Efficiency Improvements in Supply Networks

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Abstract
In this paper we discuss efficiency improvements in supply networks. Improvements of efficiency necessarily include changes in some way, such as technical and organizational innovations. This paper focuses on the interplay between efficiency and innovation. A broad approach to supply networks is made use of in order to create insight into phenomena that would otherwise be ignored. This implies to go beyond the suppliers of a company in the search for evidence, underlying causes and complex connections that are related to efficiency improvements. We present four ways in which efficiency improvements can take place in supply networks and show how ideas may be generated one place in the supply network and implemented somewhere else. To study how companies in a supply network interact to increase efficiency, a triad is used as a way to elaborate on efficiency in supply networks.
Keywords: innovation, efficiency, supply, relationship, network

Introduction
Companies are increasingly under pressure to improve performance of their products and services and reduce costs to compete internationally. To meet the increased demands companies must find ways to generate profits without increasing the costs. To be able to stay competitive companies therefore strive to be efficient. A company increases its efficiency when inputs (costs) are reduced without a corresponding reduction in outputs (value), or when an output is increased without an increase in inputs.
This paper focuses on efficiency improvements. Obviously, this requires a change in output and/or input. More specifically, this paper elaborates on efficiency improvements in supply networks. After all, supply networks are said to become increasingly important as companies are reducing the number of suppliers and working more closely with these suppliers. Companies are becoming more and more specialized which leads to closer relationships with suppliers who provide critical competence within certain areas. Competitive advantage no longer resides with a company's own innate capabilities, but rather with the relationships and linkages the firm has with its counterparts, and especially its supply network. Therefore a company's supply network is an increasingly important way to look when driving its efficiency.
The purpose of this paper is to elaborate on the nature of efficiency in supply networks. It is shown that efficiency improvements might be initiated one place in the supply network and implemented somewhere else. This paper aims to provide insight into efficiency improvements for companies by elaborating on efficiency improvements in supply networks.
In the next section, we review literature on supply networks as well as literature on efficiency and innovation. Then we discuss how efficiency improvements may be achieved in supply networks by looking at four different ways in which efficiency improvements can take place. It is emphasised that a broad approach to supply networks will create insights into phenomena that would otherwise be

ignored.

Supply Networks

Supply networks have received considerable attention among academics (e.g., Dyer, 1996; Sheth and Sharma, 1997) as well as practitioners. One way to provide some insight into this interest is to look into the two concepts: “supply” and “networks”. *Supply* is obviously of great importance to companies, as studies point out that the value of their purchased goods and services often account for 50-80% of their turnover (Dyer et al., 1998; Gadde and Håkansson, 2001). Due to company specialization the latter decades, this percentage has even increased, making supply increasingly important. *Networks* in a business context refers to the sets of interconnected companies and business relationships. Business relationships, also frequently referred to as collaboration, strategic alliances, or partnerships, have received increased attention among academics as well as practitioners. As a governance form, business relationships have received considerable attention in literature (e.g., Jarillo, 1988; Powell, 1990; Håkansson and Snehota, eds., 1995). In a similar vein, empirical studies also indicate a rapid growth in the use of strategic alliances (Gulati et al., 2000) and business relationships, e.g., in the automotive industry (e.g., Dyer, 1996). Similarly, business networks are held out to be of critical importance to companies (e.g., Håkansson and Snehota, 1989).

For the purpose of this paper, a supply network is regarded as the network of companies and business relationships that are directly or indirectly connected to the supplier-side of a focal company. In this way, supply networks hold several similarities with business networks. Business networks are frequently referred to as sets of interconnected companies and the business relationships that connect them (e.g., Miles and Snow, 1986; Anderson et al., 1994). This business network can be said to stretch out without limits. For analytical, and also practical purposes, therefore, some boundaries have to be imposed on the business network. These boundaries can be referred to as the “network horizon” (e.g., Anderson et al., 1994; Holmen and Pedersen, 2003). In a similar vein, boundaries are also required for supply networks. Whereas a business network is said to have no center (e.g., Anderson et al., 1994), a supply network takes a focal company as its point of departure. The network of interest is one for organizing supply, i.e., this network is relative in terms of “supply” for someone, in this case a company. The way a supply network is regarded in this paper includes not only suppliers and subsuppliers. Rather, “horizontal companies” and customers of both these suppliers and the focal company are included. Thus, a challenge becomes the one of drawing boundaries in order to delimit the supply network. Much of the literature on supply makes use of a far more narrow perspective than the one presented here on supply networks. In literature on supply base, a delimitation is often made in the sense that this concept refers to direct suppliers only (Baily et al., 1998). Furthermore, this approach tends to be dyadic in the sense that suppliers are often dealt with one at a time, or individually. As opposed to the logic in supply base, supply chain management often includes suppliers’ suppliers, as also indicated by the term “chain”. However, the more traditional ways to present supply base, supply chains, or supply networks seldom include any of the other customers of a focal company’s suppliers, nor other horizontal companies. For the purpose of this paper, a broad approach to supply networks is regarded as advantageous, as this provides opportunities to go beyond the suppliers of a company in the search for evidence, underlying causes and complex connections that are related to efficiency improvements. A broad approach to supply networks is made use of in order to create insight into phenomena that otherwise would be ignored. In a similar vein, more insight into a company can always be created by inquiring the business network of which it is a part (e.g., Ford et al., 2002: 121).

Basically, there can be said to exist two arguments for the sole existence of supply networks. First, supply networks contribute to a company’s efficiency (e.g., Dyer et al., 1998). They do so by consisting of suppliers that, compared to the focal company, are specialized and therefore possess certain economies of scale. For companies, this efficiency often surfaces through these suppliers being able to provide certain types of components and products at a low cost. As a consequence, companies have often found themselves in a situation where “buy” has appeared as a solution economically superior to “make”. Furthermore, the suppliers can often offer a high degree of flexibility with respect to manufacturing, hereunder responding rapidly on large variations along the manufacturing volumes. Furthermore, the business relationships of which a supply network is made up of have often proved to provide a higher degree of efficiency than what can be achieved through a supplier market, i.e., a market approach to supply: dealing with multiple and similar suppliers on an arm’s length distance by making use of bidding processes. Second, supply networks contribute to a company’s innovativity.

The supply network can come up with more innovations than a single company can on its own if the activities in hand were organized internally. In line with this, academics have typically focused on how to get more innovative solutions out of the supply network (e.g., Teece, 1992; Håkansson and Eriksson, 1993; Handfield et al., 1999; Johnsen and Ford, 2005; Van der Walk and Wynstra, 2005), or how to encourage the suppliers to cooperate closely in order to create more innovative solutions among them (e.g., Dyer, 1996). Parts of this increased potential for innovativity stems from the suppliers' other customers and horizontal partners. In this way, the supply network provides a larger pool of knowledge than any company can come up with single-handedly. However, in order for such innovations to take place within a supply network, openness and willingness to share knowledge through business relationships is crucial (e.g., Håkansson, 1987). After all, these business relationships can potentially bring together knowledge from different companies, often held to be a vital way to come up with innovations. In a similar vein, the business relationships play a vital role with respect to coordinating and mobilizing resources across company boundaries (ibid.). Again, this requires a certain degree of openness, cooperation and joint learning among the companies. Academics have focused on a number of techniques, such as lively exchange of ideas, knowledgesharing and bringing multiple suppliers and other companies together in order to spur more innovations in supply networks (e.g., Dyer, 1996; Powell et al., 1996). Several of the innovative effects that are associated with supply networks are simply not present when applying a market approach to suppliers, i.e., a arm's length approach with absence of cooperation.

To sum up, this paper focuses on efficiency improvements in supply networks. Improvements of efficiency necessarily includes changes in some way, e.g., technical or organizational changes in the supply network. These improvements can be referred to as technical or organizational innovations. I.e., by focusing on efficiency improvements this paper focuses on the interplay between efficiency and innovation. For companies, attempting to achieve efficiency improvements can be a risky venture. In some cases, the companies have to leave a well-known, well-functioning situation in order to implement new technical and organizational solutions in their pursuit to achieve a higher degree of efficiency. However, by doing so, companies often feel that they are entering into the unknown. In line with this, several authors have referred to a challenge of balancing efficiency and innovativity (e.g., March, 1991; Ghemawat and Costa, 1993; Sobrero and Roberts, 2001; Auh and Menguc, 2005). In the following sections, this paper looks closer into different ways in which efficiency improvements can take place within supply networks.

Cost and Value

Efficiency is traditionally expressed in terms of output and input. In principle, efficiency improvements can take place through a reduction of the input, an increase of the output, or changes of both output and input in ways that increases the output/input fraction. The input can also be referred to as the costs, whereas the output can be referred to as the value. A traditional way to conduct efficiency improvements for companies is to cut costs through price reductions for its suppliers. Accordingly, a large portion of the literature focuses on bargaining techniques and ways to reduce the prices on purchased products. Although this aspect is indisputably highly important for many companies, it represents an efficiency improvement *through* the supply network, rather than an efficiency improvement *in* the supply network, i.e., this approach to efficiency improvements becomes of little relevance to the purpose of this paper. After all, by applying the boundaries of the supply network, this type of cost reductions represent merely a zero-sum game. What the company wins, the suppliers lose. By returning to the input-side, or the cost-side of the efficiency, this one can be divided into two: Costs of the purchased product, Costs related to work, i.e., transactions, or further processing of the product. Through the supply network, these latter costs can be reduced. A well-developed network of business relationships can entail ideas and suggestions that lead to reductions of transaction costs. Furthermore, the companies can through these business relationships learn from each other in ways that contribute to reductions of the work that is related to the processing of the product, i.e., a supplier assists the company on how to work on the product in a new way that reduces the consumption of working hours. By turning to the output-side, or the value-side of the efficiency, several opportunities exist with respect to efficiency improvement in supply networks. The companies in the supply network can in various ways cooperate in order to increase the value of the products. Ideas may be generated one place in the supply network, and implemented somewhere else. Or, the supply network itself may be the locus of the innovation that entails increase of the value. Again, in order to increase this value, cooperation and distinct use of the network of business relationships is often required.

Technical and organizational innovations

Efficiency improvements in supply networks necessarily require changes for an organization or for the supply network of which it is part. Changes can be made to the relevant products and/or processes in order to improve product quality (improving the value of outputs), or to make the products less costly to make (reducing the value of the inputs). These changes often come from innovations of a technical kind, such as product and process innovation or organizational innovations. Technical and organizational innovations can be both incremental and radical. Incremental innovations such as evolutionary improvements to an existing product, service or process is often said to be of critical importance for efficiency improvements. It is therefore essential for companies to create new technical features and continually implement small changes to improve product performance and to find more simple ways to do complex jobs. Changing the product to make it easier to manufacture may save costs in production without any corresponding loss of quality or sales.

Both managers and scholars (e.g. Utterback, 1994; Cooper, 2005) emphasize that technical innovations are a necessity to meet the increasingly higher demands from customers of cheaper products and higher quality. Technical innovations can further be one way to increase efficiency in a supply network. Many articles focus on what effects supplier involvement has on product development (e.g. Primo & Amundson, 2002; Lakemond et al., 2006). Most of these articles find that effective integration of suppliers into the product development process can yield such benefits as reduced costs and improved quality of purchased materials, reduced product development time, and improved access to and application of technology (e.g. Ragatz et al., 1997, Wynstra et al., 2001; Takeishi, 2001). According to Clark (1989) and Clark & Fujimoto (1991) involving suppliers early in the product development phase increase innovation. Companies are therefore dependent on a supply network consisting of actors that continually challenge each other to improve and share information across company boundaries.

Within a supply network an innovation often emerge as a consequence of close cooperation between two or more actors. Studies show that innovations with potential to improve productivity and efficiency originate more frequently outside the company and as an interaction process between the company and its network (Abernathy, 1978; Håkansson, 1987; Freeman, 1991). As companies in a network come to know each others technical solutions better, they can propose adaptations that will save time and/or costs for one or several actors in the network. The conditions needed to create innovations are much different from those that support high levels of production efficiency. In line with this, studies have found (e.g. Abernathy, 1978; Utterback, 1994) that a product innovation in one company may be viewed alternatively as a process innovation for another company. An innovation can thus represent just an addition to the product line for the companies directly involved, but can represent a solution that is of great importance to achieve a higher degree of efficiency for another actor in the supply network.

Efficiency improvements in business networks can also be the result of organizational innovations, such as a fine-tuning of the processes linking the supply network and the focal company or even a new combination of actors. The actors can for instance make changes in the existing activities, e.g. improve materials flow and/or logistics chains, or make administrative changes, e.g. finding new procedures to reduce work in a given relationship (Torvatn, 1996).

Neither innovation nor efficiency improvements happens automatically. It requires actors that consciously use their network to initiate improvements, and to respond to initiatives from other partners. Further, companies may have to leave a well-known situation in order to implement new technical and organizational solutions in their pursuit to achieve a higher degree of efficiency. This might represent a problem for companies as there might be a built in resistance towards change, especially if the results of this change cannot be seen in the near future. When implementing changes such as technical and organizational innovations, substantial investments are often required before any potential reward can be observed. This might lead to a decline in efficiency for a period of time while these changes and the necessary adaptations are being made.

Efficiency improvements in Supply Networks: Roles of the Actors

As previously discussed, efficiency improvements often occur as a result of cooperation across company boundaries. Further, Håkansson & Eriksson (1993) argue that efficiency (including innovativeness) is not only determined by the way separate relationships are handled, but also by how

different relationships are combined. Network efficiency can also involve change of activities between actors that are both related to a focal firm (for example the moving of purchases from one actor to another), the entry of new actors (new in the context that they are used, and not necessarily new to the buying firm) or a restructuring of relationships so that actors which both used to be suppliers to the focal firm becomes supplier and sub-supplier (Torvatn, 1996).

This section will look at the roles of the actors in a supply network in relation to efficiency improvements. Moreover, four different ways in which efficiency improvements can take place within supply networks will be discussed. It is shown that ideas may be generated one place in the supply network, and implemented somewhere else. To find the underlying causes and complex connections that are related to efficiency improvements a broad approach to supply networks will be taken. This implies that actors not directly involved with the focal company, such as the other customers of a focal company's suppliers and horizontal companies will be included in the definition of a supply network.

Way one: Initiative - Focal Company, Implementation - Supply Network

One way efficiency improvements can take place in a supply network is through the initiative from a focal company. A focal company may influence a supplier in the network to refine its product which allows the focal company to charge a higher price for its product. This will increase the value of the product without any major changes in input and efficiency is thus increased. A focal company can spend money and /or personnel to help the supplier to develop in a direction wanted by the buyer firm. Supplier development programs initiated by a focal company are one way to influence the supply network to develop in a certain direction. Obviously, such an effort requires a lot of attention and resources from the buying firm and is usually done only with a small number of the more important suppliers.

A focal company can also assist two or more suppliers to collaborate and share knowledge to come up with solutions that will lower the price of the products the focal company is purchasing. In line with this Dubois (2003) found that a buying company was able to reduce its purchasing costs through reconsidering its purchasing strategy in terms of increasing involvement with a limited number of suppliers. The focal company may also assist the suppliers in finding solutions that will increase the value of the customer's product. Toyota is an example of a company that assists its suppliers to collaborate and find solutions that will be beneficial to Toyota (Dyer, 2000). The initiative is taken by the focal company and the implementation is done by the supply network. The efficiency increase, however, surfaces as an increase in value for the focal company's product.

Way two: Initiative - Supply Network, Implementation - Focal Company

A focal company's supply network may also be the initiator of efficiency improvements. In some situations a supply network can be of critical importance to perform at peak efficiency. This can be the case in the process industry, where certain suppliers have a direct impact on the yield of the production processes employed. The suppliers may come to the focal company with ideas of how the production process can be improved. The implementation will then be done by the focal company and the output will increase. A supplier may also suggest the implementation of a new component or solutions that will increase the value of the focal company's product.

It is easy to see that product and process innovations are closely linked in a supply network. A product innovation some place in the supply network can have great consequences for the focal company and influence the production process of this company. Changes in the production process can lead to more volume produced and also a shorter production process for a set amount of units.

Solutions to improve efficiency might come from the focal company's supply network directly or indirectly. Other customers and horizontal partners of the focal company's suppliers can also come up with solutions to increase efficiency. Further, efficiency improvements may also be the result of an idea from the focal company's customers or horizontal companies. One of the focal company's customers could have worked with similar suppliers and found ways to increase efficiency that can be transferred to the focal companies operations.

Way three: Initiative - Supply network, implementation - Supply Network

Efficiency improvements can also take place among the suppliers in a supply network. The focal company is in this case not directly involved in the changes being made, but the improvements are still important for the total supply network. The suppliers of the focal company might interact with each other to find more efficient solutions. A focal company can for instance improve the efficiency of its production process radically if the input from the suppliers specifically matches its production process. Whenever a company in the supply network changes an aspect of its operations to improve its productivity, this move will also affect the productivity of the network as well as that of other partners.

The focal company can gain from efficiency improvements at its suppliers, without involving the production process at the focal company at all. The supplier can come up with a solution to increase efficiency without interacting with the focal company e.g. by making an adaptation to one of its other customers that also will increases the efficiency for the focal company, it is however much easier to spot efficiency improvements of this kind when a company is seen to be a part of a larger network. When a broad view of supply networks is taken the inputs to the suppliers are also of great importance. If input costs are high to the direct suppliers, this will clearly affect the supply network efficiency. Therefore, cheaper products because of price reductions from direct suppliers will not result in increased efficiency for the supply network. Only when the reduction in the price of exchanged goods is due to better resource utilisation in the suppliers' productivity and/or better linking of activities can an increase in the supply network efficiency be detected.

Way four: Interaction initiated, Focal Company and Supply Network

The focal company and its supply network can through interaction find solutions to improve efficiency. As the companies in the supply network come to know each others technical solutions better, they can propose technical and organizational adaptations that will increase efficiency. The supply network, including the focal company can be the locus of innovation and increase the value of output from the supply network. Whether the efficiency improvements are initiated at the focal company's supplier's supplier, customer or horizontal partner or even the focal company's customer or generated somewhere else in the supply network is not a concern when a broad approach to supply networks is taken. An innovation as a result of the interaction between a focal company and its supply network, can improve efficiency for the supply network no matter where the idea of efficiency improvements is created and where it is implemented.

A triad as a way to elaborate on efficiency in Supply Networks

This paper focuses on efficiency improvements in supply networks. An increase in efficiency requires an increase in the input/output fraction. To study such efficiency improvements in supply networks, some boundaries have to be imposed on the network. For the purpose of this paper, a triad will be the unit of analysis. A triad is the smallest unit that can be characterized as a network and represent the complexity of a network at the same time it is a manageable number of actors to study. The companies in the triad are parts of other, partly overlapping business networks, and the network of actors involved around this triad, such as suppliers, customers and horizontal partners, will therefore also be studied in relation to efficiency improvements in supply networks. The unique networks of every actor in the triad will be considered and studied with regard to how each company in the triad are a part of a wider network and what impact the wider network has on efficiency improvements in the supply network.

Concluding remarks

The purpose of this paper is to focus on efficiency improvements in supply networks. To study how efficiency improvements occur in supply networks, a triad is taken as a point of departure. A triad allows us to study how efficiency improvements may be achieved in supply networks and what effects the companies' other, partly overlapping business networks has on efficiency improvements for the total supply network. The paper is a first attempt at trying to create insight into phenomena that are often ignored when discussing efficiency improvements. A broad approach to supply networks is made which provides opportunities to go beyond the suppliers of a company in the search for underlying causes and connections that are related to efficiency improvements.

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