Insights from the introduction of a supply chain co-ordinator

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Abstract *Many chain co-ordinating initiatives fail due to a lack of trust in and resistance against supply chain co-ordinators, unequally distributed benefits, opposing requirements of involved parties and asymmetric distribution of power. The goal of this paper is to provide insight into factors influencing the successful implementation of a supply chain co-ordinator. For this purpose, the Electronic Service Center (ESC), a successful, pan-European chain co-ordinator based in The Netherlands, is studied. The ESC acts as a central and neutral supply chain co-ordinator and aims at co-ordinating the flow of information between customers, logistics carriers, warehouses, forwarders and suppliers. This paper provides a general overview of the roles of supply chain co-ordinators and provides a short review of factors responsible for failure. It investigates the ESC, describes the supply chain and the various roles of the supply chain co-ordinator, and discusses the various trade-offs made by the organisations involved in the supply chain. In the last section conclusions are drawn and recommendations given for future research.*

Introduction

Efficient and effective co-ordination of supply chains is of increasing importance as competition is more and more at the level of supply chains instead of at the level of single organisations. Organisations participating in a supply chain are becoming increasingly aware of the opportunities and threats provided by all kinds of information and communication technology (ICT) to improve their co-ordination with their supply chain partners. Organizations whose core business does not involve ICT and supply chain management often lack ICT knowledge and experience with co-ordination of supply chains. For this purpose, a supply chain co-ordinator (SCC) can provide the necessary means to automate and manage the co-ordination of a supply chain.

There is a limited amount of literature about the specific roles of SCCs. However, a number of roles of electronic intermediaries and information brokers can be found in the literature (e.g. Resnick *et al.*, 1995; Sarkar *et al.*, 1995; Spulber, 1996; Bailey and Bakos, 1997; Janssen, 2001). Kambil and Short (1994) describe a role as a distinct, technology-independent, value-added activity undertaken by firms or individuals in a given supply chain. Roles should be described independent of technology, and should be aimed towards a goal.

Lee and Clark (1997) propose that the successful deployment of electronic co-ordination requires the consideration of existing barriers. As a result, the goal of this research is to gain insight into factors of influence on the successful implementation of an SCC. The research method is based on case study research as the main research instrument. Already existing implementations of an SCC were investigated, and one implementation was investigated in more detail. The SCC was investigated using interviews and reports. The insights are formulated based on abstractions from the case study using existing theory.

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Co-ordinator roles

Before we start investigating an empirical situation we need to have guidance for our analysis. We use roles as guidance, as they are technology-independent and have a clear aim. In the literature a number of roles of electronic intermediaries can be found. We will use these roles as a starting point to identify roles of an SCC. Sarkar *et al.* (1995) mention the following roles:

- assistance in search and evaluation;
- assessment of needs;
- product matching;
- risk reduction;
- product distribution/delivery;
- creating and disseminating product information;
- creation of product awareness;
- influencing buyer purchase;
- providing buyer information;
- reducing exposure to risk;
- reducing cost of distribution; and
- balancing and integrating conflicting interests of sellers and buyers.

Spulber (1996) identifies the roles of intermediaries as falling into four categories:

(1) To set prices and clear markets.

(2) To provide liquidity and immediacy.

(3) To co-ordinate activities of buyers and sellers.

(4) To guarantee quality and monitor performance.

Resnick *et al.* (1995) suggest that brokers are important in markets because of five limitations of privately negotiated transactions that can be better managed by intermediaries. These limitations are:

(1) Search costs.

(2) Lack of privacy.

(3) Incomplete information.

(4) Contracting risk.

(5) Pricing.

Kalakota and Whinston (1996) identify the following five tasks for intermediaries:

(1) Processing and retrieving information.

(2) Searching, filtering and summarizing large volumes of data.

(3) Translating or passing on information requests.

(4) Maintaining information directories.

(5) Monitoring usage patterns and information changes.

Bailey and Bakos (1997) make a classification into four roles based on 13 case studies. These roles are:

(1) Information aggregating.
(2) Being a trusted agent.
(3) Facilitating.
(4) Matching.

The roles of Bailey and Bakos (1997) are suitable to describe an SCC, as they include the exchange of information between supply chain members, the need to keep information confidential between supply chain members, the need for ICT to support interaction with supply chain members, and – when "matching" is interpreted as logistic control – the need for co-ordinating the logistic dependencies of supply chain members.

Failure factors

Many chain co-ordination initiatives fail because the introduction of new business models in a value chain is a cumbersome process (Lee and Clark, 1997; Janssen, 2001). We elaborate on failure factors found in the literature using the following categories:

- trust;
- resistance;
- unequally distributed benefits;
- opposing requirements of involved parties; and
- asymmetric distribution of power.

These factors might lead to a lack of commitment when using an SCC, or might even lead to a negative decision about the use of an SCC.

Trust plays an important role in the development of electronic links between firms (Kumar, 1996). The information obtained by an SCC may lead to openness and insight into the cost structure of organizations. This information can be used to negotiate lower prices, thus lowering profit margins, and can lead to a situation where carriers are only needed in the role of box truckers. The cost of implementing a system can easily be assessed, but the benefits are much more difficult to assess and often comprise qualitative or non-tangible benefits. A cost assessment is carried out during a feasibility study and the development of specified project proposals. It is significantly more difficult to obtain hard evidence of the benefits expected. A threshold is created when the benefits cannot be expressed in a monetary unit. Consequently organizations resist making use of an SCC: moreover, some organizations will probably obtain no direct benefit. Another source of resistance is the restricted knowledge of organisations regarding information and communication technology. One problem is that many people do not like computers in general (Åberg and Shahmehri, 2000). Some people are not good at, or are not interested in, using computers, since they do not understand how they work. This makes them afraid of the consequences of their actions. This is further complicated by using different terms and by giving different meanings to terms. Even the term "SCC" can have different meanings, and can consequently be interpreted positively or negatively.

Integration of information systems of supply chain members is often done in a door-to-door manner. How trading partners implement and use the system internally

and externally may directly affect the level of benefits. Often a large organization initiates the use of an SCC and integrates its information systems with the SCC, thus gaining maximum benefit. Often, small organisations implement applications on Web-based front-end systems that are not integrated with their back-end systems. Consequently, they do not exploit the advantages fully, as data has to be entered on multiple occasions. Riggins and Mukhopadhyay (1994) found that unequally distributed benefits affect the initial adoption decision negatively.

Supply chain members might have opposing aims and requirements. Carriers prefer high utilisation of their trucks, and may only want to drive fully loaded trucks. In contrast, shippers want to transport small volumes to minimise the inventory in their warehouses, and also want to have a high availability of trucks of carriers, so that orders are always processed immediately. The use of an SCC and the division of benefits seems to be dependent on the division of power between supply chain members. Power can be defined as the potential of an actor to influence the behavior of another actor on a particular issue (Tushman, 1977). Large shippers may use their bargaining power to decrease the prices of a small carrier, or vice versa. Organisations might even use their power to influence other organisations to make use of – or to avoid making use of – an SCC. An SCC might not be (fully) used due failure factors. In the following section we will look at a successful SCC initiative to investigate the factors which influence the successful implementation of an SCC.

Case study: the Electronic Service Center

The Electronic Service Center (ESC) acts as a central and neutral hub co-ordinating the flow of information between organisations in a supply chain. The ESC in Rotterdam, The Netherlands, is aimed at the co-ordination of transportation chains between suppliers and customers for products like rolls of steel, computers, mouses and keyboards, wine, etc., as shown in Figure 1. The founders of the ESC designed one flexible information system and implemented this model in a number of supply chains. We investigated a number of implementations of the ESC. The ESC concept is based on scenario management and the connectivity of information systems of independent organisations.

Scenarios are used by the ESC to describe a sequence of information exchanges between a number of organisations. For example, a product can be selected from a catalogue at the ESC and a purchase order can be placed. A transport scenario is automatically started in order to transport the product from location A to location B, based on the purchase order. The ESC distributes messages based on rules determined within a scenario. A transport scenario results in a transport order for a carrier over land, into a trans-shipment order and into a transport order over "short sea". A scenario thus determines the sequence of activities to be performed based on

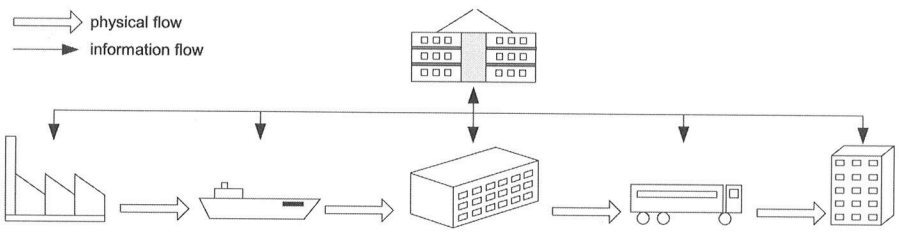

Figure 1.
Supply chain, with the ESC being shown at the top of the figure

event-driven updates. Scenarios are based on the "route-leg" model. A route refers to the starting point and the destination of a transport order (locations A and B in our example), and a leg refers to one physical activity of this order, such as warehousing or transport by truck, rail or "short sea".

The ESC enables connectivity as it integrates existing information systems with its own information system and is accessible from anywhere at any time. The ICT problems that the ESC addresses are the synchronisation of information and overcoming differences in syntax and semantics between the information systems of various organisations. Information systems are integrated by means of messaging technology. For example, when a purchase order is sent to the ESC, the ESC sends a message to the warehouse, a message to a carrier and an order confirmation. Each organisation needs only one ICT connection to the ESC, and the ESC distributes the information using various media. The ESC can send outgoing messages by fax, e-mail or by EDI over-switched or leased lines.

Figure 1 shows a supply chain, including the ESC at the top of the figure. All communication processes are from and to the SCC. Messages submitted between organisations include purchase/sales/transport orders, order confirmation, catalogue updates, receipt orders, pre-alert notices, pick-up orders, status updates, exception reports, confirmations of order fulfillment, proof of delivery (POD), receipt information, order closed, pre-invoice summaries, invoices and statistical information. A pre-alert notice can be used so that organisations can make the necessary arrangements to receive goods or to make goods available for transport. Status updates, exception reports and POD messages are used for tracking and tracing. "Tracking" refers to getting up-to-the-minute information on the whereabouts of a certain load, and "tracing" refers to the evaluation of the routes followed over a period. Financial information is consolidated in periodical (often monthly) pre-invoice messages. Statistical information includes the number of orders, types of order, and quality of service.

The ESC is primarily aimed at sharing information between supply chain partners by exchanging and synchronising information. The goal of synchronisation is to accomplish the sharing of information between partners, or in other words the synchronisation of information between information systems. The independence of the ESC from buying, selling and transporting organisations results in a greater willingness to share confidential information with other parties. The ESC takes care of technical facilities and guarantees security and quality of service (QoS), and also guarantees that information is only distributed to the intended organisations. "Quality of service" refers to reliable and fast information exchange. The implementation costs for the use of the ESC consist of costs for hardware, the possible adaptation of in-house software, and the adaptation of current business processes. Integration with in-house software is performed by the ESC in return for a fee for every time a message is transmitted. Integration of the ESC's services into in-house information systems takes a couple of days of programming work for each organization. Services which have to be customised can take much more effort, and the time it takes to do so can vary accordingly.

Analysis of roles

In this section we analyze the ESC as an SCC based on the following roles:

- aggregating information;
- being a trusted agent;

- facilitating; and
- logistics control.

From an information exchange point of view, the ESC provides a one-stop shop. Only one connection for communication to and from the ESC is necessary. The ESC aggregates information and submits messages to supply chain members.

The ESC performs a trusted role, although this is not the primary aim of the ESC. The ESC keeps logs of all messages and transactions, which can be used in case of dispute about the content of the information transmitted. Furthermore, the ESC ensures that non-authorised parties do not have access to confidential information. Supply chain partners are not inclined to provide information about their logistics processes to competitors. Organisations are more willing to share information with neutral and independent organisations, as such organisations can keep information confidential when processing information and only provide the (aggregated) results of information processing to other organisations. In this way, an SCC can solve issues such as information access and sharing by maintaining the confidentiality of sensitive information. A third party will not easily be tempted to misuse information because a third party can obtain no direct benefit by using past-performance information of organisations, and because it risks losing its position by abusing its trusted role. Note that organisations can negotiate with each other about how information such as the past-performance evaluation of sellers is used without any involvement of the trusted third party. Another advantage of a neutral or independent organisation is that it can provide systems and/or services to a number of supply chains. In this way, it is possible to take more advantage of economies of scale and scope than an organisation related to a single supply chain would be able to do.

Although the ESC is a central system from a technical point of view, control is fully decentralised. The ESC provides only the facilities for organisations to exchange information with each other. The organisations input information and control its flow by choosing a preferred scenario. They can add new scenarios, and can even decide to bypass the ESC in order to manage certain interactions. Ballou (1992), Romme and Hoekstra (1992), and van Goor *et al.* (1994) describe logistics control models that can be used to describe the co-ordination of logistics activities within a supply chain. A logistics control model describing the roles of the supply chain co-ordinator can be based on three areas:

(1) Logistics structure.

(2) Aggregate planning and control.

(3) Detailed planning and control of the flow of physical goods.

The logistics control model is shown in Figure 2. The functions of the organisations in a supply chain are shown on the right-hand side of Figure 2.

The logistics structure can be described by the mechanisms used to co-ordinate the supply chain, the messages exchanged and the technology used to communicate with supply chain members. The ESC provides the logistics structure for co-ordinating the supply chain. The logistics structure is relatively fixed, as changes may need negotiation between supply chain partners and implementation may need changes in existing information systems.

Aggregate planning involves long-term planning aimed at making long-term reservations for scarce resources, such as trucks, based on the expected demand. Aggregate planning involves negotiations between shippers and carriers about the prices and number of resources to be reserved. The ESC does not support the creation of an aggregate plan, as this might lead to the perception that the ESC favors one party over the other.

Detailed planning incorporates the day-to-day operations needed to transport one or more products from one place to another, and involves the daily scheduling of resources. The logistics structure provided by the ESC is used for this purpose. The benefits of the ESC arise from facilitating this process.

Design trade-offs

Various decisions can be made that influence the logistics control model of a supply chain. We found that implementations of the ESC in various supply chains had various forms, depending on the decisions made on these trade-offs. In following subsections we do not give a normative view for a certain design trade-offs: rather, we provide insight into possible trade-offs.

Information push or pull

Information should be entered only once to minimise error and input costs. Consequently, the information systems of different organisations should be interconnected, and information in the information systems should be shared. Keeping information up to date seems to be another problem when sharing information. How organisations can share information with other organisations, and how frequently information should be updated are important questions. It is important to gain insight into how factual the last information update is, and who is allowed to access and update information.

Information sharing can be based on a request/reply or subscribe/tell model, as shown in Figure 3. Combinations are possible because the ESC can use a subscribe/tell model with an information provider and a request/reply model with an information requester. The technology based on request/reply can be characterized by "information pull". Users ask a server to send back the information requested. The most important limitations are that users have to know the location of the server and the availability of the information requested, because users have to check the server periodically to obtain new or modified information. Information pull requires effort from the user, but has the advantage that information systems do not necessarily need to be integrated.

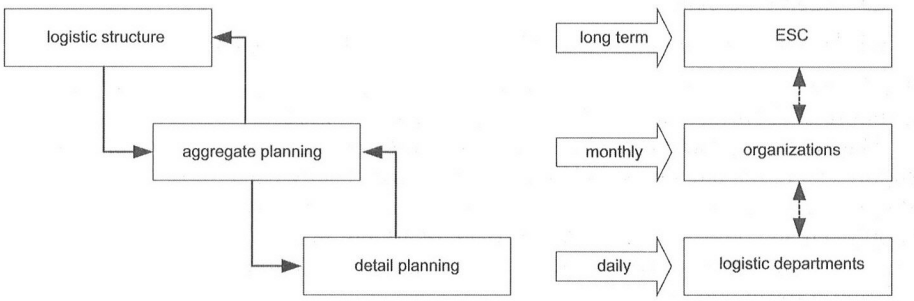

Figure 2.
Logistics control model describing the SCC

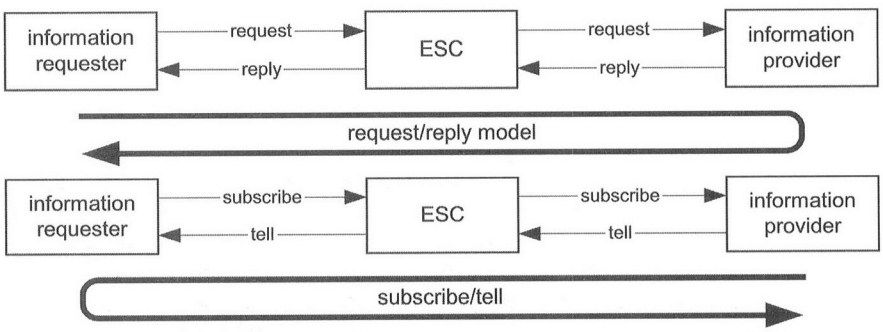

Figure 3.
Information push and pull

A subscribe/tell model can be characterized by "information push", which is the delivery of information initiated by the information provider rather than by the user. Information arrives because someone or something sent information to the receiver without an explicit request from the receiver. Information push is useful in a logistics environment in which information is delivered to the appropriate applications or people at the appropriate time. Information push technology can reduce the burden of acquiring information for jobs characterised by a large information flow across the desktop or where occasional, time-critical information must receive immediate attention. Data formats have to be mapped when information is shared between information systems.

Open or restricted information access

Information access can be a big problem, as information about past transactions can be (mis)used to reduce prices during future negotiations. Supply chain members do not want to share information such as the utilisation of capacity and number of orders with their competitors over a period of time: however, they are prepared to provide information such as status information in order to support the optimisation of the supply chain. The existence of this kind of information asymmetry represents the structure of power between organisational relationships and implies that organisations are focused on taking advantage of the disposal of information. The associated trade-off is what kind of information should be accessible, and to whom. In an open system, information is in principle accessible to everyone. In a closed system, information is only available to organisations and users that have been given access. In the case of a closed system, an SCC can perform a trusted function. An SCC can determine in co-operation with the supply chain members which data should be accessible to whom, and provide access based on an investigation of the trustworthiness of a supply chain member.

Central or decentralised control

Organisations are facilitated by the ESC to exchange information with each other. Which organisation controls the supply chain is not known. The ESC is located in one geographical position and all messages to and from supply chain members should be submitted via the ESC. From a connectivity point of view, the most efficient way to connect organisations is through the use of a central hub. In this way, organisations

need only one connection to the hub. When a network consists of n participants in total, only n relationships have to be managed. Without a central organization, each organization has to manage $n - 1$ relationships, and $n(n - 1)$ relationships have to be managed in the entire network. Looking only at the number of relationships to be managed, it is clear that the use of a central point is preferable, as shown in Figure 4. The nodes in Figure 4 are used to visualise organizations. Figure 4 shows a supply chain without a central SCC on the left and with a central SCC on the right. In the first situation all organisations communicate with each other directly, while in the second situation organisations only communicate with the SCC. A central point has advantages in the speed and cost of implementation, in the flexibility of changing the connection and in the cost of maintaining the connection, as only one connection needs to be implemented. As more connections are made, a central point can profit from economies of scale and experience to ensure secure, reliable and fast transmission.

Organisations in the supply chain looking for an SCC often viewed the use of a central hub for information exchange and a centrally controlled supply chain as one and the same thing. The term "central SCC" was often associated with an organisation controlling the supply chain, and "decentralised" was often associated with local control and the bilateral exchange of information between organisations. This was often confusing as scenarios can be determined and selected by the supply chain organisation initiating a scenario, and thus the control of the flow of information in fact belongs with the initiating organisation. The central co-ordination of the ESC means that technical facilities are provided by a central organization, but that logistics control could be decentralised at one or more of the organisations involved in the supply chain. The differences between technology facilities and logistics control functionality is often not sufficiently separated and explained, and can lead to confusion. We found that it is not relevant how a system is implemented technically: what is important is who controls the chain.

Central control has the advantage that the information of multiple supply chain partners can be used to optimise the supply chain. A central system can take into account the interest of the whole supply chain by allocating resources in the most effective and efficient ways. For example, when it is registered centrally that a truck is driving from location A to location C and that the truck is not fully utilised and is able to transport a pallet that should be transported from B to C, where B is between A and B, it could be economically more efficient to let this truck rather than another truck

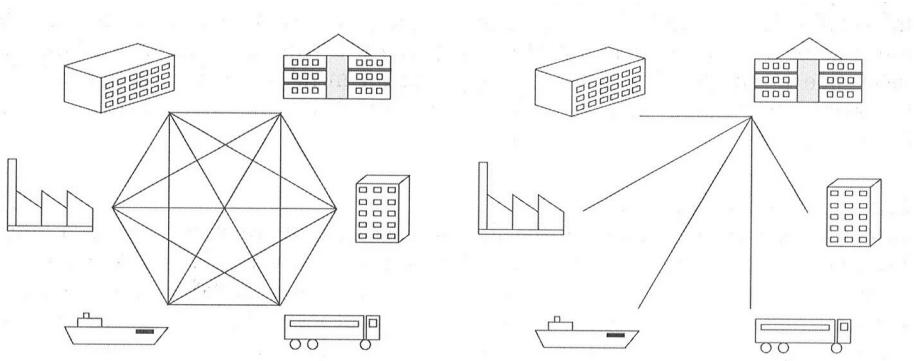

Figure 4.
Number of flows and decentralised versus central communication

transport the pallet. Decentralised control has the advantage that each organisation can initiate a scenario based on its actual needs. The advantage is that no complicated information processing mechanisms are necessary to determine the most efficient and effective allocation of scarce resources. The disadvantage is that daily planning has no capacity to plan at the supply chain level, and thus resources are not allocated in the most efficient and effective manner.

Co-operative or competitive relationships

Various needs make different demands on the organisation of a supply chain. Spot sourcing and systematic sourcing buyer-seller relationships can be distinguished as two extremes on a continuum. Spot sourcing focuses on incidental and last-minute opportunities, is transaction-oriented and involves short-term or incidental relationships. Competitive relationships often dominate spot sourcing. Systematic sourcing includes buying using pre-negotiated contracts with qualified sellers. These contracts are often long-term in nature and tend to have a co-operative nature. Systematic sourcing can benefit from volume buying and the familiarity of transporters with the situation of warehouses. A central department which has aggregated the demand of various decentralised departments often negotiates long-term contracts, while decentralised departments place individual orders.

Organisations have to co-operate in order to create an efficient and effective supply chain. However, competing organisations like road carriers are members of the supply chain. Co-operative relationships mean that organisations willingly share information with each other. More information sharing can enable more effective and efficient allocation of resources in the supply chain. Co-operative relations are often associated with centralising control. Decentralisation is often associated with more loosely coupled relationships, where relationships between organisations can even be competitive. Organisations in some supply chains demonstrate self-interested behaviour to optimise their own supply processes, and are not looking for ways to "optimize" a supply chain. For example, one aim of a carrier could be to transport large amounts in order to maximise the utilisation of its production and transport capacity. One aim of a seller or buyer could be to minimise its inventory, and therefore to order relatively small amounts. This trade-off can be negotiated in favour of one party or optimised to favour both parties.

Conclusion

The goal of this paper is to provide insight into factors influencing the successful implementation of a supply chain co-ordinator. We have identified the possible roles of a supply chain co-ordinator and have investigated a case study. A supply chain co-ordinator can be described using the information aggregating, trusted agent, facilitating and logistics control roles. The logistics control role can be analysed by identifying the differences between logistics structure, aggregate planning and detailed planning. We have found that implementation requires the SCC to be an independent, neutral party, focused on facilitating organisations instead of controlling a supply chain.

From the case study, it is clear that the composition of a logistics model of a supply chain is not "set in stone". Successful implementation requires that the organisations involved in the supply chain make a number of trade-offs to arrive at a logistics control

model. The design trade-offs and the opposing requirements and wishes of organisations involved should be made explicit. Trade-offs between information push and pull, open and closed access, central and decentralised control and processing of information, and co-operative and competitive relationships should be made. Making these trade-offs together during implementation seems to be a pre-requisite for success.

References

Åberg, J. and Shahmehri, N. (2000), "The role of human Web assistants in e-commerce: an analysis and a usability study", *Journal of Internet Research*, Vol. 10 No. 2, pp. 114-24.

Bailey, J.P. and Bakos, J.Y. (1997), "An exploratory study of the emerging role of electronic intermediaries", *International Journal of Electronic Commerce*, Vol. 1 No. 3, pp. 7-20.

Ballou, R.H. (1992), *Business Logistics Management*, Prentice-Hall, Englewood Cliffs, NJ.

Janssen, M. (2001), "Designing electronic intermediaries: an agent-based approach for designing interorganizational coordination mechanism", Doctoral dissertation, Delft University of Technology, Delft.

Kalakota, R. and Whinston, A.B. (1996), *Frontiers of Electronic Commerce*, Addison-Wesley, Reading, MA.

Kambil, A. and Short, J.E. (1994), "Electronic integration and business network redesign: a roles-linkage perspective", *Journal of Management Information Systems*, Vol. 10 No. 4, pp. 59-83.

Kumar, N. (1996), "The power of trust in manufacturer-retailer relationships: trust is stronger than fear. Partners that trust each other generate greater profits, serve customers better, and are more adaptable", *Harvard Business Review*, November-December, pp. 92-106.

Lee, H.G. and Clark, T.H. (1997), "Market process reengineering through electronic market systems: opportunities and challenges", *Journal of Management Information Systems*, Vol. 13 No. 3, pp. 113-36.

Resnick, P., Zeckhauser, R. and Avery, C. (1995), *Roles for Electronic Brokers: Towards a Competitive Telecommunication Industry*, Erlbaum, Mahwah, NJ.

Riggins, J.F. and Mukhopadhyay, T. (1994), "Interdependent benefits from interorganizational systems: opportunities for business partner reengineering", *Journal of Management Information Systems*, Vol. 11 No. 2, pp. 37-56.

Romme, J. and Hoekstra, S. (1992), *Integral Logistics Structure: Developing Customer-Oriented Goods Flows*, McGraw-Hill, London.

Sarkar, M.B., Butler, B. and Steinfield, C. (1995), "Intermediaries and cybermediaries: a continuing role for mediating players in the electronic marketplace", *Journal of Computer-Mediated Communication*, Vol. 1 No. 3, available at: http://jcmc.huji.ac.il/vol.1/issue3/sarkar.html

Spulber, D.F. (1996), "Market microstructure and intermediation", *Journal of Economic Perspectives*, Vol. 10 No. 3, pp. 135-52.

Tushman, M. (1977), "A political approach to organizations: a review and rationale", *Academy of Management Review*, Vol. 2 No. 2, pp. 206-16.

van Goor, A.R., Ploos van Amstel, M.J. and Ploos van Amstel, W. (1994), *Fysieke Distributie: Denken in Toegevoegde Waarde*, Stenfert Kroese, Houten.