Abstract

Many organisations cooperate with customers and integrate in various ways to create further operational synergy and to reduce uncertainty in demand. Supply chain integration offers the opportunity to capture synergies and there are many advantages for organisations that integrate into networks of customers (and suppliers). Sharing of information between organisations makes it possible for a supplier to obtain early signals about changing market conditions and thereby reduce its reliance on uncertain forecasts on the demand side to get a higher utilization of production facilities and lower safety
stocks. However, there are also opposite drivers of uncertainties seen from a subcontractor’s perspective, e.g. smaller customer structure that increases dependency. The optimal strategy is to balance these drivers. The aim of this paper is to observe risk and uncertainties inside the transactional environment from a subcontractor’s perspective. The paper gives a theoretical framework and observations from industry.

**Introduction**

Many organisations cooperate with customers and suppliers in networks to create further operational synergy and to reduce uncertainty in demand and supply. Research also confirms that operational performance can be improved with supply chain integration. Highly integrated partners in supply chains might provide access to each other’s business and manufacturing plans. As a result of such integration, suppliers may reduce the uncertainty in forecasts on the demand side and may also obtain early warnings about disruptions of supply due to unforeseen event and thus improve operational performance.

A supplier that is focusing its network to fewer partners will be exposed to new risks as well as possibilities to improve its competitiveness through decreasing transaction costs. The challenge for the supplier is to find a right balance between risks and potentials. Transaction cost analysis is a possible framework to describe uncertainties for organisations integrating vertically. This paper covers the area of risks and uncertainties in a dyadic relationship from a transaction cost perspective as well as a discussion about how integration and its relations to transaction costs could be empirically analysed.
Supply Chain Integration

The challenge in supply chain management is to coordinate activities across the supply chain in a system that “simultaneously” works to minimise total costs for the material flow and maintaining desired customer level, so that the enterprises within the system can improve performance, for example through reduced costs, increased service levels, reduced bullwhip effects, better utilisation of resources and more effectively respond to changing market conditions. These challenges can be met by integrating the front-end of the supply chain (the customer demand) to the back end. The availability of information obviously plays an important role in supply chain integration. Over time, the concept of supply chain integration has developed to cover production planning, allocating and controlling financial and human resources dedicated to different logistical operations throughout many systems of enterprises.

Global and local optimisation

Trying to find the best trade off for any isolated stage in the supply chain is not sufficient if the goal is to connect the front-end to the back-end. If there is only one owner of the whole system, it is clearly in this owner’s interest to make sure that the overall costs are reduced. However, even if there is not any owner for the whole system there is still a need to coordinate the various systems to make them operate effectively. A critical issue is to whom it is interesting to reduce overall system cost, through the supply chain, and how any savings will be distributed between system owners.
There are two extremes along the dimension of integration. When the system is not coordinated to any extent we have a situation of *local optimisation*, where all owners of the system do what is best for them. *Global optimisation* on the other way, are ways to globally integrate the systems. This is however a challenging problem and many factors contribute to make this a complicated problem:

The supply chain is a complex network of facilities dispersed geographically. Supply chain relationships are dynamic and evolve over time due to changes in demand. Other factors that change the relationships are that customers’ bargaining power as well as other suppliers’ power changes over time. Advertising and competitors various pricing strategies, market trends and other factors greatly influence the planning processes within the system.

The level of uncertainty in the environment makes it further more difficult for an organisation to operate within a globally optimised supply chain, compared to a system optimising locally. Some of the factors contributing to this are the problems of matching demand and supply as well as lead times in manufacturing and transportation causing uncertainty in planning and distribution. All uncertainty can not be eliminated, but there are various strategic and operational approaches that minimises the effect.

For any supplier, managing the uncertainty in product demand represents a big opportunity of improvement. The uncertainty level is a critical performance factor of the supply chain, both in terms of service levels in order fulfilment processes, and cost levels.
in manufacturing and distribution. High uncertainty levels in demand information have an unfavourable impact on supply chain performance, resulting in lost sales or obsolete inventories and inefficient utilization of resources. Collaboration with customers to achieve better understanding of market demand is one way to reduce this uncertainty.

In a supply chain with few direct contact points between the entities, communications systems are often inadequately connected and information flows are not structured. The case with high integration is often characterised of many direct connections at various decision levels across the cooperating entities. Purchasing people might communicate with product developers of the supplier. Planners of production and capacity at the supplier might be in direct contact with the buying organisation in order to take part of forecasts and buyers strategic planning. Well integrated supply chains have often implemented ERP-systems like SAP, Intentia or similar systems and making them compatible across cooperating organisations.

Another difference is that a highly-integrated supply chain is the focus on proportional balancing of risk and cost between the participants. Well-integrated supply chains are also frequently characterised by joint investments in technology, whether it is in production or in other areas, like development of common training programmes or implementation of information technology. These investments are in many cases only of partial use in alternative cases (Bagchi and Skjoett-Larsen, 2002).
Global optimisation and performance improvements

Research conducted in the area of inter-organisational integration and performance improvements (e.g. Daugherty, 1996), have often credited integrated supply chains with achieving cost reductions, as well as increasing efficiency and productivity (Gopal and Cypress, 1993; Christopher, 1994; Lambert et al, 1978). There have for example been reported benefits (see for example Muller, 1991) through reductions in inventory, shorted lead times, enhancements in customer service and improved forecasting and scheduling. A fairly representative example of these studies is Daugherty (1996), in which a mail survey was sent to in total 295 logistical executives.\(^1\) The first area of research interest involved assessing the respondents’ perceptions about their firms’ status in degree of implementation of integration of logistics. The definition of integration was taken up from earlier research by Lambert et al (1978). Respondents were asked, after a brief description of integrated logistic systems: “In your firm, what is your opinion regarding the nature of the integrated logistics concept?” Five different options were provided and respondents were asked only to mark one.

In the questionnaire, respondents indicating 1-2 were considered to be non-integrated on a five-point scale. The respondents replying 3-5 were considered being integrated. The

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\(^1\) Around two thirds (70%) came from manufacturing area of operations and the remaining 20% from retailing. Respondents represented firms in various sizes and 44% had sales exceeding $1 billion.
results were that 28% of the respondents categorised themselves 1 and 2 and 72% as 3, 4 and 5.2.

To summarise, a number of studies show that firms, that have implemented integrated logistics, have greater success in achieving logistic performance improvements than do non-integrated firms. However, measuring logistic performance or finding appropriate definitions of logistical performance, are areas where there is little agreement, according to a review of the literature (ibid). In most cases, logistical performance is usually considered to be a complex construct, where multiple indicators are used linked to the organisations goals (i.e. Rhea and Shrock, 1987; Chow et al, 1994).

Despite the reported improvements in logistical performance as discussed above, there is a large gap between the supply chain ”rhetoric” found in literature and in reality when it comes to level of integration. Research show that few companies are actually engaged in extensive supply chain management defined as several tiers of customers and suppliers (see for example Akkermans, 1999; Harps, 2000; Kilpatrick 2000; Fawcett and Magnan, 2002). The disadvantages of global optimisation thus seem to be considerable for the system owners, slowing the system wise optimisation.

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2 Level of integration and percentage of firms (N=127): (1) Not been recognised (16.7), (2) Been recognised, but the decisions was made not to implement it (11.1%), (3) Been recognised and adopted, but not successfully implemented (21.4%), (4) Implementation in progress (42.1%), (5) Been adopted and successfully implemented (8.7%)
A major study on supply chain integration between suppliers and customers was conducted in 1995 by IBM and some other companies (Neuman and Samuels, 1996). They asked how far the vision of seamless supply chain integration between partners had been adopted in industry. The study showed that the vision of supply chain integration is commonly known. However, the implementations of the vision were not taking place very rapidly. Both manufacturers and suppliers emphasized the importance of changes in culture and organisational structures to increase the pace. Typically, they mentioned the need for openness in communications, honesty and mutual trust. However, when asked how the other part was measured and evaluated, both manufacturers and retailers switched character and singled out more traditional criteria to evaluate and judge the other partners in the supply chain. Low costs, quality of goods, on time deliveries were such variables.

3 A sampling of the views among 200 executives gave in summary two major reasons for the lack of progress. The first reason was misconceptions and miscommunications between potential partners and second reason was frustrations about new roles and new relationships that the challenge of supply chain integration take. Respondents on the customer side observed that what was missed a lot of times was a clear focus on what was important for the supplier. On supplier’s side, they also did lack knowledge of what the customer’s goals were with partnering. They feel like the customers are “playing games” with them and fail to inform them on coming events that might be important for the supplier, like promotions and special orders. It is often difficult to find out what customers want in terms of things like EDI. Respondents claiming that the communication lines were functioning mentioned that open communication lines in general were important prerequisites, not necessarily at buying/selling level but involving several levels in partnering organisations. Organisations that succeeded in communicating had in many cases modified their organisational structures in order to prepare for integration with closest supply chain partners.
Transaction costs economics: the antecedents

As discussed earlier in this paper, there are many advantages for a supplier or an organisation in general to collaborate with other organisations in “supply chain” networks. However, close collaboration also brings several risks and uncertainties to “networking” companies and the level of integration is low in several lines of businesses. The transaction cost theory here offer a possible framework for analysing industrial networks as well as risks and uncertainties related to being part of networks. Transaction cost theory was developed from neoclassical economic theories. The transaction cost theory gradually developed as a result of the obvious limitations of the neoclassical economic theories when describing relationships between organisations. A basis in the neoclassical theory is the idea of a single product firm, operating in a perfectly competitive environment with a large number of competitors all producing the same type of products, facing the same costs and demand curves (Hobbs, 1996). The theory has then been extended to cover market situations as monopolistic competition as well as oligopoly.

The standardised neoclassical theory meaning of transaction is the exchange of a homogenous product, with no variations in quality and therefore no costs of measuring the quality of the product. There is, due to this, no uncertainty in prices, product performances or in the behaviour of competitors or customers. Neoclassical theories and economic analysis if focused on equilibrium market conditions and there is limited
consideration of how business relations occur. Transactions are assumed to occur in a
frictionless environment. When looking at neoclassical theory and its main assumptions,
it is obvious that its framework provides few insights when studying supply chain
management (ibid).

Unlike the neoclassical economics, the Coasian approach (Coase, 1937) dealt with costs
for using the market mechanisms. Coase (ibid.) suggests that the main reason for
establishing a firm is that there is a cost of using the price mechanisms. This costs include
(a) the costs of identifying what the prices should and (b) the costs of negotiating
individual contracts and specifying the details of transactions. These costs were later
termed transaction costs. Costs of transactions are one important explanation of the shape
of the organisation of the firm and the business relationships to the environment. One
could e.g. expect an organisation to carry out its transactions through a vertical
integration rather than through an open market, should open market transaction costs be
higher, other things equal.

Coase (ibid) is generally acknowledged as the “founder” of transaction cost economic,
although he doesn’t use this terminology (Dietriech, 1994). The first author to use this
terminology was Arrow (1969), who discussed transaction costs as “running the
economic systems”, and that transaction costs, in particular cases, block the formation of
markets. Transaction costs are basically the costs of carrying out exchange either between
firms on a marketplace or transfer of resources between stages in a vertically integrated
firm, when the neoclassical prerequisite of perfect and costless information is “relaxed”.
The word “transaction” is here used in a broader sense than the normal English language usage, which does not consider the movement of resources as transactions. Within-firm transfers of resources are also considered to be transactions.

One of the building blocks in the evolvement of transaction cost economics is Simon’s (1957, 1961) concept of ”bounded rationality”. The concept is based on two basic principles. (1) Groups of individuals or individuals have limited capacity to process and understand information that is available. Shortly, informational complexity exists. (2) Additionally, it is implausible to suggest that individuals are able to identify all cause-effect relationships, from which probabilities of outcomes might be calculated. Actors are thus faced with incomplete information; shortly, information uncertainty exists. With the same information available, there might be different understanding of this information between different actors.

Another building block in transaction cost economics is the “economics of information”. Neoclassical theory assumes that there is full information about the transaction for participating partners. Transaction cost theory in contrast, recognises that many business exchanges are characterised by incomplete, imperfect or asymmetrical information actors before, or after, a transaction has occurred. This is not the same as information incompleteness or uncertainty, which is instead referring to a situation where all parties involved in a transaction face the same, but incomplete, level of information.
Informational asymmetry arises when there is public information available to all parties but also private information that is only available to a limited number of parties. Ex ante asymmetries occur when one party, prior to a transaction, has less information about a purchase or sale than the other, but this asymmetry is eliminated after the transaction is completed. This is termed and known as adverse selection after a work of Akerlof (1970). The problem is for example manifested on markets for second-hand cars.  

Ex post asymmetrical information occurs when one actor has less information even after the transaction has happened. One type is termed moral hazard. Moral hazard occurs because of hidden actions of the parties involved in the transaction. An incentive to act opportunistically arises for an individual or an organisation if their actions are not observable by other parties involved in the transactions.  

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4 If the seller is aware of defects that are hidden for the buyer, the seller might act opportunistically by refraining from revealing these defects prior to a transaction. Buyers of second-hand cars are always facing the risk that the seller is acting opportunistically. The problem for the whole second-hand car market is that, since the buyer are not aware of the differences between a decent car and one with hidden defects, all cars must sell at the same market price. At this price, sellers of good cars will earn less money than sellers of cars with defects. Selling cars with hidden defects tend to be a better option for most sellers and supply on the market will contain more and more defected products. This is one explanation why prices on new cars depreciate rapidly after being sold (see Akerlof, 1970).

5 One example is an individual that has obtained insurance for car-theft, once it is obtained the individual is less cautious. This might in itself lead to higher insurance premiums. Individuals might also (opportunistically) damage items on purpose in order to collect insurance payments. In both cases, there exists informational asymmetry because the actions of the individuals are not directly observable by the provider of the insurance.
Williamson (1979) follows Arrow’s definitions of transaction costs as costs of running an economic system, as such being somewhat equal to “friction” in physics. Transaction costs are basically divided into three main categories:

- Information costs.
- Negotiation costs.
- Monitoring (or enforcement) costs.

Firms and individuals face costs in search for information about products, prices, buyers and sellers. Negotiating costs emerge from negotiating and writing contracts (in terms of managerial expertise, travels etc) or costs of hiring an intermediary to the transaction, such as a broker. Monitoring or enforcement costs occur after the exchange has been negotiated. This may involve the monitoring of the quality of the goods from a supplier or monitoring the behaviour of a buyer or a supplier to ensure that all the agreed terms of the transaction are met. Information is a key role in all three cases and lack of information prior to a transaction is explicitly considered to be an information cost.

Williamson (1985) argues that the existence of transaction costs depend on three factors: bounded rationality as discussed above, opportunism and asset specificity. *Opportunism* is basically the recognition that individuals will sometimes try to find out how situations can be exploited to their own advantage (see Williamson 1985: p.47). This does not imply that individuals act opportunistic all the time, more that the risk of opportunism is normally present. For example, if the numbers of alternative suppliers is low, the higher
the risk that an existing supplier will act opportunistically to change the terms to their own advantage. Opportunistic behaviour might be the result of informational asymmetry, ex ante opportunism and ex post opportunism. Ex ante opportunism is the situation where information is hidden for one of the participating partners prior to a transaction.

When an organisation has invested resources tied to a certain relationship or partnership that has little value in an alternative use, *asset specificity* arises. There are many examples of this, e.g. implementation of information technology that is adapted to the partner or development of products unique to one market. The risk is that organisation “A” that has made the unique investment, might face tougher conditions from organisation “B” that knows that organisation A is locked into an agreement with limited possibility to alter the exchange and find new customers in the short run. Organisation A might have limited possibility to refuse a renewed contract, with lowered prices, from organisation B.

Organisation A needs a certain “rent”, or a certain minimum amount over the minimum return it need to cover the expenses for the investment. Organisation A faces the risk that B will appropriate some of this rent when A is locked into the agreement. The opportunistic behaviour of firm B is termed post-contractual opportunistic behaviour or opportunistic contracting. The appropriate rent captured by firm B is called quasi-rent, which obviously is a risk for firm A when integrating with B.

According to Williamson (ibid) there will be no transaction costs if bounded rationality, opportunism and asset specificity do not exist. Were there no opportunism, any gap that
existed in contracts would not cause any damages to the involved parties, because neither party would attempt to gain any advantage over the other. When asset specificity is not present there is no need to have continuous economic relationships, thus markets will be fully enough (see also Dietriech, 1994).

Given the existence of the three factors mentioned above, transaction cost economics claims to be able to specify governance structures that can efficiently manage economic activities in different situations. Different situations are defined in terms of combinations of three factors; asset specificity, uncertainty and frequency of use (Dietriech, 1994, Hobbs, 1996).

A more common interest in transaction cost theory did not evolve in the scientific community until the late 1970s and an outline of theories gradually emerged based on the conception of transaction costs, including transaction cost economics, property rights school, agency theory, the economics of the multinational enterprise and transaction cost approach to economic history. Although focusing on different problems, these approaches all have their roots in the original ideas of Coase (1937) and use the concept of the transaction costs to explain the organisation of the firm and the way they interact along the supply chain.
Vertical co-ordination – a transaction cost perspective

Vertical co-ordination is a central issue in supply chains and includes ways to harmonize the successive stages of production, distribution and marketing. The level of vertical co-ordination varies a lot between different industries and market areas. Spot markets are at one extreme of the “vertical co-ordination spectrum”, where price is the most important determinant of the transactions taking place. No negotiations take place concerning the specific transaction, the buyer either accept the product as it is or doesn’t buy it.

Examples of spot markets are stock markets and consumer goods purchases in supermarkets. There is no management of the supply chain in spot markets (see for example Hobbs, 1996; Williamson, 1985). At the other end of the scale is full vertical integration, where products move between different stages of the supply chain more as a result of organisational orders. Thus, there must be some supply chain management or other managerial activities to make the supply chain functional, in contrast to the case of spot markets. There are of course a myriad of ways to co-ordinate economic activity between these extremes of spot markets and fully vertically integrated firms. Strategic alliances is sometimes a less formal way to integrate vertically than setting up formal contracts but they are both examples of alternative ways to co-ordinate economic activities between firms that lies between the two extremes.

Transaction costs are one of many determinants of appropriate level of vertical integration. Strategic issues, economies of scale are examples of other determinants. Some of the key determinants of vertical co-ordination according to transaction cost
theory are (1) the degree of uncertainty surrounding the transaction, (2) the degree of asset specificity and (3) the frequency of the transactions (Hobbs, ibid.).

<table>
<thead>
<tr>
<th>Determinants of level of vertical integration</th>
<th>Spot market</th>
<th>Full vertical integration</th>
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<tbody>
<tr>
<td>Degree of uncertainty surrounding the transaction.</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Asset specificity.</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Frequency of the transactions.</td>
<td>High</td>
<td>Low</td>
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</table>

*Table 1. Determinants of level of vertical integration*

The degree of uncertainty in the transaction is normally low in spot market transactions. When uncertainty in the transaction is high (such as uncertainty in product functionality, time of delivery etc), it usually results in a more formal sort of vertical co-ordination between the involved parties. The high level of uncertainty usually makes it necessary for the parties to take control over the outcome of the product through different measures, e.g. formal contracts or predefined ways to measure quality (see table 1).

Goods that have many different uses (low asset specificity) are likely to be sold on a spot market with no vertical co-operation between organisations. If asset specificity increases and alternative uses for goods sold are less common, they tend to be sold through e.g. long-term formal contracts and with more vertical co-operation in the supply chain.

Frequent transactions provide trading partners with information about each other on a frequent basis which lowers the transaction costs. Organisations with many transactions
tend to carry out their transactions on spot markets. However, if transactions become less frequent, organisations might face incentives to act opportunistically by exploiting informational asymmetry that might exist in the co-ordination.

To summarise, transaction cost theory give important insights within the area of supply chain management. In addition, many hypotheses can be derived from transaction cost theory. However, testable hypothesis require information about transactions which is usually very difficult to identify within organisations which has inhibited the use of transaction cost theory in the study of supply chains.

Uncertainty- a transaction cost perspective

Sources of uncertainty surrounding information

A general prerequisite in classical decision theory is that the decision maker is always acting in a way that choosing the appropriate alternatives maximizes total benefit. After the alternatives are chosen there is an outcome, which leads to different consequences that are possible to value in monetary units. In case those consequences are known and outcomes are also known, we talk about decision under certainty\(^6\) (NUTEK, 1992). In case several outcomes are possible, but the probabilities for each outcome are not known,\(^6\) Assume a game of roulette. If a person knows in advance that a certain number between 1 to 37 will come up on the board, say number 13, this is a decision under certainty. If the same person knows the probability, 1/37, as well as the consequences (the prize) and the game is not being manipulated in any way, it is a decision under risk. Assume that someone is manipulating with the roulette-table, so that the probabilities of the outcomes are not known, but the prizes are known, we have a case of decision under uncertainty.
and at the same time the consequences, which could be valued in monetary units, are known, we talk about *decision under uncertainty*. When probabilities of outcomes are known as well as consequences, we talk about *decision under risk*.

There are several problems when using this formal decision theory in reality. It is far from certain that we, for example succeed in finding the probabilities for the different outcomes, are aware of all relevant outcomes or are able to find the right estimated monetary values of the consequences. However, by gathering more information from a customer it is possible in many ways to increase the knowledge and to be more aware of e.g. outcomes and consequences (reducing the uncertainty). As mentioned earlier, one of the greatest challenges for any supplier in improving the business is to reduce the level of uncertainty in demand and supply, and thereby prevent it from disturbing logistic flows.

One of the categories in transaction cost analysis is the cost of information as discussed earlier in the paper. High uncertainty in short termed information prior to and after a transaction increases the transaction costs. Qualitative and quantitative sources or transaction related uncertainties are, for example, the accuracy in transferred order information and forecasts, see table 2 for examples.
### Sources of uncertainty

<table>
<thead>
<tr>
<th>Factors</th>
<th>Qualitative</th>
<th>Quantitative</th>
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<tbody>
<tr>
<td>Information accuracy</td>
<td>- Technical specifications</td>
<td>- Accuracy and completeness in transferred order information and forecasts</td>
</tr>
<tr>
<td>Information quality</td>
<td>- Proper formats of transferred information</td>
<td>- order and forecast accuracy</td>
</tr>
<tr>
<td>Information timeliness</td>
<td>- customer’s sharing of updates with supplier</td>
<td>- transfer speed of forecasts and orders</td>
</tr>
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Table 2. Examples of drivers of demand uncertainty in vertical co-ordination of a dyadic relationship related to short termed operational information.

Examples of long termed uncertainties are customer’s future pricing strategies, new product development, distribution or promotional strategies that may affect the future volumes and prices of the products.

### Consequences of uncertainties surrounding transactions

Shortcomings in information exchange, information qualities or order handling efficiency are all drivers of uncertainty and, consequently, transaction costs in relationships (through increasing information costs). In case planning processes are worsened, these uncertainties may result in lower than necessary capacity utilization, costs for overtime or delivery delays.

In a supply chain, the general level of customer demand uncertainty is an important antecedent in identifying and choosing the appropriate strategy for production and
distribution. One main question is whether an organisation should choose a “push-based” strategy or a “pull-based” strategy. Assuming everything else is equal, a higher level in demand uncertainty leads to a preference for managing the supply chain based on real demand, which is a “pull-based strategy”. On the other hand, a small level of uncertainty in demand leads to a preference in managing the supply chain based on long-term forecasts.

Reasoning in a similar way, everything else being equal, the higher the importance of economies in scale in reducing costs, the more important is the value of aggregating demand and thus the greater is the importance of managing the supply chain based on long-term forecasts. On the other hand, if economies of scale are not important, aggregated demand does not particularly reduce cost, thus a pull-based strategy makes more sense (see for example Semchi-Levi et al, 2003). Industries, or more precise, products, characterised by high uncertainty in demand and that economies in scale in production, assembly or distribution are not important, such as in the personal computer industry represent cases when pull-strategies are suitable. Dell computer is an example of this. Products might also be characterised by low demand uncertainty and important characteristics of economies of scale. Products in the grocery sector like beer, soup and pasta represent this category. Demand for these products is stable and a pull strategy is not appropriate.

The remaining two cases represent situations where the two attributes, demand uncertainty and importance of economies of scale mismatch. In these boxes, demand
uncertainty pulls the appropriate strategy in one direction, while importance of economies of scale pulls it the opposite direction (Simchi-Levi et al, 2003). A more precise analysis is required in these cases because both traditional push and pull strategies might be appropriate depending on cost and revenue structures in the business. Examples of that are books and CDs as well as furniture. A combined push-pull strategy might be more appropriate in these cases. Finally, there is a case for which products and industries are characterised by high uncertainty in demand while importance in economies of scale is important. The furniture industry is a good example of this. A typical furniture retailer offers a large number of similar products distinguished by shape, colour etc. and as a result of this, the demand uncertainty is high. Delivery costs are also high because these products are bulky. In this case there is a need to distinguish between manufacturing and distribution strategy. In this case, the manufacturing has to follow a pull strategy since it is impossible to follow a long-term forecast. On the other hand, the distribution has to take advantage of economies of scale in order to reduce transportation costs of the bulky products. This is also the strategy implemented by many furniture retailers. When a product is sold, an order is sent to a manufacturer, who makes the necessary procurements and produces to order. Once it is finished, it is sent to the retailer together with many other products.

The discussion above suggests that a push strategy is appropriate in those parts of the supply chains where demand uncertainty is low. Cost minimization can be in focus in a push strategy. It is achieved by better utilization of resources like production and distribution capacities while minimizing inventory, transportation and production costs.
Portions of supply chains that are characterised by push strategies are often complex with many manufacturing and fabrication centres at various levels and lead times usually long. Supply chain planning processes are usually in focus here, in order to keep the focus on resource utilization and cost minimization.

On the other hand, the pull strategy is appropriate where demand uncertainty is high and therefore it is important to manage those parts in the supply chain based on realised demand. These parts of the supply chains are often characterised by rather simple structures of fabrication and distribution and usually short lead times. The supply chain must respond quickly to changing demand. Order fulfilment processes are usually in focus here as well, as to maximise the service level.

However, supply chains are usually characterised by a combined “push-pull” strategy, to take advantage of benefits of both strategies. Typically the initial stages operate push-based and later stages operate in a more “pull-based” manner. The interface between the push – based stages and the pull – based stages is know as the “push-pull boundary”. It is simply the stage when an organisation is switching from managing the supply chain using one strategy to another, typically changing from push- to pull-based strategy.

To summarise the discussion on demand uncertainty in supply chains, it is obvious that the level of uncertainty in customer demand (and thus the level of transaction costs since the costs of information increases when uncertainty increases) is a critical factor for finding an appropriate supply chain design in general. It is also a critical factor for the
performance of the supply chain, both in terms of service levels in order fulfilment processes, and cost levels in manufacturing and distribution.

Whatever strategy an organisation is choosing, it is dependent on demand information. The level of uncertainty in customer demand also affects the “push-pull” boundary. High uncertainty levels in demand information have an extraordinarily unfavourable impact on supply chain performance, resulting in lost sales or obsolete inventories and inefficient utilization of resources. Collaboration with customers (higher level of supply chain integration) to achieve better understanding of market demand is one way to reduce this uncertainty. A reduction of uncertainty makes it possible to move the “push-pull” boundary upstream in the logistic flow and thus to increase utilization of resources.

Inter-organisational development of operations might lower transaction costs by reducing some of the uncertainties surrounding the transactions in the relationship as discussed earlier in this paper. However, reduced uncertainty through further integration with customers and thus reduced transactions costs in one dimension e.g. reduced information costs might lead to other problems for the supplier. Asset specificity might lead to pre- or post contractual opportunism. To summarise the discussions above: Considerable insights from transaction cost theory can be made for supply chain management. Hypotheses regarding supply chain management can be devised using transaction cost analysis but testable hypotheses needs empirical information about transaction costs. Reduction of transaction costs is of obvious interest in supply chain management. Extensive exchange of accurate information and other forms of cooperation between parties in a dyadic
relationship might reduce transaction costs. To gain understanding how new relationships reduce transaction costs, those who wish to make analysis of transaction costs need information that can only be provided by firms.

**Empirical measurements of transaction costs**

A major problem with transaction cost analysis is that the theoretical development has been going on at a higher pace than empirical observations of transaction costs. Unlike other direct costs in an organisation, transaction costs are not easily separated from other costs or easily quantified and measurable. There are obviously costs, for example to monitor the actions of a buyer; it is however difficult to measure these costs and put them in financial terms. Transaction costs are not usually collected by governments or organisations, consequently other methods to measure these costs must be used.

Transaction costs have been measured, in other ways, primarily by economists. Three main methodologies can be identified (Hobbs, 1996, Mahoney, 1992):

(a) Those that evaluate the effect of transaction costs on vertical integration across industries using secondary data.

(b) Industry focused studies of the impact of transaction costs on vertical coordination using secondary data.

(c) Like (b) above but using primary data.
Proxy measures of transaction costs are usually used in these studies. Intensity of research and development can for example be used as a proxy measure for asset specificity. Proxy measures of uncertainty are for example changes in sales volume (volume uncertainty) or expected deviation between forecast and actual sales a following year expressed as a percentage (volume uncertainty). Proxy measures of transaction costs have been regressed against developed indexes of vertical integration in some studies. Several studies, not surprisingly, indicate that transaction costs are one of a number of factors that lead to vertical integration (see for example Mahoney, 1992).

Evaluating determinants of vertical integration at a multi-industry level is extremely complicated due to limited data. Available data often require the researcher to make indirect proxy measures of transaction costs which might be confusing. For this reason, most empirical work regarding transaction costs has been carried out on individual industry levels or on a case-study basis using secondary data sources (Hobbs, 1996). However this approach also faces obvious limitations in data availability.

Using primary data at the level of the individual firm is a more appropriate approach if the researcher more wants to measure transaction costs at different organisational levels. Unfortunately the accounting principles of most firms do not admit collection of this type of information. An alternative to a descriptive case study is to make an industry profile by survey industry participants. Questions to find out are about the characteristics of the industry participants. Do suppliers and buyers interact through spot markets or contracts etc. or combinations of these? A thorough understanding of the industry must be carried
out before any analysis can be carried out. Once a thorough understanding of the industry has been made, the transaction costs that the participants face can be identified. According to Hobbs (1996) this process is easier if the transaction costs are divided into information costs, negotiation and monitoring costs. Then a methodology for analysing the transaction costs can be chosen. Hobbs (ibid) discusses two different methodologies. The first method is about making an in-depth survey of industry participants, in one or more levels, to identify the most important transaction costs facing those participants. The challenge is to construct questions that accurately identify and measure the transaction costs and to obtain responses that can be meaningfully analysed. For an example of this see Hobbs (1995).

Another method, according to Hobbs (1996), is to use survey data that describes the marketing channel the company is using in terms of their main transaction cost attributes. This method also requires a thorough profile of the linkages between the participants. When the main transaction cost attributes of the marketing channel has been identified, different scenarios can be suggested using different combinations of transaction cost attributes. Respondents may be asked to rank the scenarios in terms of preference. A regression analysis of preferences against the scenarios indicates to which extent respondents are willing to trade-off one transaction cost attribute towards another. It also provides a measure of the relative importance of the transaction cost attributes. For an
example of a work using this methodology, which is known as conjoint analysis, see Hobbs (1995).  

Neither of the conjoint analysis or the econometric methodologies described above provides a monetary or percentage measurement of the size of the transaction costs in the accounting sense of the word. Perhaps the terminology from accountancy is misleading. Methodologies that identify the significant transaction costs and measure their importance in relative terms may be sufficient in many cases. That improves the understanding of relationships and may indicate which transaction costs should be reduced in order to enhance the efficiency of vertical coordination.

**Conclusions**

Transaction cost theory offers a framework to describe uncertainties and its relationship to vertical integration in supply chains and dyadic relationships. A major problem with transaction cost analysis is that the theoretical development has been going on at a higher pace than the development of methods and tools to conduct empirical observations of transaction costs in organisations.

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7 The importance of transaction costs when UK meat producers chose their beef supply channels was studied in Hobbs (1995). Another similar study was made to determine UK supermarket beef buyers. Results of these studies provided information on the relative importance of the transaction cost but neither of them provided information on the absolute levels of the transaction costs.
When empirical studies have been conducted it has usually been within the fields of economics. There are few empirical models adapted to the fields of logistics. Econometric methodologies have not provided a monetary or percentage measurement of the size of the transaction costs in the accounting sense of the word. Further research is needed to more exactly identify empirical approaches to identify transaction costs related to logistical activities between organisations.

References


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