internal integration can create inefficiency and inhibit the seamless flow of materials and products across departments that will in turn negatively affect customer service (Mentzer 2004).

Internal integration is one of the prerequisites to achieving external collaboration with supply chain

partners (Mentzer *et al.* 2000, Barratt 2004). Collaboration with partners requires inter-company integration exemplified by free flow of information amongst collaborative partners. Lack of internal integration becomes the biggest obstacle to translating the collaborative activities into operational efficiency. Lee and Whang (2000) argue that lack of internal integration is one of the obstacles in achieving effective information sharing. Various researchers have reported significant positive correlation between internal integration and external integration (see e.g. Stank *et al.* 1999, Gimenez and Ventura 2003, 2005, Eng 2006). Thus, the following hypotheses are proposed:

Hypothesis 4: There is a positive relationship between internal integration practices and the intensity of information sharing.

Hypothesis 5: There is a positive relationship between internal integration practices and collaboration practices

2.5. Collaboration practices

The central tenet of effective SCM is collaboration amongst supply chain members. The fundamental belief is that a company cannot compete by itself (Min *et al.* 2005). Collaboration is considered as one of the core capabilities that companies need in order to remain viable in the current business environment (Bowersox *et al.* 2000). Simatupang and Sridharan (2002, p. 19) define collaboration in the supply chain context as 'two or more independent companies working jointly to plan and execute supply chain operations with greater success than when acting in isolation'. Vickery *et al.* (2003) identified that collaboration encompasses supplier partnering and customer relationship. Accordingly, Bowersox *et al.* (2003) specify that collaboration comprises integration with suppliers and customers. Following Li *et al.* (2006), this research particularly categorises collaboration into strategic supplier partnering and customer relationship management.

Li *et al.* (2006) define strategic supplier partnership as the long-term relationship between the company and its suppliers, that is designed to leverage the strategic and operational capabilities of individual participating organisations to help them achieve significant, ongoing benefits. The partnership often entails involving suppliers in product development and joint problem solving through accessing superior technological capabilities (Simatupang and Sridharan 2002, Droge *et al.* 2004).

Customer relationship management comprises activities and management practices aimed at building long-term relationship with customers, managing customer complains and improving customer satisfaction (Li *et al.* 2006). A characteristic of customer relationship is proactively determining customer requirements and committing to meet those requirements. Close relationships with customers can generate a distinctive competitive advantage (Droge *et al.* 2004). An example in this respect is Dell that can deliver more customised products to its customers through close collaboration (Magretta 1998).

Information sharing is the basis for effective collaboration in a supply chain (Lee 2000, Bowersox *et al.* 2003, Barratt 2004, Mentzer 2004). Although many researchers have reported that information sharing can increase supply chain performance (Ince and Çemberci 2011), firms need to implement collaborative supply chain initiatives (e.g. Vendor Manage Inventory and joint decision-making) to achieve increased supply chain performance (Lee 2000, Barratt 2004). The study of Kulp *et al.* (2004) on the benefits of information sharing for manufacturers shows that the best performing firms not only share information with their partners but also work closely with them to achieve superior performance derived from activities such as collaborative planning and collaborative product development.

The increased availability of information along a supply chain allows firms to better coordinate their activities with their partners leading to better performance for both the supply chain as a whole and its constituent firms (Lee 2000, Lee and Whang 2000, Simchi-Levi *et al.* 2003). Many researchers provide evidence that sharing information such as order, demand and inventory can improve the performance of the supply chain and firms. For example, Lin *et al.* (2002) observed, through a simulation study, that with more detailed information shared between firms, the result was higher reduction in total supply chain cost.

The above arguments lead to the formulation of the following hypotheses:

Hypothesis 6: There is a positive relationship between information sharing intensity (ISI) and collaboration practices.

Hypothesis 7: There is a positive relationship between ISI and organisation performance.

Hypothesis 8: There is a positive relationship between collaboration practices and organisation performance.

These above hypotheses are tested through a quantitative study involving a questionnaire survey as discussed below.

3. Methodology

This section describes the data collection procedure and the measurements used in the operationalisation of the key constructs.

3.1. *Data collection and respondents profile*

Data were collected through mail and Internet surveys targeted at managers and other senior executives responsible for SCM. The sample used was randomly selected from the list of Australian manufacturing companies in 'Business Who's Who Australia' and from the membership database of the Supply Chain and Logistics Association of Australia. From a total sample size of 1510 organisations that were sent the questionnaire, a total of 150 usable responses were received, a response rate of 9.9%.

The low response rate occurred probably due to a common case in organisational-level studies involving surveys (Li *et al.* 2006) where executives receive many requests to participate. The fact that the survey instrument covers a wide range of areas may also contribute to the low response rate. However, the composition of respondents was representative enough as depicted in Table A3.

Non-response bias was tested by comparing the data from the companies who responded early with those who responded late (Armstrong and Overton 1977). The chi-squared statistics did not show any significant difference between the two groups.

3.2. *Measurements*

All items used to build the scale used in this study were developed based on the literature review of conceptual studies as well as empirical studies in the relevant areas. *Intensity of information sharing* measures the extent to which a number of distinct types of information flow between a company and its suppliers and customers (Cai *et al.* 2006). According to Barut *et al.* (2002), there are a number of distinct types of information that flow from and to both customers and suppliers as depicted in Figure 2. Therefore, information intensity comprises four dimensions: information provided to suppliers, information received from suppliers, information provided to customers and information received from customers.

The items measuring these four flows of information were derived from various past studies including: Cannon and Perreault (1999), Moberg *et al.* (2002), Simatupang and Sridharan (2005), Cai *et al.* (2006), Vereecke and Muylle (2006) and Patnayakuni *et al.* (2006). The measures for *costs and benefits sharing* were
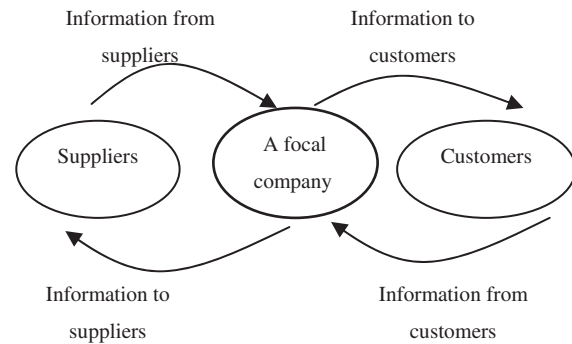

Figure 2. Four flows of information.

drawn from analytically based research on information sharing in supply chains and theoretical literature (Gavirneni *et al.* 1999, Lee *et al.* 2000, Yu *et al.* 2001). The complete list of the items used to measure each of the constructs is depicted in Table A1. Also shown in this appendix is the set of measures used for measuring organisational performance representing market and financial performance, cost performance and delivery performance.

4. Data analysis

4.1. *Data reduction process*

Data reduction was aimed to collapse all measurement items into their respective construct. All constructs were subjected to validity and reliability tests before a composite score can be calculated to represent each construct. Following Ahire and Devaraj (2001), the validity was assessed using exploratory factor analysis (EFA) using principal component analysis with varimax rotation. The Kaiser–Meyer–Olkin measure of sampling adequacy (Kaiser 1970, 1974) and the Barlett test of sphericity (Bartlett 1954) were used to assess the suitability of the sample for principal component analysis. The reliability test was conducted using Cronbach's alpha coefficient. The results of this procedure are presented in Table A1.

Having met the requirements of the validity and reliability tests, the composite measure of each construct was then computed using their mean values (Bobko *et al.* 2007).

4.2. *Analysis of the structural model and hypotheses testing*

The research framework (Figure 1) was analysed using the structural equation model (SEM) in AMOS 7. The goodness-of-fit indices (GFIs) of the SEM model

yielded a moderate good fit. The values of standardised root mean square residual (SRMR) and root mean square error of approximation (RMSEA) were 0.06 and 0.07, respectively, both below the maximum acceptable level of 0.08. The normed chi-square (χ^2/df) yielded 1.76 which is within the acceptable range (Bollen 1989). The values of comparative fix index (CFI) and GFI were 0.88 and 0.89, respectively, slightly below minimum level of 0.90. However, some relationships amongst latent variables were not statistically significant.

The non-significant paths were then subsequently deleted from the model in order to build a better competing model following the model trimming method proposed by Kline (2005). The final structural model is shown in Figure 3. This model achieved a better fit that the original model as shown by the fit measures. The values of GFI and CFI were all above 0.90; the SRMR and RMSEA showed the value below the maximum level of GFI of 0.08; and the normed chi-square (χ^2/df) was within the acceptable range (Bollen 1989). These results indicate good fit of the model to the data. Thus, the final model presented in Figure 3 was used to address the hypotheses developed for this study.

The summary of hypothesis testing is outlined below.

Hypothesis 1: There is a positive relationship between information quality and the intensity of information sharing. The analysis shows that this relationship was found to be significant (standardised coefficient 0.47; $p < 0.05$). This suggests that the good quality of information sharing will drive companies to share more information with their partners.

Hypothesis 2: There is a positive relationship between costs and benefits sharing and the intensity of information sharing. This hypothesis is not supported (standardised coefficient = 0.15; $p = 0.23$).

Hypothesis 3: There is a positive relationship between IITs and the intensity of information sharing. This hypothesis is supported (standardised coefficient 0.46; $p < 0.05$) which suggests that high implementation of IITs enables companies to provide usable information to their partners and also increases their ability to utilise the shared information that they receive from their partners. Further analysis of the results shows that the value of squared multiple correlation of ISI indicates that the quality of information sharing and IITs account for 58% of the variance in ISI.

Hypothesis 4: There is a positive relationship between internal integration practices and the intensity of information sharing. This relationship was found to be not significant (standardised coefficient = −0.23; $p = 0.11$). This may be explained by there being too few data points to detect a relationship or because the items used in the survey instrument did not aptly identify internal integration. It is possible that, in some organisations, computer systems and internal integration are so much taken for granted or 'part of the furniture', that they were no longer visible to informants.

Hypothesis 5: There is a positive relationship between internal integration practices and collaboration practices. This hypothesis is supported (standardised coefficient 0.53; $p < 0.05$). This suggests that companies' internal integration is one of the ingredients for collaboration with external parties both upstream and downstream of a supply chain.

Hypothesis 6: There is a positive relationship between ISI and collaboration practices. This relationship is supported (standardised coefficient 0.46; $p < 0.05$). Close collaboration with supply chain partners requires a high degree of information sharing.

Hypothesis 7: There is a positive relationship between ISI and organisation performance. In the initial model, none of the relationships between ISI and the organisational performance variables were significant; hence this hypothesis is supported. This result is surprising since the impact of information sharing on organisational performance has been widely reported in the literature. The non-significant results of direct relationship between ISI and organisational performance variables leaves open the possibility that the relationship is mediated by other variables. Further analysis using SEM on the final model was carried out to examine the indirect effect of ISI on organisation performance variables through collaboration practices. The coefficients of indirect effect of ISI to delivery performance, cost performance and market and financial performance are 0.10, 0.11, and 0.10, respectively. All of these indirect effects were significant at $p < 0.05$. The significance of indirect effects supports the notion that customer and supplier relationship practices mediate the relationship between information sharing and performance variables.

Hypothesis 8: There is a positive relationship between collaboration practices and organisation performance. The analysis shows that all relationships between the three organisational performance measures and collaboration practices were found to be significant at $p < 0.05$, with the standardised coefficient of path linking collaboration practices to cost performance being the highest (standardised coefficient 0.25).
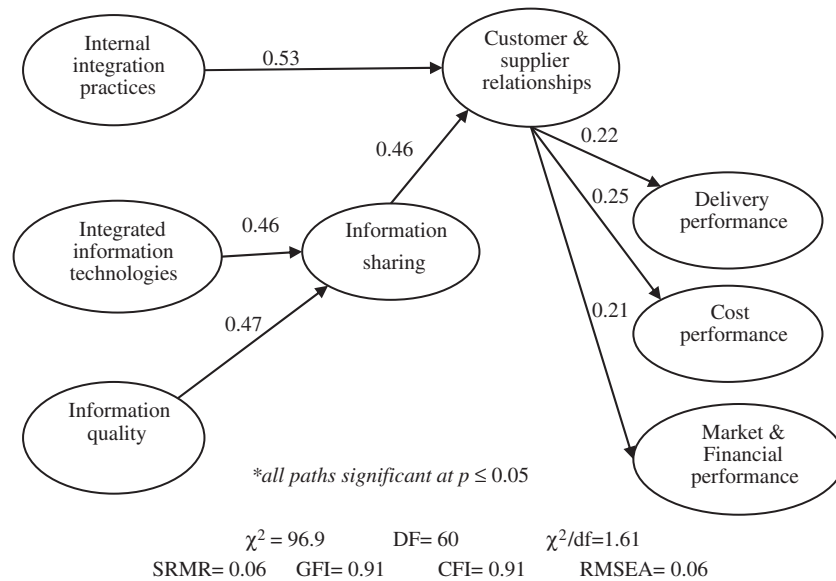
Figure 3. Path diagram.

In the next section of this article, we discuss the results of these hypotheses and their implications.

5. Discussion and implications

This study has empirically tested the role of information sharing in supply chains and how information sharing is impacted by several factors (namely IITs, internal integration practices, information quality and costs–benefits sharing) that influence the degree of information sharing in supply chains. Overall, the results show that information sharing is essential to achieve superior performance. However, information sharing does not generate good performance unless the shared information has a good quality and is effectively exploited in the decision-making processes. Information sharing should be used to increase collaboration with supply chain partners and to enhance the organisation's internal integration practices. Information sharing, facilitated by IT, serves as the backbone for supply chain integration. This section discusses the major findings of this research.

5.1. *Information quality*

The quality of information is significantly and positively correlated with the intensity of information sharing. In this study, the quality of information was measured using several dimensions including the timeliness, accuracy, adequacy, completeness and reliability of shared information. This suggests that companies will share more information with their partners if they perceive that the information received from their partners is of high quality. This finding is consistent with previous research (Moberg *et al.* 2002, Li and Lin 2006) – providing business partners with good quality information signify trustworthiness and may encourage partners to share more information. Likewise, increased information sharing activities will improve the quality of information by encouraging more complete and frequent information flow. Thus, information sharing can be started by sharing a limited amount of operational information and then progressing to sharing more, and perhaps more important and sensitive, information once mutual trust has been established.

5.2. *Integrated information technologies*

High degree of information sharing is highly characterised by the high degree of implementation of IITs. This result confirms earlier research that IT fosters companies' communication competencies, especially in disseminating and exchanging information internally and externally with its customers and suppliers (Li and Lin 2006, Paulraj and Chen 2007, Paulraj *et al.* 2008). IITs enable a company to provide information and utilise the shared information accurately and in a timely fashion.

5.3. *Costs and benefits sharing*

This study highlights the non-significant relationship between costs and benefits sharing and the intensity of information sharing. This suggests that companies may perceive that information sharing is a necessary part of doing business and/or staying in business and sustaining their competitive position. The real issue is no longer who gains more benefits, but how to make better use of shared information to achieve better supply chain effectiveness. Companies should communicate and develop a better understanding of the objectives and benefits of sharing information with their partners to establish superior capability. Companies may perceive unequal distribution of the benefits simply because they do not see the benefits (Corsten and Kumar 2003, 2005) or are unable to utilise the shared information in their decision-making processes (Småros 2007). Partners may not share the required information simply because they do not have the necessary resources or capabilities. Supporting partners' development of technical capabilities will not only help partners implement information sharing but also allow them to realise its benefits. For example, investment in training to help less sophisticated partners establish information sharing capabilities may be appropriate. Such investment will not only increase effective information sharing but, most significantly, strengthen relationships with supply chain partners.

5.4. *Internal integration practices*

This study also tested the role of internal integration practices. It was found that internal integration is critical to reaping the benefits of information sharing. Shared information from supply chain partners will have limited value if a company is unable to integrate the information into its own decision-making processes. Significant correlation between internal integration and collaboration practices suggests that internal integration practices need to be fully implemented in order to build closer relationships and collaborations with supply chain partners. Lack of internal integration may impede companies in obtaining benefits from collaboration. The success of SCM presumes the integration of business processes within a company as well as across companies in a supply chain.

This finding supports the notion that internal integration is one of ingredients of close collaboration with supply chain partners (Mentzer *et al.* 2000). Stevens (1989) argues that companies should achieve internal integration before pursuing external integration. Working in cross-functional teams can be excellent preparation for their collaboration with supply chain partners (Lank 2006). Internal integration and inter-firm collaboration are necessary conditions, but neither of them is sufficient in itself to having a successful supply chain (Min 2001).

5.5. *Collaboration practices*

Collaboration with customers and suppliers mediates the relationship between information sharing and organisational performance. High degrees of information sharing may not bring significant improvement to the company's performance or to a supply chain unless there is high degree collaboration between companies comprising the supply chain. Sharing of information has been widely known to be critical to the success of supply chain but is not an end in itself (Stank *et al.* 1996). Shared information provides tools for companies to create harmonised and synchronised activities along the supply chain and thereby deliver value to customers. The SEM results also show that the level of internal integration practices and the intensity of information sharing explain 71% of variance of collaboration practices. This suggests that the interplay between internal integration practices and information sharing may increase the level of collaboration with suppliers and customers.

The finding of an indirect impact of information sharing on performance confirms Kulp *et al.*'s (2004) study where they found that information sharing is necessary for companies to remain in the competition but not sufficient to bring a superior performance. Working closely in a collaborative fashion rather than simply exchanging information leads to the greatest benefits.

Information sharing with supply chain partners is necessary, but not sufficient, to achieve high organisational performance (Karkkainen *et al.* 2007). Results of this study suggest that companies need to have excellent internal practices and collaboration with their supply chain partners to achieve superior performance. Information sharing serves as the 'glue' that links all activities within a company and across the supply chain.

6. Conclusions and suggestions for future research

This study finds that information sharing is not directly related to organisational performance. Its relationship is mediated by collaboration practices with supply chain partners. This suggests that information sharing is essential but insufficient by itself to

bring about significant performance improvements. Hence, it is necessary that information sharing is used to enhance collaboration activities with supply chain partners. These findings indicate that internal integration is absolutely necessary for realising the benefits of information sharing. This is an important finding for managers to take note of – that they must first concentrate on internal integration otherwise efforts to share information with supply chain partners will be wasted.

High degree of information sharing must be built upon trust between the supply chain partners. Rather than relying on the shared information received from partners or asking partners to share information, companies need to focus on building good relationships with their partners and hence having trust in each other that good quality information is shared in a timely manner. Managers need to work closely to decide what information to share and the best mechanism for information sharing that could bring significant improvements for both parties.

The findings of this empirical study suggest that effective information sharing, facilitated by IITs, enables companies to achieve internal integration and work in a collaborative fashion with their supply chain partners. Information sharing can create a cohesive supply chain and allow companies to synchronise their activities with supply chain partners. The greatest performance improvements come from the interplay between internal integration and collaboration with supply chain partners.

Previous studies suggest that sharing costs and benefits of information sharing can motivate partners to share more information. However, this study found no relationship in this respect. Companies may share information with their partners because of the competitive pressure that dictates their behaviours towards their partners. This finding warrants further research. For example, how does power affects the nature of the relationship between supply chain partners? How does the competitive environment and institutional isomorphism influence information sharing and collaboration in supply chains? These are the questions that are worthy of further investigation. In this article, we have not specifically focussed on how various aspects of organisational culture impact on supply chain integration. This is an important area of study and one such recent study is by Yunus and Tadisina (2010). They examine group, developmental, hierarchical and rational culture and their impact on supply chain integration. Future research in this area is clearly warranted.

Acknowledgements

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References

Ahire, S.L. and Devaraj, S., 2001. An empirical comparison of statistical construct validation approaches. *IEEE Transactions on Engineering Management*, 48 (3), 319–329.

Armstrong, J.S. and Overton, T.S., 1977. Estimating non-response bias in mail surveys. *Journal of Marketing Research*, 14 (3), 396–402.

Barratt, M., 2004. Understanding the meaning of collaboration in the supply chain management. *Supply Chain Management*, 9 (1), 30–42.

Bartlett, M.S., 1954. A note on the multiplying factors for various chi-square approximations. *Journal of the Royal Statistical Society. Series B (Methodological)*, 16 (2), 296–298.

Barut, M., Faisst, W., and Kanet, J.J., 2002. Measuring supply chain coupling: an information system perspective. *European Journal of Purchasing and Supply Management*, 8, 161–171.

Bobko, P., Roth, P.L., and Buster, M.A., 2007. The usefulness of unit weights in creating composite scores: a literature review, application to content validity, and meta-analysis. *Organizational Research Methods*, 10 (4), 689–709.

Bollen, K.A., 1989. *Structural equations with latent variables*. New York, NY: Wiley.

Bourland, K.E., Powell, S.G., and Pyke, D.F., 1996. Exploiting timely demand information to reduce inventories. *European Journal of Operational Research*, 92 (2), 239–253.

Bowersox, D.J., Closs, D.J., and Stank, T.P., 2003. How to master cross-enterprise collaboration. *Supply Chain Management Review*, 7 (4), 18–27.

Bowersox, D.J., et al., 2000. How supply chain competency leads to business success. *Supply Chain Management Review*, 4 (4), 70–78.

Cai, S., Jun, M., and Yang, Z., 2006. The impact of interorganizational internet communication on purchasing performance: a study of Chinese manufacturing firms. *The Journal of Supply Chain Management*, 42 (3), 16–29.

Cannon, J.P. and Perreault Jr, W.D., 1999. Buyer-seller relationships in business markets. *Journal of Marketing Research*, 36, 439–460.

Childerhouse, P., et al., 2003. Information flow in automotive supply chain – present industrial practice. *Industrial Management and Data Systems*, 103 (3), 137–149.

Chopra, S. and Meindl, P., 2004. *Supply chain management: strategy, planning, and operation*. 2nd ed. Upper Saddle River, NJ: Pearson Education.

Christopher, M., 1992. *Logistics and supply chain management: strategies for reducing costs and improving services*. London: Financial Times & Pitman.

Clark, T.H. and Hammond, J.H., 1997. Reengineering channel reordering processes to improve total supply-chain performance. *Production and Operations Management*, 6 (3), 248–265.

Cooper, M.C., Lambert, D.M., and Pagh, J.D., 1997. Supply chain management: more than a new name for logistics. *The International Journal of Logistics Management*, 8 (1), 1–14.

Corsten, D. and Kumar, N., 2003. Profits in the pie of the beholder. *Harvard Business Review*, 81 (5), 22–23.

Corsten, D. and Kumar, N., 2005. Do suppliers benefit from collaborative relationships with large retailers? An empirical investigation of efficient consumer response adoption. *Journal of Marketing*, 69 (3), 80–94.

Droge, C., Jayaram, J., and Vickery, S.K., 2004. The effects of internal versus external integration practices on time-based performance and overall firm performance. *Journal of Operations Management*, 22 (6), 557–573.

Dyer, J.H., 1997. Effective interfirm collaboration: how firms minimize transaction costs and maximize transaction value. *Strategic Management Journal*, 18 (7), 535–556.

Eng, T.-Y., 2006. An investigation into the mediating role of cross-functional coordination on the linkage between organizational norms and SCM performance. *Industrial Marketing Management*, 35 (6), 762–773.

Fisher, M., 1997. What is the right supply chain for your product? *Harvard Business Review*, 75 (2), 105–116.

Forrester, J.W., 1958. Industrial dynamics: a major breakthrough for decision makers. *Harvard Business Review*, 36 (4), 37–66.

Frohlich, M.T., 2002. e-Integration in the supply chain: barriers and performance. *Decision Science*, 33 (4), 537–556.

Garcia-Dastugue, S.J. and Lambert, D.M., 2003. Internet-enabled coordination in the supply chain. *Industrial Marketing Management*, 32 (3), 251–263.

Gavirneni, S., Kapuscinski, R., and Tayur, S., 1999. Value of information in capacitated supply chains. *Management Science*, 45 (1), 16–24.

Gimenez, C. and Ventura, E., 2003. Supply chain management as a competitive advantage in the Spanish grocery sector. *The International Journal of Logistics Management*, 14 (1), 77–88.

Gimenez, C. and Ventura, E., 2005. Logistics-production, logistics-marketing and external integration. *International Journal of Operations and Production Management*, 25 (1), 20–38.

Handfield, R.B. and Nichols Jr, E.L., 2002. *Supply chain redesign: transforming supply chains into integrated value systems*. Upper Saddle River, NJ: Financial Times & Prentice Hall.

Huang, G.Q., Lau, J.S.K., and Mak, K.L., 2003. The impact of sharing production information on supply chain dynamics: a review of the literature. *International Journal of Production Research*, 41 (7), 1483–1517.

Ince, H. and Çemberci, M., 2011. The effect of inter firm knowledge sharing on supply chain and firm performance: a conceptual model proposal. *Journal of Global Strategic Management*, 9, 50–61.

Kahn, K.B. and Mentzer, J.T., 1996. Logistics and interdepartmental integration. *Management*, 26 (8), 6–14.

Kaiser, H.F., 1970. A second generation little jiffy. *Psychometrika*, 35 (4), 401–415.

Kaiser, H.F., 1974. An index of factorial simplicity. *Psychometrika*, 39 (1), 31–36.

Karkkainen, M., et al., 2007. Roles of interfirm information systems in supply chain management. *International Journal of Physical Distribution and Logistic Management*, 37 (4), 264–286.

Kelle, P. and Akbulut, A., 2005. The role of ERP tools in supply chain information sharing, cooperation, and cost optimization. *International Journal of Production Economics*, 93–94, 41–52.

Kline, R.B., 2005. *Principles and practice of structural equation modeling*. New York, NY: Guilford Press.

Kulp, S.C., 2002. The effect of information precision and information reliability on manufacturer-retailer relationships. *The Accounting Review*, 77 (3), 653–677.

Kulp, S.C., Lee, H.L., and Ofek, E., 2004. Manufacturer benefits from information integration with retail customer. *Management Science*, 50 (4), 431–444.

Lank, E., 2006. *Collaborative advantage: how organizations win by working together*. New York, NY: Palgrave Macmillan.

Larson, P.D. and Kulchitsky, J.D., 2000. The use and impact of communication media in purchasing and supply management. *The Journal of Supply Chain Management*, 36 (3), 29–39.

Lee, H.L., 2000. Creating value through supply chain integration. *Supply Chain Management Review*, 4 (4), 30–36.

Lee, H.L., Padmanabhan, V., and Whang, S., 1997. Information distortion in a supply chain: the bullwhip effect. *Management Science*, 43 (4), 546–558.

Lee, H.L., So, K.C., and Tang, C.S., 2000. The value of information sharing in a two-level supply chain. *Management Science*, 46 (5), 626–643.

Lee, H.L. and Whang, S., 2000. Information sharing in a supply chain. *International Journal of Technology Management*, 20 (3–4), 373–387.

Lewis, J.D., 1995. *The connected corporation*. New York, NY: The Free Press.

Lewis, A., 2006. *The effects of information sharing, organizational capability and relationship characteristics on outsourcing performance in the supply chain: an empirical study*. Dissertation (PhD). The Ohio State University, 1–169.

Li, S. and Lin, B., 2006. Accessing information sharing and information quality in supply chain management. *Decision Support Systems*, 42 (3), 1641–1656.

Li, S., *et al.*, 2005. Development and validation of a measurement instrument for studying supply chain management practices. *Journal of Operations Management*, 23 (6), 618–641.

Li, S., *et al.*, 2006. The impact of supply chain management practices on competitive advantage and organizational performance. *Omega*, 34 (2), 107–124.

Lin, F.-R., Huang, S.-H., and Lin, S.-C., 2002. Effects of information sharing on supply chain performance in electronic commerce. *IEEE Transactions on Engineering Management*, 49 (3), 258–268.

Magretta, J., 1998. The power of virtual integration: an interview with Dell computer's Michael Dell. *Harvard Business Review*, 76 (2), 73–84.

Mason-Jones, R. and Towill, D.R., 1997. Information enrichment: designing the supply chain for competitive advantage. *Supply Chain Management*, 2 (4), 137–148.

Mentzer, J.T., 2004. *Fundamentals of supply chain management: twelve drivers for competitive advantage*. Thousand Oaks, CA: Sage.

Mentzer, J.T., Foggin, J.H., and Golicic, S.L., 2000. Collaboration: the enablers, impediments, and benefits. *Supply Chain Management Review*, 4 (4), 52–58.

Min, S., 2001. Inter-functional coordination in supply chain management. *In*: J.T. Mentzer, ed. *Supply chain management*. Thousand Oaks, CA: Sage, 371–389.

Min, S., *et al.*, 2005. Supply chain collaboration: what's happening. *The International Journal of Logistics Management*, 16 (2), 237–256.

Moberg, C.R., *et al.*, 2002. Identifying antecendents of information exchange within supply chains. *International Journal of Physical Distribution and Logistics Management*, 32 (9), 755–770.

Patnayakuni, R., Rai, A., and Seth, N., 2006. Relational antecedents of information flow integration for supply chain coordination. *Journal of Management Information Systems*, 23 (1), 13–49.

Paulraj, A. and Chen, I.J., 2007. Strategic buyer-supplier relationships, information technology and external logistics integration. *The Journal of Supply Chain Management*, 43 (2), 2–14.

Paulraj, A., Lado, A.A., and Chen, I.J., 2008. Inter-organizational communication as a relational competency: antecedents and performance outcomes in collaborative buyer–supplier relationships. *Journal of Operations Management*, 26 (1), 45–64.

Perry, M. and Sohal, A.S., 2000. Quick response practices and technologies in developing supply chains a case study. *International Journal of Physical Distribution and Logistics Management*, 30 (7–8), 627–639.

Petersen, K.J., 1999. The effect of information quality on supply chain performance: An interorganizational information system perspective. Unpublished PhD. Michigan State University, Michigan.

Petersen, K.J., Ragatz, G.L., and Monczka, R.M., 2005. An examination of collaborative planning effectiveness and supply chain performance. *The Journal of Supply Chain Management*, 41 (2), 14–25.

Rashed, C.A.A., Azeem, A., and Halim, Z., 2010. Effect of information and knowledge sharing on supply chain performance: a survey based approach. *Journal of Operations and Supply Chain Management*, 3 (2), 61–77.

Ross, D.F., 2002. *Introduction to e-supply chain management: engaging techonology to build market-winning business partnership*. Boca Rotan, FL: St Lucie Press.

Sambasivan, M. and Jacob, G., 2008. An empirical study on the impact of supply chain practices on competitive position of MNEs in Malaysia. *International Journal of Economics and Management*, 2 (2), 369–394.

Sanders, N.R. and Premus, R., 2002. IT applications in supply chain organizations: a link between competitive priorities and organizational benefits. *Journal of Business Logistics*, 23 (1), 65–83.

Siau, K. and Tian, Y., 2004. Supply chain integration: architecture and enabling technologies. *Journal of Computer Information Systems*, 44 (3), 67–72.

Simatupang, T.M. and Sridharan, R., 2002. The collaborative supply chain. *International Journal of Logistics Management*, 13 (1), 15–30.

Simatupang, T.M. and Sridharan, R., 2005. The collaboration index: a measure for supply chain collaboration. *International Journal of Physical Distribution and Logistics Management*, 35 (1), 44–62.

Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., 2003. *Designing and managing the supply chain: concepts, strategies, and case studies*. 2nd ed. Boston, MA: Irwin/McGraw-Hill.

Simchi-Levi, D. and Zhao, Y., 2003. The value of information sharing in a two-stage supply chain with production capacity constraint. *Naval Research Logistics*, 50 (8), 888–916.

Småros, J., 2007. Forecasting collaboration in the European grocery sector: observations from a case study. *Journal of Operations Management*, 25 (3), 702–716.

Småros, J., et al., 2003. The impact of increasing demand visibility on production and inventory control efficiency. *International Journal of Physical Distribution and Logistics Management*, 33 (4), 336–354.

Spekman, R.E., Kamauff Jr, J.W., and Myhr, N., 1998. An empirical investigation into supply chain management: a perspective on partnerships. *Supply Chain Management*, 3 (2), 53–67.

Stank, T.P., Daugherty, P.J., and Ellinger, A.E., 1996. Information exchange, responsiveness and logistics provider performance. *International Journal of Logistics Management*, 7, 43–58.

Stank, T.P., Daugherty, J.P., and Ellinger, E.A., 1999. Marketing/logistics integration and firm performance. *The International Journal of Logistics Management*, 10 (1), 11–24.

Stefansson, G., 2002. Business-to-business data sharing: a source for integration of supply chains. *International Journal of Production Economics*, 75, 135–146.

Stevens, G.C., 1989. Integrating the supply chain. *International Journal of Physical Distribution and Logistics Management*, 19 (8), 3–8.

Taylor, D.A., 2003. *Supply chains: a manager's guide*. Boston, MA: Addison Wesley.

Vereecke, A. and Muylle, S., 2006. Performance improvement through supply chain collaboration in Europe. *International Journal of Operations and Production Management*, 26 (11), 1176–1198.

Vickery, S.K., et al., 2003. The effects of an integrative supply chain strategy on customer service and financial performance: an analysis of direct versus indirect relationships. *Journal of Operations Management*, 21, 523–539.

Whipple, J.M., Frankel, R., and Daugherty, P.J., 2002. Information support for alliances: performance implications. *Journal of Business Logistics*, 23 (2), 67–82.

Yu, Z., Yan, H., and Cheng, T.C.E., 2001. Benefits of information sharing with supply chain partnerships. *Industrial Management and Data Systems*, 101 (3), 114–119.

Yunus, E. and Tadisina, S.K., 2010. Organizational culture context, supply chain integration and performance. *In: POMS 21 annual conference*, 7–12 May, Vancouver, Canada.

Appendix 1

Table A1. EFA for dependent variables.

Item description	Mean	SD	Factor loading	Scale statistics
Provide the following information to suppliers (1 = not at all to 5 = to a very large extent)				
Actual sales data	2.33	1.12	0.49	Cronbach's alpha 0.78
Forecasts of demand	3.69	0.90	0.76	Eigenvalue 2.9
Inventory levels	2.95	1.15	0.76	Percentage of variance 48.3
Production schedules	2.97	1.25	0.79	
Forthcoming promotions	2.50	1.30	0.61	
Delivery schedules	3.32	1.12	0.71	
Receives the following information from suppliers (1 = not at all to 5 = to a very large extent)				
Order status	3.25	1.01	0.71	Cronbach's alpha 0.84
Production capacity	2.91	1.03	0.83	Eigenvalue 3.1
Supply disruption	3.42	0.94	0.76	Percentage of variance 61.3
Production schedules	2.72	1.14	0.81	
Delivery schedules	3.49	1.02	0.79	
Provides the following information to customers (1 = not at all to 5 = to a very large extent)				
Order status	3.65	1.04	0.56	Cronbach's alpha 0.76
Production capacity	2.92	1.18	0.75	Eigenvalue 2.6
Production schedules	2.78	1.23	0.81	Percentage of variance 51.1
Supply disruptions	3.53	1.09	0.70	
Delivery schedules	3.72	1.10	0.74	
Receives the following information to customers (1 = not at all to 5 = to a very large extent)				
Actual sales data	2.85	1.18	0.71	Cronbach's alpha 0.79
Forecasts of demand	3.22	1.07	0.75	Eigenvalue 2.9
Inventory levels	2.65	1.14	0.70	Percentage of variance 48.8
Production schedules	2.35	1.22	0.63	
Forthcoming promotions	2.79	1.19	0.64	
Delivery schedules	2.81	1.26	0.74	
IITs (1 = not at all to 5 = to a very large extent)				
Common shared and integrated database	3.51	1.23	0.67	Cronbach's Alpha 0.75
Integrated information system (enterprise resource planning)	3.43	1.37	0.79	Eigenvalue 2.5 Percentage of variance 50
Computerised production planning system (e.g. material requirement planning – MRP/ MRP II, computer integrated manufacturing)	3.49	1.46	0.75	
Automated data capture (e.g. bar-coding)	2.85	1.43	0.67	
Internet technology	3.61	0.94	0.65	
Internal integration practices (1 = strongly disagree to 5 = strongly agree)				
We use cross-functional teams for planning and improvement programmes	3.88	0.87	0.71	Cronbach's alpha 0.79 Eigenvalue 2.7
Our business units routinely share information, knowledge, ideas and/or resources with each other	3.81	0.84	0.82	Percentage of variance 54.1
We have adequate ability to share both standardised and customised information internally	3.63	0.85	0.69	
We have compensation, incentive and reward systems that encourage internal integration	2.77	1.00	0.70	
Our organisation's structure facilitates seam-less communication between functions/ departments	3.07	0.95	0.75	
Costs and benefits sharing (1 = strongly disagree to 5 = strongly agree)				
We share the costs of information sharing with our partners (suppliers and customers)	2.53	0.90	0.67	Cronbach's alpha 0.77 Eigenvalue 2.3
We have a clear agreement with our partners (suppliers and customers) to deal with any risk of information sharing	2.99	1.04	0.74	Percentage of variance 58.3
We and our partners have joint performance measures that monitor each others' activities	2.92	1.05	0.79	

Table A1. Continued.

Item description	Mean	SD	Factor loading	Scale statistics
We and our partners have mechanisms to align benefits, risks and costs of information sharing	2.53	0.93	0.82	
The quality of information sharing with customers				
Accurate	3.51	0.77	0.88	Cronbach's alpha 0.92
Reliable	3.52	0.76	0.88	Eigenvalue 5.0
Adequate	3.23	0.89	0.86	Percentage of variance 50.1
Complete	3.11	0.89	0.85	
Timely	3.36	0.86	0.82	
The quality of information sharing with suppliers				
Complete	3.40	0.95	0.83	Cronbach's alpha 0.88
Adequate	3.43	0.98	0.83	Eigenvalue 2.2
Reliable	3.21	1.02	0.80	Percentage of variance 72.1
Accurate	3.15	0.93	0.79	
Timely	3.20	1.03	0.78	
Strategic supplier partnership				
We regularly solve problems jointly with our suppliers	3.88	0.57	0.81	Cronbach's alpha 0.84 Eigenvalue 4.24
We have helped our suppliers to improve their product quality	3.87	0.74	0.80	Percentage of variance 42.3
We have continuous improvement programmes that include our key suppliers	3.49	0.91	0.77	
We include our key suppliers in our planning and goal-setting activities	3.01	0.98	0.75	
We actively involve our key suppliers in new product development processes	3.58	0.94	0.68	
Customer relationship				
We frequently interact with customers to establish reliability, responsiveness, and other standards important to us	3.93	0.71	0.78	Cronbach's alpha 0.81 Eigenvalue 1.7 Percentage of variance 59.31
We frequently measure and evaluate customer satisfaction	3.85	0.85	0.73	
We frequently determine future customer expectations	3.74	0.83	0.73	
We facilitate customers' ability to seek assistance from us	3.93	0.75	0.73	
We periodically evaluate the importance of our relationship with our customers	3.91	0.87	0.69	

Table A2. EFA of organisational performance.

	Factors		
	Market and financial performance	Cost performance	Delivery performance
Growth in return on assets	0.84		
Growth in sales	0.81		
Growth in market share	0.73		
Profits margin on sales	0.73		
Total production costs		0.77	
Total logistics cost		0.76	
Order fulfilment rate			0.93
On time delivery			0.89
Eigenvalue	2.73	2.38	1.52
Percentage of variance	24.9	21.7	13.8
Cumulative percentage of variance	24.9	46.6	60.4
Cronbach's alpha	0.79	0.71	0.86

Note: For simplicity, only loading factors above 0.50 are displayed.

Appendix 2

Table A3. Respondents' profile.

Industry type	Frequency	Percent
Food, beverage and tobacco manufacturing	29	19.3
Textile, clothing, footwear and leather manufacturing	5	3.3
Wood and paper product manufacturing	5	3.3
Printing, publishing and recording media	9	6.0
Petroleum, coal, chemical and associated product manufacturing	27	18.0
Non-metallic mineral product manufacturing	11	7.3
Metal product manufacturing	21	14.0
Machinery and equipment manufacturing	27	18.0
Other	16	10.7
Total	150	100
Annual sales (AU$)		
<20 millions	28	18.7
20–99 millions	33	22.0
100–299 millions	35	23.3
300–499 millions	15	10.0
500 million–1 billions	17	11.3
>1 billion	19	12.7
Missing	3	2.0
Total	150	100
Position of respondents		
CEO/president/vice president	31	20.7
Director	27	18.0
Manager	82	54.7
Other	10	6.7
Total	150	100.0