

Paper submitted for the 23rd IMP Conference,
30th August – 1st September 2007, Manchester, UK

Innovating Through Suppliers: A Network Approach

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Abstract

Suppliers seem to play an important role in many companies' innovation processes. This paper presents a taxonomy of innovating through suppliers. The taxonomy is created by the introduction of two central dimensions in relation to innovating through suppliers. The first dimension concerns the number of companies involved, i.e., the innovation can involve a single supplier or a networking supplier. The second dimension concerns the level of cooperation between the customer and the supplier, i.e., either low or high. Thus, innovating through suppliers can involve the single supplier as a cooperating partner, the single supplier as a problem-solver, the networking supplier as a cooperating partner, and the networking supplier as a problem-solver. The empirical material consists of Alfa, a producer of newsprint, which conducts a number of innovations together with its supplier, Bravo, an engineering company.

Keywords: innovation, supplier, business relationship, business network

1 Introduction

Suppliers seem to play an important role in many companies' innovation processes. This phenomena has experienced growing recognition among both companies and academics (e.g., Womack et al., 1990; Clark and Fujimoto, 1991; Kamath and Liker, 1994; Dyer, 1996; Lamming, 1996). In fact, a supplier's ability to contribute to a company's innovations is pointed out to represent one of its two basic roles (Gadde and Håkansson, 2001; Sobrero and Roberts, 2001), i.e., contributions to change and improvements, hereunder development of new products and processes. The other one being efficiency, i.e., the more traditional recognition of a supplier being able to produce the same product or component at a lower cost than the company itself.

The advantages associated with innovating through suppliers can be divided into two groups. First, there is said to be advantages for the innovation itself, the product or process that is being developed. One frequently cited advantage concerns reductions of the time-to-market (Clark and Fujimoto, 1991; Ragatz et al., 1997). Another advantage concerns reduction of the development costs (ibid.), e.g., certain components, of the innovation can be developed or tested at a lower cost by specialized suppliers. A third advantage concerns the quality of the outcome of the innovation process, the product or service that is developed (ibid.). After all, involving more companies can open up for new ideas and improvements. These advantages follow the traditional measures of time, cost and performance, widely used in the fields of product development management and project management (Morris and Pinto, eds., 2004; Meredith and Mantel, 2006). Second, there is said to be advantages for the company that innovates through suppliers. This way of organizing the innovation can have a positive impact on the company's knowledge development, e.g., through joint learning (Teece, 1992; Nonaka and Takeuchi, 1995). Another advantage concerns the company's ability to focus on its competences and to obtain a high level of specialization (Hamel and Prahalad, 1994). In line with this, many companies put a lot of emphasis on the outsourcing of activities in their innovation processes.

An increased attention towards specialization and a systematic use of counterparts in business activities has in the latter decades challenged the dominant, company-internal perspective on innovation. This traditional perspective view innovation as something associated with secrecy and protection in the sense that companies were reluctant to involve external companies at all. This held particularly true when the innovations included products that were built on new technology, patents, or new knowledge. This perspective on innovations manifested itself in the majority of the innovation models made use of by companies at that time, as tended to regard this process as a "company-internal challenge", e.g., departmental-stage models (Robertson, 1974; Saren, 1984), or decision-stage models (e.g., Cooper, 1993).

Thus, innovating through suppliers is a topic that receives considerable attention within the field of business. Furthermore, several authors call for a variety with respect to the organization of such innovations (e.g., Clark and Fujimoto, 1991; Kamath and Liker, 1994). Similar advice can be found in relation to use of suppliers in general (Gadde and Snehota, 2000; Dubois, 2003). Against this background, the purpose of this paper is to present a taxonomy of innovating through suppliers. Two central dimensions are identified: the number of suppliers involved as part of the innovation process, and the level of cooperation throughout the innovation process.

In general, an innovation can be regarded as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers, 1995: 11). Others refer to innovations as combining of resources in new ways, or the combining of new resources (e.g., Penrose, 1959). This paper focuses on product innovations, and more specifically on the

development of new technical solutions that are put into use by the customer. Innovations are frequently referred to as “back-and-forth” processes that vary greatly in their progress (Tidd et al., 1997). However, three broad phases, or stages, can often be identified: initiation, development and implementation (Utterback, 1994; Handfield, Ragatz, Petersen and Monczka, 1999). Initiation refers to the planning stage: the beginning of the innovation process. Development refers to the physical creation of the product, or technical solution. Implementation refers to the installation of the product, or technical solution: the end of the innovation process. All three phases can include comprehensive testing, such as simulations, testing of prototype and testing of the product when connected to other technical facilities.

The empirical part of this paper takes Alfa and Bravo as a point of departure. Alfa is a global producer of newsprint and magazine paper, and Bravo is a global engineering company. In order to improve Alfa’s facilities, a number of innovations have been conducted together with Bravo, sometimes also involving third parties. The empirical part is followed by analysis of the empirical material by making use of the taxonomy of innovating through suppliers, discussions and managerial implications.

2 Innovating through Suppliers: A Taxonomy

There are several ways in which a company can innovate through suppliers. In order to elaborate on this issue, two central dimensions form a point of departure. First, by focusing on the number of companies involved, innovating through suppliers can either involve a single supplier or a networking supplier. Innovating through a single supplier means that the innovation involves the customer company and the supplier. Innovating through a networking supplier means that the innovation in addition to the supplier and the customer involves third parties. These third parties can be directly connected to the supplier, the customer, or both. However, they can also be only indirectly connected to the supplier or the customer. Second, by focusing on the level of cooperation between the customer and the supplier, innovating through suppliers can either involve a supplier as cooperating partner or supplier as problem-solver. Innovating with the supplier as cooperating partner means that there is a high level of cooperation between the two parties throughout the innovation. Correspondingly, innovating with the supplier as problem-solver means that there is a low level of cooperation. In the following, these two dimensions are combined, creating a taxonomy consisting of four different ways in which a buying company can innovate through suppliers. See figure 1.

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Single Supplier as Cooperating Partner

Innovating through a single supplier as a cooperating partner represents a quite common approach. In the field of supply management, main attention has been paid to direct suppliers, and furthermore how to deal with each supplier individually (Bailey et al., 1998; Nobeoka, Dyer and Madhok, 2002: 718). Such a dyadic approach towards suppliers can be said to be characterized by being simple, direct, and clear-cut.

Innovating through the supplier as a cooperating partner entails a high level of cooperation between the two parties. This cooperation can take place during one or several of

the phases of the innovation process, i.e., initiation, development, and implementation. As long as the level of cooperation is high in any of these three critical phases of the innovation process, the supplier is here regarded as a cooperative partner. The cooperation in relation to the innovation may concern design tasks, specifications, development, engineering, or sub-assembly, to mention some (e.g., Petroni and Panciroli, 2002: 136). Clark and Fujimoto (1991; in Petroni and Panciroli, 2002: 137) classify suppliers in relation to innovations, and introduce “black box part”, where the customer provides standards of cost, performance and basic features, whereas the supplier is responsible for specifications and engineering, and “detailed controlled part”, where the customer also handles the specifications and the detailed engineering, leaving process engineering and manufacturing to the supplier. Both these approaches entail innovating through the supplier as a cooperative partner. One reason for this high level of cooperation can be related to the innovation itself. If both parties possess knowledge that is needed in the innovation process, and this knowledge is of a tacit and “sticky” nature, this may call for a high level of cooperation (von Hippel, 1994; Sobrero and Roberts, 2001: 497). This high level of cooperation in parts of, or the whole innovation process, implies the presence of a business relationship between the two parties. Such business relationships are frequently held out as important tools that open up for cooperation in the process of innovating through suppliers (Womack et al., 1990; Wheelwright and Clark, 1992). Accordingly, different methods and techniques on how to cooperate with suppliers on product development exist. Early Supplier Involvement (ESI) in product development represent one technique that include co-design activities and joint concept development (e.g., Clark and Fujimoto, 1991; Bidault et al., 1998). Others in a more general way point out that supplier involvement on product development may span from simple consultations to full responsibility for the development of a system (Ragatz, Handfield and Petersen, 2002). Others report that the cooperation with the supplier can either be an integrated, systematic way of working together, or based on a more ad hoc approach, where contact is made as problems occur (Lakemond, Berggren and van Weele, 2006: 59). Several authors pay attention to this high level of cooperation with suppliers in relation to innovations as a phenomena that is particularly common in Japan (e.g., Clark and Fujimoto, 1991; Dyer, Cho and Chu, 1998: 58).

Furthermore, this interest in supplier relationships as an important tool for innovations can be seen as part of an increasing interest in supplier relationships and business relationships. In general, supplier relationships have received increased attention as a way to connect with the suppliers and develop JIT-systems, lean production, reduce costs and uncertainties, and increase quality (Womack et al., 1990; Lamming, 1996; Sheth and Sharma, 1997: 91) This approach towards supplier relationships means use of long-term rather than short-term contracts, reduction of the number of suppliers and a trend away from the traditional arm’s length way of dealing with suppliers (e.g., Dyer, 1996). This represents a shift from a transaction oriented to a relationship oriented approach (Sheth and Sharma, 1997: 91). In a similar vein, business relationships in general have received considerable attention (e.g., Arndt, 1979; Webster, 1992; Morgan and Hunt, 1994). Business relationships are pointed out to hold the potential to create long-term benefits for companies, and are reported to frequently outperform market solutions as well as hierarchical solutions. Accordingly, companies’ use of business relationships, hereunder strategic alliances, is reported to be increasing (Anderson, Håkansson and Johanson, 1994; Gulati et al., 2000).

Viewed in isolation, conducting a single innovation through a supplier as a cooperative partner may project as a quite resource demanding process. However, although innovating through the use of a cooperative partner may seem less efficient than approaching a supplier in a more clear-cut way and encouraging only limited cooperation, the development of a cooperative partner provides more opportunities for joint learning. Sobrero and Roberts (2001) focus on this aspect in their article “The Trade-Off Between Efficiency and Learning

in Interorganizational Relationships for Product Development". In a similar vein, other authors point at an underlying dilemma of either aiming at short-term or long-term benefits when innovating with suppliers (Wynstra, van Weele and Weggemann, 2001; Sako, 2004; Dunn and Young, 2004). This challenge holds similarities with the quest for balancing between exploration and exploitation in the seminal work by March (1991). Developing a business relationship is a time-consuming and resource demanding process, in particular in the early phases. However, well-developed business relationships can be highly valuable resources that pay off for the companies that possess them (Anderson et al., 1994; Holm, Erikson and Johanson, 1999). Therefore, a central aspect when innovating through a supplier as a cooperating partner is whether a previous business relationship between the two companies exists. If so, the parties have already made investments related to knowing each other, how to cooperate, joint learning, routines, etc. In accordance with this, Dyer and Ouchi (in Handfield, Ragatz, Petersen and Monczka, 1999) report that an existing business relationship strengthens the opportunities to conduct a successful innovation. If, however, no previous business relationship between the parties exist, it can be wise to consider whether this way of organizing the innovation process can be followed by a further use of this business relationship, e.g., conducting more innovations with the same supplier in order to harvest from the investment made.

Single Supplier as Problem Solver

Innovating through a single supplier as a problem solver may be the most traditional approach. By making use of the supplier as a problem solver, the company approaches the challenge of innovating with only a low level of cooperation. This does not refrain the company from conducting the initiation of the innovation itself, such as communicating its needs and requirements to the supplier, or even come up with specifications. However, the situation may also be that the supplier conducts both the initiation and the development without cooperating with the customer. This may even take place with no contact between the customer and the supplier prior to the development of the innovation, also referred to as "supply proprietary part" by Clark and Fujimoto (1991; in Petroni and Panciroli, 2002: 137). Either way, the interface between the customer and the supplier for the innovation in hand is less complex than the situation with the supplier as a cooperative partner. Contrasting the integrated way of working together as well as the more ad hoc one, which both fit into a cooperative approach, this means that the supplier takes on a more independent role of developing the innovation (Lakemond, Berggren and van Weele, 2006: 59). Innovating through a supplier as a problem solver can be linked to popular concepts within the field of business, such as specialization, outsourcing, or core competence (Hamel and Prahalad, 1994).

Innovating through a supplier as a problem solver puts forward certain requirements to the product at hand. Von Hippel (1990; see also Holmen and Kristensen, 1998) introduces the concept of "task partitioning", a technique of partitioning the innovation process into a number of tasks and subtasks. A similar concept is task interdependency. In order for the supplier to act as a problem solver in relation to an innovation, the tasks must either be easily partitioned in the sense that they can be distributed between the customer and supplier and still be handled with a low level of cooperation, or the tasks are all-importantly handed over to the supplier, leaving no complex interfaces in the boundaries between the two companies. Sobrero and Roberts (2001) addresses this issue, and point out that such challenges are approached in the design scope.

Whereas innovating through a supplier as a cooperative partner necessitated the development of a business relationship, innovating through a supplier as a problem solver

does not. Rather, this approach can bear the resemblance with discrete transactions, limited to the exchange of a product for financial resources (e.g., Dwyer, Schurr, and Oh, 1987). This type of exchange is characterized by a short time perspective, and limited or no exchange of knowledge, or joint learning, a so-called arm's length approach to suppliers, where reduction of price is a main concern (e.g., xx). Accordingly, a large proportion of the literature on supply focuses on techniques and methods on how to reduce prices on purchased products (e.g., xx). However, innovating through a supplier as a problem solver can draw upon an already existing business relationship, i.e., the company and the supplier have already cooperated for a while. In this situation, making use of the supplier as a problem solver can represent an efficient way to generate a new technical solution for the customer. Furthermore, even though innovating through a supplier as a problem solver in itself involves a low level of cooperation, this process may form a foundation for the development of a business relationship between the two parties. After all, if the parties experience this way of organizing to be efficient, this may motivate repeated transactions, even though the adaptations between the parties are limited. However, as the level of cooperation is low, the parties may also feel that they are "returning to square one" every time they enter another innovation process.

By returning to the underlying dilemma of short-term versus long-term benefits, the solution of approaching the supplier as a problem solver is primarily associated with benefits related to efficiency in a short-term perspective, i.e., this solution may require less resources in the cooperation between the parties (e.g., Sobrero and Roberts, 2001). However, it may also be that the parties have been able to routinize the way the supplier provides the customer with innovative solutions, and still keeping a low level of cooperation. In this way, there may be beneficial long-term effects from this way of organizing innovative activity.

Networking Supplier as Cooperating Partner

Innovating through a networking supplier as a cooperating partner brings a whole new set of challenges, as third parties are now active throughout the process. Whereas innovating through a single supplier provided a process that is delimited to two companies, this picture opens up when innovating through a networking supplier as a cooperating partner. First, this situation involves a high level of cooperation between the customer and the supplier. In addition, this situation involves third parties: other companies that the customer and supplier interact with. Each of the relationships with these other companies can either involve a low or a high level of cooperation.

Although not as widely focused as the single approach to suppliers, a network approach to innovating through suppliers is definitely gaining increased attention among companies as well as in literature (e.g., Dyer, 1996; Lamming, 1996; Dyer and Nobeoka, 2000).

In the following, three main ways of innovating through a networking supplier as a cooperating partner are identified. First, the supplier and the customer can jointly cooperate with one or several other companies as part of the innovation process. Dyer and Nobeoka (2000) point at Toyota as an example of this, cooperating closely with its suppliers, and furthermore encouraging them to cooperate with each other and openly share knowledge in the processes of improving and innovating. Furthermore, the authors illustrate how Toyota addresses challenges related to the free rider problem and transfer of tacit knowledge among the parties. This type of network, the authors point out, becomes "highly interconnected" and with "multiple pathways". Similar reports exist on other companies, such as Océ, which organized itself with several of its suppliers in inter-organizational teams in order to create innovations through new combinations of knowledge located at different companies (Batenburg and Rutten, 2003). Connecting with, and working directly with companies, rather

than solely indirectly, is referred to as “network intervention” (e.g., Johnsen and Ford, 2005; referring to among others Lamming, 1996).

Second, the supplier can single-handedly cooperate with one or several other companies as part of the innovation process. This approach can be used by customers that consider it too resource demanding to involve directly with other companies. However, it may also be the supplier that prefers to cooperate with others without involving, or even informing, the customer, other companies’ participation in the innovation process may then be unknown to the customer. This approach furthermore covers the more conventional methods on innovations within supply chains and supply networks, such as assigning a first-tier supplier to team up with second-tier suppliers (Womack, Jones and Roos, 1990; Hines, 1996). Working through other companies indirectly in this way, may be referred to as “network delegation” (e.g., Johnsen and Ford, 2005; referring to among others Lamming, 1996).

Third, the customer can single-handedly cooperate with one or several other companies as part of the innovation process. At first glance, it may seem strange to refer to a “networking supplier”, while it for the innovation in hand only holds one relationship, namely the one with the customer. However, business networks consist of connected relationships, and exchange in one relationship is conditioned by exchange in other relationships (Cook and Emerson, 1978; Anderson et al., 1994). Accordingly, the supplier networks not only through the direct relationships that it holds for the innovation in hand, but also the indirect ones. Many companies involve several companies in their supply network when conducting an innovation (e.g., Wynstra, Wegeman and van Wele, 2003). Furthermore, many companies see to it that the information passes through itself, rather than through direct relationships between the suppliers (Krause et al., 2000). This approach to organizing innovation processes is not limited to the customer’s supply network. Other companies from the customer’s business network can also take part in the innovation process, e.g., its customers, or their counterparts. This approach provides the customer with a feeling of control, which is, to many companies, quite essential. The supplier can be said to gain a more passive role with respect to the networking, as this takes place only indirectly, i.e., through the customer. These processes of networking may even be unknown to the supplier, i.e., it has no knowledge of whether or not the customer involves other companies in parts of the innovation process.

In addition, combinations of these three above mentioned ways exist, e.g., the supplier single-handedly cooperates with some companies and the supplier and the customer jointly cooperate with other companies, or other combinations.

When innovating through a supplier, the further involvement of third parties, i.e., involving a network of companies, is associated with several advantages. One of these advantages concern specialization and economies of scale (Teece, 1992). As one example, the supplier is often involved by the customer as it represents a more specialized company for the innovation in hand. In turn, this supplier can involve its suppliers in parts of the innovation process, benefiting even further on specialization. Utilization of this potential advantage requires that the customer and the supplier are willing to involve other companies in the innovation process. Another advantage concerns access to new ideas. By involving a network of companies in the innovation process, these companies can contribute with ideas throughout the process, and possibly improving the quality of the output. This network may even bring up the ideas that form the foundation for conducting the innovation process. After all, ideas that lead to innovations can be found in networks of learning, rather than in individual companies (e.g., Håkansson, 1987; Freeman, 1991; Powell, Koput and Smith-Doerr, 1996). Accordingly, a number of techniques exist on knowledge-sharing and knowledge transfer in order to make use of these potential sources of innovative ideas, and even to “out-innovate” networks that are less efficient along these dimensions (von Hippel, 1988; Dyer and Nobeoka, 2000: 346). As yet another advantage, involving a network of companies in the innovation process can

ease the process of mobilizing resources. The development of an innovation is likely to require the resources from several companies (complementary assets). This is particularly true for the more complex innovations, hereunder systemic innovations (Teece, 1992). Furthermore, this mobilization of resources may turn out to be critical in relation to the use of the innovation. This use often requires that several companies direct their actions. After all, “Inventions hardly function in isolation.” (Rosenberg, 1982: 56). Naturally, these potential advantages associated with innovating through a network have to be held up against the fact that these activities are time- and energy consuming, can tap a company for knowledge, and furthermore sets certain requirements to any company that sets out to make use of this way of organizing.

This interest in innovating through a networking supplier can be seen as part of an increasing interest in supply networks and business networks in general. Supply networks receive considerable attention among academics as well as companies (Lei and Slocum, 1992; Dyer, 1996; Sheth and Sharma, 1997; Gadde and Håkansson, 2001). These supply networks hold the potential to make significant impact on any company’s profitability, and they are frequently used in order to innovate, create efficient manufacturing, communicate, and learn. Turning to business networks, these have as well achieved a considerable attention among academics as well as companies (e.g., Anderson et al., 1994; Powell et al., 1996). These phenomena can be regarded as a way of doing business that contrasts the neoclassical market thinking (Granovetter, 1985; Uzzi, 1996). Achrol and Kotler (1999) furthermore point at business networks as superior learning organizations due to their way of connecting knowledge and resources.

Networking Supplier as Problem Solver

Innovating through a networking supplier as a problem solver involves a low level of cooperation between the supplier and the customer. However, both the supplier and the customer may as part of the innovation process hold business relationships with either a low or high level of cooperation with other companies.

Accordingly, the three ways of innovating through a networking supplier, as identified in the previous section, also apply here. First, the supplier and the customer can, despite of holding a low level of cooperation in relation to the innovation, jointly hold business relationships with one or several other companies as part of the innovation process. If these business relationships with the third parties also involve a low level of cooperation, it may be that the nature of the innovation in hand simply does not require close cooperation, e.g., due to “task participation” (von Hippel, 1990). However, although the companies are loosely connected to each other, the innovation involves a network of companies. It could also be that one, or several of these business relationships with the third parties involve a high level of cooperation in relation to the innovation. This could be the case if the innovation requires a high level of cooperation between these parties, or simply because a well-developed business relationship already existed at the time of the initiation of the innovation. After all, companies tend to involve companies with which they hold previous experience when conducting innovations processes. The low level of cooperation between the customer and the supplier in relation to the innovation may be regarded as an efficient way of organization, as the resource-demanding process of creating a business relationship characterized by a high level of cooperation is avoided (e.g., Hallen et al., 1991). However, such a solution may disrupt the potential for creating “multiple pathways” for innovation among the participating companies (Dyer and Nobeoka, 2000).

Second, the supplier can single-handedly cooperate with one or several other companies as part of the innovation process. For the customer, this solution is associated with

specialization (Teece, 1992). Not only are parts of the innovation handed over to a supplier, in turn making use of its suppliers. Neither does the customer and the supplier develop a high level of cooperation in relation to the innovation, i.e., the boundary between the two is quite clear-cut. The degree of “network delegation” (Johnsen and Ford, 2005) for the customer is strong; parts of the innovation are delegated to the supplier, which furthermore involves other companies, e.g., second-tier suppliers. This way of organizing limits the customer’s opportunities to influence how the supplier in turn organizes its cooperation with other companies as parts of the innovation process. Rather, this way of organizing directs the attention towards the outcome of the parts of the innovation process that are handed over to the supplier, i.e., can the supplier deliver according to the agreement? In this way, the customer takes on a quite traditional approach towards use of suppliers.

However, even though this way of organizing an innovation process delimits the customer’s opportunities to involve with the supplier’s counterparts, the supplier holds the potential to accomplish its parts of the process in close cooperation with a network of companies. Thus, it can be argued that this way of organizing the innovation process, offers two potential advantages: a clear division of work, which delimits the need for the customer to interact with the supplier, and access to a network of companies.

Third, as part of the innovation process, the customer and the supplier can hold a low level of cooperation at the same time as the customer single-handedly holds business relationships to other companies. It may be that the customer keeps a low level of cooperation with all the companies involved in the innovation process. In that case, it can be that the customer applies a standardized approach to its counterparts, where these are assigned to conduct clear-cut tasks that form parts of the innovation process. This approach to organizing the innovation process truly places the customer “in charge”. Each of the counterparts will likely report to the customer in dyadic way, although the customer holds the potential to create network effects by combining and passing on information, new knowledge, etc. This represents a very direct “network delegation” in the sense of making use of direct suppliers and other counterparts. The creative potential that might exist if suppliers are connected into a network (Dyer and Nobeoka, 2000), however, is not released. In this way, by taking on such a central role, the customer only partly makes use of the potential network effects from its suppliers and counterparts.

By returning to the underlying dilemma of short-term versus long-term benefits, this approach to innovation processes can be said to potentially make use of benefits associated with both these types. First, by holding a low level of cooperation, the supplier and the customer avoid what is referred to as the cost-side, or the investments, that are associated with a well-developed business relationship (e.g., Hallen et al., 1991). Furthermore, these investments tend to crop up in the early stages of the development (e.g., Ford, 1980). As a consequence, if the two companies can cope with the innovation process attending a low level of cooperation, this might project as an efficient way of organization. Second, either the supplier, the customer, or both may hold other business relationships that involve a high level of cooperation, and perhaps existed prior to the initiation of the innovation in hand. This way of organizing the innovation process can through such business relationships bring long term benefits.

3 Case: Alfa

The empirical material consists of a single case study with Alfa as the focal company. In total, eleven semi-structured, face-to-face interviews with Alfa and one of its main suppliers:

Bravo, have been conducted over a period one year. In addition, various secondary sources on the two companies have been collected, e.g., company documents, product descriptions and annual reports.

Alfa is one of the largest newsprint mills in Europe, and together with its sister organizations form the Alfa Group. The Alfa Group holds plants throughout the world and is a leading producer of newsprint and magazine paper. For Alfa, the production of newsprint started in 1966. The mill has three paper machines as of today with a production capacity of 600,000 tones per year. Serving customers world-wide, the mill has its own port facilities, and operates a twice-a-week regular line to the UK and Continental Europe.

Just as other producers in the pulp and paper industry, Alfa has a high level of capital tied up in its facilities. Alfa therefore continuously searches for ways to increase the productivity of its paper machines and at the same time deliver high-quality paper at the lowest possible cost. Key process indicators such as quality, production, sheet quality, caliper weight and cross-direction profiles are analyzed on a daily basis and the whole organization is kept informed about the mill's status every week. Once every year, a team consisting of management and engineers responsible for the paper machines, look for improvement potential in the paper mill. The team prepares a list of different goals and objectives that Alfa should strive to attain in the course of one year. One such goal could be to reduce unwanted stoppages in the paper machines, which is quite evident since one hour stoppage costs around 50,000 NOK. To achieve the goals set, Alfa is dependent on systematic improvements of the paper machines. These improvements are mainly being implemented because of top-class engineers within in the organization. As well as having excellent internal competence, Alfa is dependent on specialized suppliers to find solutions that will make the paper machines produce at desired speed and with the right quality as well as to reduce unwanted production stoppages. One such supplier, which is a significant contribution to the success of Alfa, is Bravo, one of the world's leading engineering companies.

Bravo is a global provider of power and automation technologies that enable utility and industry customers to improve their performance. The Bravo Group of companies operates in around 100 countries and employs about 108,000 people. More than 85 percent of the world's pulp and paper mills have Bravo products installed and running. It could be a complete automation system, motor, power transformer or instrument, but a part of the process depends on Bravo. Bravo was established as the result of a merger between Delta and Echo in 1987. Both Delta and Echo had been suppliers of Alfa since the establishment of the paper mill in Norway in 1962. Bravo and Alfa, therefore, have a long history of working together and have carried out a number of projects in cooperation.

A paper mill consists of numerous different functions from the process of making fiber of timber, via the pulping process, to the making of paper in the paper machines. Bravo is involved as a supplier at many different areas; this article, however, only focus on the areas that involves Bravo in the paper making process. Over a period of 40 years, Alfa and Bravo have cooperated to increase the performance of the paper machines, by updating and developing the automation systems. The high quality requirements for paper producers today makes it crucial to have the ability to control and obtain the right information to make correct decisions and manage a plant. Process automation is therefore essential to manage a mill like Alfa and to optimize existing equipment efficiencies.

Alfa operates, as previously mentioned, three paper machines. Paper machine 1 (PM1) started its production in 1966 and has a production capacity of 172,000 tones per year. Paper machine 2 (PM2) started its production in 1967 and has a production capacity of 186,000 tones per year. Paper machine 3 (PM3) was built in 1981 and is the largest and most modern paper machine at the Alfa mill, with a production capacity of 242,000 tones per year. PM3 is also

the only paper machine in Norway using pulp recovered from recycled paper for production of newsprint.

Over the years, Bravo has been involved in several small upgrading projects to improve efficiency over the entire mill as well as large projects involving rebuilding of a complete paper machine. As an example, PM3 was rebuilt in 1995 and PM1 in 1999. In both these projects Alfa wanted to renew and upgrade the automation systems and chose Bravo as their main automation supplier. Originally, PM1 had a control system supplied by two other suppliers for both the analogue and digital side. This existing control system was at the end of its life span without a well-defined upgrade path. Instead of having several suppliers delivering the control system, which is the most common strategy, Alfa decided to make Bravo the sole supplier. A control system is a device or set of devices to manage, command, direct or regulate the behavior of other devices or systems. In this project Bravo installed a Distributed Control System (DCS), a manufacturing system in which the controller elements are not centrally located, but distributed throughout the system with each component sub-system under the control of one or more controllers.

In addition to installing the DCS system, Bravo also installed a Quality Control System (QCS) used for accurate measurement of all sheet parameters providing extra information for greater and faster control. The QCS system consists of a measuring frame incorporating traversing sensors ensuring that the specified weight, moisture level and color are maintained for the paper produced. Finally, a Drives system was installed by Bravo which is a system to drive a machinery of different engines at the same speed. If these engines drive at different speeds, the paper might tear or crumple up.

The control system replacement at PM1 began in 1999 with a mill wide study of the existing control system including making documentation for 250 drives, 3,500 signals and 200 valves. This phase was completed by close cooperation between Bravo and Alfa. A second supplier was also involved in making the specifications, the Finnish based machine supplier Charlie. PM1, 2 and 3 have been delivered and installed by Charlie, giving the company extensive knowledge about the paper machines, and therefore a key actor in this project. Charlie sent functional descriptions regarding the paper machines to Bravo, as well as supplying various mechanical components. Even though Alfa handled most of the coordination between Bravo and Charlie, the two suppliers were very dependent on each other in this project. The detailed engineering to make a control system fit the mill's processes was mostly done internally in Bravo, involving departments from Norway, Sweden and Finland. During the implementation phase all three actors, Alfa, Bravo and Charlie were involved doing a Site Acceptance Test (SAT) to ensure the new system was working prior to startup. It took about three weeks to install the new system. The project at PM1 resulted in a production increase of 200 meters/minute, which represented a 20 percent production increase.

In 2003 Alfa and Bravo completed a project that involved the upgrade of PM2. Some parts of the control system needed replacement and certain components had reached the end of their life cycle, especially the quality control system. Alfa also wanted improvements in the paper quality and to increase the speed of the paper machine. Bravo had previously been involved in similar projects with the upgrade of PM3 and PM1, and could therefore transfer much of this knowledge to the work at PM2.

Alfa gave Bravo all the documentation needed about the paper machine for making a new system to fit the mill's processes. Much of the base programs that had been developed in earlier projects could also be applied in this project, however, much detailed engineering and special applications had to be done. Bravo did most of the detailed engineering in this project, which included defining the way the new DCS would be configured, installed and operated. Even though Bravo did most of the engineering, Alfa's process knowledge about paper production was invaluable. The parties interacted closely throughout this project to find

process control solutions that would fit PM2's production process in an optimal way. The project included the replacement of the DCS system, QCS system and Drive system.

Although much of the technology developed in this project was very similar to the earlier projects at PM3 and PM1, one particular process control technology was completely new. When it came to selecting a DCS system, Bravo and Alfa chose Bravo's latest technology, 800xA based on Industrial IT. 800xA extends the scope of traditional control systems to include all automation functions in a single user and engineering environment so that mills can run smarter and more efficiently with substantial cost savings. The system integrates the domain of traditional process control with the domain of IT technologies and applications that provides unique single-point data access for the entire mill. The benefits of the integrated system include efficiency of process management and maintenance, common operator interface and tools, fewer spares and a fast response and access to all control parameters. The 800xA DCS equipment enables connectivity to systems of other automation suppliers which is a strong argument by plants installing this system. Alfa wanted to make use of these benefits and was the first paper mill in Norway to install 800xA.

In addition to the control system replacement, the QCS system was also replaced. Bravo's department in Sweden made the application for the QCS system and the implementation on the System 800xA control platform. This integration enabled the operators of Alfa to view useful information regarding the paper quality as well as other useful parameters. Combined with the changes in the DCS and QCS systems, the Drives system was also replaced with a more advanced system. This part was mainly done by Bravo's department in Finland. The project leader for the upgrade of PM2 was situated in Norway and made the application for the integration of all three systems; DCS, QCS and Drives.

During the installation of the new control system, several engineers from Bravo and Alfa were involved. The same procedure with a Site Acceptance Test was conducted before startup of the machine. Alfa and Bravo worked closely on installing and testing the new system for a period of 14 days while the machine was shut down. Alfa experienced some problems with PM2 right after the project that had to be solved in cooperation with Bravo. These problems were, however, resolved after some time and PM2 stabilized its production of high quality paper.

In addition to the three large rebuilding projects at Alfa, a number of smaller projects have been carried out to improve the paper making process. Many of these small changes have also been implemented by Bravo and other suppliers. One solution implemented by Bravo that has solved a problem for Alfa was the installation of a fiber orientation measurement laser, developed by Bravo. Bravo introduced Alfa to the first online two-sided fiber orientation measurement, freeing operators from the constraint of laboratory gauges, and providing the information necessary to eliminate process problems such as curls and twist warp. This laser is able to measure the position of the fibers when the pulp is being poured onto the moving belt of woven nylon mesh or "wire" of the paper machine. Being able to continually measure and analyze the position of the fibers is of great importance to the paper producers because of an increasing demand from their customers of having paper with fibers in the right direction. The printing works are building faster and faster printing machines and are therefore interested in paper that has a high wear resistance. Alfa decided to install this new product and because of its limited knowledge about this particular technology, all the detailed engineering was handed over to Bravo.

In 2005 a new small change was done at PM1. The head box was replaced to improve the paper quality. After the pulp has been produced, it is diluted, screened and pumped through a paper machine head box onto the forming wire, where some of the water is removed by natural drainage and vacuum pumps. One of the more cost-effective measurements in a paper mill is that which monitors the flow of pulp stock into the head box of the paper

machine. The stock level in the head box directly affects the thickness of the pulp being laid onto the wire and the thickness of the paper. PM1 is an old paper machine and improvements at different parts of the machine, like the head box, have to be done regularly in order to sell the paper produced at that machine. Charlie, the machine supplier, was selected to upgrade the head box of PM1 with RetroDilution, a dilution control retrofit that would improve the basis weight profiles. Charlie had previously supplied the head box of the other paper machines at Alfa and had obtained detailed knowledge of its functionalities. To make sure the pulp flows at a desired pace, the head box had to be connected to the quality control system (QCS), supplied by Bravo. QCS controls the paper on a number of parameters and signals back to the head box. If the paper, for instance, is uneven, the valves in the head box have to be regulated to make sure the flow of pulp is more even across the wire. Bravo and Charlie, therefore, had to coordinate extensively in this project in order for Bravo to be able to make the programming changes necessary to link the QCS system and the head box. This project was a turnkey delivery with short installation and startup. The shutdown only took a few days as the main part of the mechanical installation work was done beforehand. The result of this project was improved basis weight profiles and sheet homogeneity.

4 Analysis

Drawing on the taxonomy on innovating through suppliers as presented in figure 1, the analysis consists of four different ways in which Bravo as a supplier participates in innovations for Alfa.

Bravo as a Single Cooperative Partner

For the rebuilding project of PM2, Bravo and Alfa communicated intensively throughout the innovation process. Among other things, this project involved cooperation to find process control solutions that would fit PM2's production process in an optimal way. Alfa made the early specifications of solutions they wanted as a result of the project and cooperated closely with Bravo during the detailed engineering phase. As the first paper mill in Norway, Alfa decided to install the new DCS system, 800xA based on Industrial IT. This opened up for many new opportunities, especially for the operator interface, and required extensive interaction between Alfa and Bravo to find the optimal application. The new system contains numerous possibilities which made it challenging for the companies to select and find applications that were most beneficial. As well as having close interaction during the initiation and development phases, the implementation was also conducted in collaboration. For this project, Bravo can be identified as a single cooperative partner. Bravo was a cooperative partner of Alfa throughout the process, and utilized Alfa's know-how about paper making to find the best process automation system for PM2.

Bravo as a Single Problem-Solver

When Bravo installed the fiber orientation measurement laser at the Alfa mill, Bravo solved a major problem experienced by Alfa. With this innovation, Alfa was able to receive necessary information to eliminate problems of getting the fibers in the right position. Throughout this project, Bravo did most of the work to make the fiber orientation measurement laser fit Alfa's paper machines. Bravo initiated the project, as well as completing the detailed engineering and most of the implementation. Alfa was not significantly involved in this project because of

their limited knowledge about this particular technology. Bravo can therefore be regarded as a single problem-solving partner for Alfa in this specific project. Bravo solved a problem faced by Alfa by installing a product developed internally in Bravo.

Bravo as a Networking Cooperative Partner

For the PM1 project in 1999 which included a rebuilding and upgrading of the paper machine, Bravo can be identified as a networking cooperative partner. During the initiation phase of the process, both Bravo and Charlie were involved making the specifications in close cooperation with Alfa. Charlie had detailed knowledge about the paper machines and Bravo had detailed knowledge about automation. Together with Alfa, the two suppliers cooperated to develop a process automation system to ensure that the selected system would meet the future needs of Alfa. Much of the information exchange between the suppliers went through Alfa, who wanted to have a detailed overview of the project. The developments of the DCS, QCS and Drive systems were done by Bravo while the development of some mechanical components was done by Charlie. Even though much of the development in this project was done by the two suppliers separately, they were mutually dependent on the work done by the other party. The installation was a collaborative effort by Charlie, Bravo and Alfa which lasted for around three weeks. Bravo cooperated closely with Alfa and Alfa's other supplier Charlie for the rebuilding of PM1, and can therefore be regarded as a networking cooperative partner of Alfa for this project.

Bravo as a Networking Problem-Solver

For the project involving the replacement of the head box of PM1, Bravo can be regarded as a networking problem-solving partner. The involvement from Alfa was very low in this project, limited to some assistance in the implementation phase. The specifications and detailed engineering was done by Bravo and Charlie. Bravo did the programming changes necessary to link the QCS system to the head box and Charlie upgraded the head box with their new product; RetroDilution. Bravo and Charlie coordinated extensively throughout the project and managed to install the new head box in only a few days. By collaborating with another supplier in Alfa's supply network to replace the head box, Bravo can be regarded as a networking problem-solving partner in this project. Bravo and Charlie solved a problem for Alfa which was essential to produce good quality paper.

5. Discussions and Conclusions

The taxonomy introduced four different ways of innovating through suppliers. However, as also indicated by the empirical material, an innovation process is not necessarily easy to classify according to this taxonomy. As an example, a customer may regard an innovation process to take place through a single supplier as a problem-solver. The supplier, however, may have cooperated with two other companies as part of this innovation process, without discussing this issue with the customer. I.e., the classification of an innovation process according to this taxonomy is highly actor dependent. A deeper understanding of a phenomenon often reveals a more complex picture (Welch and Wilkinson, 2005). In a similar vein, the customer and the supplier may have different views with respect to whether the level of cooperation between them was high or low throughout the innovation process, i.e., whether the supplier should be regarded as a problem-solver or as a cooperating partner.

Both the customer and the supplier can naturally change the organization of the innovation process in ways that alter how the process is classified. The supplier can invite the customer to increase the level of cooperation between them, the customer and the supplier can see potential advantages in jointly connecting with third parties, etc. However, attempts to conduct such changes may also be prevented by other companies. As an example, the customer may deny the supplier to cooperate with other companies as part of the innovation process.

Each of the four ways of innovating through suppliers as introduced in the taxonomy can be said to represent well-known ways to organize such processes. Furthermore, innovation processes are complex phenomena, and no one way of organizing them performs better than the other in an absolute sense (Araujo et al., 1999). By systematically examining the organization of the innovation processes according to this taxonomy, a company may discover potential advantages related to conducting certain changes.

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level of cooperation between supplier and customer

		<i>high</i>	<i>low</i>
Number of companies involved (in addition to the customer)	<i>one</i>	Single supplier as cooperating partner	Single supplier as problem-solver
	<i>several</i>	Networking supplier as cooperating partner	Networking supplier as problem-solver

Figure 1: Innovating through suppliers: a taxonomy