Information Sharing with Key Suppliers: A Transaction Cost Theory Perspective

Introduction

Although, much has been written about the merits of interfirm collaboration, i.e. how it affects company and supply chain performances (e.g. Li et al., 2006; Bagchi and Skjoett-Larsen, 2005; Petersen et al., 2005; Saeed et al., 2005; Fröhlich and Westbrook, 2001), only a few studies attempt to explain why collaboration efforts across organizations differ and are somewhat limited (e.g. Zhou and Benton 2007; Li and Lin, 2006, Bagchi and Skjoett-Larsen, 2002; Wagner 2003). Since collaboration is important due to its desirable effects on company performance, a thorough investigation into the forces that drive collaboration is essential. Hence, this paper is motivated by the shortcomings in the existing literature in explaining why certain buyers and sellers in supply chains collaborate more intensely than others. The main objective of this paper is to provide a theoretical framework with which the recent developments in supply chains with regard to collaboration and integration can be interpreted. The results of the study could also be helpful to practitioners who are considering collaboration or who are already collaborating with exchange partners by discussing the critical issues raised by the topic.

One could argue that the stream of research investigating interfirm collaboration gained momentum with the development of advanced interorganizational information systems that are enabled through private or public networks such as the Internet. Often, these technologies are promoted together with supply chain philosophies such as Collaborative Planning, Forecasting, and Replenishment and Advanced Planning and Scheduling, which engage multiple parties in decision-making on issues such as inventory management and capacity planning. There seems to be a pay-off for investing resources into these schemes as recent studies found empirical evidence about a positive relationship between various forms of collaboration and company/supply chain performance (e.g. Bagchi and Skjoett-Larsen, 2005; Petersen et al., 2005; Saeed et al., 2005; Li et al., 2006). These findings support the conventional wisdom in supply chain literature that the more integration there is, the better the performance (Bagchi and Skjoett-Larsen, 2005). Despite this view, companies have been somewhat slow and hesitant to adopt collaborative supply chain practices and their supporting

technologies (Bagchi and Skjoett-Larsen, 2005; Kemppainen and Vepsäläinen, 2003). Could this be explained through the existence of a different view – that companies should go for limited or selective collaboration as there is a risk of integrated systems and processes being obsolete once they are created (Bask and Juga, 2001)? Although existing theory gives some indication on the factors that might influence the decision of companies to collaborate with for example a key supplier (e.g. trust), there is a lack of empirical evidence.

First of all, it will be beneficial to define and clarify some key concepts, which are often used interchangeably in the literature. The Webster Dictionary defines cooperation "as the association of persons for common benefit". For Spekman et al. (1998) cooperation is the first level of integration in the supply chain followed by co-ordination and collaboration. According to Alter (1999), integration itself refers to the level of goals, culture, and information shared with the other partner. Co-ordination in the words of Spekman et al., (1998:55) is

> "*whereby both specified workflow and information is exchanged in a manner that permits JIT systems, EDI , and other mechanisms that attempt to make seamless many of the traditional linkages between and among trading parties*."

The unit of analysis for this paper is information sharing as it is the most essential and common element in any integration and collaboration effort between two companies. In this study, information sharing between firms refers to information shared between a buyer and key suppliers that is detailed enough, frequent enough (Carr and Smeltzer, 2002; Humphreys et al., 2004; Krause and Ellram, 1997), and timely enough (Dyer, 1997; Krause and Ellram, 1997; Leek et al., 2003) to meet a firm's requirements. Here, the scope of information is much broader than the information exchanged between buyers and sellers for transaction processing purposes. Hence, in the reminder of this paper, information sharing will refer to the sharing of private and discretionary information, what is beyond the information required to carry out the day-to-day transactions between buyers and sellers. This study focuses on information sharing with key suppliers as opposed to customers or both in order to limit the scope of the study. However, the results of the study are also very likely to be applicable to the customer side.

Information sharing: A transaction cost theory perspective

Transaction cost theory could serve as a good starting point for the analysis, which explains why certain tasks are performed by firms and others by markets (Coase, 1937). Transaction costs can be divided into coordination costs and transaction risk (Clemons and Row, 1992). "Coordination costs are the direct costs of integrating decisions between economic activities [such as search and bargaining costs]. Transaction risk is associated with the exposure to being exploited in the relationship" (Clemons and Row 1992:3). Uncertainty and asset specificity are two factors, which increase coordination costs and transaction risk respectively (Williamson, 1975, 1985).

The use of Information Technology has facilitated the reduction of coordination costs, which has been extensively documented in the literature (e.g. Bakos, 1991; Cash and Konsynski, 1985; Johnston and Vitale, 1988). For example, electronic market places, facilitated through IT, reduce the cost of searching for obtaining information about product offerings and prices (Bakos, 1991). Also collaboration facilitated by information sharing can lower transaction costs (in particular coordination costs) as companies can thereby reduce supply chain uncertainty and thus the cost of contracting. This can be explained with an example: If a supplier is unable to accurately predict the price of its product inputs, it will be reluctant to enter into a contract, which locks it into a fixed price for an extended period of time (Artz and Brush, 2000).

Uncertainty in the context of supply chains and more specifically in manufacturing is caused by supply uncertainty, demand uncertainty, new product development uncertainty, and technology uncertainty (Koh and Tan, 2006). Supply uncertainty relates to unpredictable events that occur in the upstream part of the supply chain. Among the causes to supply uncertainty are shortages of materials and late deliveries. Clearly, supply uncertainty can disrupt manufacturing and have an adverse affect on sales, where distributors and retailers down the chain are also affected. Demand uncertainty can be defined as unpredictable events that occur in the downstream part of the supply chain (Koh and Tan, 2006). Demand uncertainty (or demand risk) can result from seasonality, volatility of fads, new product adoptions or short product life cycles (Juttner, 2005). Furthermore, Chung, Anthony, and Michael (2004) identify three sources for the uncertainty of demand arising (i) from the final

consumer, (ii) the behavior of the economic system at the current time, and (iii) the immediate downstream customers. Another uncertainty related to manufacturing concerns new product development. New product development uncertainty can stem from unpredictable events during the process of market research, product design, and product prototyping. Finally, technology uncertainty refers to the fuzziness in the selection of a suitable technology platform (Koh and Tan, 2006). An example is the trade-off between a fool-proof manufacturing technology (perhaps dated), compared to a prospective technology offering better price to performance but whose viability is not certain (Krishnan and Bhattacharya, 2002). Furthermore, uncertainty can also arise from political (e.g. fuel crisis), natural (e.g. fire, earthquake), and social uncertainties (e.g. strikes) (Juttner, 2005).

Approaching the concept of uncertainty from the transaction cost economics (TCE) point of view might provide further insight into the value of information sharing between organizations. The concept of uncertainty is central to TCE, which assumes that individuals have bounded rationality and act opportunistically. The early transaction cost literature did not make a distinction between different forms of uncertainty. More recent literature has disaggregated the construct of uncertainty (Meuleman et al., 2006). For example, Williamson (1985), who built on Koopmans (1957), distinguished between primary and behavioral (or secondary) uncertainty. Primary uncertainty refers to the underlying transaction and arises from mainly exogenous sources such as uncertainty relating to natural events, consumer preferences, regulations, and technology (Sutcliffe and Zaheer, 1998). Primary uncertainty may lead to problems of communication, technological difficulties, and coordination problems that can as a consequence adversely impact the execution of transactions (Meuleman et al., 2006). Behavioral uncertainty refers to the risk of opportunism on transactions that are executed through incomplete contracts.

Similarly, Sutcliffe and Zaheer (1998), classified uncertainty as primary, competitive, and supplier uncertainty. Primary uncertainty is consistent with Koopmans' (1957) and Williamson's (1985) and refers to the "lack of knowledge of states of nature" (Sutcliffe and Zaheer 1998:6). Competitive uncertainty arises from the innocent or strategic actions of potential or actual competitors (Sutcliffe and Zaheer 1998). Supplier uncertainty is essentially behavioral uncertainty and refers to possible opportunism by upstream or downstream partners. In organizational theory uncertainty is often referred to as environmental uncertainty (Thompson, 1967) and includes a number of factors such as uncertainty regarding suppliers

and competitors actions, as well as uncertainty in regulations and technology, which captures both primary and behavioral uncertainty. Based on the reviewed literature, the definitions of the various types of uncertainty are not consistent. Some definitions overlap, whereas others ignore certain factors.

The presence of demand uncertainty and the lack of information sharing in the supply chain can lead to a problem known as the bullwhip effect: the amplification of demand variability as orders move up the supply chain (Forrester, 1958; Lee et al., 1997). Jones and Simmons (2000) provide evidence for this finding from the food industry, whereas Naim, Disney, and Evans (2002) report on the bullwhip effect in the automotive sector. There are four sources of the bullwhip effect: (i) demand signal processing, (ii) rationing game, (iii) order batching, and (iv) price fluctuations (Lee et al., 1997). The bullwhip effect can be alleviated through sharing demand information in the supply chain, which reduces information asymmetry and uncertainty (Lee et al., 1997). Thus, limiting uncertainty through information sharing can in turn reduce companies' internal risk as companies' can optimize inventory, production, and capacity planning. Although, information sharing seems to bring with it many benefits, it can simultaneously increase transaction risk, as higher levels of business transparency can lead to opportunistic behavior. Nevertheless, uncertainty as a factor might affect companies' incentives to share information. This also agrees with contingency theory, which states that the amount of uncertainty and rate of change in an environment affects the development of internal features in organizations (Lawrence and Lorsch, 1967).

With respect to the sign of the relationship between uncertainty and information sharing, the literature is ambiguous. Fisher (1997) and Kaufman and Mohtadi (2003) claim that there is a negative relationship between uncertainty and information sharing. Kaufman and Mohtadi (2003, p. 28) argue, "information sharing and information withholding might take place depending on the degree of initial uncertainty". On the other hand, Xu (1996) argues that manufacturers will find it more difficult to plan when demand is more variable, encouraging them to share more information. The relationship between uncertainty (demand uncertainty in Kulp, 2002 and environmental uncertainty in Li and Lin, 2006) and information sharing (operationalized as the extent of Vendor Managed Inventory in Kulp) was previously hypothesized but no support was found. However, a more recent study by Zhou and Benton (2007) did find support for a relationship between supply chain dynamism and information sharing. As evident from the literature, supply chain uncertainty refers to many aspects of the

supply chain, which can be classified as demand and environmental uncertainties. Demand uncertainty refers to the characteristics of demand that the company's products face such as the rate of product introductions and product demand. Environmental uncertainty is broader and is concerned with issues such as supplier actions, customer demands and macroeconomic factors. Based on the theory and previous research, we formulate the following two hypotheses.

Hypothesis 1: Environmental uncertainty is positively related to the intensity of information shared with key suppliers.

Hypothesis 2: Demand uncertainty is positively related to the intensity of information shared with key suppliers.

The relational view of the firm suggests that buying and supplying firms systematically share valuable know-how with each other and make relationship-specific investments in return for access to profit from rents that can only be generated by working jointly (Dyer and Singh 1998). However, exchange and investment in relationship-specific assets will take place under conditions where the expected value of the combined inflows of knowledge and investment exceeds the expected loss/erosion of advantages due to knowledge spill-overs to competitors (Dyer and Singh, 1998; Osborn and Hagedorn, 1997). Asset specificity refers to the degree of investment made by the supplier of goods and/or services for a specific buyer (Williamson, 1985). Asset specific investments include site specificity, physical asset specificity, human asset specificity and dedicated assets (Williamson, 1993). As investments in assets are specific and cannot be put to work without a significant loss for other purposes, increasing asset specific investments can put an exchange partner into greater (transaction) risk. A buyer that observes its supplier having no alternative buyers due to asset specific investments can use its monopoly power to demand, for example, a price reduction. There is a well-known case study of Fisher Body (FB) and General Motors (GM) where a buyer goes into extreme measures and purchases the supplier due to asset specific investments (Klein et al., 1978). In other cases, involved parties may request additional safeguards through penalties for premature termination, information disclosure and verification mechanisms, and specialized dispute settlement, which lead to market supported hybrid contracting (Williamson 2008).

Asset specificity can be regarded as a lock-in or as some degree of dependency on the other firm. Dependency between companies is a function of the criticality of the resource

(Thompson, 1967; Pfeffer and Salancik, 1978; Bourantas, 1989, Sririam et al., 1992) and availability of alternative suppliers and/or buyers (Thompson, 1967; Pfeffer and Salancik, 1978; Sririam et al., 1992; Geyskens et al., 1996; Kim, 2001; Buvik and Halskau, 2001). When a company is dependent on another, the concept of "power" might arise. In fact, power has been used as a factor to explain the adoption of EDI, which facilitates information sharing (Hart and Saunders, 1997; Webster 1995). In the economic context, power is defined "as the ability to influence the intentions and actions of another firm" (Emerson 1962). The term power itself is not very informative, as the source for power requires some explanation. According to Emerson (1962), the basis for power is dependency. Thus, this study focuses on the concept of dependency rather than power.

Switching costs have also been found to play a role in determining the level of dependency (Bourantas, 1989; Sririam et al., 1992; Johnson, 1999; Buvik and Halskau, 2001) between firms. Switching costs are those costs incurred when having to switch from one supplier to another when purchasing the same goods. The costs might be both monetary (labor time spent) and non-monetary (including routines and procedures for dealing with a particular supplier) (Dick and Basu, 1994; Heide and Weiss, 1995). When dependency is high as a result of asset specific investments and/or switching costs, companies might be forced to share more information by the more powerful partner. Alternatively, an exchange partner might attempt to gain the trust of another partner by sharing information, which can be seen as a commitment into the relationship (Spekman et al. 1998). Thus, we formulate the following hypotheses, which were previously not tested.

Hypothesis 3: A key supplier's dependence on the buyer is positively related to the intensity of information shared with key supplier.

Hypothesis 4: A buyer's dependence on the key supplier is positively related to the intensity of information shared with the key supplier.

Information can be viewed as an asset (King, 1984). The provision of private information can then be regarded as an asset invested into the exchange relationship. This is comparable to an asset specific investment. However, this "investment" as opposed to the classical view of asset specificity does not necessarily make the invested asset (information) less useful when employed elsewhere. Furthermore, the provision of private information is not mandatory; it is likely to be voluntary to enhance transactions. However, similar to an asset specific

investment, it might lead to a power shift in the bargaining position of the involved parties due to opening the possibility for opportunism. The investment (or risk of opportunism) can be regarded as a negative investment being equal to the net present value (NPV) of the future losses of financial benefits in case of opportunism. Hence, companies will share information only up to the point where the benefits of sharing information will be equal to or greater than the NPV of future losses due to opportunism. In reality, companies will find it hard to quantify the benefits and the risks of information sharing and decisions might have to be made based on rules of thumb rather than marginal analysis.

Information in the wrong hands or when abused can expose a company to risk. For example, a supplier that knows its buyer's upcoming production might increase the price of direct materials as the buyer is now in a weaker position. On the other hand, a buyer might demand a lower price from a key supplier if the excess supplier inventory is known, leading to risk of obsolescence if not purchased and utilized soon enough. Also unintentional harm can arise from information sharing in the form of spillovers to competitors.

Given the risk of information sharing, the role of trust, which has been extensively studied in interorganizational relationships (e.g. Neuman and Samuels, 1996; Hart and Saunders, 1997; Petersen et al., 2005), cannot be neglected. Trust on the other party is desired in order to minimize the risk that the other party behaves opportunistically. Hence, trust can play an important role when exchanging critical company information. For example, Bagchi and Skjoett-Larsen (2005) reported from a European survey that companies were cautious when sharing information. Similar claims were also made in the studies of Eng (2003), Kemppainen and Vepsäläinen (2003), Dekker (2003), and Bagchi and Skjoett-Larsen (2002), and Akintoye et al. (2000) where resistance to sharing proprietary data was either found or argued. To overcome the fear of being exploited due to information sharing, a certain level of trust might be needed. Trust can be defined as "the willingness to rely on an exchange partner in whom one has confidence" (Moorman et al. 1992).

In the commercial context, TCE refines the term trust and refers to calculative trust, where contractors, in the presence of incomplete contracts, carry out some form of cost – benefit analysis to assess the risks of contracting (Williamson 1996). Here, institutional trust becomes also relevant, which refers to the social and organizational context within which contracts are embedded (Williamson 1996). Institutional trust includes, among other things, sanctioning

mechanisms (such as through the implementation of the legal process), informal codes of conduct and values (Welter and Smallbone 2006), and professionalization. TCE does not adequately address trust in terms of how it forms between organizations and how it should be managed to sustain organizational effectiveness and efficiency (Ireland and Webb, 2006).

Greater levels of trust increase the probability of a firm's willingness to expand the amount of information shared through EDI (Hart and Saunders, 1997). According to Hart and Saunders (1997), trust between organizations in EDI implementations consists of competence (how efficiently information is processed), openness (the ability to listen and share new ideas), caring (joint goal setting and refraining from opportunism), and reliability (consistent behavior).

The risk of opportunism becomes relatively more important when there is more at stake: when the NPV of a company's future income is relatively large. This is the case when a company offers a unique product that faces low competition and can therefore generate high economic rents. To do so, companies must foresee future opportunities in advance so as to invest in the right products and capabilities on time. A company can do this successfully if it possesses unique knowledge about market conditions and future customer requirements, due to perhaps advanced business intelligence, capabilities and/or relational capital. Once companies start developing capabilities and products, it then becomes a matter of protecting this information so as to be able to reap the benefits of their future monopoly power as long as possible. Hence companies might be reluctant to share information at an early stage of the Product Life Cycle (development or growth stage), as this could lead to a relatively larger risk of opportunism. Wagner (2003) provides some evidence about this phenomenon. Wagner (2003) reported that there are patterns relating to the phase of integration efforts (e.g. product development stage) and the intensity of integration with suppliers. For example, the optics and precision industry (e.g. cameras, medical and surgical devices) tends to integrate only at a latter stage (industrial stage), as they often need to protect their know-how by avoiding integration at the R&D stage. Bagchi and Skjoett-Larsen (2002) claim that companies in rapidly evolving industries prefer not to integrate but as the opportunistic behavior threat recedes with industry maturity, firms open up gradually. Also Fisher (1997) and Kaufman and Mohtadi (2003) argue that manufacturers with stable demand (which is the case when they are at a later stage of PLC) are more likely to share information. Thus, we propose the fifth

hypothesis based on the product life cycle stage of the focal company, which addresses the risk of information sharing with other companies.

Hypothesis 5: The intensity of information shared with key suppliers is positively related to the product life cycle stage of the buyer.

Finally, we propose that information sharing leads to better performance, which has been previously reported (Bagchi and Larsen, 2005; Petersen et al., 2005; Cassivi et al., 2004; Fröhlich and Westbrook 2001). However, we distinguish between 3 performance measures in the supply chain - for output, resource and flexibility as recommended in Beamon (1999). This leads to the following 3 hypotheses.

Hypothesis 6a: The intensity of information shared with key suppliers is positively related to resource performance.
Hypothesis 6b: The intensity of information shared with key suppliers is positively related to output performance.
Hypothesis 6c: The intensity of information shared with key suppliers is positively related to flexibility performance.

The proposed model is presented in Figure 1, where information sharing mediates the contingent factors and performance.

Figure 1 here

Data collection and research method

Data was collected by a mail survey from Finnish and Swedish companies in 2006. Finland and Sweden are one of the most developed countries in terms of information technology and have been consistently ranked as one of the most competitive countries in the world (World Economic Forum 2009). The sample of Finnish companies was obtained from the Voitto database. The sample of Swedish companies was acquired from the largest companies in the Nordic countries database. The two databases were accessible from Hanken

School of Economics' network. The selection criteria for the Finnish and Swedish companies were the following:

- a turnover of 15 million EUR minimum (140.000 mskr for Sweden; 1 EUR = 9.27 in May 2006)
- manufacturing, assembly companies and companies which distribute or sell those products (distributors and retailers)
- excluded raw material extractors as the key-supplier concept is less relevant to them

The first criterion was chosen in order to limit the sample size. This was done in favor of large companies. Larger companies have more resources and the scale of operations justifies the use of more advanced information systems for collaboration, where cost saving incentives are more significant. Service companies (other than distributors and suppliers) were excluded from both Finnish and Swedish samples, as many of the issues related to manufacturing companies such as inventory optimization, obsolescence, and stockouts do not necessarily apply to service companies.

The query returned 1170 companies from Finland, which were fully retained in the sample. For Sweden, the database returned 2581 companies, which was subsequently reduced to 1290 through random sampling (elimination). Hence, the final sample for Finland and Sweden (Finland: 1170, Sweden 1290) totaled 2460. The respondent in the target companies was the purchasing manager. Purchasing managers were considered to have the most knowledge about suppliers and performance. Managers were appropriate as high-ranking respondents are more likely to provide reliable information than their subordinate ranks (Philips, 1981).

Out of the 1170 Finnish questionnaires, a total of 134 were returned of which more than half were received in the first week. Three questionnaires were returned as undelivered. Fifteen responses were unusable as either data was missing or because the company was a subsidiary of a foreign company and as it mainly purchased from key suppliers within the group. The total response rate (134/1167) was 11.5%. The number of usable responses were n=119 for Finland. Regarding the 1290 questionnaires that were also sent by post to the Swedish companies, sixteen questionnaires were returned as undelivered bringing the sample

size down to 1274. Responses from Sweden totaled 130, out of which 28 could not be used mainly due to missing data or the respondent being a subsidiary of a foreign multinational. Nearly two thirds of the responses were received within the first week after the first responses started arriving. Most of the remaining responses arrived during the following two weeks. The number of usable responses were n=102. The response rate for Sweden (130/1274) was 10.2%, about 1% lower than for Finland. A response rate of about 10% is considered acceptable especially given the fact that no reminders were sent. Similar studies obtained comparable or even lower response rates from the Nordic region (see, for example, Bagchi et al., 2007; Bagchi Skjoett-Larsen, 2005) and elsewhere (e.g. Li et al., 2006).

The presence/absence of non-response bias was checked using t-statistics for independent samples. Each sample was divided according to early and late respondents. The responses were spread across 5 weeks. The cut-off point for early responses was the first week (first seven days), which allowed the remaining four weeks to be identified as the period of late responses. The ratio for the Finnish sample in terms of the number of companies in the two groups (early versus late respondent) was 68:51, whereas for the Swedish sample it was 73:29. There were differences in the means of the constructs (e.g. the intensity of information sharing and performance was higher for the early respondents). However, the differences were insignificant according to a 95% confidence interval. Hence non-response bias was not found in both of the samples.

Measurement of variables

All variables in the questionnaire except company background information and the product life cycle stage were measured on a 7-point Likert scale. In addition to the information sharing construct in the model, the respondents were also asked to indicate the exact type of information they provide to their suppliers (Table 1). We operationalized the model using pre-tested instruments. Environmental uncertainty and demand uncertainty were adopted from Hoque (2004) and Ho et al. (2005) respectively, where the measures have been found to perform well. However, as opposed to the original studies from which the measures originate, the indicators were considered to be constructive instead of reflective. This is further explained in the next section. The measure for buyer dependency was borrowed from Straub et al. (2004) and supplier dependency was subsequently developed based on the

former. The measure for product life cycle stage was adopted from Hoque and James (2000), where respondents were asked to estimate what percentage of their products were in the different stages of the product life cycle. The intensity of information sharing was borrowed from Li et al. (2006) consisting of six indicators. The measure for performance was adopted from Beamon (1999) supporting the view that a multidimensional scale should be used to capture the different characteristics of supply chain performance.

Figure 2 here

Figure 2 illustrates the positions of the respondents within the supply chain. Regarding the industries, when combined and in both samples, more than half of the respondents represented the materials, capital goods and technology industries. On the other hand, the retailing, health equipment, and pharmaceutical industries were the smallest groups among all the industries in both samples. Furthermore, about half of the companies' turnover fell in the range of 49 to 15 million Euros, whereas less than 10% of the companies had a turnover larger than 1 billion Euros. This was consistent for both samples. With respect to the usage of technologies for information sharing with key suppliers, ERPS, Web Portals and EDI were used by more than one third of the Finnish companies. Regarding the Swedish sample, only the use of EDI was as high. The use of ERPS and Web Portals was significantly lower (half less) compared to the Finnish sample. The category "Other Means" (e.g. telephone, fax, meetings) in Sweden (almost half of the respondents) was in comparison to Finland about twice as high. On the other hand the use of SRM software was very low (less than 5%) for both of the samples. Regarding supply chain practices, the differences between the two countries were smaller. Most common practices used by companies were supply chain planning and VMI (Figure 3).

Figure 3 here

Regarding information provided to key-suppliers (Table 1), demand forecast information ranked the highest in both countries. T-tests for the two independent samples indicated that information shared on demand forecasts was significantly different in the two countries. The results agree with Ollhager and Selldin (2004), where demand forecast was also found to be the highest among similar collaboration items. This may not be surprising as sharing demand forecast information is relatively harmless when compared to for example, R&D or promotion information, as well as, probably the most urgent to share.

Table 1: Information Provided to Buyers

	Finland Mean Scale: 1-7	Sweden Mean	significance
Demand forecasts	4.81	5.61	**
Production plans	4.28	4.71	no
Production capacity	4.13	4.53	no
Inventory status	4.08	4.13	no
Product design	3.82	4.50	no
R&D information/plans	3.54	3.42	no
Promotion/campaign plans	3.42	2.81	no
Customer information (e.g. POS data)	2.35	2.77	no
Warehouse/transp. system access	1.89	2.53	no

** significant at $p<0.01$

We also checked whether there were any differences based on the respondents' position in the supply chain and the extent of information shared with key suppliers. For this purpose, three groups were compared, i.e. manufacturers, wholesalers/distributors, and retailers. T-tests showed no significant differences among the three groups. The same test was also done for the two dependence variables (key supplier dependency and buyer dependency) but also here the differences were insignificant according to a 95% confidence interval. This was the case for both of the samples.

Statistical analysis and results

Tests were initially performed for individual samples in order to see differences between countries. Confirmatory factor analysis was performed for reflective constructs, which were dependency and performance. All factor analyses were based on the principal axis factoring direct oblimin rotation method. Oblimin rotation was used as high correlations between indicators were expected and found. Only components with an Eigenvalue above one were retained. Pairwise deletion for missing values was used and no large outliers were found in the data, which could otherwise lead to skewed results. This was verified by comparing the 5% trimmed mean values with the non-trimmed mean values, which were very close.

The results of the factor analysis for the reflective measures (performance, supplier-, buyer dependency, information sharing) are presented in Appendix 1. Although, the dimensions for the performance measures were known from Cassivi et al. (2004), an exploratory factor analysis on all the items in the three dimensions was performed. This had not been done before. The factor analysis resulted in three components, consistent with the number of underlying dimensions (resource, output, flexibility). However, the indicators were not exactly clustered as according to the given dimensions. Loadings and scale reliabilities (Cronbach's alpha) were sufficient (loadings > 0.3, Cronbach's alpha > 0.7). The mean scores for on-time delivery, flexibility to deliver, and stock-out costs were particularly high, indicating that a substantial improvement on the said items had been perceived by companies as a result of information shared. Factor analysis for supplier dependency was satisfactory, which resulted in a single component with high loadings and Cronbach's alpha. Factor analysis on buyer dependency returned one component as expected. One indicator, specific investments into machinery or procedures was dropped as it loaded low on the construct. The scale reliability for the construct was high. For demand uncertainty, no factor analysis was required as the construct was considered to be formative. This is the case when indicators forming the construct can have different antecedents and do not necessarily correlate, e.g. the number of sales channels with the lead times of the products. Nevertheless, to support this claim, factor analysis was performed, which resulted in three components indicating the multidimensionality of the data. Ho et al. (2005), who developed the demand uncertainty construct found four components in an explorative factor analysis with the same indicators, which they labeled as channel characteristics, product characteristics, demand forecast, and demand change. However, Ho et al. (2005) in the study used the indicators as reflective, where the results were satisfactory. To further explore the data, correlations between the demand uncertainty indicators were computed. For the majority of the correlations, Pearson correlation coefficients were found to be low (0.10 – 0.29), which also supports the argument that the indicators form rather than reflect the construct. Factor analysis on intensity of information sharing returned one component with high loadings and good reliability (see Appendix 6). Environmental uncertainty as a construct was perceived as a formative construct. Ho et al. (2005) used the indicators as reflective although the indicators do not necessarily have common antecedents, e.g. uncertainty in production and information technologies and market activities of competitors. A correlation analysis showed that the items correlated weakly, which also supports this claim. Similar and satisfactory results were also obtained for the Swedish sample.

Partial Least Squares Modeling

The partial least squares (using PLS-graph version 3.00) approach to structural equation modeling was used to test the hypothesized relationships for the two samples. The demand uncertainty and environmental uncertainty constructs were set as formative, whereas supplier dependency, buyer dependency, information sharing, and performance were set as reflective and as according to the components of the factor analysis. The results of the model for the Finnish sample is shown in Figure 4.

Figure 4 here

In PLS, the measurement model is evaluated according to item loadings, reliability coefficients, convergent, and discriminant validity. Item loadings exceeding 0.7 are considered adequate (Fornell and Larcker, 1981) for reflective indicators. For formative indicators, the weights not the loadings are taken into consideration. Composite reliability, which is interpreted like Cronbach's alpha for internal consistency reliability is considered adequate when greater than 0.7 (Fornell and Larcker, 1981). Average Variance Extracted (AVE), a measure indicating how much the indicators explain the variance in the construct is acceptable when it exceeds 0.5 (Barclay, Thompson, and Higgins, 1995). Discriminant validity is assessed by verifying that items across constructs have minimum correlations than with the corresponding construct.

Appendix 2 presents the results for the measurement (outer) model in terms of item loadings, AVE, and composite reliability. All item loadings for the reflective indicators except product quality and personnel requirements were satisfactory, exceeding 0.7 (see Table 2). AVE and composite reliability were sufficient for all reflective constructs. Discriminant validity was checked by comparing the square roots of AVE to construct correlations. The correlations were all smaller than the square roots of AVE indicating that a construct shared more variance with its measures than with other constructs (see Appendix 2). The strengths of the relationships (betas) and R squares are shown in Figures 4 and 5. In PLS, for testing the fit of the model, in addition to AVE values, t-statistics for the path coefficients must be checked. For this purpose, bootstrapping with 500 samples was generated.

Uncertainty and information sharing (H1 and H2)

According to the t-statistics for the Finnish sample (see Appendix 2), demand and environmental uncertainties had a significant and positive relationship with the intensity of information shared with key suppliers. Regarding demand uncertainty, the weights of the formative indicators were the highest for the product to market cycle and changes in order content. The negative weight for the product to market cycle was unexpected, which might mean that as product to market cycles times get longer, companies see little value in sharing information with suppliers. However, with increasing pressures to bring products to markets faster, Finnish companies are finding it useful to collaborate with their suppliers. On the other hand, the same indicator weight in the Swedish sample was positive, which reverses the argument: perhaps more information is shared as complex products with longer product to market cycle times require a higher level of supply chain planning and collaboration. For environmental uncertainty, government regulation and production and IT had the largest weights, which are factors that companies can hardly estimate themselves.

These overall results for hypotheses one and two were consistent with the theoretical framework of the paper, which argued that companies strive at minimizing uncertainty as this enables better decision making. The results agree with Zhou and Benton (2007), where supply chain dynamism was found to be significantly related to information sharing. However supply chain dynamism in Zhou and Benton (2007) referred to only the rate of product innovation, which in comparison to the uncertainty constructs in this study was narrow in focus. The results also agree with the hypothesis in Li and Lin (2006). However, unlike in Li and Lin (2006), the results were all significant and positively related to information sharing (including supplier uncertainty).

Dependency and information sharing (H3) and (H4)

According to the t-statistics (see Appendix 2), key supplier dependency and buyer dependency had a significant and positive relationship with the intensity of information shared with key suppliers. This can be interpreted in many ways: as companies become more dependent on each other, they might want to improve their relationship and to gain each

others trust, which could be possibly achieved through some kind of collaboration. Another explanation could be that as buyers become more dependent (because of for example increasing asset specific investments) on their key suppliers, suppliers are able to demand more information from their buyers. It might also be the case that, as buyers become more dependent on their suppliers, buyers are willing to "pay" for more information by, for example, financing the implementation of integrated information systems and by providing free consulting. These kinds of "gestures" however cannot guarantee the sharing of information, especially of a strategic nature. The same logic can also be applied to a supplier's dependency on the buyer: Powerful buyers can force smaller suppliers to act in their own interest, which might conflict with suppliers' interests. To give an example of extreme buyer power, Wal-Mart, the biggest retailer in the world, was in the position to demand from its key suppliers to have all supplied products to be tagged with Radio Frequency Identification (RFID) (Hoffman, 2005). If this mandate was not met by a certain date, Wal-Mart threatened to abandon or fine them. The reason for this mandate was that Wal-Mart saw RFID tags, which help track goods as they move along the supply chain, as an important cost reducing technology. The implementation of RFID was however seen to be too costly for some suppliers, which operate with low margins.

PLC stage and information sharing (H5)

The relationship between the PLC stage and information sharing was slightly positive but not significant. For this hypothesis, the relationship was also tested for curve linearity but this neither yielded significance. One explanation could be the possible deficiency of the proxy measure for risk. It might have been better to focus on information sharing at different stages of a company's PLC as in Wagner (2003) rather than at the company level. The measure used in this study was perhaps too general.

Information sharing and performance (H6)

Hypothesis 6 was supported, as a positive relationship between information sharing and the three performance measures was found. This was consistent with previous studies (e.g. Li et al., 2006; Bagchi and Skjoett-Larsen, 2005; Petersen et al., 2005; Saeed et al., 2005) and the theoretical argumentation of this study: Information sharing reduces uncertainty and improves decision-making. The strongest relationship was found between information

sharing and output. This was expected. Whereas information sharing reduces the bullwhip effect and relatively swiftly impacts customer satisfaction, on-time delivery, etc. (output performance), resource (or flexibility) improvements in, for example, personnel requirements and operational costs, might take longer and are also somewhat less obvious to all the personnel. In some cases, the benefits of information sharing might take rather long, that is, when, for example, new capital budgeting decisions based on enhanced information availability are implemented.

The results for the Swedish sample are in Figure 5 and in Appendix 2 (loadings/weights, AVE, and t-statistics). The results were similar. All the hypotheses except H5 were supported. Also, direct and saturated models were tested to compare with the proposed model. Results gave support that the proposed model was better than alternative models.

Figure 5 here

Since the results from the two samples were similar, it was appropriate to pool the data. The results were similar to country specific results. All hypotheses were supported except for the relationship between PLC and information sharing. The loadings, AVE, and composite reliability scores, were above the minimum threshold and were therefore satisfactory. R squared for the first part (determinants) of the model was 0.22 and for the second part (consequences) 0.168, 0.226, and 0.112, where the average R squared was 0.182. Regarding the first part of the model, the values were clearly higher for the country specific values (Finland 0.34, Sweden 0.29). Hence, pooling the data lead to a loss in variance explained. For the second part of the model, R squared for the pooled data was an average of the values obtained for each country. The summary of the results in terms of which hypotheses were supported and which were not is given in Table 2.

Table 2: Summary of the results

Hypoth. Nr.	Hypothesis	Support
H1	Environmental uncertainty is positively related to the intensity of information shared with key suppliers.	Yes
H2	Demand uncertainty is positively related to the intensity of information shared with key suppliers.	Yes
H3	A key supplier's dependence on the buyer is positively related to the intensity of information shared with key supplier.	Yes
H4	A buyer's dependence on the key supplier is positively related to the intensity of information shared with the key supplier.	Yes
H5	The intensity of information shared with key suppliers is positively related to the product life cycle stage of the buyer.	No
H6a	The intensity of information shared with key suppliers is positively related to resource performance.	Yes
H6b	The intensity of information shared with key suppliers is positively related to output performance	Yes
H6c	The intensity of information shared with key suppliers is positively related to flexibility performance.	Yes

Conclusion

The purpose of this study was to find out what factors determine information sharing between companies, which is a desired but in practice, a limited phenomenon. The study developed a model using the transaction cost theory framework to explain information sharing in a buyer supplier context. The model was separately tested with data from 119 Finnish and 102 Swedish companies. The results indicated that uncertainty (both demand and environmental), and dependency had explanatory power (positive relationships) for the level of information shared with key suppliers, whereas the product life cycle stage of the focal company was found not to be significant. This study makes theoretical and methodological contributions by extending on a number of studies including, Zhou and Benton (2007), Li and Lin (2006), and Bagchi and Larsen (2002). This is so with respect to the hypotheses on the relationship between uncertainty and information sharing, which were previously unsupported. There is also a contribution to transaction cost theory by investigating whether asset specificity and switching costs (dependency) play a role in interorganizational information sharing. The results confirm Dyer (1996) and Williamson (1991), that asset specificity encourages integration, although not only in the sense of vertical integration. One of the methodological highlights of the study was to use formative indicators as opposed to reflective indicators for demand and environmental uncertainty, which had not been done before. This study also confirmed previous results with respect to information sharing leading to better firm performance especially regarding output.

As for the limitations of this study, first of all, only the buyer's perspective was investigated. Future studies should also include key suppliers or multiple parties in the supply chain. Furthermore, since a single respondent answered all the questions in the survey, the likelihood of common method bias has to be taken into account. Another limitation or weakness of the study is the low response rate. Although comparable to similar studies in the Nordic Region, reminders for completing the survey would have improved the response rate. However, no reminders were sent out to the companies.

The overall results shed descriptive light on a common trend in supply chains today. Companies continue to adopt supply chain technologies and practices. However, being contingent on the factors discussed in this study, information sharing is limited and selective.

Clearly, there are many research possibilities in this field. More research can be done on other factors that might influence information sharing between companies and perhaps factors that are moderating this relationship. This would complement theory and thus lead to a better understanding of the topic. For example, a factor of interest to research might be absorptive capacity: “the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends” (Cohen and Levinthal, 1990). Absorptive capacity might mediate the relationship between information sharing and performance. This topic would also benefit from case study research, where only a few exist (some examples are Bagchi and Skjoett-Larsen, 2002; Cassivi et al., 2004). Qualitative information from case studies could provide more insight and depth for discussions and interpretation, which are so far based on, primarily, quantitative data.

Having confirmed that transaction cost theory can be used as a lens to view interorganizational information sharing, it might be interesting to look at more specific and/or strategic types of practices such as interorganizational cost management through the use of integrated measurement systems and interorganizational teams. However such practices might be relatively uncommon. Thus, multiple case studies might be more appropriate for this kind of research. In addition, longitudinal studies would provide insight into the practices of firms, using alternative lenses such as the old institutional economics, which focuses upon processes rather than outcomes.

More practitioner-oriented research could be valuable too. For example, how can a cost – benefit analysis be carried out for the purpose of integration? How can the risk of opportunism be quantified versus benefits of integration? This would help firms make more efficient and effective choices when evaluating integration opportunities with other firms.

Managerial implications

Despite the many uncertainties they face, companies have to constantly make critical business decisions such as in which future capabilities and products to invest as well as what and how much to produce. Sound decision making requires access to timely and accurate information. For this purpose, companies can turn to their supply chain partners for valuable

information, knowledge, and coordination. Sharing forecasts, trends, and plans can reduce, among others, stock outs, obsolescence, inventory and logistics costs. So, practitioners might want to reconsider the importance of working more closely with their exchange partners in order to maintain and improve their competitiveness. Furthermore, information sharing between supply chain partners is a relatively easy and cost-effective solution against uncertainty when compared to alternatives such as adding buffers, flexibility, and capacity to the supply chain.

Information sharing requires that the exchange partners clearly see the advantages of collaboration. This requires an initiator, who can effectively communicate with the involved parties. A powerful exchange partner with high influence on the supply chain can better accomplish such a task (Bagchi and Skjoett-Larsen, 2002). A reputable and powerful exchange partner can also help build confidence and trust into the initiative by showing commitment and determination. Thus, as long as the parties act fairly and power is not abused, power can act as a positive force in the supply chain.

The lack of trust is seen as an impediment to information sharing (Kemppainen and Vepsäläinen, 2003; Akintoye et al., 2000; Dekker, 2003 and Bagchi and Skjoett-Larsen, 2002, 2005). This is not surprising as the sharing of critical company information might carry the risk of opportunism or information spill-over. Thus, if a partner expects opportunistic behavior, it can withhold or exchange inaccurate information so that information in no longer valuable (Inkpen, 2001). Companies might also perceive the sharing of private information as a threat to their bargaining power and might therefore withhold information (Kaufman and Mohtadi, 2003). Whereas, a certain level of trust could possibly be achieved over time, through refraining from opportunistic behavior, the perceived loss of power is more difficult to solve. Furthermore, because information can be viewed as an asset, companies might not want to give it away for free, unless they are compensated. One solution could be the negotiation of the terms of compensation in advance, although it might be hard to quantify the exact stakes. Also, selective collaboration with the most trusted partners could be a good strategy to follow so as to keep the risk of opportunism at minimum.

Given that the involved parties understand the potential for mutual benefit (although their magnitude might differ), the companies are likely to engage in information sharing. For example, if order variability is a problem, the companies could begin to collaborate by sharing

demand forecast data, what today, as the results of this study suggest, many companies already do. Once the companies begin to realize the benefits (e.g. through smaller order variance) of information sharing, more advanced forms of collaboration can follow. Moreover, collaboration will become even more effective when similar initiatives are carried out at different exchange points along the supply chain, gradually leading to supply chain management in a true sense.

A drawback of information sharing but more so process integration is the likelihood of intensifying interdependencies between companies, e.g. as a result of dedicated IT systems (Teo et al., 2003) or relying too much on one key supplier. The drawbacks and risks to information sharing can be to some extent mitigated if a more cautious approach is followed. This would involve a gradual and step by step approach to adopting promoted solutions and practices, weighing carefully costs and benefits and avoiding hasty implementations that follow trends.

Collaboration and information sharing is a relational phenomenon and means more than setting up physical communication linkages between companies. This may also explain why collaboration is not as extensive as one would expect, given the recent attention this topic has received from both academia and industry. Often, companies tend to focus on the applications of IT on SCM but do not give enough attention to the development of interfirm relationships (Li and Lin 2006). Thus, the building of trust, commitment, and shared vision is crucial. Trust, commitment, and shared vision not only increase information shared but also improves its quality (Li and Lin 2006). However, trust in itself is not the motivation for information sharing but it is the benefit that companies expect from it. Thus, trust can be seen as a risk minimizing factor whereas uncertainty and dependency motivate and increase the pay-off. Hence, the level of uncertainty and dependency between companies determine collaboration intensity because with increasing uncertainty and dependency, companies are likely to benefit more from collaboration through streamlining the supply chain and better safeguarding their assets. Therefore, comparisons and benchmarking should be done with caution as the level of information sharing and collaboration need not be high across all supply chains.

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Appendices

Appendix 1

Factor Analysis – Performance – Confirmatory - Finland

Factor	Loading	Variance Expl.	Cronbach's Alpha	Item Mean Scale: 1-7	Stand. Dev.
Resource Measures		49%	0.813		
energy use	0.756			2.43	1.29
equipment utilization	0.736			3.47	1.48
operational costs	0.734			4.30	1.36
inventory turnover	0.662			4.58	1.47
personnel	0.584			3.19	1.55
Output Measures		56%	0.841		
on-time delivery	0.901			5.10	1.49
customer satisfaction	0.869			4.92	1.56
fill rates	0.780			4.15	1.68
stock-out costs	0.710			5.02	1.45
product quality	0.339			3.84	1.63
Flexibility Measures		50%	0.723		
new product introd.	0.897			3.89	1.68
product variety	0.687			3.53	1.68
flexibility to deliver	0.475			5.18	1.37

Factor Analysis - Supplier Dependence - Finland

Factor	Loading	Variance Expl.	Cronbach's Alpha	Item Mean Scale: 1-7	Stand. Dev.
Supp. Depend.		66%	0.828		
monetary costs	0.960			4.15	1.74
search costs	0.869			3.89	1.76
specific investm.	0.542			3.66	1.73

Factor Analysis - Buyer Dependence - Finland

Factor	Loading	Variance Expl.	Cronbach's Alpha	Item Mean Scale: 1-7	Stand. Dev.
Buyer Depend.		56%	0.893		
monetary costs	0.991			4.43	1.54
search, contr. costs	0.811			4.16	1.55

Factor Analysis - Information Sharing –Finland

Factor	Loading	Variance Expl.	Cronbach's Alpha	Item Mean Scale: 1-7	Stand. Dev.
Inf. Sha.		49%	0.868		
processes	0.792			4.25	1.39
informed	0.724			4.04	1.52
proprietary (1)	0.695			3.74	1.65
proprietary (2)	0.690			3.98	1.36
issues	0.688			4.87	1.15
needs	0.676			5.30	1.20
planning	0.642			4.13	1.45

KMO: 0.79, Barlett's Test: significant

Appendix 2

Model – Finland (T-statistics)

	InfoSha.	Resour.	Output	Flexib.	DemUn.	Supdep.	Buydep.	ExtUn.	PLC
InfoSha.	0	0	0	0	3.9595	2.1431	2.9244	3.154	0.5794
Resou.	7.9926	0	0	0	0	0	0	0	0
Output	10.0784	0	0	0	0	0	0	0	0
Flexib.	5.0297	0	0	0	0	0	0	0	0
DemUn.	0	0	0	0	0	0	0	0	0
Supdep.	0	0	0	0	0	0	0	0	0
Buydep.	0	0	0	0	0	0	0	0	0
ExtUn	0	0	0	0	0	0	0	0	0
PLC	0	0	0	0	0	0	0	0	0

The Outer Model - Finland

Factors	l/(w)	AVE	Comp. Rel.
Demand Uncertainty		NA	NA
rate of product introductions	(0.107)		
product demand	(-0.131)		
short life cycle times	(0.413)		
large product variety	(0.245)		
sales channels	(-0.024)		
product to market cycle time	(-0.602)		
frequent orders	(-0.255)		
changes in order content	(0.424)		
orders expedited frequently	(0.363)		
lead times of products	(0.283)		
Environm. Uncertainty		NA	NA
supplier's actions	(0.024)		
customer demands	(-0.121)		
deregulation and globalization	(-0.276)		
competitors	(-0.062)		
production and IT	(0.396)		
government regulation	(0.877)		
economic environment	(0.054)		
industrial relations	(-0.138)		
Supplier Dependency		0.735	0.893
lost sales	0.894		
searching effort	0.883		
asset specific investments	0.791		
Buyer Dependency		0.899	0.947
monetary cost	0.947		
effort	0.950		
Product Life Cycle			
Intensity of Information Sharing		0.564	0.900
proprietary (1)	0.745		
needs	0.730		
proprietary (2)	0.738		
informed	0.726		
processes	0.806		
planning	0.727		
events	0.779		
Perform. resource		0.628	0.832
equipment utilization	0.874		
energy use	0.852		
product quality	0.627		
Perform. output		0.627	0.921
inventory turnover	0.683		
operational costs	0.793		
stock-out costs	0.763		
fill rates	0.766		
on-time delivery	0.898		
flexibility to deliver	0.777		
customer satisfaction	0.833		
Perform. flexibility		0.642	0.843
personnel requirements	0.772		
product variety	0.826		
new product introductions	0.805		

NA: Not applicable

Model – Sweden (T-statistics)

	InfoSha.	Flexib.	Output	Resource	DemUn.	Supdep.	Buydep.	ExtUn.	PLC
InfoSha.	0	0	0	0	3.747	2.0611	2.3465	2.7627	1.4328
Flexib.	3.2002	0	0	0	0	0	0	0	0
Output	4.2898	0	0	0	0	0	0	0	0
Resource	3.5608	0	0	0	0	0	0	0	0
DemUn.	0	0	0	0	0	0	0	0	0
Supdep.	0	0	0	0	0	0	0	0	0
Buydep.	0	0	0	0	0	0	0	0	0
ExtUn.	0	0	0	0	0	0	0	0	0
PLC	0	0	0	0	0	0	0	0	0

The Outer Model - Sweden

Factors	**l/(w)**	**AVE**	**Comp. Rel.**
Demand Uncertainty			NA
rate of product introductions	(0.641)		
product demand	(-0.080)		
short life cycle times	(-0.353)		
large product variety	(0.381)		
sales channels	(0.207)		
product to market cycle time	(0.257)		
frequent orders	(0.001)		
changes in order content	(0.173)		
orders expedited frequently	(-0.030)		
lead times of products	(-0.012)		
Environm. Uncertainty		NA	NA
supplier's actions	(-0.941)		
customer demands	(0.380)		
deregulation and globalization	(-0.020)		
competitors	(0.126)		
production and IT	(0.027)		
government regulation	(0.184)		
economic environment	(0.497)		
industrial relations	(-0.155)		
Supplier Dependency		0.89	0.947
lost sales	0.933		
searching effort	0.963		
asset specific invest.*			
Buyer Dependency		0.66	0.857
monetary cost	0.854		
effort	0.909		
asset specific invest.	0.671		
Information Sharing		0.57	0.904
proprietary (1)	0.699		
needs	0.766		
proprietary (2)	0.755		
informed	0.808		
processes	0.687		
planning	0.824		

events	0.751		
Perform Resource		0.71	0.880
energy use	0.810		
oper. costs	0.868		
equipm. utiliz.	0.848		
Perform Output		0.57	0.888
On-time del.	0.835		
flex. to del.	0.809		
cust. satisf.	0.825		
fill rates	0.779		
inv. turnover	0.656		
stock-out costs	0.603		
pers. requirem.*			
Perform Flexibility		0.79	0.919
prod. variety	0.911		
new prod. intro.	0.912		
prod. quality	0.842		

* discarded as it loaded 0.598 in PLS
NA: Not applicable