Managing interdependencies in supplier portfolios

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Abstract

Building and managing a supplier base has been referred in the literature as a key issue of supplier management. Since the seminal work of Kraljic in 1983, scholars have proposed a number of models aimed at enhancing the effectiveness of supplier portfolio management. In the IMP arena, those models are often criticized as they seem to ignore the interdependencies between the existing dyadic relationships. Such interdependencies are the main focus of this paper. It has four objectives. (1) To analyse the types of relationships linking suppliers and to (2) understand the factors and dynamics underlying their creation and management. (3) To uncover existing links between buyer-supplier and supplier-supplier relationships. (4) To clarify how supplier relationships within the portfolio may impact the performance of the actors involved. The paper discusses evidence collected in a study of two industrial firms' supplier portfolios. A main conclusion of the paper is that suppliers' interdependences are mainly a by-product of buyer-supplier dyads. Furthermore, the nature and dynamics of those dyads are a strong determinant of the scope and frequency of supplier connections and corresponding effects.

Introduction

Globalization and specialization processes led to the intensification of competition in most industries (Harland et al., 2001). In order to cope with such challenges, companies tend to reorganize their competitive positioning by specializing around their core capabilities and resources, and buying the other resources from suppliers (Cousins and Spekman, 2000). Industrial purchasing gains a growing importance, giving supply management a strategic character (Gattorna and Walters, 1996). As suppliers are diverse and fit in the buyer context and strategy differently, they must be managed differently. Due to this need for differentiated supplier management, portfolio models have attracted substantial attention as management tools. Managing supplier portfolios involves not only the individual supplier relationships but the entire set of supplier relationships where interdependencies are created. Although empirical studies (Gelderman and van Weele, 2005; Wagner and Johnson, 2004) have shown that portfolio models enjoy a high reputation among practitioners, they have been received with scepticism by academics. Authors from the IMP Group (e.g., Dubois and Pedersen, 2003) have been particular critic to portfolio models' lack of an integrative view of supplier's interdependencies. This paper focuses on those interdependencies. The main goal of this paper is to investigate the nature, creation, dynamics and effects of supplier's interdependences. A better understanding of these issues will clarify the potential benefits but also the caveats of suppliers' connections and crossed-effects on firms' performance.

The paper is divided in seven sections. After this introduction, the second section presents the work produced in the area of portfolio management and its limitations from an interaction point of view. The third section presents the research questions and the fourth reviews the methodology of the research project. The fifth section describes the empirical cases and the sixth section discusses the research findings. Finally, the last section presents the conclusions and the main theoretical and managerial contributions drawn from this paper.

Managing Supplier Portfolios

The content of purchases has been changing, moving from the 'simple' outsourcing of production to design and product development (Gadde and Häkansson, 2001). Companies buy different things (products, knowledge, brands, reputation) from different suppliers in order to put their services and products together. In this context, the supplier base is considered the cornerstone of supplier management (Dubois and Pedersen (2002). The concept of a product as a network entity (Dubois and Pedersen, 2002) is an excellent image of the interconnectedness of actors, activities and resources needed to create a single product. It also stresses the increasingly important role suppliers play in their customers' success (Wagner and Johnson, 2004). Inasmuch as the type of resources and activities integrated in a product and the degree of exploitation/exploration are different, the organisation of their access must also be different (Araújo and al., 1999; Araújo and al, 2003, Loasby, 1998). There is not an ideal relationship type and the determination of what constitutes an adequate relationship is contingent in nature. So, companies must decide what relational strategy to adopt with each supplier and how to allocate resources between relationships (Ritter, 2004). One solution to his problem is said to lay on selective strategies and approaches to reach "optimum" supplier relationships, identifying which suppliers should consume a greater share of resources and which should be managed in a less resource consuming way (Wagner and Johnson, 2004). In this setting, portfolio models, presented as a tool to set a balanced combination of supplier

relationships best serving the long-term interests of the company (Turnbull, 1990) are clearly compelling.

The first major step in this area was taken by Kraljic's matrix in 1983, whose goal was to minimize supply risks and maximize the customer's bargaining power. The departing point of the Kraljic's matrix is the definition of two variables: product relevance and supply risk. Each item is analysed according to this two criteria and placed in on of the four categories of the matrix (leverage, strategic, non-critical and critical). Companies then analyse their bargaining power vis-à-vis the suppliers, identify areas of opportunities or vulnerabilities, evaluate supply risks, and set purchase strategies for each category (e.g. explore or diversify sources). Kraljic matrix was widely accepted by managers and is considered till our days the standard in the field of purchasing (Gelderman and van Weele, 2005).

Other portfolio models have been developed since then. Some of them focus on clients (Turnbull and Zolkiewski, 1997), while others focus on suppliers (Olsen and Ellrman, 1997; Bensaou, 1999; Nellore and Söderquist, 2000; Hartmann et al., 2001; Geldermann and van Weele, 2002) and others 'simply' on relationships (Krapfel et al, 1991; Zolkiewski and Turnbull, 2000). These models commonly present the buying situation (a set of products or relationships with suppliers) as a given situation that constitutes the departing point to action and defines the adequate relational strategy in each case. But these models present wide disparities in terms of the factors and corresponding weights used in the matrixes. They also vary in terms of the number of analysis steps considered in each of them, depending on what their authors think is most adequate to characterize the 'buying situation'. Thus, it seems reasonable to admit that the application of different portfolio models to the same situation may result in different matrix combinations, suggesting different relational approaches in each case. The choice of variables, a cornerstone of portfolio models, is quite problematic as it seems impossible to assure that the most suitable variables are being chosen (Nellore and Söderquist, 2000).

In addition to the variability issue, Dubois and Pedersen (2002) question the possibility of reducing the complexity of business management to a two dimension matrix and defining business strategies based on this oversimplification of reality. Portfolio models also present important limitations from an interaction point of view: they are seen as static, not translating the dynamism inherent to interaction processes (Dubois and Pedersen, 2002) and assuming suppliers to be passive actors (Gelderman and van Weele, 2002), disregarding the fact that the implementation of a supply strategy depends on the joint effort the customer and the suppliers (Axelsson, 1992; Hartman and al., 2001). Thus, besides identifying critical suppliers, where portfolio models may be helpful, managers still need to realize how to mobilize them and portfolios seem useless at this point. Trying to deal with these problems, portfolio models are becoming increasingly sophisticated. They integrate more factors, allow for movements within the matrix (Gelderman and van Weele, 2002), integrate indirect relationships (Turnbull and Zolkiewski, 1997), consider multiple phase or longitudinal analysis or allow for periodical revision (Hartman et al., 2001; Zolkiewski and Turnbull, 2000). While it is questionable if these changes effectively respond to criticisms, it's probable that portfolios may become too complicated and hard to apply in management settings.

A fundamental criticism is also raised by Dubois and Pedersen (2002) who contend that portfolios treat buyer-supplier relationships as isolated dyads that can be managed in an optimization perspective. The interdependence between supplier relationships is restricted to the allocation of resources so as to optimize their consumption. Other interdependences

between supplier relationships are ignored, even if they can produce substantial benefits for the companies (e.g. economies of scale, coordination of suppliers). For instance, as Dyer and his colleagues have shown (Dyer and Noeboka, 2000; Dyer and Hatch, 2004) Toyota has long recognized the benefits on learning of sharing knowledge with its suppliers and of stimulating the sharing of knowledge between the suppliers themselves. In a similar vein, Häkansson et al. (1999) claim that a supplier has a higher probability of learning when it is connected with the buyer's other suppliers. Inasmuch as competitive advantages are growingly linked to interorganizational learning (Dyear and Noeboka, 2000), treating supplier relationships as isolated dyads can harshly limit the buyer's possibility of exploring their full potential.

The unrealism of portfolio models is also demonstrated by the studies of Araújo et al. (1999) and Mota and de Castro (2005). These studies show how the decisions concerning a specific client or supplier may affect the relationships with other clients or suppliers. Mota and Castro (2005) claim that interdependences within a portfolio are better analysed through the association between the variety of extant relationships and the firm's strategies to use and develop their capabilities. The goals and perceptions of suppliers are equally important in this process.

Other authors (cf. Håkansson and Johanson, 1993; Ford and McDowell, 1999; Holmen and Pedersen, 2003) also refer to the importance of the direct or indirect effects that relationships may have upon each other. In general terms, the effects of each relationship depend on its complementarity with the structure of activities and resources of the company and of its other relationship partners (Häkansson and Snehota, 1992). Individual relationships may have crossed effects that may or may not be intended, predictable and positive to the buying company (Ford and McDowell, 1999). The existence of crossed effects means that at least three companies and two relationships are involved. For instance, the improvement of quality patterns of a particular supplier may lead the customer to demand similar changes from its other suppliers. Anticipating and/or managing those effects may help the company minimize possible negative outcomes and maximize positive ones. Actively supporting supplier cooperation may result in better combinations of suppliers' resources and activity coordination, with benefits to the customer (Gadde and Håkansson, 2001).

Managing (eg., fostering or limiting) crossed effects implies that one (or more) of the actors involved assumes an active role towards the other actors and the relationships that link them. The studies produced by Holmen and Pedersen (2003) and Havila (2004) about indirect relationships or actual interaction between former indirect partner in networks settings may also be of use in supplier portfolios. Holmen and Pedersen (2003) identified three functions – relating, isolating and mediating. In supplier portfolios, when assuming a relating function, the client brings suppliers together allowing them to relate directly (as it happens with Toyota). But the customer may also assume intentionally isolate suppliers from each other (e.g., in order to play one against the other). It may also assume a mediating function, choosing what to transfer from one supplier relationship to another. Havila (2004) refers the concepts of serial triads (actors interact with each other, but not all at the same time or in the same way) and group poliads (Havila et al., 2004), that require the reunion of all the actors to develop shared activities. Creating and managing those processes will probably involve different relational functions and produce different effects on the actors involved.

To sum up, portfolio models rely heavily on segmentation processes (through matrixes, ABC analysis, etc.) to define which suppliers should the company work with (its supplier base) and

how should they be managed according to its strategic goals (Wagner and Johnson, 2004). Portfolio models are useful to organize disperse information and to provide some indicators on how to deal with suppliers (Nellore and Söderquist, 2000), to make managers reflect on the future value of a supplier or the investments needed to develop its relationship (Möller and Halinen, 1999), or even to help them understand and simplify complex contexts (Mota and de Castro, 2005). This paper does not question the usefulness of portfolios to do so. Actually, these aspects possibly explain their popularity among managers. Nonetheless, the paper shares the criticisms that portfolios do not provide a truly integrative perspective of interdependences between supplier relationships or a dynamic perspective of how relationships, capabilities and resources evolve within portfolios that should not be ignored when managing suppliers. These issues are the main focus of this paper.

Research Questions

As the previous section made clear, portfolio models disregard the concepts of connectivity and interaction that are central in the IMP approach. Authors from the IMP group are prescriptive on the need to evaluate and eventually manage the effects that supplier relationships and their interaction processes bear one upon another (Araújo et al, 1999; Ford and McDowell, 1999; Dubois and Pedersen, 2002; Mota and de Castro, 2005). Nonetheless, studies going beyond a collection of dyadic relationships and taking an integrated view on their connections and interdependences seem still scarce (cf. Araújo at al., 1999; Ford and McDowell, 1999; Mota and de Castro, 2005), leaving room for further research on how firms coordinate, influence and mobilize supplier portfolios.

In fact, little is known about the existence of horizontal relationships between suppliers and how buying firms perceive and try to manage them. More specifically, extant literature does not help us understand how these relationships (if they do exist) are established, developed and coordinated, which goals they respond to and which is the role of the parties involved. Considering the interactive nature of relationships it seems unreasonable to expect that they can be 'decided' and implemented unilaterally by a company; rather one would expect them to be co-determined by the actors involved. And how are they organized? Do they correspond to the concept of serial triads (Havila et al., 2004), where activities are executed sequentially and do not require the simultaneous interaction of all participants or do they have a more integrative character? The same of type of questions can be asked concerning crossed-effects of supplier relationships. What is their nature and goals? Are they intentionally managed by the customers and/or the suppliers?

Either considering direct or indirect effects, one important issue in understanding how they are created is to identify the roles that suppliers and customers play in these processes. In 2003, Holmen and Pedersen explained how relationships can work as an economic coordination mechanism in networks, allowing firms to ignore their counterparts' other relationships and avoid being involved in them. Direct counterparts may play an isolation function (making direct contact between indirect counterparts superfluous), a joining function (enabling direct coordination), a relating function (enabling coordination via the common counterpart) or a mediating (enabling coordination of the indirect counterparts without their knowledge). The use of these concepts at the portfolio level (a limited network) may provide useful insights on the roles customers and suppliers play and on how capabilities and resources of different partners are coordinated and developed.

Although this paper is not about dyadic customer-supplier relationships and even less about how they should be differentiated in order to optimize resource investments, dyads can not be ignored. They constitute an essential element of the context where direct and indirect connections between suppliers are created. Furthermore, inasmuch as one of the major flaws of portfolio models is the disregard for the complementarities and interdependence of dyadic relationships, the analysis of those issues requires some basic understanding of supplier dyads, namely their goals (e.g. efficiency or innovation), technical interfaces (standardized, specified, translated or interactive as suggested by Araújo and al. in 1999) and actors' perceptions and attitudes. In the same sense, it is probably impossible to separate the dynamics of the portfolio from the networks the customer and suppliers are embedded in. Thus, in order to understand supplier portfolios, some knowledge on networks and the way they affect customer-supplier relationships may be rather useful.

To sum up, the main goal of this paper is to further explore the structure and dynamics of supplier portfolios. Departing from this generic topic, three research questions emerge as important and interesting:
(1) What types of relationships exist within supplier portfolios and how do they emerge and develop?
(2) What types of crossed effects of buyer-supplier dyads exist and how are they produced?
(3) What is the perceived impact of those relationships on the involved actors?

The next section briefly reviews the methodology used to investigate these questions.

Research Methodology

The investigation of these questions was part of a wider research project, covering other aspects of supplier management, namely the management of buyer-supplier dyads and supplier networks and a meta-level where focal firms' network theories and strategies are analysed. The multilevel nature of the research was essential to understand the factors that condition the creation, structure and dynamic of inter-supplier relationships. A case study approach was adopted to conduct this multi-level investigation. The research was mainly based on semi-structured interviews. Two industrial firms were selected and interviewees included interface managers from the focal customers (14 in total) and from their suppliers (31 in total). Buyer-supplier dyads were the departing point to disclose the links of each supplier with other suppliers and the nature of the buyer's involvement in those relationships. In this way it was possible to progressively map existing direct inter-supplier relationships and to have a better understanding of their relevance within each portfolio of suppliers. The dyadic relationships were also used to analyse the crossed effects of individual buyer-supplier relationships. The selection of the cases and the collection of data follow a process close to the configuration analysis proposed by Ragin (2000). Each case was analysed individually in order to understand how the several dimensions combine in an integrated and coherent way to form different configurations of the same phenomenon, followed by a comparative analysis between the two cases in order to identify and explain their (dis)similarities.

Empirical Cases

Case 1 – Vulcano

Vulcano is a Bosch manufacturer of gas-fired hot water. Since its foundation in 1977, the company assumes that its success depends on its ability to forge links with external actors to add value to the activities executed in-house. It invests in an external organization that allows it to "integrate suppliers' capabilities as if they were ours". Traditionally, Vulcano specified all parts' details (functions, materials, dimensions) and suppliers manufactured them. In the last years, Vulcano's development team has been actively seeking suppliers' assistance to develop the parts, especially in areas where it does not hold sufficient productive or knowledge capabilities and does not want to develop them. The focal company expects all suppliers to "proactively produce and suggest new solutions in terms of product specifications, materials or processes". To make participation of suppliers possible, technical interfaces are generally interactive. Additionally, suppliers' relationships are seen as a source of diversity that may reflect positively on Vulcano.

Figure 1 depicts the existing direct relationships between Vulcano's suppliers included in this research project. 14 out of the 18 suppliers have economic links with other suppliers with or without the involvement of the focal customer.

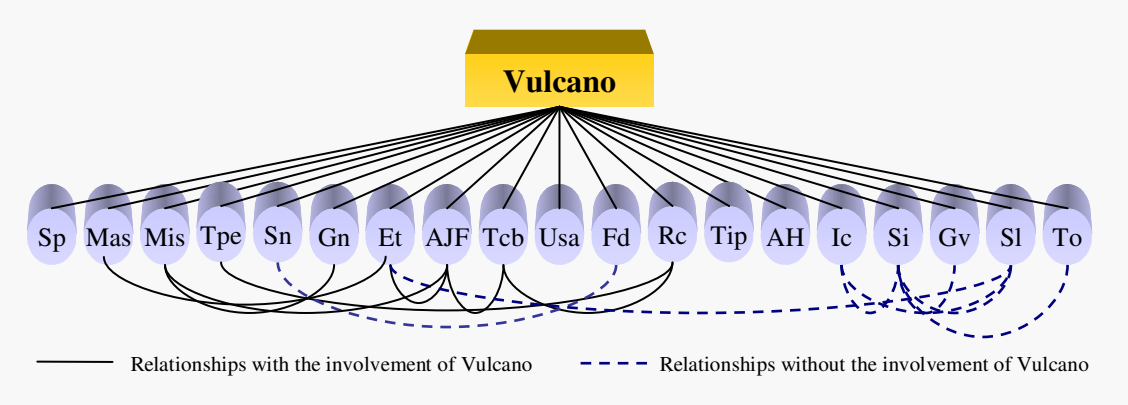

Figure 1 – Vulcano's supplier portfolio

Furthermore, 13 suppliers know who their direct competitors are. However, this information is not transmitted by the focal customer; rather it is a characteristic of their industries where competitors normally know each other. Despite the abundance of inter-supplier links, most suppliers feel no need to know the suppliers whose parts are technically connected with their own. All the needs of adaptation in this context are solved with Vulcano. Vulcano assumes a similar position as its mediating role is perceived as an effective way to promote the coordination of suppliers. The majority of the seven relationships outside the sphere of Vulcano link two suppliers of steel and other metals (Sl and GV in Figure 1) to suppliers that use those raw-materials in their products. There are also two cases (SI-IC and SN-FD), where one firm (IC and FD) supplied parts to the other (SI and SN) prior to the involvement of IC and FD with Vulcano. In fact, IC and FD were 'presented' to Vulcano by SI and SN. Despite the joining role initially played SI and SN, all the actors believe that the relationships between Vulcano and these suppliers is completely independent from the relationship that exists between the suppliers themselves.

Relationships involving Vulcano are basically buyer-supplier relationships with some peculiar characteristics. As they are of similar nature, only one of these cases is analysed. AJF is an electronic manufacturer of alarm systems. It was selected by Vulcano to develop and manufacture a remote control for one of its gas-fired hot water models. AJF developed and specified all the electronic parts of the remote control and selected the suppliers in this area. As the company does not possess the resources and capabilities needed to manufacture other parts, such as the plastic case, cables and LCD screen, it had to buy them from other companies. Despite the fact that AJF was responsible for this project, it did not intervene in the development of the non-electronic parts or in the selection of their respective suppliers. In fact, all the parts were specified by Vulcano or co-developed with current suppliers and the customer was also in charge of negotiating the supply terms. When the developing and test phases were completed and regular production began, AJF assumed the management of relationships with the suppliers of all the remote control's parts. This solution is considered beneficial by Vulcano and AJF. It explores the complementarities between both firms' specific capabilities and network connections. Vulcano uses known suppliers with adequate performance, accelerating the process of developing and testing the various parts. AJF has benefits that would be improbable without the association with Vulcano, from lower purchase prices, reduced time and costs of selecting and auditing the other suppliers as this was previously done by Vulcano. Furthermore, inasmuch as the focal customer was responsible for the selection of non-electronic suppliers, it makes it easier to AJF to press Vulcano to intervene if problems should arise. Suppliers assuming the double role of direct (to Vulcano) and indirect (AJF) suppliers assume a position of indifference. Inasmuch as the critical activities (e.g. specification and negotiation of terms) are solved with Vulcano, the inter-supplier relationships are restricted to the operational issues of managing orders (as logistics and payments) that are perceived as rather irrelevant. The fact that the sales to the other suppliers are only a small portion of their sales to Vulcano also contributes to this perception.

In the past, Vulcano has unsuccessfully tried to develop other relationships between its suppliers. It was pressing GV (one of its two suppliers of steel) to expand the conditions and terms granted to Vulcano to all its suppliers that use these raw-materials. Some of these suppliers already buy metals from GV but at a higher price. The benefit to Vulcano and the suppliers of parts is clear: a reduction in raw-materials will necessarily reflect on the costs of parts and on their selling price. But GV has quite a different view on this issue, as this situation would inevitably result in a reduction of its margins. While this loss could be offset by the reinforcement of GV's relationship with Vulcano, GV was very reluctant to accept this agreement. In other failed experiences, Vulcano 'vaguely' tried to bring suppliers together to develop technically connected parts. However, although some suppliers say that these contacts existed, they were unable to explain how and why they were initiated and terminated and who was involved. Neither Vulcano nor the suppliers seem interested in repeating or deepening these experiences and Vulcano-suppliers dyads are still seen as the best arena for innovation and adaptation processes.

Indirect crossed-effects of Vulcano-supplier dyads are much more frequent and relevant than direct inter-supplier relationships. They are basically related with prices and capabilities (e.g., technical or logistical) and diffusion of innovation of products, processes or routines. Most Vulcano-supplier interfaces are interactive and many new solutions are co-created with or created by suppliers. When new solutions produce relevant effects, Vulcano diffuses them to other suppliers or relationships in order to multiply its benefits. This diffusion is mandatory when it relates to changes in parts bought under dual sourcing. In one situation, a Chinese

manufacturer proposed a change of one part; the solution was tested and considered quite positive. Consequently, the alternative Spanish manufacturer had to adopt the same changes.

Crossed-effects relate to prices and changes in capabilities and other resources may have a transitory or structural nature, as depicted in Table 1. These effects and their underlying causes are described in the next paragraphs.

Transfer of orders and transitory repositioning	Structural repositioning
• Reduction of prices and other efficiency related investments • Improvement of logistical and quality processes. • Introduction of new suppliers	• Developing of new capabilities and activities, leading to the reconfiguration of the portfolio structure

Table 1 – Changes of current suppliers' positioning (Vulcano)

Price is an important factor when selecting a supplier for a new part or when renegotiating supply terms. Vulcano does not bargain prices or use a supplier bid to force alternative suppliers to cut prices. However, the number of requests for bids and the number of suppliers actually 'win' is perceived by them as an indicator of their relative positioning. Every two or three years, Vulcano monitors the markets in order to compare current suppliers to potential ones. According to Vulcano, this pressure forces suppliers to think how to become more productive in order to strengthen their relative positioning to rival suppliers. Logistics is an area where crossed effects are also present. Logistical procedures (e.g. orders, production and delivery plans) adopted with one supplier are often replicated in other suppliers. This replication is easier in rival suppliers that normally have similar production resources and processes. On the other hand, suppliers know the average supplier performance in this area. As logistics accounts for one third of suppliers' evaluation, this information is a strong incentive for suppliers standing below the average to improve their performance.

The evolution suppliers' resources and capabilities has a strong impact on the evolution of their relationships with Vulcano. Changes in one supplier or relationship may have more or less profound impacts on other suppliers or relationships. When investments relate with efficiency gains (e.g. buying an equipment with higher productivity), they may result in reduction of purchases from the less efficient suppliers. However, if these suppliers improve their performance, they may recover their previous position. If a supplier invests in new and more valued activities (e.g. product development), its relationship with Vulcano may be substantially altered resulting in a positioning change (e.g., become a preferred supplier in new projects). The development of new capabilities and activities may also lead to the reconfiguration of supplier structure, as in the case described above where on supplier assumes an integrating role and others become its suppliers.

Case 2- Adira

Adira is a machinery manufacturer founded in 1956. Adira strongly believes that its success is based on its internal set of capabilities and suppliers are granted limited relevance on the value creation process. This belief is reinforced by Adira's view of its suppliers as having

very limited technical capabilities. Consequently, Adira prefers to hold proprietary control of resources rather than exploring external resources. Machines are entirely developed and designed by Adira that also specifies all their parts and materials. The company has two main types of suppliers: catalogue suppliers and subcontracted suppliers. Catalogue suppliers range from multi-brand representatives to national agents or local subsidiaries of firms like Bosch or Siemens, selling standardized materials and components. Subcontracted suppliers range from micro to medium-size firms that manufacture parts according to Adira's specifications. Adira uses both groups of suppliers to pursue direct/efficiency functions: low costs, high flexibility and sourcing safeguarding. The major benefits the focal company looks for when selecting suppliers are low prices, product quality/reliability, flexibility and availability. Catalogue suppliers are managed through standardized interfaces and subcontracted suppliers through specified interfaces. In both cases, Adira generally controls and dominates the relationships.

Figure 2 depicts Adira's portfolio of the suppliers included in this research project. 11 out of the 13 suppliers know or are aware of other suppliers and 9 are involved in actual interaction.

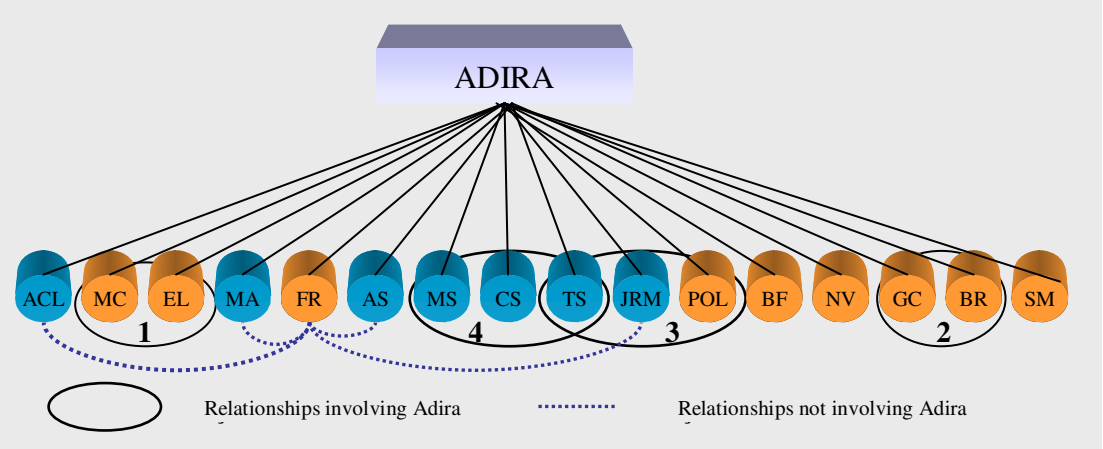

Figure 2 – Adira's supplier portfolio

Reciprocal knowledge results from the characteristic of their industries or from knowledge involuntarily provided by the focal customer (e.g. mixed orders or simultaneous delivery windows). This knowledge is unintentional and is perceived as low value by all the actors involved. In fact, customer and suppliers feel that relationships between suppliers are unnecessary. Inasmuch as the focal customer specifies all the parts, suppliers do not need to have direct contact, even when they are producing interconnected parts. In addition, each supplier claims to know nothing about the other supplier relationships held by Adira and to feel no impact from those relationships. Inter-supplier relationships developed outside Adira's sphere are generally not systematic. With the exception of the distributor of steel (FR in Figure 2) that sells to several part manufacturers, suppliers don't see themselves as customers or suppliers of each other. In any case, those relationships are seen as totally independent from Adira and having no relevance in their relationships with the focal customer.

Inter-supplier relationships with the involvement of Adira are rare. In fact, two of the cases depicted in Figure 2 were terminated during this project. In triad 1, MC supplied Adira with electric components and bought electric transformers from EL. MC performed a logistical and administrative role: taking care of orders and deliveries, invoices and payments and received a

commission for this work. Prices and product specification were set by Adira and EL. But MC was frequently ignored by Adira that contacted EL directly to discuss technical issues and to place and pick up urgent orders. As MC was seen by both as adding costs rather than value to the relationship, it was cut off and Adira and EL formed a direct dyad. Triad 2 is a similar case. GC was Bosch national representative; Adira bought hydraulic valves from Rexroth and other components from GC. When Bosch bought Rexroth, GC became its representative, too. As buying valves from GC would be very expensive, Adira kept on buying them from Rexroth and GC received a commission to take care of logistics, orders and payments and to provide technical support. Adira saw GC's technical capabilities as very poor and claimed that it only worked as a "mail box" and a "buffer" between Adira and Rexroth. During the completion of the research project, Bosch-Rexroth changed its international strategy and promoted the joint management of Spanish and Portuguese markets. GC then lost the representation to a Spanish affiliate of Bosch-Rexroth and its intermediation role was terminated. GC still sells Adira other hydraulic components and technical support.

In case 3, Pol makes surface treatments of metallic parts and supplies Adira and some subcontracted suppliers. Prices and supply terms are negotiated by Adira. Part suppliers transport the parts to Pol, and after the treatment they pick the parts up and deliver them to Adira. Adira could easily concentrate all the suppliers' parts and be the sole client of Pol, but this arrangement enables it to cut costs by transferring logistic activities to subcontracted suppliers. As subcontracted suppliers get better prices from Pol this also reflects in a reduction of the parts' prices. The relationships between Pol and the subcontracted suppliers are very tense and conflictive. Due to the small sizes and short delivery lead times of Adira's orders, the costs of suppliers are very high (e.g. transport, machine setup) and none of the involved is happy with this solution. Adira accepts it because it was not able to find a better solution. Suppliers feel complied to accept it due to the importance of Adira's purchases in their sales. Finally, in case 4, suppliers, who are also neighbours, informally coordinate their deliveries to Adira. Each supplier has a delivery day defined by Adira. When an order is needed in a different day, one of the other suppliers delivers the order together with its own. As effects are seen as positive and reciprocal (delivery costs and lead times are reduced) all the involved actors are willing to keep this solution.

Crossed-effects of Adira-suppliers dyads have the highest impact in the portfolio. Price is an important dimension of those effects. Regarding the catalogue suppliers, Adira compares the biddings and prices are often renegotiated in order to force suppliers to cut them. In the case of subcontract suppliers, Adira defines the prices of parts and they are generally accepted. When this does not happen, the supplier will lose the part. Transfer of orders is also a frequent effect of supplier interdependence. Besides the competition on prices, the ability to respond to the frequent changes of Adira's production plans is also very important in this context. In a less frequent situation, Adira has reciprocity agreements with suppliers: Adira sells a machine to a supplier and in return it is obliged to buy them a given quantity of parts. This may result in transferring the production of parts from other suppliers until the agreement is fulfilled. Transfer of orders has an oscillating effect - when its causes are eliminated (e.g. prices or logistics) the regular supplier wins the order back. These transfers are considered as making part of the business and are accepted by all suppliers. Changes linked to suppliers' resources have a more structural nature. Suppliers that invest in more efficient machinery or processes gain a higher share of Adira's purchases. Even if this makes the less efficient suppliers unsatisfied, the importance of Adira in their sales make them comply still with its requirements. Table 2 depicts the most frequent crossed-effects produced in Adira' portfolio.

Type of transfers / Suppliers	Transitory	Structural
Catalogue suppliers	Prices Delivery lead times Reciprocity agreements	Persistent problems of prices and delivery lead times
Subcontracted suppliers		Evolution of resources Unsolvable conflicts

Table 2 – Changes of current suppliers' positioning (Adira)

Structural repositioning causes are not the same in the two groups of suppliers. In the case of catalogue suppliers, persistence of problems in prices and delivery lead times are the most important factors. In the case of subcontracted suppliers, prices are set by the customer and delivery lead times are highly conditioned by the frequent changes that occur in its production plans. Thus, these factors are not the major factors of repositioning. Suppliers' investments in more efficient resources appear as the most important factor in this context. Exclusion of suppliers is a rare phenomenon. It is associated with serious conflicts with suppliers, e.g. loyalty issues, rather than resulting from changes emerging elsewhere in the portfolio.

Discussion of Findings

In this section, the findings of both cases will be discussed in order to answer the research questions presented earlier. Figure 3 depicts the factors that seem more relevant to understand why and how supplier relationships impact each other, both in terms of frequency and scope. Supplier's markets dynamics bares the highest impact on efficiency, especially on prices; interfaces are crucial to understand the role granted to suppliers in innovation processes; (dis)similarity of suppliers and the customer's strategies and roles condition how effects (efficiency, innovation) are diffused along the portfolio. These factors are further discussed in the following paragraphs.

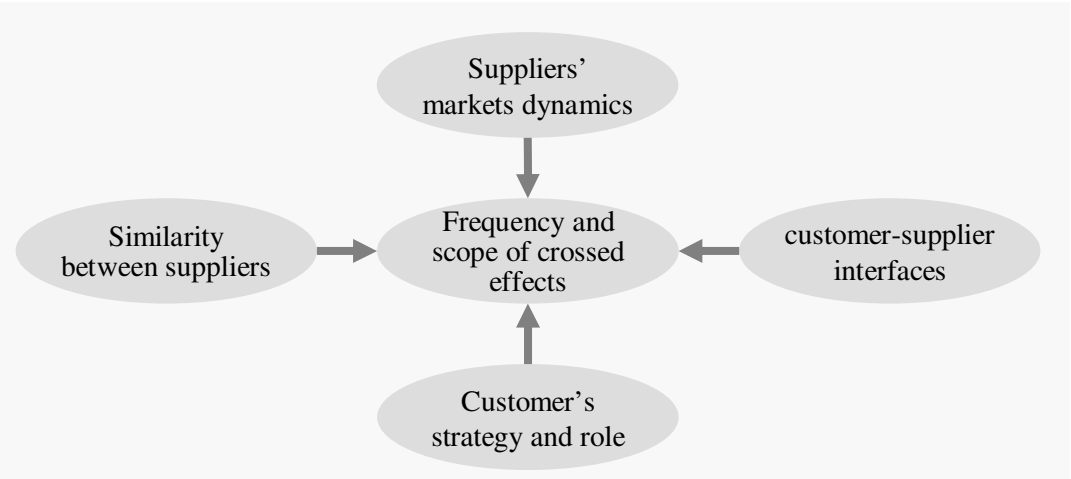

Figure 3 – Causal factors of crossed-effects between supplier relationships

Types of relationships between suppliers

As seen before, links between suppliers exist, sometimes outside the sphere of influence of the focal customers. These links range from mere awareness of each other's existence, to social bonds, or to actual economic relationships. In any case, they are normally associated with the way suppliers' industries work and are perceived, both by suppliers and focal customers, as baring no consequences on their relationships with the focal customers.

Two types of links between suppliers emerged involving the focal customers: indirect links resulting from the crossed effects of customer supplier dyads and direct links embodied in actual interactions between two or more suppliers. The most frequent effects arise from customer-supplier dyads rather than from direct links between suppliers. Both cases indicate that both direct and indirect interactions are focused on efficiency issues (as price and logistics) while innovation is produced either at the focal customers, at the suppliers or in their dyadic relationships.

Nature and impact of crossed effects

Crossed-effects are not homogeneously distributed along the portfolio. One factor playing an important role in this context is the technical similarity of suppliers, as depicted in Figure 4. As both companies use multiple sourcing, they frequently have two or three suppliers with similar activities and resources and selling similar parts (e.g. suppliers of injected plastic parts). As would be expected, crossed-effects are stronger in the groups of rival suppliers and weaker between them. The higher intensity in the groups is related to the most frequent crossed-effects that were identified: reduction of prices and transfer of orders that necessarily occur between alternative suppliers.

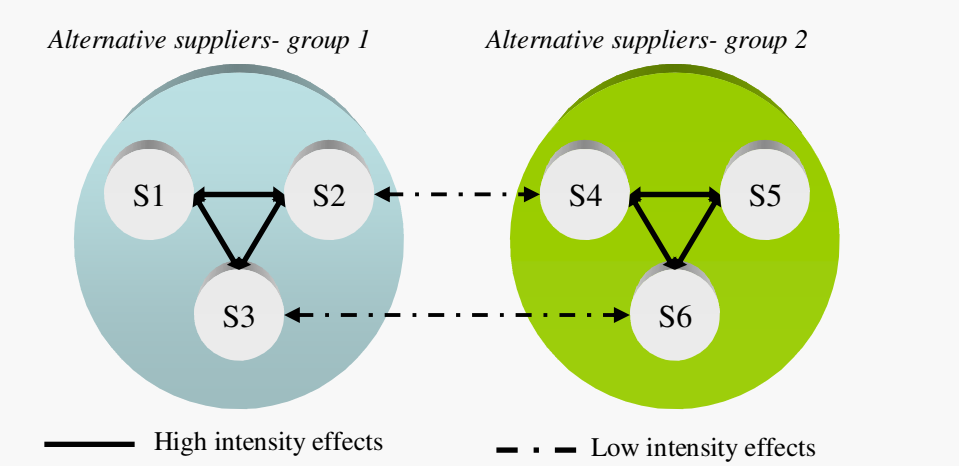

Figure 4 – Intensity of crossed-effects in supplier portfolios

In fact, even when the customer does not use alternative supply sources to force suppliers to cut prices, as in the case of Vulcano, suppliers feel that pressure and link lost orders with their refusal or inability to follow their competitors' prices. Furthermore, the diffusion of innovation is easier within the same specialization groups. Production contexts and resources tend to be similar, facilitating the replication of changes of parts, quality procedures, productive processes, etc. Still, despite context similarities, changes are sometimes hard to

transfer due to their tacit dimension. These and other emerging problems are always dealt with in each customer supplier relationships.

Changes in suppliers' networks may also be a strong inducer of change. In both cases, the pressure of focal customers to obtain lower prices is fostered by a similar trend in suppliers' markets. Thus, price reduction tends to affect all suppliers due to this global trend, even if affecting more severely some supplier groups than others. Meanwhile, aspects of more specific nature, like the evolution in production equipments, have different impacts in different groups. When efficiency is pursued through the indirect links described so far, changes are contained in each group of similar suppliers and do not normally affect the existing structure of actors, resources and activities. But, less frequently, efficiency goals may require the reorganization of this structure and the reconfiguration of actors' roles leading to the establishment of direct interaction between suppliers. This issue is discussed later.

Understanding the dynamics of crossed effects

Crossed effects can translate in the diffusion of innovation (changes in parts, raw-materials or production processes), or more frequently in efficiency improvements (price reduction, logistical procedures, etc.). The dynamics of the diffusion of change from one customer-supplier dyad to other dyads is conditioned by the roles actors play and the type of relationship adopted with the various suppliers. As shown in Figure 5, the origin of changes can be the suppliers (Model 1) or the client (Model 2). The adoption of relationships that foster suppliers' initiative and proactivity multiplies the sources and frequency of changes inducing a stronger dynamic in the portfolio. Furthermore, when suppliers play an active role (Model 1), there is a higher potential for innovation that derives from the diversity of their idiosyncratic experiences with other actors, e.g. clients. In the opposite direction, the possibility of exploring that diversity is severely reduced when the focal customer dominates the relationships (Model 2).

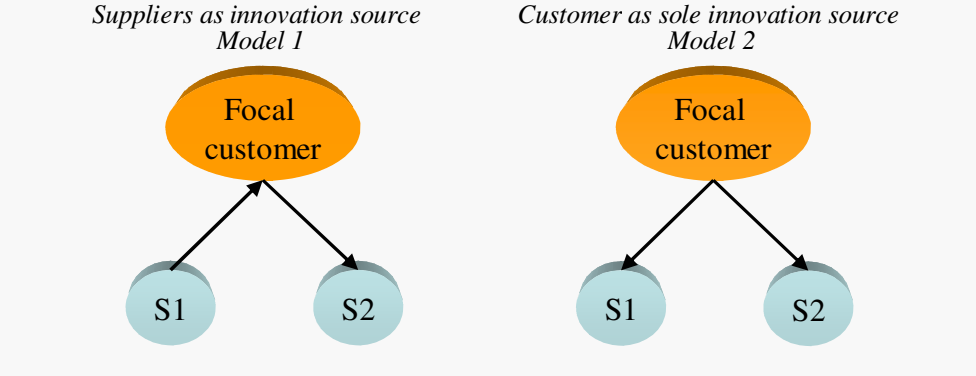

Figure 5 – Dynamics of relationships' crossed effects

Inasmuch as the creation of knowledge is fostered by the diversity of conjectures about new uses for existing resources (Foss and Loasby, 1998), a strong control by the customer diminishes that diversity and the possibility to innovate. As Loasby (1998) puts it, control frustrates the development of capabilities that one might later wish to access.

A higher openness and interactivity of relationships also contributes to a higher awareness of supplier interdependence. For instance, Adira's suppliers see themselves as independent from

each other. Changes in their resources or in customer's purchases are not associated with the relationships the customer holds with other suppliers, even when they are direct competitors. Differently, Vulcano's suppliers are more aware of their interdependences and they actively seek to protect or strengthen their positioning *vis-à-vis* the other suppliers. Consequently, awareness of interdependencies feeds suppliers' initiatives to invest in new resources, capabilities, and activities and their response to customer's requests regarding innovation or efficiency related investments.

Despite these differences, the customer plays a major role as a mediator between the suppliers in both models. In fact, customers (Adira and Vulcano) normally assume an isolation or mediation function (Holmen and Pedersen, 2003), that enables them to filter the effects that are transferred from one supplier to another according to their interests and goals.

Creation and evolution of triads

When suppliers assume the execution of tasks previously performed by the customer, e.g. assembly tasks, it normally implies the creation of direct relationships between suppliers of different specialization groups. In fact, the triads identified in both cases normally involve suppliers that execute dissimilar and close complementary activities in the production chain of customer's products. Their basic underlying factor is efficiency benefits, translated in lower costs of suppliers' products (that reflect in their own selling prices to the focal customer) and more efficient logistical processes. In Vulcano's case, these arrangements also eliminate the need to audit and test sub-suppliers, reducing the time-to-market of new products.

The analysis of the content and dynamic of these arrangements revealed that they are similar to the concept of serial triads (Havila, 2004), where actors do not interact with all the others at the same time or in the same way. Figure 6 represents this situation.

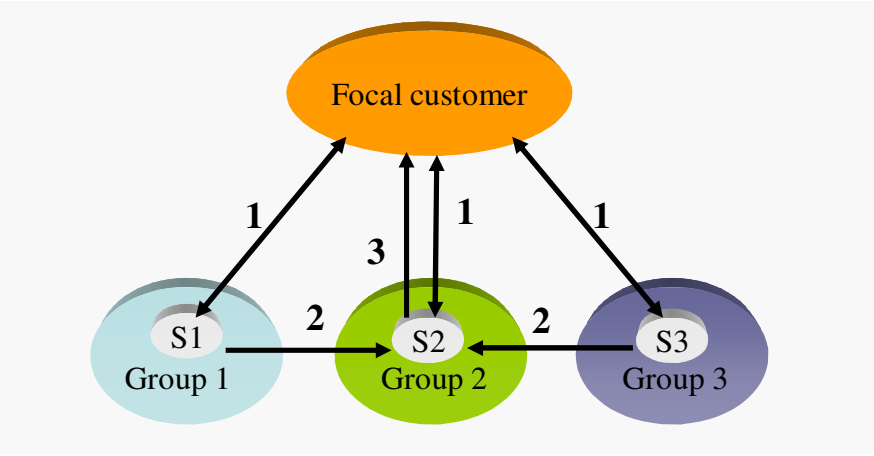

Figure 6 – Sequential triads

In these schemes, relationships are 'incomplete'. Each of them uses only a part of the resources and activities that normally exist in buyer-supplier relationships, working as a piece of a wider puzzle. In fact, the activities executed in customer-suppliers relationships are different from those performed in the supplier-supplier relationships, corresponding to different phases of a 'classical' buyer-supplier relationship. This sequential organization is supported by the complementary and dissimilar activities of the several actors involved.

Activities like specification of parts, product development or negotiation of supply terms are kept in the strict sphere of the dyads between the customer and each supplier (phase **1** in Figure 6). Suppliers then (phase **2**) coordinate the ordering/delivering of the parts/ materials to the supplier in charge of the assembly or finishing of the component that is later on delivered to the focal customer (phase **3**). Thus, the coordination and exploration of the most complex and dynamic of supplier capabilities is always performed by the focal customer. Suppliers are responsible for the more operational activities, less dense in resources and supported mainly by static capabilities. These schemes allow suppliers to coordinate strongly complementary and dissimilar activities (Richardson, 1972) while keeping relational processes close to transactional relationships with low interactivity and complexity. The more complex tasks of combining the resources and activities of suppliers (deciding who does what) is done less in their direct relationships but rather in their dyadic relationships with the focal customer.

The role and value of intermediates

In all the identified triads, one of the companies acts as an intermediary between the other companies. The focal customer plays this relating function (Holmen and Pedersen, 2003) when there are no previous economic interactions between the suppliers, facilitating the beginning of relationships. The value of the intermediary in the eyes of the intermediated seems to condition the success of these relational schemes strongly. In the triads that were dissolved during the empirical phase of this project (Adira case) the intermediary was perceived as useless and as not adding any real value compared to a direct connection of the intermediated companies. The persistence of supplier-supplier relationships outside the intermediary influence is highly dependent on the widening of the interaction beyond the activities of the triad. In order to clarify this idea, let us go back to Figure 6. S1 produces a part that is assembled with other parts by S2 to form a component specified by or with the focal customer. The activities and resources mobilized between S1 and S2 are contingent to their relationships with the focal customer. If the relationship between the focal customer and S1 or S2 is broken, the dissolution of the connection between S1 and S2 will follow as it is solely grounded on the presence of the common customer. This is a common event when Vulcano transfers the assembly activities from one supplier to another and the relationships between the suppliers of the parts with the former 'assembler' are broken and replicated with the new one. In the opposite direction, as GC role was not restricted to the intermediation between Adira and Bosch-Rexroth, it was able to maintain the relationship (even if modified) with the focal customer when the triad was dissolved.

These findings expose the strong dependence of direct inter-supplier relationships on customer-supplier dyads. As seen before, the creation of triads was mainly due to changes of the activities performed by some suppliers within those dyads. Thus, it seems reasonable to expect that further changes, namely, a deeper involvement and responsibility of suppliers in the development process, may require more intense contacts between them. In such a situation, suppliers will quite probably need to share or co-develop activities, e.g. designing and testing new components. In such cases, some of the existing serial triads may become group poliads (Havila et al., 2004), that require the reunion of all the actors to develop shared activities. If this evolution proves to be positive to the suppliers involved in shared or co-developed activities, they may decide to replicate these arrangements in their relationships with other customers.

To sum up, the individual and comparative analysis of the cases revealed that (1) the management of supplier portfolios is not a main issue in the context of supplier management. Horizontal relationships between suppliers, with or without the intervention of the focal customer, have limited prevalence. This marginality of relationships between suppliers results from the perceptions of dyadic relationships as the most adequate mechanism to fulfil the both customers and suppliers' goals. In fact, although suppliers are necessarily interdependent, that interdependence is embodied more in the crossed effects of buyer-supplier dyads than in direct links between suppliers. The cases also suggest (2) that the dynamics of the diffusion of the effects of one buyer-supplier dyad to other dyads is conditioned by the roles actors play in those relationships and by the formats (e.g., interfaces) and content (e.g., functions) of those relationships. Finally, (3) as direct relationships between suppliers are rare and of limited effects, the focal customer exerts a strong control over suppliers' interdependencies and seems able to manage them in a way that fits best its own goals and interests.

Theoretical Contributions

This paper provides new insights on the management of supplier portfolios, as well as on its dynamics and perceived impact by both the focal customers and their suppliers. It also furthers the knowledge and understanding of firms' attitudes and actions in this field.

Firstly, the paper identifies a number of factors that contribute to the prevalence or absence of direct links between suppliers. It also highlights the process and dynamics of knowledge and innovation diffusion within supplier portfolios. The paper identifies buyer-supplier dyads as the essential pillar both of the creation and management of direct relationships between suppliers and of the management of crossed effects of individual buyer-supplier relationships. Dyads are the space reserved for the combination and development of the most valued resources, leaving to the scarce inter-supplier relationships the activities perceived as low-value and low-impact for their businesses. Dyads are also important as their content and configuration condition the frequency and scope of crossed-effects.

The paper suggests that an excessive control on the customer side makes it the single source of innovation, thereby restricting the possibility to explore suppliers' innovation capabilities and to replicate their effects in the portfolio. Evidence was also found that in order to organize and mobilize actual interaction between indirect counterparts, the 'intermediator'/ 'mobilizer' must conciliate, or at least, not harm their interests and make itself valuable to them.

Finally, at a methodological level, by conducting a multi-level investigation (where the buyer-supplier dyadic level and supplier portfolio level were central to this paper), it was possible to picture a holistic and integrative nature of supplier management than previous studies have done. Namely, the paper uncovers links between the dyadic and portfolio levels enabling a degree of understanding and explanation of the questions under study that would be probably impossible to get had the research focused exclusively on the portfolio level.

Managerial Contributions

For managers, the paper stresses the potential impact of supplier portfolios in the enhancement of focal buyers' performance. Fostering the creation of direct relationships

between suppliers and managing their crossed effects may result in a higher efficiency and innovation of both buyers and suppliers.

However, managers must not forget that this potential is severely conditioned by the type of suppliers firms work with and by what goes on in dyadic relationships, e.g. the roles played by suppliers. If a set of efficient and innovative suppliers is a *sine qua non* condition to enhance the performance of all the actors involved, the focal buyer has a central role in diffusing and leveraging efficiency and innovation gains produced in individual relationships to other relationships within the portfolio. Being able to recognize the potential that resides in each supplier relationship and how its benefits can be multiplied by its diffusion to other relationships appears as a central task in the management of supplier portfolios.

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