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A typology of the situations of cooperation in supply chains

Yue Ming, Bernard Grabot¹, Raymond Houé

University of Toulouse, INPT, LGP-ENIT
47, avenue d'Azereix, BP1629
F-65016 Tarbes Cedex, France

{yue.ming, bernard, rhoue}@enit.fr

Phone: 00 33 5 62 44 27 21

Abstract: Pushed by globalization and its consequent increased competition, supply chain managers have understood the importance of information sharing, joint decision-making and cooperation across supply chains. Therefore, how to synchronize local activities through global processes and how to establish a collaborative supply chain relationship are actual difficulties that supply chain members have to address. In this context, this paper suggests a model of the situations of cooperation in supply chains for coping with real industrial situations, based on an analysis of the limitations of previous models. It is shown how the suggested model may allow to identify dysfunctions in the cooperation process, especially when both large and small companies are involved, and can also be used to describe and monitor the possible evolution of the cooperation process. Finally, the model may help to specify the way information should be efficiently processed all along a supply chain, depending on the situation of cooperation.

Key words: supply chain, cooperation, relationship, trust, power.

1. Introduction

In today's global market, it is a current statement that companies no longer compete as independent entities but rather as integral part of Collaborative Networks (Camarinha-Matos et al., 2005), grouping entities for allowing them to seize opportunities to which a single partner could not answer alone (Msanjila et al., 2010). Within collaborative networks, the manufacturing processes are implemented by Supply Chains. As also underlined in the generic case of Collaborative Networks (Afsarmanesh et al., 2009), information sharing, joint-planning, cooperation and strategic

¹ corresponding author

partnerships over the entire networks are nowadays considered as conditions for building more efficient and reactive supply chains (see for instance recent surveys on this topic in (Arkan et al., 2012), (Ding et al., 2010) or (Cheng, 2010)). In order to develop supply chains based on collaborative processes, a first step can be to implement "best practices" (O'Leary and Selfridge (1998) suggest "promising practices" as a better term) defining the relationships between partners. SCOR (SCOR, 2008) is certainly the best-known and most widely used reference framework in that purpose. Nevertheless, working in a collaborative context is not only a matter of exchanging the right information at the right time: above all, it is a question of creating a favorable context, allowing deep commitment of all the partners in a climate of trust. The analysis of the quality of relationship between partners in a supply chain is therefore a key issue for implementing collaborative processes. As a consequence, academics and practitioners have suggested several typologies of situations allowing a better identification of the types of relationships between partners of a supply chain.

On the base of an analysis of real industrial situations of the aeronautical sector, we show that these typologies may have limitations in some real cases. With a specific emphasis on supply chains involving large and small companies, we so suggest a new typology which may allow to correlate identified situations of cooperation with the "best practices" often promoted in this sector. Especially, we show that usual "best practices" may be poorly adapted to some specific (but common) cooperation contexts. Therefore, classical cooperative processes (including information processing for planning) should be adapted according to the identified situations of cooperation. We suggest that this improved cooperation model may provide a support for diagnosis the relationship, but may also act as a guide for conducting a project aiming at managing the lifecycle of this relationship.

The paper is organized as follows: after having introduced the case of aeronautical supply chains, practical ways to coordinate partners in this sector are described (section 2). In the third section, the factors influencing cooperation/collaboration as they are identified in the literature are analyzed, together with the typologies already suggested on their base. A dynamic model is then described, which better explains real cooperation situations as identified during interviews conducted in the aeronautical sector (section 4). In section five, different ways to use this model are suggested, providing a first validation of its interest and relevance.

2. Coordination of the partners in aeronautical supply chains

2.1 The case aeronautical supply chains

Developing more collaborative supply chains is considered as a key issue for improving performance in all the industrial sectors, but among them, the aeronautical sector has some specific interests:

- the aeronautical industry is a sector with high added value. This has allowed the actors of the sector to focus during many years on technical aspects, and to put the emphasis on high quality and innovation more than on prices. Nevertheless, competition has dramatically increased during these last years, and has motivated all the large actors of the domain to focus on their core business. As a consequence, the aeronautical supply chains have made in ten years what has been done in twenty in the automotive sector: supply chains have become rapidly larger and more complex, leading to the necessity to optimize their performance.
- a specificity of the aeronautical sector is the diversity of the exchanged materials and components: the quantities of products manufactured are of course much lower than in the automotive sector for instance, but the number of different parts in each product is much higher. As a consequence, many SMEs, created on the base of specific technical skills, are active in these chains, since they can provide a significant ratio of the load concerning a given material or elementary part.
- The role of the SMEs has changed a lot in the sector through time: some years ago, they were only subcontractors for simple operations, but since the large customers do not want anymore to process the material flow between their partners, these SMEs have now to manage their own suppliers. This is quite unusual for them, leading to the problem to master new tools and develop new skills in a short amount of time.

As a consequence, aeronautical supply chains are in a rapid evolution, and in comparison to other industrial sectors, have the additional difficulty of combining large and small companies, with very different cultures and levels of maturity in the technical and behavioral management of their own partners. Therefore, many projects aiming at better understanding and improving relationships and information processing in these supply chains have been recently launched.

2.2 Coordination of partners in aeronautical supply chains

Implementing standard and efficient processes is usually considered as a first way to insure coordination in a supply chain (Arshinder et al., 2008). Therefore, several reference models of the

operational and business processes have been defined and promoted by various professional associations. The most common and recognized ones are certainly the SCOR model (SCOR, 2008) and the GSCF Supply Chain Management Framework (Lambert, 2008), while CPFR (CPFR, 2004) describes business practices based on such closer relationships. These models have different focus and industrial targets; however, they all suggest lists of processes considered as necessary for managing and synchronizing partners in a supply chain, through the optimization of the internal activities and an increased cooperation with the other supply chain members. The dissemination of these frameworks is therefore encouraged in aeronautical supply chains. In practice, the daily data processing and information exchanges required for managing a relationship will most of the time be performed by the information system of each company, and more precisely by ERP (Enterprise Resource Planning) systems (centralized systems like APS (Advanced Planning Systems - Stadler et al., 2000) are poorly adapted to the coordination of autonomous entities). Within an ERP, in the context of aeronautical supply chains as discussed in previous section (high diversity, large number of partners), production is most of the time managed using the MRP2 (Manufacturing Resource Planning) technique (Orlicky and Plossl, 1994), even if just-in-time techniques can occasionally be used for execution.

Using the MRP2 method, forecasts are gathered by a company and used as inputs for building a Sales and Operation Plan (SOP), often with a 1-3 years horizon in the aeronautical sector. A Master Production Schedule (MPS) is then deduced at lower term. On the base of the obtained sequenced requirements on the final products, the bills of materials are used for generating on one side a Supply Planning, and on the other a Production Planning (Material Requirement Planning step). The adequacy between the load generated by the Production Plan and the capacity of the company is checked (Load Planning), then the production is scheduled, with a typical horizon of 1-2 weeks. Release and work in progress management can be done using classical methods, or using the Kanban method.

MRP allows to deal with complex bills of materials when the demand is known through programs, which is the case in the aeronautical industry. Therefore, Supply Chain management is usually implemented in this sector through a cascade of MRP systems, one in each company (see Figure 1). In this configuration, the supply plan of each company is used to create the forecasts sent to his suppliers. Considering Figure 1 (and even if real supply chains have the topology of a network), it is clear that information can only be correctly propagated through the supply chain under

condition that each partner, whatever his size or culture, is able to efficiently perform his local role concerning data processing.

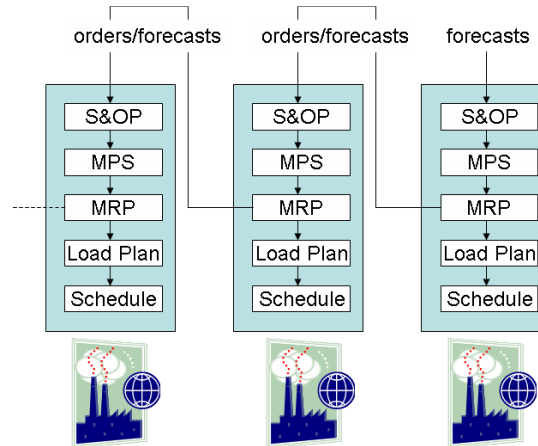


Figure 1. Supply chain management as a cascade of MRP systems (Grabot and Mayère, 2009)

It is shown in next section that this consistent management paradigm (business processes defined by reference models like SCOR, then implemented using the MRP2 production management method, supported by ERP systems) may be difficult to operationalize in practice, especially when SMEs are involved in the supply chain.

2.3 Specificity of the SMEs: a literature view

As seen in previous sections, the presence of SMEs in aeronautical supply chains can be explained by the diversity of the technical skills required for fulfilling the orders and by the low quantities required in each reference. In addition, the "natural" qualities of SMEs, e.g. flexibility and quick decision making, are more and more needed for increasing the reactivity and agility of supply chains (Caskey et al., 2001; Dangayach and Desmukh, 2001). Nevertheless, many studies have pointed out the specific difficulties of the SMEs for adopting the Supply Chain Management (SCM) standards and management methods (Quayle, 2003). Harland et al. (2007) correlate this problem with a lack of motivations regarding "new" management techniques, due to a poor awareness of the possible advantages of these techniques. For Mehrrens et al. (2001), adoption of Information Technology in SMEs requires perceived benefits, organizational readiness but also external pressure which can be performed by the large customers. This context explains the ongoing projects launched by most of the large companies aiming at "supplier development". This term, introduced in (Leenders,

1966), summarizes the efforts made by a customer in order to increase the number of viable suppliers and improve supplier's performance or capability (Krause et al., 2007). Lean manufacturing is a major constituent of supplier development programs (Jensen, 2007; von Axelson, 2009) but the resulting simplification of the material flows is not sufficient for keeping the system under control: it is usually considered that SMEs should switch from simple financial plans to forecast based planning (Thakkar et al., 2008). In that purpose, ERP systems including MRP2 modules are more and more considered as mandatory for SMEs to join Supply chains (Lenny Koh and Simpson, 2005). Nevertheless, for Arend and Wisner (2005), SCM implementation can be negatively correlated with SME performance, reasons being that business processes may be differently implemented in large and small companies.

On the other hand, the necessity to better integrate SMEs in nowadays Supply Chains is not only a matter of information processing. The behavioral aspects influencing the relationship between the members of a network, especially on supply chain aspects, are discussed in next section.

3. From Collaborative Networks to Collaborative Supply Chains

Networks of Companies have been object of an increasing attention during these last years, with a specific interest on the links between partners inside the networks. The generic context of Collaborative Networks is first summarized in next section; the more specific literature on Collaborative Supply Chains is then explored.

3.1 Collaborative Networks

Companies have always worked with suppliers and customers, but the present competitive context makes that a specific focus of interest can be noticed during these last years on how close collaboration could improve performance and open new markets. In this context, a Collaborative Network (CN) has been defined in (Camarinha-Matos et al., 2005) as a network of autonomous organizations that collaborate to better achieve common or compatible goals (which can result in the manufacture of a product or service). For a company, the interest to belong to such networks is to extend its competences and share risks, therefore allowing the company to benefit from opportunities that it could not address alone. A condition is to create a real "collaboration" within

the network. In that purpose, the recent literature on Collaborative Networks insists on the necessary trust between partners (Msanjila et al., 2010), trust being often considered as based on shared beliefs (Camarinha-Matos et al., 2010). The development of a common value system is therefore a significant element for the sustainability of collaboration. The various aspects of collaboration are for instance analysed thanks to a dedicated model in (Afsarmanesh et al., 2009), with structural, componential, functional and behavioural dimensions.

Collaborative Networks can take various forms, including highly integrated supply chains (Choudhary et al., 2013). Positioning supply chains as key elements of collaborative networks was already present in the early work of Li et al. (2000), in which the term "Global Manufacturing Virtual Network" was suggested. This term is also used in (Rodriguez Monroy et al., 2010) in which the case of the aeronautical industry is considered: in this article are analyzed the causes and conditions of formation of such networks in the sector, trust being again considered as a mechanism for avoiding opportunistic behaviors, and as a mean to overcome the fear inherent to collaborating with external companies. Nevertheless, the article is mainly oriented on the strategic level, and does not address practical issues linked to exchanges of materials.

Being mainly interested in aspects linked to the material flows, we shall investigate with more details in next section the literature dedicated to coordination, cooperation and collaboration in supply chains.

3.2 Coordination, cooperation and collaboration in Supply Chains

Supply chains have nowadays more and more complex structures, and may involve partners from different domains, size, countries, therefore of different cultures. In that context, the performance of the partnership can be assessed through technical criteria (see for instance (Ounnar et al., 2007)), but is also concerned with behavioral issues (Möllering, 2003). Therefore, the factors conditioning the relationship between partners are object of an increasing attention from both academics and practitioners.

Many terms are used in the literature for qualifying the relationship between supply chain partners: among them, "coordination", "cooperation" and "collaboration" are often found, but not always with the same meaning. For Arabe (2003), they must be understood by opposition to the traditional "arm-length relationship", which is still the most common in supply chain environments. This type of relationship is characterized by little investment, hardly any information sharing and

limited interaction between companies, together with low trust and commitment. Relationships at this stage are short-term, contract-based and adversarial, several suppliers competing where price being the overriding factor. Under that scheme, partners are protected by contracts and can efficiently perform routine tasks. On the other hand, it is quite easy to change partners.

According to Arabe, cooperation is the following level of the relationship: companies are more tightly tied together, sharing more information than they would even in an extended arm-length relationship. In case of cooperation, there are fewer suppliers and longer-term supplier-customer relationships. Cooperation is therefore an upper level of relationship, determined by the degree of information sharing (Sepulveda Rojas and Frein, 2008). At this level, firms' information systems are more strongly linked, and there is more emphasis on strategy. Companies are able to perform joint initiatives, such as Collaborative Planning, Forecasting and Replenishment (CPRF) and Vendor Managed Inventories (VMI). Finally, collaboration refers to the most committed relationship between separated organizations, the following step being joint venture or vertical integration.

For other authors like Malone (1987), coordination is only a model of decision-making and communication between partners who execute interrelated tasks in order to meet an objective. Coordination is here opposed to integration, which would remove the boundaries between companies. For Lauras et al. (2003), cooperation is at an upper level than collaboration: for the authors, communication means a punctual exchange of information, while coordination would require a regular exchange. Collaboration and cooperation would concern exchanges of both information and data processing facilities, according to the type of data and data processing facilities exchanged between enterprises: punctually for collaboration, regularly for cooperation.

For clarity purpose, we shall adopt here quite simple definitions: coordination will refer to the synchronization of activities that are mutually dependent (which requires a minimum level of information exchange). In that case, each company performs its activities in its own way but keeps its partner informed. Cooperation will be considered as a generic term used when the expected quality of relationship is higher than a simple coordination, implying information and knowledge sharing for instance. Collaboration will refer to a higher level of relationship, including for instance the possibility that a company modifies its behavior for being more compliant with its partners' attitude (see for instance a classification of the levels of collaboration between companies in (Jagdev and Thoben, 2001)). Within collaboration, a partner may accept to decrease the satisfaction of its own local objectives for increasing the satisfaction of common ones. Conditions for these different types of relationships will be investigated in next section.

3.3 Factors influencing supply chain relationship

Many authors have already investigated the various kinds of factors influencing supply chain relationship, sometimes summarized by the concept of "relationship atmosphere" (Hallén and Sandström, 1991). For Andersen and Kumar (2006), the "relationship atmosphere" addresses six specific dimensions that are often listed in the literature: power/dependence balance, trust/opportunism, cooperativeness/competitiveness, understanding, closeness/distance, and commitment. More precise frameworks are sometimes suggested: a total of 18 key relationship indicators have for instance been identified in (Meng, 2010). Authors sometimes use different concepts to interpret quite similar statements, but in most of the identified studies, the preponderant importance of confidence, trust, commitment and benevolence is underlined, these different notions expressing the level of perception of the supply chain member's about the dependability and reliability of the other members (Boer et al, 2005; Hausman and Johnston, 2010), based on their capability, actions and behaviors. This perception undoubtedly affects the level of commitment, informal agreement, willingness to cooperate, communication, information sharing, opportunistic actions and certainly operational processes (Carter and Jennings, 2002; Johnston et al., 2004). Information sharing is quite commonly considered as an essential condition for making trust possible, allowing therefore to maintain long term and collaborative supply chain relationship (Nyaga et al., 2010; Ren et al., 2010). According to Fynes et al. (2005), there are different types of trust: contractual trust, competence trust and goodwill trust, based on keeping promise, confidence in partner's competence and commitment to maintain a trading relationship. Two dimensions of trust are also discussed in (Johnston et al., 2004): trust as the belief that the other party is dependable or reliable on one hand, and belief that the partner would act in the best interest of the partner even if there is no way to check it on the other hand.

With a slightly different point of view, power, dependence, control and monitoring have also a clear influence on the relationship (Hvolby et al., 2007; Zhao et al., 2008; Liu et al., 2010). Mutual dependence and power appear to be the foundations of a collaborative relationship, allowing to develop and maintain long term relationship (Narasimhan et al., 2009; Cheng, 2010). Trust and power are also considered as conditioning the type of knowledge exchange in (Cai et al., 2013). Various categories of power have been suggested in the literature. A common classification is to distinguish coercive and non-coercive power, depending on the direct or indirect effect on member's

behaviors (Brown et al., 1995; Kim, 2000). According to Maloni and Benton (2000) or Flynn et al. (2008), a more specific typology of power includes expert power, reference power, legitimate power, reward power and coercive power.

Table 1. Factors of supply chain relationships in the literature

	Year	Atmosphere	Attitude	Closeness/ Distance	Commitment	Common Purpose	Common Understanding	Communication	Culture	Dependency	Goodwill/ Cooperativeness	Information sharing	Opportunistic	Power	Trust
Carter and Jennings	2002				√										√
Johnston et al.	2004									√					√
Fynes et al.	2005				√			√		√					√
Benton and Maloni	2005													√	
Andersen and Kumar	2006	√		√	√		√			√	√		√	√	√
Ireland and Webb	2007									√				√	√
Su et al.	2008	√						√							√
Zhao et al.	2008				√									√	
Narasimhan et al.	2009									√				√	
Nyaga et al.	2010				√							√			√
Hausman and Johnston	2010				√										√
Liu et al.	2010		√		√								√	√	√
Ren et al.	2010				√			√		√		√			
Lee et al.	2010				√					√					√
Meng	2010		√			√		√							√
Cheung	2010								√						√
Total		2	2	1	9	1	1	4	1	7	1	2	2	6	12

Table 1 suggests a brief summary of the concepts identified in a panorama on this literature. Trust, commitment, dependency and power are the concepts most often considered, commitment being clearly seen as a consequence of trust, while dependency proceeds from the partner's power. Indeed, trust and power are often considered as the basic pillars of relationship, which influence many of the other listed aspects (like commitment, cooperativeness, etc.) (See for instance (Hémont et al., 2010) for details on the links between these concepts in the supply chain context).

3.4 Typologies of Supply chain relationship

Suggesting classifications is a common way for better understanding complex phenomena. Since the types of relationships between partners of a supply chain do influence the performance of the chain, several typologies have been suggested in the literature, with different objectives.

On the base of 196 cases, and considering trust and performance as discriminating factors, Möllering (2003) defines three clusters of partners: traditional wary traders (50% of the companies; lower levels of trust and performance), committed flexible partners (30%; high levels of trust and performance) and controlled routine partners (14%; high trust and performance, but based on a strict observance of agreed terms). Nevertheless, the independence of the two factors may be set into question, performance being linked to trust by many authors (Andersen and Kumar, 2006; Johnston et al., 2004; Möllering, 2003). In (Hallikas et al., 2005) is suggested a classification of supplier relationship (see Figure 2), built after a questionnaire and based on the concept of dependency risk: buyer dependency risk (low or high) and supplier dependency risk (low or high). The authors define four types of relationships: strategic relationship, non-strategic relationship, captive buyer, and captive supplier. After analyzing 42 questionnaires, the theoretical "captive buyer" cell was still empty, showing of course the usual power of the buyers, or their reluctance for building such unfavorable relationship.

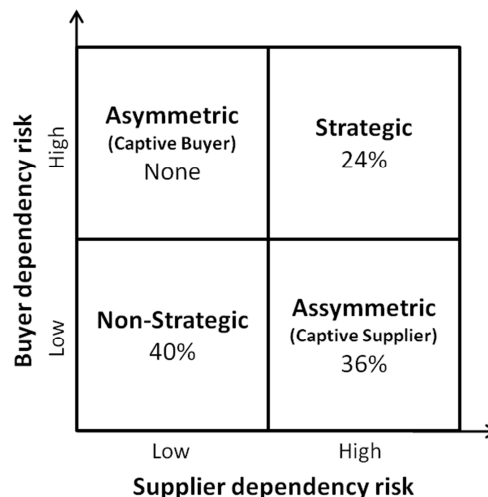


Figure 2. Typology from (Hallikas et al., 2005)

A close classification has been suggested in (Marcotte et al., 2009), based on the supply chain's power on the company (low or high) and the company's power on the supply chain (low or high) (see

Figure 3). Since power can be considered as conversely proportional to dependency, the four resulting categories are quite similar to those of Figure 1, but the typology considers the integration of a partner in the chain, and not point-to-point buyer-supplier relationship, as in (Hallikas et al., 2005). Moreover, the definition of the categories gives additional information. For Marcotte et al., a partner is strategic when the supply chain and the company power are balanced; in that case, there is a mutual interest to cooperate. This situation is usually considered as the ideal one for building a collaborative link (Geyskens et al., 1996). Nevertheless, the relationship may be difficult to build: it has to be based on mutual respect, and none of the partners can impose its processes or methods to the other.

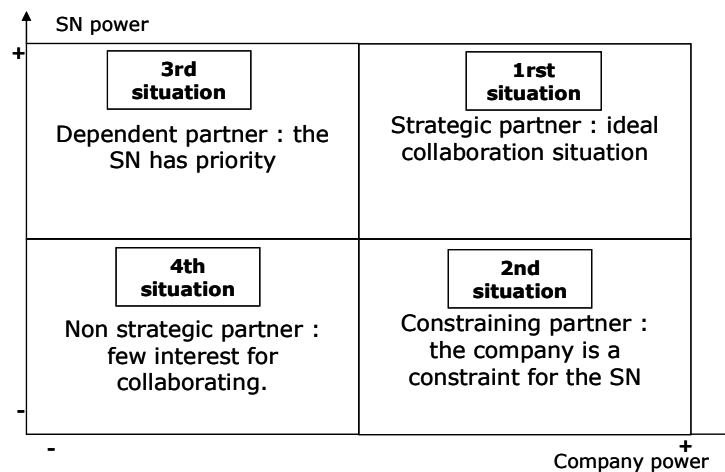


Figure 3. Typology from (Marcotte et al., 2009)

A link can be made between (Hallikas et al., 2005) and (Marcotte et al., 2009): a captive buyer from (Hallikas et al., 2005) has for supplier a constraining partner according to (Marcotte et al., 2009); the supplier power on the chain is higher than the supply chain power on the supplier. In that case, the constraints set by the supplier should be taken into account by the chain. This case, which can often be met in real industrial situations, is poorly compatible with usual practices as described in section 2.

A partner is dependent when his power over the chain is lower than the supply chain power over him. Therefore, the chain may impose its constraints on the partner. This situation remains very ambiguous: for many authors (and for large companies), it is the perfect situation, since the large companies (which are often the focus companies of the supply chain) can influence their smallest

partners and impose them "good" practices and tools, such as those described in section 2 (Vaaland and Heide, 2007; Harland et al., 2007). On the other hand, many authors notice that power prevents the growth of trust, leading only to an appearance of adoption of the new practices (Johnson et al., 1990; Skinner et al., 1992, Brown et al., 1995; Thakkar et al, 2008; Hémond et al., 2010).

A non-strategic partner is involved in a relationship in which both powers are low. The partner is independent from the chain, and vice versa. In that case, each entity has an opportunistic behavior, which does not allow the emergence of a collaborative relationship (Liu et al., 2010).

On the base of this typology, different models of cooperation are suggested in (Marcotte et al., 2009), showing that the links between objectives, constraints or decision variables of the company and of the supply chain (represented by the focal company) may vary according to the identified situations.

Another typical typology of relationship is presented in (Liu et al., 2010), again based on two factors, namely trust and commitment, one more time considered at two levels (low and high) (see Figure 4). Four types of relationship are so defined: "buddy" for high level of trust and high level of commitment (Type I), "relier" for high trust and low commitment (Type II), "arm's length" for low trust and low commitment (Type III) and "initiative" for low trust and high commitment (Type IV). These four distinct contexts are coupled with control mechanism involving both coercive and non-coercive power in order to achieve better coordination with the partners. Nevertheless, the independence of the two axis of the suggested model remains questionable: many authors indeed agree on the fact that trust and commitment are closely linked (Andersen and Kumar, 2006; Essig and Amann, 2009; Hémond et al., 2010).

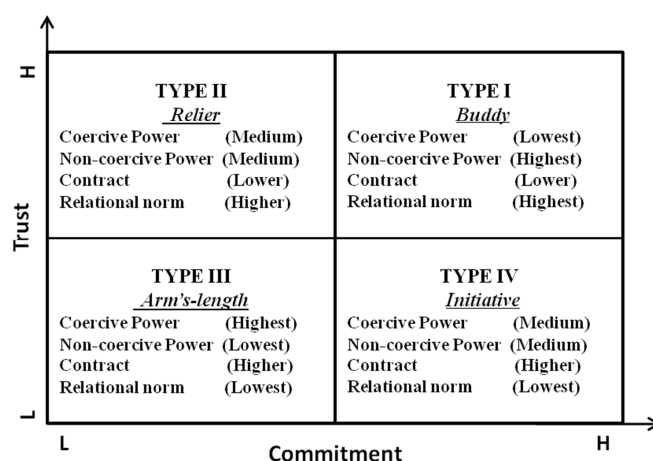


Figure 4. Typology of relationships (Liu et al., 2010)

The analyzed typologies focus on specific aspects of the relationship between customer and supplier, like dependency risk (Hallikas et al., 2005), power (Marcotte et al., 2009) or trust and commitment (Liu et al., 2010). After having tested them on real cases (see section 4.2), we have estimated that these typologies, designed to be simple, were unable to explain some complex situations. A first reason is that, as suggested in section 4.1, other factors than those chosen could be useful to explain some situations. Another is that these typologies are all based on a binary assessment of the factors (usually: "low" and "high"), which may be rather limitative. A third reason is that these typologies do not consider the possibility that the same factor is not assessed in the same way by the two partners, which is according to our experience a key point for explaining some misunderstandings in real situations. The different steps leading to the development of a typology of the situations of collaboration allowing such possibilities are described in the following section.

4. A typology of the situations of supply chain cooperation

4.1 Bases of the typology

According to the panorama of the literature summarized in Table 1, trust, power, dependency and commitment are the concepts which seem to be the most widely used for explaining the relationships between partners in Supply Chains. Defining a simple typology on the base of these concepts requires to choose among them rather independent ones, but many of them seem to be mutually dependent. As discussed above, trust and commitment are considered as linked by most authors, while for (Laaksonen et al., 2008), the relationship between trust and dependence has not yet received enough attention. Similarly, power and dependency are the two opposite sides of the same phenomenon. As a consequence, we have as a first step decided to investigate the relevance of a typology based on trust on one side, and power on the other side. Therefore, our main hypothesis is here that the two concepts are independent, i.e. that it is possible that the trust of a partner on another is independent of its power over him.

Concerning the number of levels to consider, it is clear for us that the usual categories low/high are not sufficient for describing complex phenomena. For instance, power can be on the side of the supplier, on the side of the customer, or balanced, leading to at least three categories. This number

of levels could still increase if the strength of the power is considered, but as a first step, we have decided to test these three categories for describing the power.

Several choices are possible for assessing trust (see an exhaustive methodology in (Msanjila et al., 2010)). In a simple way, the level of trust can be subjectively described by several grades, like low/high, or using more levels. Nevertheless, distrust between partners is certainly a situation to consider, leading to three possible levels: distrust - indifference - trust. Another consideration is that, as suggested above, trust is perhaps not necessarily a symmetrical feeling. With two partners and three levels, this brings to $2^3=8$ possible combinations. Therefore, 24 global situations should be distinguished when combined with the three levels of the "Power" dimension.

In order to have a better accuracy without suffering from a combinatorial explosion of the situations to consider, we have decided to split the typology in two components, one describing the situations of the supplier, the other those of the customer. As shown in Figure 5, the two parts of the typology are almost identical, and a global situation of cooperation is identified by the combination of the situation of the supplier with the situation of the customer. As a first step, it will be considered that the power is assessed in the same way by the two partners, but another solution would be to consider that the x-axis describes the power as felt by the partner. This would allow to model complex situations where, for instance, the customer thinks that he is the most powerful partner of the relationship, while the supplier thinks the opposite for different reasons.

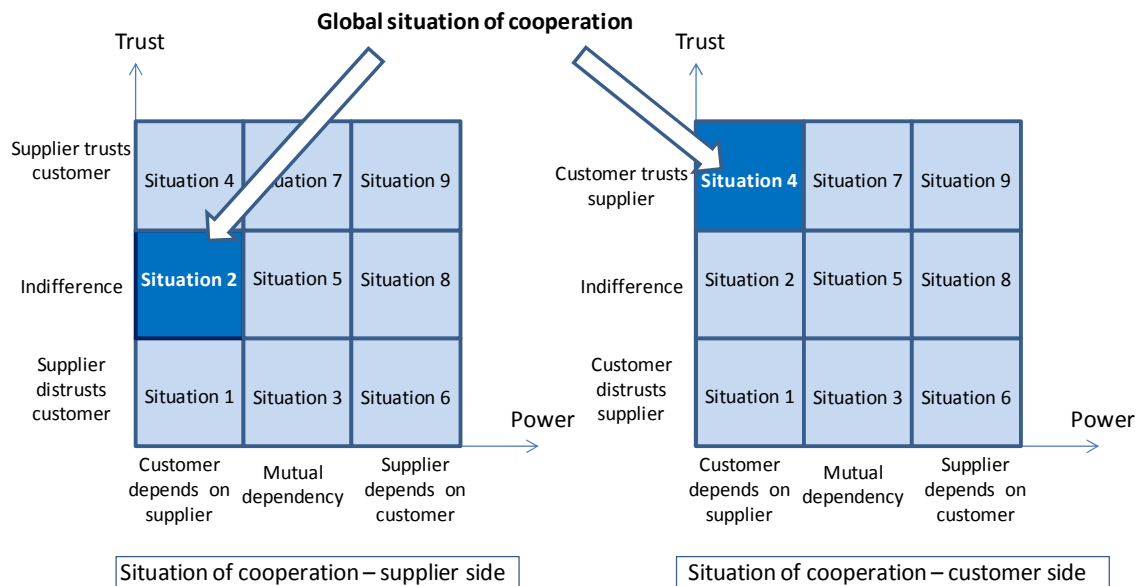


Figure 5. Typology for the situations of cooperation

Figure 5 shows a theoretical situation in which the customer depends on the supplier, the supplier is indifferent and the customer trusts the supplier. The situation is so described by (situation 2, supplier; situation 4, customer). As a first element of validation, it is interesting to try to correlate the situations of Fig. 5 with cooperative/collaborative situations as discussed in the literature.

The literature emphasizes the interest of balanced relationships (Anderson et al., 1994; Frazier and Summers, 1991; Geyskens et al., 1996; Caniëls and Gederman, 2007). On the other hand, trust is also considered as a major condition for performance (Johnston et al., 2004; Möllering, 2003; Andersen, 2006), therefore Situations 7 in the two tables can be considered as the ideal situation leading to *collaboration*.

In each case, the situations of the first line (distrust of the partner) have very different consequences depending on who holds the power. Situation 1 may be considered as favorable for the supplier; the lack of trust may be compensated by the power over the partner, which is another way to prevent opportunistic behaviors (Liu et al., 2010), its symmetric for the customer being Situation 6. On the opposite, Situations 3 appears to be rather unconformable, the company (supplier or customer) being dependent on a distrusted partner. In Situation 6 of the supplier and Situation 1 of the customer, both companies will certainly try to decrease the risk of the relationship through precise contracts, allowing to compensate the lack of trust. The main attitude between partners will so certainly be the "no exception" policy (Möllering, 2003): no initiative outside the contract is expected from the distrusted partner.

The middle line of the two matrices, denoting indifference, is the perfect field for the so called "arm's length" policy (Forker and Stannack, 2000; Möllering, 2003): like for the first line, the contract will be the base of the relationship, even if at a lower degree, since the partner is not suspected to have a selfish (nor benevolent) attitude.

The top lines of the matrices denote the trust of the considered company for his partner (either reciprocal or not, depending on the synchronization of the two models). Trust allows to reject the "no exception" attitude (Möllering 2003) and decreases the level of required monitoring of the relationship (Andersen and Kumar, 2006): relationship may become relatively informal; the contract is not anymore an absolute reference, with the result of a better flexibility and reactivity of the relationship, leading to the increased performance usually associated with trust (Johnston et al., 2004).

These theoretical considerations show that this typology is consistent with the literature, which is obviously not enough for validating its interest. In order to check whether it could really help to

better understand real situations, we have therefore tested it on relationships in the aeronautical industry, as analyzed by the research group IODE², in several contexts. This analysis of real situations of cooperation and their position in the suggested typology are described in next section. We shall show that the use of the typology does not only allow to classify the situations, but also to better understand them. It also allows to formalize misunderstandings which may occur between partners, and finally permits to identify the main points that limit the quality of the cooperation.

4.2 Analysis of real cooperation processes

The following analysis of real cooperation processes has been performed between 2009 and 2012 in different contexts, but mainly during a project conducted by IODE, assisted by several consultants, in collaboration with a large association grouping companies of the aeronautic industry in the South-West of France and with a public body aiming at developing the regional SMEs. The goal of the project was to analyze the problems linked to the relationships between partners of several supply chains on two main aspects: collaborative design and product flow management. Twenty companies were visited in that purpose: seven large ones and thirteen of middle (around 200 employees) or low (less than 100 employees) size. The panel of companies was defined by the Association and by the public entity in order to have a good representativeness of sizes and technical domains³. If the relatively low number of visited companies does not allow to fully assess the generality of the identified problems and situations, we shall see that it nevertheless allows to show that some existing problems cannot be fully expressed using existing models.

The interviews on product flow management have been conducted by researchers and consultants using the general framework depicted in Figure 1, aiming at identifying how the relationship was created and managed through time, so that the related problems which occurred during the relationship. The results have been structured in four major operational processes describing:

- the "Request for Quotation", having for result the creation of a middle/long term relationship,
- the middle term order management,

² IODE (Ingénierie des Organisations Distribuées) is a virtual research group gathering 80 researchers in Industrial Management from Regions Aquitaine and Midi-Pyrénées, in the South-West of France.

³ The term "aircraft" will be used here as a generic product, but the visited companies were also involved in the design and manufacturing of satellites, rockets or other aerospace products.

- the fulfillment of the orders (short term),
- the supplier development, through audit and transfer of various tools and techniques among which MRP and Lean Manufacturing.

Some differences appeared between companies in the way these processes were managed, but they mainly concern details, or means used to exchange information (from Web portals to Excel sheets or fax). The convergence of the processes used by the different actors was therefore clear.

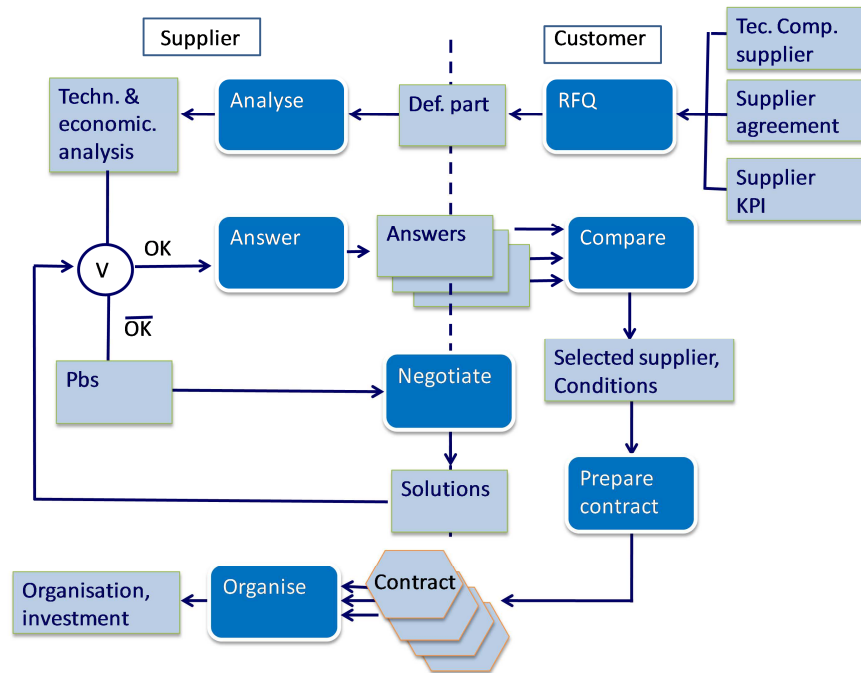


Figure 6. "Request for Quotation" Process

A simplified view on the first process is shown in Figure 6. When partners have to be found for manufacturing new parts, the technical competences of the possible suppliers, their quality agreements and their performance indicators (if they are already suppliers of other parts) are considered by the customer for defining a list of possible suppliers. The Request for Quotation (RFQ), describing the part and the conditions of the program, is sent to these suppliers. The suppliers analyze this RFQ and send an answer, or detect problems either on the part definition or on the conditions, which they will try to negotiate. The customer receives the answers, compares them and selects a supplier (or several). A contract is then prepared, defining global quantities, prices and delivery conditions through time. The selected supplier tries then to organize his production for the last months/years according to the programs in which he is involved, for all the supply chains to which he belongs.

In Figure 7 is summarized the "Middle term management" process, which is a more detailed view on the general framework, already depicted in Figure 1. On the base of the forecasts he receives from his clients, the customer builds the forecasts for his suppliers. Most of the time, the forecasts are composed of a firm period (in which the orders cannot be changed) followed by a flexible period (during which orders may be modified under given limits) and a free period, only given for information. The total of the three periods may cover an horizon of two to three years. The forecasts are updated every month or every two months.

The supplier enters these forecasts in his MRP system and generates a supply plan and a production plan at mid-term. The supply plan is used by the supplier for managing his own suppliers, including those providing raw materials. A constraint is that the "suppliers of the suppliers" have sometimes to be agreed by the focal company (the aircraft assembler). Another interesting point is that the firm/flexible/free periods of the forecasts sent to the suppliers are not automatically deduced from those received from the customer. Many large companies understand that their smaller suppliers could not bear the variations induced by their own customers, and increase the firm period of their orders in order to protect them. Therefore, the contract and the characteristics of the supplier may be taken into account when generating the forecasts.

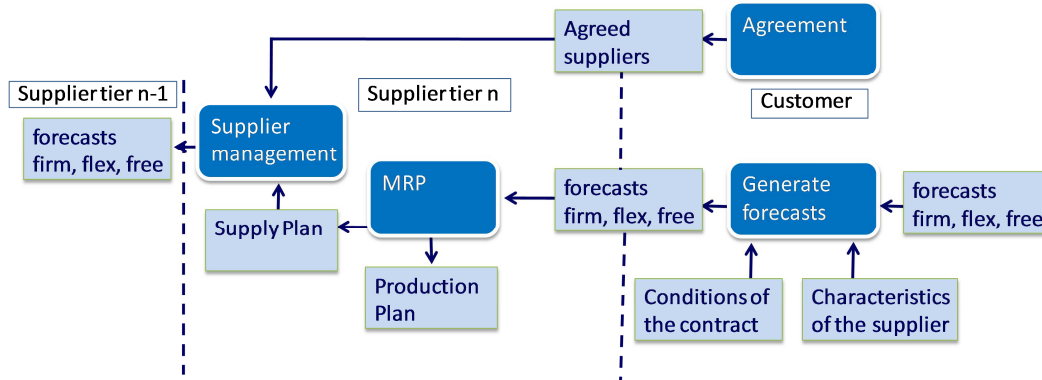


Figure 7. "Middle term management" Process

Figure 8 shows the "Order fulfillment" process as generalized from the interviews. On customer's side, the short term planning is made according to the mid-term planning, in accordance with the programs and terms defined in the contracts with the suppliers. The firm orders are confirmed regularly, allowing the supplier to build his own short term planning. A typical problem identified during the interviews is that, in order to decrease their prices, suppliers tend to try to manufacture the parts in larger lots. In that purpose, they group similar orders, sometimes on long

periods since the aeronautical industry mainly processes low quantities of very diverse parts. Problems may be detected either at the short-term planning or execution levels, often linked to the supplies of raw materials or sub-contracted parts. When the parts are delivered, the quality is verified and the indicators related to the supplier are updated by the customer (service ratio, etc.).

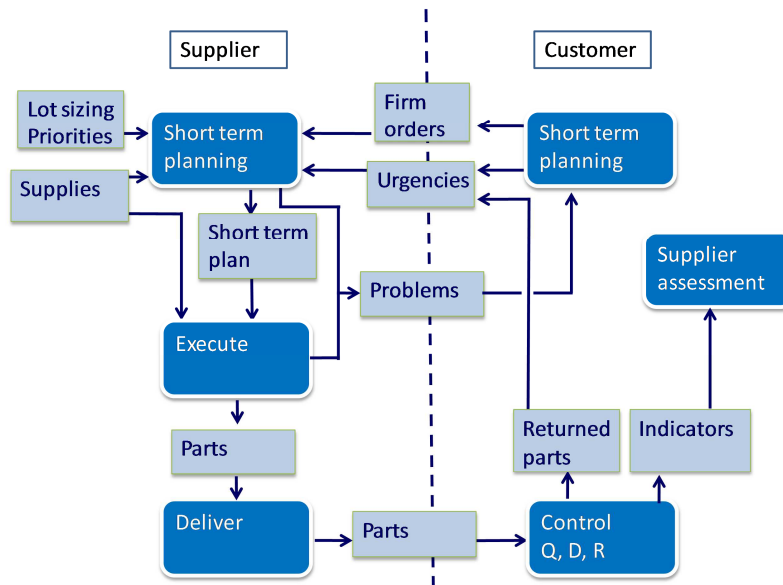


Figure 8. "Order fulfillment" Process

The supplier development process identified during the interviews is summarized in Figure 9. The concept of supplier development has for instance been formalized in (Krause et al., 2007) or (Ghijsen et al., 2010). A global program is built by the customer according to the methods and tools that he considers as mandatory for improving the supply chain. This concerns mainly information processing through MRP2, allowing to create two control loops at short and middle term, and lean manufacturing, universally considered today as a way to simplify the flow management within the supply chains. According to their criticality and to their expected potential of development, key suppliers are chosen and are asked to participate to development programs. If they accept, their customer provides them consulting and training, directly or by mean of Associations created by several large companies in order to coordinate their efforts towards their suppliers.

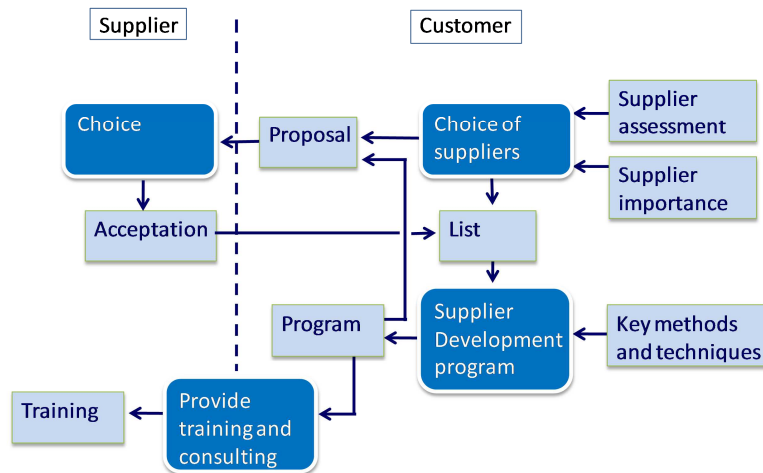


Figure 9. "Supplier development" Process

Obviously, these processes describe an "ideal" functioning of the supply chain, which mainly reflects the view of the large companies. As shown later on, reality is more complex. An interesting point is nevertheless that these processes are supposed to be "the right ones" whatever the supplier: officially, the specificity of each supplier only appears in some parameters of the exchanged information (length of the firm period for instance), but not in the definition of the activities. Our hypothesis is that the performance of the relationship could be improved if the type of relationship with the supplier is more formally taken into account in the processes. This requires that it is firstly clearly identified. In the next sections, we shall match the typology suggested in section 4.1 with real situations identified during our interviews.

4.3 Matching between real situations and suggested typology

4.3.1 Situations from the supplier point of view

We shall check in this section how real situations may be positioned in the left table of Figure 5, sometimes with some accuracy, other times as a set of possible situations.

Many illustrations of situations linked to the right column of the left table of Figure 5 have of course been met during the interviews, since the power is usually on the customer's side, especially when the suppliers are SMEs. For instance:

- A supplier wanted to create a trust relationship with one of his important customers. In that purpose, he wanted to have a very good service ratio. Considering that the firm period of the

received forecasts was too low for being sure to deliver on time, he preferred to release his internal orders on the base of the flexible period sent by the customer, taking the risk that some orders may be cancelled (situation: supplier trusts customer).

- The supply time of some alloys and casting parts used in the aeronautic industry may be long (up to 12 months), and is often longer than the fixed period of the forecast. In that case, the supplier should send firm orders on raw materials on the base of the flexible period of the forecasts, taking therefore a risk, denoting his trust for his customer (Situation 9). Some suppliers refused to do it, but did not dare to clearly discuss this issue with their customer, showing that they are in Situation 6. This led to delays, unexpected by the customer but perfectly foreseeable. Sometimes, the supplier refuses the situation and discusses possible issues with the customer: this attitude may denote Situations 1, 2, 3 or 5 (poor trust, balanced power or power on the supplier's side).
- Supplier development is a good way to assess trust. The SMEs have sometimes entered the programs under the insistence of their customer (right column: supplier depends on customer), but see this as a real opportunity (Situation 9: they trust their customer). In other cases, the suppliers have entered the programs even if they were thinking that the methods on which they would be trained (MRP2 or Lean) were not applicable for them (Situation 6: they do not trust the customer, but depend on him). For some SMEs, lean manufacturing is indeed considered as a way for large customer to decrease their autonomy: instead of giving priorities to the orders, some customers ask for instance their suppliers to process the orders in FIFO⁴ (Situation 6). In some cases, a real negotiation was engaged on the object of the training (denoting Situations 3, 5 or 8).
- Some customers know that their technical skills give them some power over their customers, but enter the development programs on a voluntary base in order to still increase the quality of relationship (Situations 4 or 7).
- Similar situations were observed in another context: the large companies of the sector want to impose that their smaller suppliers buy ERPs (in order to be able to use the MRP method, for having a better visibility on the future). In addition, they ask for proofs of correct use of these systems, e.g. load plans (showing their distrust). Most of the time, the SMEs were very doubtful on the possible results, but accepted to buy and implement the products (Situations 6 or 8).

⁴ First In First Out

- In many cases, the suppliers group the orders sent by their customers in order to decrease their set-up times. These groups were sometimes made without taking into account the due dates, with the result of early and tardy orders. For the suppliers, customers have slack times that they do not communicate, so these delays are not really important (bottom line of the matrix: no trust in the due dates). Nevertheless, they do not clearly discuss the problem with the customers, since they know this attitude would not be appreciated (Situation 6: dependence).

Column 1 (customer depends on the supplier) of course denotes unusual situations. Nevertheless, the following cases were encountered:

- A small supplier has a very specific position in the supply chain of a large customer: he has a high and scarce technical skill and very low costs, because of a light infrastructure. The customer wanted him to buy a production management tool, since his ratio of service was poor. The supplier refused: he was already overloaded, and the customer could hardly find another supplier with comparable prices... The relationship is clearly here in Situation 1 or 2 for the supplier.
- A SME specialized in surface treatment has also a quite favorable position: his technical skills being rare (left column: the customer depends on him), he has been able to impose to his customers that the price of the treatments depends on the cycle time: if the parts are urgent, the customer has to pay more for fast processing. Using that strategy, the supplier has seen a considerable decrease in the number of urgent parts, which was one of his goals (Situation 1: no trust in the urgency of the orders).
- Again on the urgency: in aeronautical supply chains, the higher urgency is denoted "AOG" for "Aircraft On Ground", this status being normally given by the final assembler when an aircraft is immobilized. Since more than 30% of the orders he received were AOG according to his customers, a supplier located at the end of the process (therefore inheriting from all the upstream hazards) decided to systematically refer to the final assembler for checking the status of the parts. It appeared that 60% of the orders were not real AOG: the companies of tiers 1 or 2 were using this status for trying to increase their own ratio of service for their customer... (Situation 1: no dependence, no trust).

The situations of the middle line and column of the matrix are often considered as a goal by the suppliers. Indeed, actors of SMEs usually trust persons more than organizations (see for instance (Andersen and Kumar, 2006) for investigations on the role of personal trust in SCM), but because of

the turnover of the large companies, they may prefer a relationship based on clear contractual bases than on a person-to-person agreement. Additionally, many of them do not want to depend too much on a customer, and as a consequence would prefer Situation 2 (which requires to have a specific interest for the customer) or 5.

Such balanced situations have also been identified in the process of Request For Quotation. The parts object of the request may be difficult to produce. For the suppliers, the reason is mainly that the designers at the customers' side have less technical competences than before, while for the customers, it is the sign of an increased complexity of the parts. In this situation, some suppliers manage to negotiate with the customers, showing that they are in a situation of mutual dependency and that they want a clear contract (Situation 5: mutual dependency and indifference leading to emphasize the role of the contract). Others, who depend heavily on the customer but trust him, choose to answer to the request in spite of their doubts, considering that the customer will afterwards help them to industrialize the parts (Situation 7: mutual dependency and trust).

4.3.2 Situations from the customer point of view

The situations as seen by the customers have mainly been identified by interviews of large companies, but also, indirectly, during discussions with the suppliers, and especially with SMEs. Many of the discussed problems indeed denote situations belonging to the bottom line (customer distrusts supplier) of the right table of Figure 5 (customer's point of view):

- A customer had some doubts on the capacity of one of his suppliers to buy casting parts. In order to decrease the risk of delayed delivery, he decided to create a safety stock that he could eventually sell to his supplier in case of need. Therefore, without notice to the supplier, he ordered parts to the caster. The consequence was that the caster, who was overloaded, preferred to fulfill the large company's demand and not the supplier's. It is interesting to notice that the customer had in that case created the situation he wanted to prevent. This denotes Situation 1 or 3: the customer distrusts the supplier (bottom line), and would work with other suppliers if possible (therefore, Situation 6 is improbable).
- Proofs of trust can also be found: in order to give to one of his suppliers the information allowing him to manage his internal priorities, a customer was used to send his level of inventory together with the orders. In case of problem, the supplier was able to decide which parts to prioritize, according to his customer's interest (Situation 4 or 7: the customer trusts the supplier, and does not try to exert his power on him).

- Many customers perform regular audits at their supplier's, with the consequence of great time wastes for the supplier because of the multiplication of these audits: Situation 6 (the customer does not trust the supplier, who cannot refuse the audits).
- Situation 6 was also easy to identify when a representative of a large company claimed in a public meeting that the SMEs do not have to discuss the content of the development programs, since the large companies know what the best is for them...
- Situation 1 of the customer has already been illustrated by one of the examples detailed in previous section: the customer depends on its supplier because of his technical skills and low prices, but knows that he is not reliable.
- The criteria of selection of the suppliers are also a good way to identify a situation. In most cases, large companies want to represent a significant ratio of their supplier's income (for having some influence on them) but not too much (for being able to decrease their orders if needed without setting into question the viability of the supplier). This denotes a clear strategy to privilege situations belonging to the middle column. Their final goal is to work with reliable partners (by promoting the use of methods and tools allowing their partners to better manage their production): at least Situation 5 is targeted (mutual dependency, indifference), even if Situation 7 is preferred (mutual dependency, the customer trusts the supplier).
- During the interviews, the large companies gave us many examples of problems coming (according to them) from the low skills of small companies on production management, leading to a global distrust on this aspect (middle line of the table). This is consistent with (Lenny Koh, 2005) for instance, who points out the reluctance of small companies to invest on information technology, and more specifically on planning tools. At short term, this poor trust may be compensated by power in Situation 6. Nevertheless, even if the power of the supplier on his customer has only positive aspects for the supplier, the power of the customer on his supplier may create responsibility concerning the survival of the supplier. Therefore, Situation 3 (mutual dependency) is preferred to Situation 6 (the supplier depends on the customer).
- According to our experience, the links of large companies with SMEs seem to be often based on personal relationships, since the contact for the SME's is often the director, who is usually very stable (the company belongs to him in many cases). Therefore, a SME has a reputation for a customer (good or bad), which is known by all the employees of the customer. As a

consequence, large companies put a lot of emphasis on their trust on their small partners (mainly on the director) and less on the contracts. Such relationship is often unbalanced, the large companies being considered as unstable by the small ones, because of their turnover and perpetual restructuration. Indeed, trust is known as a condition for flexibility and adaptability (Andersen, 2006), which are properties looked for by large customers, but not by small suppliers, looking for stability, which can be brought by contracts.

4.4 Lessons learnt from the study

Even if limited, these first experiences have encouraged us on several points:

- Clearly, the two dimensions of our typologies are not completely decoupled: it is of course more difficult to trust somebody who has some power over you, since his capacity to be harmful is augmented by his power. Nevertheless, we have verified that in many situations, trust and power were not related (evidences of trust or distrust towards weak or powerful partners have been found).
- The interest of "mutual dependency" is underlined in the literature (Caniëls and Gederman, 2007), and the reality of unsymmetrical attitudes, which led us to define two separated matrices, was to be validated. According to our discussions with small and large companies unsymmetrical attitudes seem to be in fact quite usual: large companies can trust SMEs, often personalized by their director, while SMEs seem to be more reluctant to create a relationship based on trust with a large company, since their experience has often shown that the attitude of their large partners may vary according to the turnover of their managers.
- The previous point also allows to justify the interest of considering the level of "indifference" in the trust assessment. We have already seen that in SCM, trust is usually considered as a condition for a good performance, especially through exceptions acceptance leading to flexibility and reactivity (Möllering, 2003; Andersen and Kumar, 2006). On the opposite, indifference is implicitly associated with the "arm's length" relationship, often considered as belonging to the past (Möllering, 2003). Nevertheless, we have also seen that SMEs are more inclined towards trusting people than organizations, which is more difficult when the partner is a large company. This point encouraged us to consider that "indifference", denoting a relationship based on a precise contract and not on informal relationships conducted by

mutual trust, has a still great interest for describing nowadays situations of cooperation, especially when SMEs are concerned.

The use of these interviews for identifying situations of cooperation has nevertheless clear limits. Especially, symmetrical interviews have not been systematically conducted. Therefore, we have not been always able to formally link the situations of a customer and of his suppliers in the typology. Finally, the interviews were not specifically conducted for identifying the situations of cooperation. Therefore, their exploitation sometimes leads to some ambiguity (all the information is not always available to discriminate two close situations). Nevertheless, we tend to think that this experiment allows a first validation of the model.

Another issue is that the interviews have shown that "trust" between partners is perhaps not a monolithic aspect. Two issues should be further investigated:

- Even if we do think that a "global" trust between partners governs the relationship, we also think that at a more accurate level, the level of trust may be different depending on the activity/process considered. For instance, most of the customers trust their suppliers on the point of view of the quality of the parts, or on the price, since these issues are easy to check and are completely integrated in the criteria used to select a supplier. On the other hand, large customers often have a poor trust on the reliability of their suppliers considering the respect of the due dates (which is a reason why development programs are promoted). In order to take this point into account, it could be interesting to test a more complex typology, obtained by adding a third dimension linked to the life cycle of the product to the model of Figure 5. Trust and dependence could so be distinguished within the specification, design, test, manufacturing, maintenance and withdrawal phases.
- At another level, it could also be interesting to investigate the objects of trust of the partners. For instance, we interpret the fact that the large companies select their new suppliers on the base of criteria including the use of methods (MRP2) and tools (ERP), but also on the certifications they have, ISO or others, as the fact that the first level of trust between unknown partners is based on the use of recognized tools or standards. After a given period of positive relationship, the nature of trust should move to interpersonal or inter organizational trust based on shared beliefs (Kim, 2000; Laaksonen et al., 2008; Camarinha-Matos et al., 2010). This is consistent with (Laaksonen et al., 2008), who distinguishes between contractual trust, trust in competences and goodwill.

In next section, two other dimensions of the typologies are explored, again on the base of findings brought by the interviews. They concern on one hand the evolution of the situations, and on the other hand the way the processes described in section 4 should be adapted to the situations.

5. Practical use of the typology

5.1 Evolution of the situations: classical cases

The situations of cooperation are in perpetual evolution, which should be kept under control. A condition for controlling is to be able to measure an initial state, target a final state and control a trajectory. The suggested typology may provide some support in that purpose, as explained hereafter.

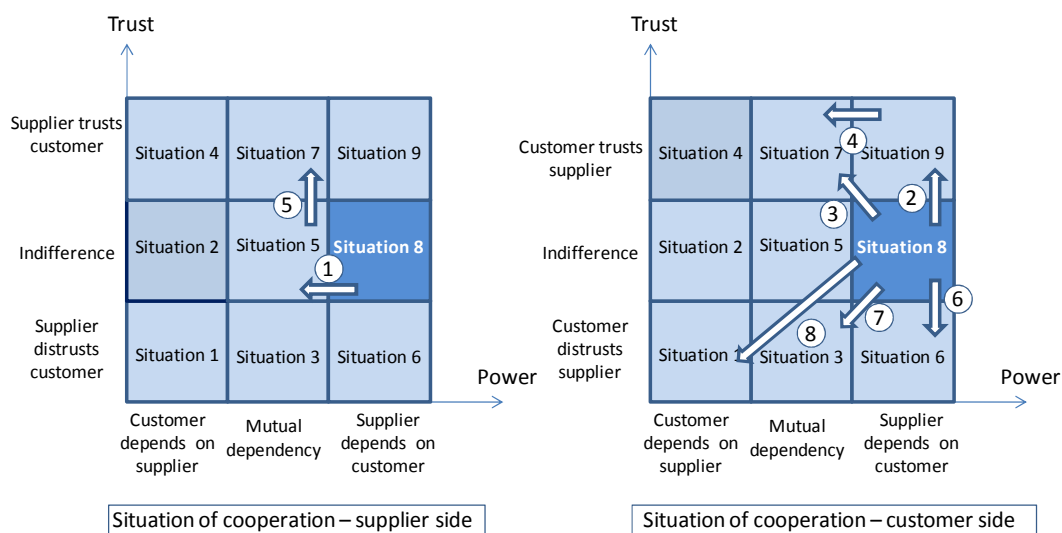


Figure 10. Classical evolutions of the situations of cooperation

Let us describe a typical evolution as an illustrative example (see Figure 10):

On the supplier side, a relationship typically begins in Situation 8 (or Situation 5 if the supplier has some scarce competence, or even Situation 2 if he has a critical one). In a more or less formalized way, the goal of the supplier will be to evolve from the right column to the central one, providing a better balance of power (arrow 1 in the supplier matrix). In that purpose, the supplier may rely on its technical skills (by becoming competent on processes which are important for its customer), or on other aspects of performance also discriminant for his customer (reliability or reactivity for instance).

Typically, the customer is in Situation 8 at the beginning of the relationship (he has preferably chosen a customer on which he has some power). In order to increase the reliability of his supplier, he will eventually suggest him a development program. If the supplier accepts and if the program is a success (i.e. the performance indicators of the supplier evolve positively), the situation may move from 8 to 9 (increase of trust). Nevertheless, if the supplier has succeeded in creating a privileged relationship, the arrival situation can be 7 (mutual dependency), either directly (arrow 3) or indirectly (arrows 2 and 4). If the development program is a success, and if the supplier gets rewards (new orders, etc.), it is probable that his trust towards the customer will increase in parallel (arrival in Situation 7 by arrow 5 on the supplier matrix).

As detailed in next section, the evolution of the situation may be less favorable. If the performance of the customer through time is poor, his customer will jump from Situation 8 to Situation 6 (arrow 6 - distrust), which is highly unstable (there is no interest to keep a distrusted partner if he is not critical). As seen in previous sections, in some unusual cases, the customer may also evolve to Situation 3 (arrow 7) or even 1 (arrow 8) (denoting that even if part of his performances is poor (on the reliability for instance), the supplier has gained some power on the customer, often through critical competences or low prices).

The previous evolution schemes are rather logical and predictable. Nevertheless, we have also identified more atypical evolutions, detailed in next section.

5.2 Inconsistencies in the evolution of the situations

Having two separated typologies of situations for the supplier and the customer also allows to model the situation of the partner as it is expected, then as it is in reality. For instance, we have seen in several interviews that a company may think that his partner trusts him, whereas it is not the case. Indeed, assessing trust is a matter of interpreting signs, which may lead to ambiguity. We shall illustrate this on the case of supplier development.

We have suggested in (Ming et al., 2009) to describe the dynamics of supplier development using four main concepts:

- *Trust*, interpreted as the degree of partners' confidence in each other for accomplishing behaviors and achieving benefits as the agreements.
- *Common Understanding/shared beliefs*, which is a kind of agreed interpretation between customers and sub-contractors, required in several issues in which misunderstanding often

occur, like in problems linked to uncertainty of forecasts, urgency, standards of quality and etc.

- *Willing to Cooperate*, understood as the motivation for improving the cooperation, including the satisfaction of the partner.
- *Balance of Power*.

In Figure 11 is summarized the reasoning of the large companies when promoting Supplier development programs, using the formalism of qualitative reasoning: ellipses denote here characteristics of the situation of cooperation, while the rectangles stand for actions influencing these characteristics. Influences are denoted by arrows, with "+" for a positive influence and "-" for a negative one.

A key point is that the customers have a very positive view on all their incentives towards their suppliers: for them, audits, certification, and competition with other suppliers are good means for increasing the motivation of the partner, and so his performance. Similarly, having shared beliefs with the suppliers comes from common standards and methods (MRP2, Lean) brought by training and controlled by audits. Balance of power is only of interest for allowing risk sharing, which is one of the ultimate goals of large companies within supply chains.

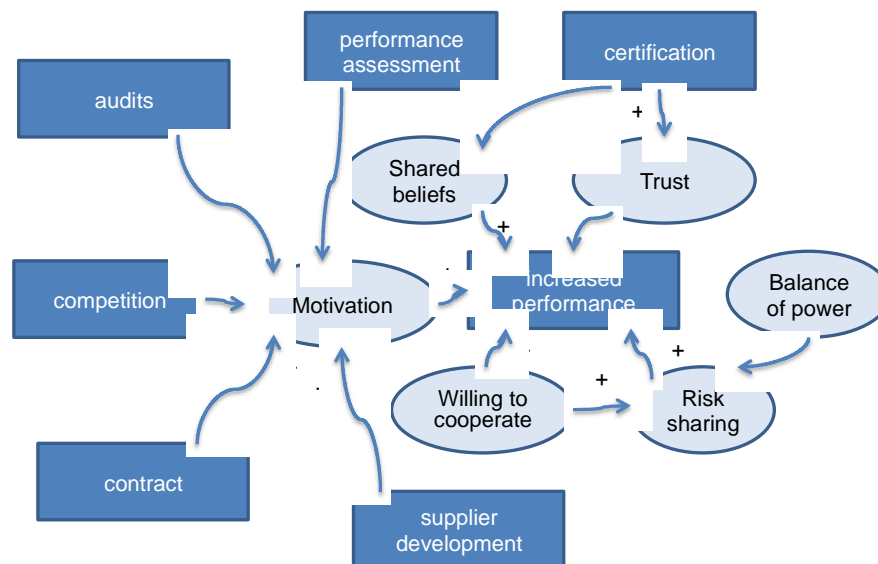


Figure 11. Relationships between concepts – the customer's side

On the opposite, the same concepts are positioned in Figure 12 according to the point of view of many suppliers, as they were expressed during the interviews. Most of the initiatives of the

customers aiming at improving their maturity and motivation are considered as a proof of distrust, and have a negative influence on their willing to cooperate. The idea of mutual respect is here of prime importance, since the small companies want to be recognized as competent partners. This need for mutual respect is set into question by the attempts of the customers to change them (according to their point of view, “increase their maturity”), especially when the methods promoted are considered by the SMEs as poorly adapted to their situation. The origin of most of these misunderstandings is certainly a lack of dialogue: in the customer’s mind, standardization of the relationship (through the use of common tools, common processes, etc.) leads to performance. For the SMEs, dialogue and actions are more important than standards (Grabot and Mayère, 2009). Balance of power is mainly expected to have an influence on the contracts, which is clearly not the idea of the large companies. As an ultimate consequence, supplier development projects may result in a decrease of the trust level, and of the willing to cooperate.

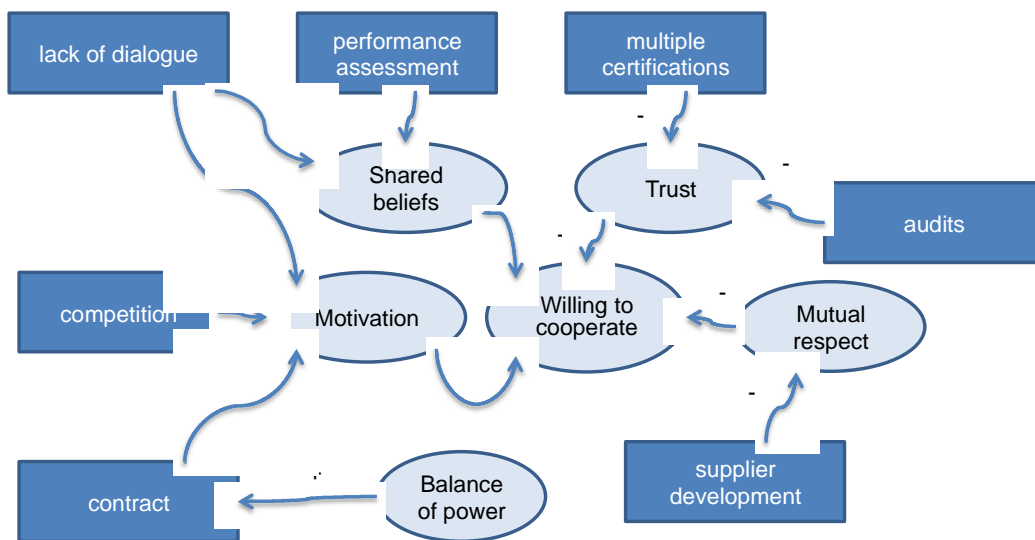


Figure 12. Relationships between concepts – the sub-contractor’s side

If we interpret this according to our typologies, we would say that sometimes, the efforts conducted by the large companies for developing their suppliers bring them from Situation 8 to Situation 6 (decrease of trust), whereas the customer thinks that his support is appreciated, and has conducted the supplier to Situation 9.

5.3 Influence of the situation of cooperation on information processing

We have seen in section 2 that the exchanges of information between partners are mainly based on the MRP technique: lead times are negotiated when the contract is established, then forecasts are sent and the orders are fulfilled at the short term level. We have also seen during the interviews that many practices are added to these basic principles, in an open way when they come from the customers, but in a more hidden manner when they come from the suppliers. Indeed, the suppliers often think that these practices would not be accepted by their customers, since they are not fully consistent with the theoretical processes described in Figure 1 and in section 4.

On the customer's side, these practices are for instance:

- The use of the firm and flexible periods of the forecasts for protecting, or on the contrary, for putting some pressure on the suppliers. Accepting to send a firm period longer than the one received means to protect the suppliers, while transmitting the same firm period means to transmit the pressure on the suppliers. Sending a firm period longer than the one received would mean to try to gain some security by urging the suppliers more than needed. The percentage of accepted variation in the quantities requested in the flexible period can be used in a very similar way.
- The communication to the supplier of elements of information allowing him to assess the priority of the orders, in addition to the due dates (e.g. his inventory level was communicated by the customer in the interview, but other types of information could be considered).

On the supplier's side, we have for instance seen:

- The grouping of some orders, in order to decrease the set-up times (i.e. increase of the lot-sizes).
- The use of an internal priority when all the orders cannot be fulfilled in time.
- The pre-order of some raw materials if the firm period of the forecasts is insufficient.
- The anticipation of the release of some orders, for smoothing the load.
- The possibility to link price and lead-time, in order to avoid losing money while processing urgent orders.

As seen in the previous section, the "informal" use of these degrees of freedom (sometimes non-declared, especially by the suppliers) may lead to problems, and the customers usually struggle against it. In our opinion, these practices are the operational translation of constraints of the

suppliers, understood or not by the customers (the above listed practices of some customers show that these constraints may be understood in some cases). In practice, instead of coping with hidden (but mandatory) practices which may set into question the performance of the relationship because they are not based on adequate information sharing, it may be better to discuss these constraints, then to negotiate an acceptable compromise. This is what is done empirically by the large company cited in 4.2 when negotiating the lot sizes with its suppliers.

The official acceptance of these practices should in our opinion lead to decrease the problems caused by their hidden use, but is linked to two known issues: information sharing and power.

The literature clearly shows the interest of information sharing for increasing the performance of the supply chain (Möllering, 2003; Johnston et al., 2004). Nevertheless, information sharing which would allow a better use of the above listed practices increases the risk that the partner may have an opportunistic behavior, which is a known drawback of information sharing (Liu et al., 2010). Trust is so a pre-requisite for information sharing.

On the other hand, accepting to take into account new constraints, mainly coming from the supplier, is uneasy for the large companies. Instead of considering that these behaviors are prohibited, it is important to help the companies understanding that mutual dependency creates the obligation to care about the partner on which one depends. Therefore, we argue on the interest to formalize the fact that a partner who has some power over you (balanced or not) should have the opportunity to express its constraints so that they can be negotiated.

Since the suggested typology is based both on trust and dependence, and also allows to materialize some misunderstandings between partners, we do think that a clear positioning of the situation of cooperation in the typology could help to accept negotiation around the issue of information sharing, leading to a better global performance of the Supply Chain.

6. Conclusion

Large companies have set a huge effort on promoting processes suggesting "best practices" for managing the relationship between customer and supplier in nowadays Supply Chains. Nevertheless, the recent literature on Collaborative Networks and Supply Chain Management shows that the performance of the relationship in a Supply Chain context is not only a technical problem, which would be solved by blindly adopt "best practices": trust, power, commitment, dependence are some

of the non-technical concepts that may help to understand a situation of cooperation, and its underlying problems.

On the base of an analysis of previous typologies of situations of cooperation, we have suggested a new typology, which has some clear originality regarding the literature:

- We have selected trust and power/dependence as the two main relevant dimensions for distinguishing between the situations of cooperation,
- We have included a "distrust" level which may seem paradoxical in the context of a partnership, but helps to explain many situations,
- We have distinguished the situation of the customer from the one of the supplier, allowing to describe non-symmetrical situations, but also situations in which the expected and real situations are different.

In order to provide a first validation of the interest of the typology, we have used it to explain the situations as identified during interviews in both large and small companies. We have then shown how the typology may also be the support for explaining the actions performed by large companies in order to improve the quality of the relationship and their results, sometimes opposite to those expected.

Finally, we argue on the fact that a better understanding of the situation of cooperation based on trust and dependence should allow to improve information sharing in SCM, but also the way the constraints that undergo a local partner are taken into account at the relationship level.

In order to assess the interest to modify the classical MRP/point-to-point-based relationship which is the most common aeronautical supply chains, we have developed a simulator for comparing the performance of the supply chain with and without use of these constraints at an upper level. These tests should show that, instead of denying the existence of these constraints, processing them at an upper level provides better performance than their "clandestine" use at a local level.

References

Afsarmanesh H., Ermilova E., Msanjila S.S., Camarinha-Matos L.M., 2009. Modeling and Management of Information Supporting Functional Dimension of Collaborative Networks, A. Hameurlain et al. (Eds.): Trans. on Large-Scale Data- & Knowl.-Cent. Syst. I, LNCS 5740, 1–37.

- Andersen, P.H., Kumar, R., 2006. Emotions, trust and relationship development in business relationship: A conceptual model for buyer-seller dyads. *Industrial Marketing Management* 35, 522-535.
- Anderson, J.C., Håkansson, H., Johanson, J., 1994. Dyadic business relationships within a business context. *Journal of Marketing* 54(4), 42-58.
- Arabe K.C., 2003, Supply Chain Collaboration Unscrambled. http://news.thomasnet.com/IMT/archives/2003/03/supply_chain_co.html
- Arend, R.J., Wisner, J.D., 2005. Small business and supply chain management, is there a fit? *Journal of Business Venturing* 20(3), 403-436.
- Arkan, A., Hejazi S.R., 2012, Coordinating orders in a two echelon supply chain with controllable lead time and ordering cost using the credit period, *Computers & Industrial Engineering*, 62, 56-69.
- Arshinder, A. Kanda, A., Desmukh, S.G., 2008. Supply chain coordination: empirical studies and research directions, *International Journal of Production Economics* 115, 316-355.
- Benton, W.C., Maloni, M., 2005. The influence of power driven buyer/seller relationship on supply chain satisfaction. *Journal of Operations Management* 23, 1-22.
- Boer, H., Gertsen, B. F., Kaltoft, R., Steendahl N. J., 2005. Factors affecting the development of collaborative improvement with strategic suppliers, *Production Planning & Control*, 16(4), 356-367.
- Brown, J.R., Lusch, R.F., Nicholson, C.Y., 1995. Power and relationship commitment: their impact on marketing channel member performance. *Journal of Retailing* 71 (4), 363-392.
- Cai, S., M. Goh, R. De Souza, Li, G., 2013. Knowledge Sharing in Collaborative Supply Chains: Twin Effects of Trust and Power. *International Journal of Production Research* 51 (7), pp. 2060–2076.
- Camarinha-Matos, L.M., Afsarmanesh, H., 2005. Collaborative networks: A new scientific discipline. *Journal of Intelligent Manufacturing*, 16(4-5), 439–452.
- Camarinha-Matos, L.M., Macedo, P., 2010. A conceptual model of value systems in collaborative networks, *Journal of Intelligent Manufacturing*, 21, 287-299.
- Caniëls, M.C.J., Gederman, C.J., 2007. Power and interdependence in buyer supplier relationships: a purchasing portfolio approach, *Industrial Marketing Management* 36, 219-229.
- Carter, C.R., Jennings, M.M., 2002. Social responsibility and supply chain relationships. *Transportation Research Part E* 28, 37-52.
- Caskey, K. R., Hunt, I., Browne, J., 2001. Enabling SMEs to take full advantage of e-business, *Production Planning & Control* 12(5), 548-557.

- Cheng, J.H., 2010. Inter-organizational relationships and information sharing in supply chains, *International Journal of Information Management*, doi:10.1016/j.ijinfomgt.2010.09.004.
- Choudhary, A.K., Harding, J. , Camarinha-Matos, L.M., Lenny Koh S.C., Tiwari, M.K., 2013. Knowledge management and supporting tools for collaborative networks, *International Journal of Production Research*, 51(7), 1953-1957.
- CPFR, 2004. Collaborative Planning, Forecasting and Replenishment: an overview. Available online <http://www.vics.org>.
- Dangayach, G.S., Desmukh, S.G., 2001. Manufacturing strategy literature review and some issues. *International Journal of Operations and Production Management* 21(7), 884-932.
- Ding, H., Guo, B., Liu, Z., 2010. Information sharing and profit allotment based on supply chain cooperation, *International Journal of Production Economics*, doi:10.1016/j.ijpe.2010.06.015
- Essig, M., Amann, M., 2009. Supplier satisfaction: Conceptual basics and explorative findings. *Journal of purchasing and supply management* 15, 103-113.
- Flynn, B.B., Zhao, X.D., Huo, B.F., Yeung, J.H.Y., 2008. We've got the power! How customer power affects supply chain relationships. *Business Horizons* 51, 169-174.
- Forker, L., Stannack, P., 2000. Cooperation versus competition: do buyers and suppliers really see eye-to-eye?. *European journal of purchasing and supply management* 6, 31-40.
- Frazier, G.L., Summers, J.D., 1986. Perceptions of Interfirm Power and Its Use Within a Franchised Channel of Distribution. *Journal of Marketing Research*, 23, 169-176.
- Fynes, B., Voss, C., Búrca, S.de, 2005. The impact of supply chain relationship quality on quality performance. *International Journal of Production Economics* 96 (3), 339-354.
- Geyskens, I., Steenkamp, J.E.M., Scheer, L.K., Kumar, N., 1996. The effects of trust and interdependence on relationship commitment: A trans-Atlantic study. *International Journal of Research in Marketing* 13, 303-317.
- Ghijzen, P.W.Th., Semeijn, J., Ernstson, S., 2010. Supplier satisfaction and commitment: The role of influence strategies and supplier development. *Journal of Purchasing and Supply Management* 16(1), 17-26.
- Grabot, B., Mayère, A., 2009. SME and Planning in Supply Chains: a Socio-technical View. IESM'09, May 13-15, Montréal, Canada.
- Hallén, L., Sandström, M., 1991. Relationship atmosphere in international business. In S.J. Paliwoda (Ed.). *New perspectives on international marketing*, London.

- Hallikas, J., Puumalainen, K., Vesterinen, T., Virolainen, V-M, 2005. Risk-based classification of supplier relationship. *Journal of Purchasing and Management* 11, 72-82.
- Harland, C.M., Caldwell, N.D., Powell, P., Zheng, J., 2007. Barriers to supply chain information integration: SMEs adrift of elands. *Journal of Operations Management*, 25, 1234-1254.
- Hausman, A., Johnston, W.J., 2010. The impact of coercive and non-coercive forms of influence on trust, commitment, and compliance in supply chains. *Industrial Marketing Management* 39(3), 519-526.
- Hémont, F., Grabot, B., Mayère, A., 2010. Cooperation in Supply Chains: from practical problems to conceptual models, APMS'2010, Como, Italy, 11-13 October.
- Hvolby, H.-H., Trienekens, J., Steger-Jensen, K., 2007. Buyer–supplier relationships and planning solutions, *Production Planning & Control* 18(6), 487-496.
- Ireland, R.D., Webb, J.W., 2007. A multi-theoretic perspective on trust and power in strategic supply chains. *Journal of Operations management* 25, 482-497.
- Jagdev, H.S., Thoben, K.-D., 2001. Anatomy of enterprise collaborations, *Production Planning & Control* 12(5), 437-451.
- Jensen, S.H., Jensen, K.H., 2007. Implementing lean manufacturing in SME companies. *International Conference on Economic Engineering and Manufacturing Systems*, Brasov, October 25-26.
- Johnson, J.L., Sakano, T., Onzo, N., 1990. Behavioral relations in across-culture distribution systems: influence, control and conflicts in US-Japanese marketing channels. *International Journal of Business Studies* 21(4), 639-655.
- Johnston, D.A., McCutcheon, D.M., Stuart, F.I., Kerwood, H., 2004. Effects of supplier trust on performance of cooperative supplier relationship. *Journal of Operations Management* 22, 23-38.
- Kim, K., 2000. On interfirm power, channel climate, and solidarity in industrial distributor–supplier dyads. *Journal of the Academy of Marketing Science* 28 (3), 388-405.
- Krause, D.R., Hanfield, R.B., Tyler, B.B., 2007. The relationship between supplier development, commitment, social capital accumulation and performance improvement. *Journal of Operations Management*, 25, 528-545.
- Laaksonen, T., Pajunen, K., Kulmala, H.I., 2008. Co-evolution of trust and dependence in customer–supplier relationships. *Industrial Marketing Management* 37, 910-930.
- Lambert, D.M., 2008. *Supply Chain Management: Processes, Partnerships, Performance*, 3Ed. Supply Chain Management Institute.

- Lauras, M., Lamothe, J., Pingaud, H., 2003. Cooperation model for the management of an international Supply Chain in a growth phase. INFORMS'03, Atlanta, October 19-22.
- Lee, B.C., Kim, P.S., Hong, K.S., Lee, I., 2010. Evaluating antecedents and consequences of supply chain activities: an integrative perspective. *International Journal of Production Research* 48 (3), 657-682.
- Leenders, M.R., 1966. Supplier development. *Journal of Purchasing* 24, 47-62.
- Lenny, Koh, S.C., Simpson, M., 2005. Change and uncertainty in SME manufacturing environments using ERP. *Journal of Manufacturing Technology Management*, 16(6), 629-653.
- Liu, Y., Li, Y., Zhang, L.N., 2010. Control mechanisms across a buyer-supplier relationship quality matrix. *Journal of Business Research* 63, 3-12.
- Malone, T. W., 1987. Modelling coordination in organizations and markets. *Management Science* 33 (10), 1317-1332.
- Maloni, M., Benton, W.C., 2000. Power influences in the supply chain. *Journal of Business Logistics* 21 (1), 49-73.
- Marcotte, F., Grabot, B., Affonso, R., 2009. Cooperation models for supply chain management. *International Journal of Logistics Systems and Management* 5 (1/2), 123-153.
- Meng, X.H., 2010. Assessment framework for construction supply chain relationships: Development and evaluation. *International Journal of Project Management* 8(7), 893-707.
- Mentzer, J.T., DeWitt, W., Keebler, J.S., Min, S., Nix, N.W., Smith, C.D., Zacharia, Z.G., 2001. Defining supply chain management. *Journal of Business Logistics* 22 (2), 1-24.
- Min, H., Zhou, G.H., 2002. Supply Chain Modeling: past, present and future. *Computers & Industrial Engineering* 43, 231-249.
- Ming, Y., Houé, R., Grabot, B., 2009. Coordination in Supply Chains: from case studies to reference models. APMS'09 (IFIP), September 19-23, Bordeaux, France.
- Möllering, G., 2003. A typology of supplier relations: from determinism to pluralism in inter-firm empirical research. *Journal of Purchasing & Supply Management* 9, 31-41.
- Msanjila, S.S., Afsarmanesh, H., 2010. FETR: a framework to establish trust relationships among organizations in VBEs, *Journal of Intelligent Manufacturing*, 21, 251-265.
- Narasimhan, R., Nair, A., Griffith, D.A., Arlbjørn, J.S., Bendoly, E., 2009. Lock-in situations in supply chain: A social exchange theoretic study of sourcing arrangements in buyer-supplier relationships. *Journal of Operations Management* 27, 374-389.

- Nyaga, G.N., Whipple, J.M., Lynch, D.F., 2010. Examining supply chain relationship: Do buyer and supplier perspectives on collaborative relationships differ. *Journal of Operations Management* 28, 101-114.
- O'Leary, D, Selfridge, P., 1998. Knowledge Management for best practices. *Intelligence*, Winter, 13-24.
- Orlicky, J., Plossl, G.W., 1994. *Orlicky's Material Requirements Planning*, McGraw-Hill Professional.
- Ounnar, F., Pujo, P., Mekaouche, L., Giambiasi, N., 2007. Customer-supplier relationship management in an intelligent supply chain network, *Production Planning & Control* 18(5), 377-387.
- Quayle, M., 2003. A study of supply chain management practice in UK industrial SMEs. *Supply Chain Management: An International Journal* 8(1), 79-86.
- Ren, S.J.F., Ngai, E.W.T., Cho, V., 2010. Examining the determinants of outsourcing partnership quality in Chinese small- and medium-sized enterprise. *International Journal of Production Research* 48 (2), 453-475.
- Rodriguez Monroy, C., Vilana Arto, J.R., 2010. Analysis of global manufacturing virtual networks in the aeronautical industry, *International Journal of Production Economics*, 126, 314-323.
- SCOR, 2008. *Supply Chain Operations Reference Model: version 9.0*. Supply Chain Council Inc. Available online <http://www.supply-chain.org>.
- Seifert, D., 2003. *Collaborative planning, forecasting, and replenishment-How to create a supply chain advantage*. American Management Association, New York.
- Sepulveda Rojas, J.P., Frein, Y., 2008. Coordination and demand uncertainty in supply chains, *Production Planning & Control* 19(7), 712-721.
- Skinner, S.J., Gassenheimer, J.B., Kelley, S.W. 1992. Cooperation in Supplier-dealer relations, *Journal of Retailing* 68(2), 119-134.
- Stadtler, H., Kilger, C., (Eds.), 2000. *Supply Chain Management and Advanced Planning*, Springer.
- Su, Q., Song, Y.T., Li, Z., Dang, J.X., 2008. The impact of supply chain relationship quality on cooperative strategy. *Journal of Purchasing & Supply Management* 14, 263-272.
- Thakkar, J., Kanda, A., Deshmukh, S.G., 2008. Supply Chain Management in SMEs: development of constructs and propositions. *Asia Pacific Journal of Marketing and Logistics* 20(1), 97-131.
- Vaaland, T.I., Heide, M., 2007. Can the SME survive the supply chain challenges?. *Supply Chain Management: An International Journal*, 12(1), 20-31.
- von Axelson, J., 2009. Developing lean production implementation methodology for SME learning networks. 16th International Annual EurOMA Conference, June 14-17, Göteborg, Sweden.

Zhao, X.D., Huo, B.F., Flynn, B.B., Yeung, J.H.Y., 2008. The impact of power and relationship commitment on the integration between manufacturers and customers in a supply chain. *Journal of Operations Management* 26, 368-388.