



Designing CPFR collaborations: insights from seven case studies

Designing CPFR
collaborations

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Abstract

Purpose – To comprehend the rationale behind managerial choices that lead companies to implement different types of collaborative planning, forecasting and replenishment (CPFR) collaborations.

Design/methodology/approach – Seven case studies of supply networks whose central firms operate in different sectors have been analysed.

Findings – Identifies six types of CPFR collaborations, the choice of which can be explained by considering some important contingent factors, such as the CPFR goals, characteristics of the products and markets in which they are sold, supply network's physical and relational structure, and CPFR development stage.

Research limitations/implications – Further research developed in other contexts is necessary to refine the domain of applicability of the research findings. The opportunity to use the relationships found in this research as a managerial tool calls for the testing of research findings within larger samples of firms, representative of a broader range of industries.

Practical implications – Suggests managers how to select the most appropriate action to be taken to implement CPFR, through the analysis of the context in which CPFR should be implemented.

Originality/value – This paper fulfils the need to clarify the reasons why companies decide to implement different types of CPFR collaborations. Moreover, it contributes to the definition of measures for the CPFR concept, and to the advance of substantive research on CPFR. In literature, few authors devote their attention to rigorously defining CPFR variables or proposing relationships among variables and measures.

Keywords Supply chain management, Forecasting, Contingency planning

Paper type Case study

Introduction

Collaborative planning, forecasting and replenishment (CPFR) programs concern:

... collaboration where two or more parties in the supply chain jointly plan a number of promotional activities and work out synchronised forecasts, on the basis of which the production and replenishment processes are determined (Larsen *et al.*, 2003, p. 532).

The term CPFR was first introduced in 1995 in connection with a pilot project between fWal-Mart, Warner-Lambert, Benchmarking partners, SAP and Manugistics (Cooke, 1998). A few years later, in 1998, the Voluntary Interindustry Commerce Standards (VICS) committee, a group dedicated to the adoption of bar-coding and EDI in department store/mass merchandise industries, developed a nine-step process model as a guideline for CPFR implementation (Figure 1) (VICS, 1998).

The CPFR process has three major sub-processes – namely planning, forecasting and replenishment – each of which is formed by a number of steps. The VICS Guide (1998) suggests that participating companies first formally commit to a program of



demand forecast collaboration – including an agreement on sponsors within each organisation and key metrics (step 1) – and develop a joint plan (step 2) that establishes item management profiles, such as order minimums and multiples, lead times, reorder frequency and promotions for those stock-keeping units (SKUs) upon which they will collaborate. On the basis of consumption data, participating companies create sales forecasts to support the joint business plan (step 3), and cooperate in identifying and resolving those exceptions/deviations (e.g. forecast inaccuracies, over/under stock situations, execution problems) that require the readjustment of the joint sales forecast (steps 4 and 5). Then, by combining the sales forecast, inventory strategies and other information it is possible to generate a specific order forecast that allows the seller to allocate production capacity against demand while minimising safety stock (step 6). Again in this case, the participating companies jointly set order forecast constraints and cooperate in identifying and resolving exceptions, thus creating new adjusted order forecasts (steps 7 and 8). The final step establishes the replenishment plan by transforming the order forecast into a committed order (step 9).

Much of the research on CPFR is based on the VICS process model (Barratt and Oliveira, 2001; Harrington, 2003; Seifert, 2003; Crum and Palmatier, 2004). However, despite the existence of such a detailed and comprehensive model, some authors (ECR Europe, 2001; Larsen *et al.*, 2003; Seifert, 2003) state that CPFR can take a number of different forms across supply networks. In a similar way to these studies, this paper considers different degrees of CPFR collaborations, rather than follows a slavish step-by-step model as suggested by VICS. In particular, this research aims to explain the rationale behind the managerial choices that lead companies to implement different types of CPFR collaborations.

The paper is organised as follows. Firstly, the existing literature on CPFR is analysed in order to highlight what researchers have found on the subject, what theories have been put forward, and what gaps exist in the relevant body of knowledge. A discussion on the research design follows. Then variables that differentiate CPFR collaborations are identified, and key propositions explaining the relationships between these variables and some contingent factors are extracted. Finally, the conclusions summarise the main theoretical and managerial contributions of the research and discuss generalisations.

Literature review

Several authors (Aichlmayr, 2000; Ireland and Bruce, 2000; Barratt and Oliveira, 2001; Seifert, 2003) maintain that at the heart of the CPFR process lies the aspiration to cover the gaps left by previous supply chain management (SCM) practices, such as vendor managed inventory (VMI) or continuous replenishment. Compared to these

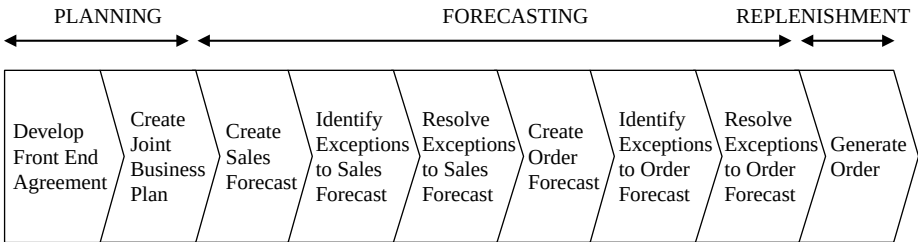


Figure 1.
Activities in the CPFR
process

collaborative-based practices, CPFR has a more comprehensive focus that includes planning, forecasting and replenishment processes, as pointed out in the CPFR VICS model (Figure 1).

Based on VICS' guidelines and definition of CPFR, a number of researchers and practitioners have studied the use and implementation of CPFR. For instance, the Efficient Consumer Response (ECR) Europe Executive Board initiated the European project on CPFR, whose first results were published in 2001 in a document entitled: "A Guide to CPFR Implementation". This document aims to highlight how to adjust the VICS model to adapt it to European market characteristics. Analysis of the original VICS model from a European point of view revealed that no major adjustments were necessary, although promotion planning was identified as a key process for European companies.

Similarly, Barratt and Oliveira (2001) analysed CPFR implementation, by using VICS model as their starting point. They revisited this model by adopting an IDEF0 process mapping tool. By utilising the reviewed version of the CPFR process, the authors then conducted a survey among the members of VICS' CPFR contact list to examine the CPFR implementation process.

Noekkentved (2000) argues that the VICS' guidelines explain how to manage processes from a SCM perspective. He also analyses where CPFR works best. Generally, it works best when the focus is on long-term relationships involving highly differentiated products with limited sources of supply.

Unlike these previous studies, Larsen *et al.* (2003) view CPFR as a general approach to coordination of processes between participants in a supply chain. They state that CPFR can be implemented in various ways, as it can be differentiated both in terms of scope of the collaboration – indicating the number of business processes involved – and depth of the collaboration – measuring the integration of business processes. In particular, the authors suggest that CPFR can be classified into three levels – basic, developed and advanced – depending on these two variables. Larsen *et al.* (2003) maintain that the basic CPFR is frequently the starting point for the other collaborative initiatives.

A similar concept also emerges from the ECR guide (2001) on CPFR. It suggests that the VICS model is indeed a "modular" model because in some circumstances it is not necessary to implement all nine steps of the model to gain advantages. A company, for example, may decide to collaborate only in managing order forecasts (steps 6-8 of the VICS model). In particular, CPFR implementation options should vary according to the CPFR development stages. The slogan is "think big, start small, and scale intelligently" (ECR Europe, 2001, p. 67). In implementing CPFR, a company should plan the implementation by considering the final objectives of the project. Nevertheless, it is necessary to "start small" focusing on only a few processes in the early stage of the project's development, and collaborating with a few preferred partners. The "scale intelligently" step relies on the lessons learned during the CPFR pilots. Companies need to evaluate their experiences in order to develop their individual plan towards roll-out. They may, for instance, decide to involve more actors or processes in the collaboration.

Again, Seifert (2003) recognizes that different forms of CPFR collaboration can exist among customers and suppliers. He believes it is due to the fact that CPFR is implemented by means of a phased approach. For example, several companies are reevaluating programs such as the VMI and modernising them by adding collaborative

technologies to facilitate greater communication and improve the results. As trust builds and technology infrastructure is acquired, the collaborative process can then be extended to take on additional aspects of the CPFR standards and achieve greater benefits.

CPFR implementation cases described in the literature seem to confirm that CPFR can take a number of different forms across supply networks. Various types of CPFR partnerships are being tried. Wal-Mart and Warner-Lambert embarked on the first CPFR pilot, involving Listerine products. In their pilot scheme, Wal-Mart and Warner-Lambert used special CPFR software to exchange forecasts. Supportive data, such as past sales trends, promotion plans and even the weather, were frequently transferred in an iterative fashion to allow them to converge on a single forecast should their original forecasts differ. The pilot scheme was very successful, resulting in an increase in Listerine sales and better fill rates, and in a reduction of inventory investment (Cooke, 1998; Hill, 1999). Other examples of CPFR pilots include Sara Lee's Hanes and Wal-Mart, involving 50 SKUs of underwear supplied to almost 2,500 Wal-Mart stores (Hill, 1999; Parks, 1999, 2001; Songini, 2001). In 1996, Heineken USA employed CPFR to cut its order-cycle time and is currently providing collaborative planning and replenishment software to its top 100 distributors (Aviv, 2001). Procter and Gamble has several active CPFR pilots underway (Schachtman, 2000). Levi Strauss & Co. incorporates certain aspects of the CPFR business process into its retail replenishment service (e.g. by creating joint business plans and identifying exceptions) (Aviv, 2001). Additionally, in the ECR report entitled "European CPFR Insights" several CPFR pilots are described including: Unilever-Sainsbury's-GNX, Condis-Henkel-Cartisa, Kraft-Sainsbury's-GNX, Carton-Scholler, Vandemoortele-Delhaize (ECR Europe, 2002).

By comparing the CPFR cases mentioned above, the existence of commonalities as well as significant differences in CPFR implementation emerge. In particular, one of the main differences concerns the collaboration approach – business processes included in the collaboration and the way of collaborating (e.g. degree of discussion, communication/synchronisation, etc.) may differ. Moreover, although several CPFR cases involve manufacturer-retailer dyads, it is worth noting that in some cases a company can collaborate with numerous other supply network members both upstream and downstream in the supply network (ECR Europe, 2001, 2002). As a result, the types of technologies and tools used for supporting CPFR can vary across implementation cases. Technology adoption ranges from the use of simple tools, such as a fax, to more advanced Internet-based CPFR solutions (Attaran and Attaran, 2002a, b; Sparks and Wagner, 2003).

Research aim

From the selected and analysed body of literature on CPFR, two primary key issues emerged that determined the research objectives:

- (1) Despite the existence of a detailed and comprehensive process model (VICS, 1998), some authors (Larsen *et al.*, 2003; Seifert, 2003) state that CPFR can take a number of different forms across supply networks. Nevertheless, research is still at an early stage of investigating the problem. In fact, most of the studies on CPFR focus on identifying the advantages and future developments of CPFR, or describe cases of CPFR implementation (see previous section).

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- (2) The dominant theory explaining differences in CPFR implementation states that CPFR forms vary according to the development stages of the implementation process (ECR Europe, 2001, 2002; Larsen *et al.*, 2003; Seifert, 2003). However, this theory does not always seem to be enough to explain CPFR differences. In some cases, for instance, a company might decide to limit CPFR collaboration to only a few processes and collaborate with a small number of partners, even if it has reached an advanced stage of CPFR development. Thus, the question as to why CPFR implementation varies across supply networks is still open.

As a result, this research aims to comprehend the rationale behind the managerial choices that lead companies to implement different types of CPFR collaborations. In particular, the aim is to analyse the relationships between:

- the dimensions explaining the variety of CPFR collaborations; and
- the contingent factors influencing these dimensions.

With regard to the dimensions explaining the variety of CPFR collaborations, the critical review of the literature and investigated cases suggests consideration of the following factors:

- the number and type of business processes involved in the collaboration;
- the level of integration (e.g. degree of discussion, co-ordination/synchronisation, etc.); and
- the number of units with which a company collaborates.

In addition, among the contingent factors that might influence CPFR collaborations, this research considers the following:

- (1) *CPFR goals*. That is, the reasons driving companies towards CPFR implementation (e.g. cost reductions, increased service levels, etc.).
- (2) *Product/market characteristics*. Including the characteristics of the products managed through CPFR and the markets in which they are sold (e.g. product types, characteristics of demand, effect of promotions, etc.).
- (3) *Supply network structure*. Encompassing issues relating to:
 - the supply network's physical structure (e.g. sourcing policies, location, size, number, degree of specialisation of facilities, etc.); and
 - the supply network's relational structure (e.g. nature of customer-supplier relationships, SCM initiatives, vertical integration, etc.).
- (4) *CPFR development stage*. Stage of development of the CPFR project.

The analysed contingent factors were limited to these variables because it was felt that they are most directly linked to CPFR implementation, as suggested by the literature and as emerged from the investigated cases.

The investigation of the reasons why companies implement different types of CPFR collaborations is valuable from both a managerial and theoretical perspective. From a practical point of view, the understanding of the contingent factors influencing CPFR implementation decisions could support managers in selecting the most appropriate

action to be taken to implement CPFR, through the analysis of the context where CPFR should be implemented. Moreover, from a theoretical point of view, theory building on CPFR (i.e. definition of variables characterising CPFR collaborations and context, measures for these variables, and relationships) significantly contributes to advance CPFR theory, as most of literature on this theme is descriptive.

Research methodology

The multiple-case study method is adopted to investigate the research questions. Indeed, the research objectives demand a thorough analysis of different CPFR collaborations and of the contexts in which they are implemented. In particular, the implementation of CPFR in seven supply networks is examined.

Case selection

As usually occurs in case study research (Yin, 1984; Eisenhardt, 1989), the choice of research sample was not random (random or statistical sampling) but theoretical (theoretical sampling). The logic behind the sampling of the seven cases is now discussed. The selection process required two steps. Firstly, a list of companies was selected as possible central firms; secondly, data and information on each company were collected to decide on the cases. The initial selection of potential central companies led to choosing firms in different sectors that were implementing CPFR collaborations. These companies were mainly identified by looking at:

- companies collaborating in master courses on SCM by presenting and discussing their experience on CPFR; and
- the CPFR cases described in the literature.

The literal and theoretical replication issues guided the selection of the cases from the identified list of potential companies. In particular, literal/theoretical replication in case selection was assessed by ascertaining that similarities as well as differences, regarding the CPFR collaborations, existed among the cases.

This case selection process resulted in the identification of seven companies (Table I).

Data collection

All data was gathered through company visits made from 2001 to 2004. Triangulation was used to ensure research reliability obtaining the same piece of information from different sources: semi-structured interviews, documentation, archival records and direct observations (McCutcheon and Meredith, 1993).

The semi-structured interviews allowed the researcher to collect information on products/markets, manufacturing processes, the central company's organisational structure, characteristics of the industry, the central company's strategies, the supply network structure, the CPFR process (e.g. CPFR phases, reasons leading to CPFR implementation, advantages gained, adopted information and communication technologies, etc.). During the interviews a data collection protocol based on a common scheme was used for each case. No fixed words were used to ask questions, ensuring that the conversation developed at its own pace (Sutton and Callahan, 1987). The same questions were asked to different interviewees from the same or different companies within the supply network. Between two and five people from each supply

Central company	Product managed through CPFR	Supply network members involved in the collaboration	Interviewees
A	Starter batteries	Company A: MU producing starter batteries 2 owned central DCs; several international DCs	Logistics operations manager and planners (forecasting, production and distribution of starter batteries); external consultant involved in CPFR implementation; area managers (selling and marketing products to DCs in well-defined geographical areas)
B	Injectable cephalosporins	Company B: MU producing injectable cephalosporins Owned DCs located worldwide and directly replenished by company B Owned and independent suppliers	Logistics director (production and distribution of injectable cephalosporins); production planners (evaluating DRP results); product managers (estimating sales forecasts of well-defined DCs); factory managers and planners (distribution of labels and bulk to company B)
C	Antibiotics and anaesthetics	Company C: MU producing an anaesthetic and responsible for the final packaging of an antibiotic Owned DCs located worldwide Production and packaging plants (owned and independent)	Logistics director (activities of production planning, control and distribution relative to the supply chains of antibiotic and anaesthetic); planners (evaluating DRP results); product team's members (estimating sales forecasts of well-defined DCs)
D	Industrial system components and air conditioners	Company D: MU producing and distributing components for industrial systems and air conditioners Some OEMs, distributors and contractors	Sales manager (selling company D products to OEMs, distributors and contractors); Comfort & Refrigeration and OEM Business Unit managers (driving and checking sales company activity); product manager (production and distribution of company D products); OEM factory managers and planners (long-term purchasing plans)

(continued)

Table I.
Overview of the cases

Table I.

Central company	Product managed through CPFR	Supply network members involved in the collaboration	Interviewees
E	Consumer and soft goods	Company E: sales company selling and marketing consumer and soft goods Large customers (retailers)	Customer supply chain manager (distribution of products to Western European customers); company E's sales manager (distribution of products to Belgian customers); external consultant involved in CPFR implementation
F	Fats and margarines, candy bars, toilet paper and feminine hygiene products	Company F: subsidiary of a food retailer located in Belgium, responsible for establishing promotional plans for the local supermarkets and for managing the replenishment of the Belgian DC Three suppliers producing fats and margarines; candy bars and feminine hygiene products Company G: MU producing corrugated cardboard Some customers (food producers)	Supply chain manager (distribution of products and promotions in the Belgian supermarkets); external consultant involved in CPFR implementation; factory manager and planners within supplier plant producing fats and margarines (forecasting, promotions, production and distribution)
G	Corrugated cardboard for product transport		Chief supply chain officer and planners (production and distribution of company G); factory manager and planners within a customer's plant (purchasing activities)

network member (e.g. manufacturing unit, customer or supplier) were interviewed. Each interview lasted on average two and a half hours. In the case of very long interviews with key informants, more than one visit was necessary to complete the data gathering. Details of the roles and responsibilities of interviewees are contained in Table I.

The documents collected concerned: publications on the case studies, descriptive documents on process and product structures, the company's organisational structure, the supply network configuration, internal documents on SCM program implementation and reports on performance measurement. In addition, documents on the CPFR implementation, such as software manuals, leaflets, procedures, front-end agreement reports and the minutes of the meetings were used. Analysis of these documents allowed the researcher to corroborate information collected from other sources: where data discrepancies were found, the aspects generating contradictions were thoroughly investigated.

The archival records made it possible to collect data on the supplier and customer portfolio. This information was central to mapping the supply network configuration and contacting certain supply network members. Other archival records concerned performance measures and data on product demand trends.

Finally, plant visits were conducted in person to collect further information and verify the correctness of the data/information gathered during the interviews and from documents.

Data analysis

Data analysis involves two steps:

- (1) within-case analysis; and
- (2) cross-case analysis.

Following the procedure recommended by Voss *et al.* (2002), case study data was broken down in the within-case analysis and grouped according to the macro-categories illustrated in Table II, concerning CPFR collaboration and contextual factors.

As suggested by Ellram (1996), data categorization encourages further analysis and allows researchers to identify additional questions related to the data. Moreover, the within-case analysis makes it possible to compare and contrast CPFR in the seven analysed networks. This step is necessary in order to discuss the cross-case issues where the foundation for the theoretical arguments derived from data interpretation is built.

Axial and selective coding techniques are used to group issues identified during within-case analysis, summarise them into themes, and make connections among categories to explain the phenomenon of interest.

Analysis and findings

CPFR collaborations

As a first step towards analysing the contingent factors influencing CPFR collaborations, the specific ways of implementing CPFR across the seven cases were pinpointed. In particular, differences in CPFR collaborations can be grasped by considering the following two variables:

Macro-category		Data to be included
Contingent factors	CPFR goals	Industry order-winner factors, competitors, most significant changes occurring in the sector in recent years; basic objectives that the supply network members involved in the collaboration seek to satisfy; supply network performances before CPFR implementation.
	Supply network's physical structure	Supply network characteristics (facility location, size, specialisation, number of facilities, material pattern flows); decisions for supplier selection (selection criteria, how many suppliers, single/multiple sourcing decisions, supplier location, local/international sourcing decisions).
	Supply network's relational structure	Characteristics of supply network member relationships (type of contracts, relational forms, degree of vertical integration); SCM integration initiatives: tools used for monitoring supplier performances; quality management activities requiring supplier/customer direct contribution; supplier/customer involvement in the product/process improvement; past projects to implement SCM initiatives to integrate plans, jointly manage inventory along the supply networks, enhance information exchanges.
	Product/market characteristics	Data concerning products upon which company collaborates (peculiarities of these products, markets, production processes, production strategies); component demand (trends, seasonality, cycle); effect of promotions on demand.
	CPFR development stage	Evolution in defining CPFR procedure with regard to the timing of the plans, frequency of the data exchange between supply network members, CPFR partner selection, etc.
	CPFR collaboration	CPFR phases; collaboration in defining promotional, sales and order forecast plans.
	Level of integration	Supply network member roles in conducting CPFR phases; how each phase is carried out (data to be exchanged, synchronisation of plans, meetings, identification of exceptions, etc.).
	Number of interacting members	Number of CPFR partners collaborating with the central company.

Table II.
Within-case analysis

- (1) the number of interacting units; and
- (2) the depth of the collaboration (Figure 2).

The “number of interacting units” variable indicates the number of supply network members with whom the central company collaborates in performing CPFR. The number of interacting units can be high or low. In fact, from the analysed cases, a clear distinction between a group of companies collaborating with only a few partners (less than 4) – assigned to the low-class – and a group of companies collaborating with several partners (more than 20) – assigned to the high-class – seems to emerge. For instance, central company G collaborates with four customers, while central company B collaborates with about 50 distribution centres (DCs) located worldwide.

As to the depth of the collaboration, three levels have been identified:

- (1) communication;
- (2) limited collaboration; and
- (3) full collaboration.

by comparing:

- the number of business processes involved in the collaboration; and
- the level of integration.

According to Barratt and Oliveira (2001), CPFR includes four major sub-processes:

- (1) issuing of the front-end agreement;
- (2) development of the joint business plan;
- (3) management of sales forecasts; and
- (4) management of order forecasts (Figure 1).

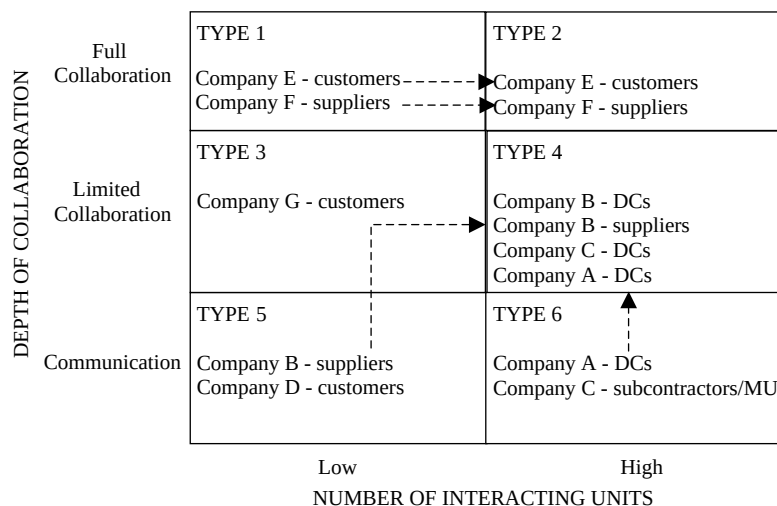


Figure 2.
Types of CPFR
collaborations

By analysing the cases, it can be seen that the CPFR is not always extended to all these sub-processes. Moreover, the level of integration among companies can be very different, confirming the literature. In some cases, for example, two or more companies exchange data/information alone without coordinating or synchronizing their plans. In other cases, companies collaborate to agree upon how they should coordinate their plans through joint decision-making or to jointly solve sales or order forecast “exceptions”.

On a communication level, companies often collaborate simply by exchanging data and information with trading partners. The types of data exchanged can differ. For example, central company D receives order forecast plans from its customers and then uses them to elaborate sales forecasts. Instead, central company A receives stock level and consumption data from the DCs. In both cases the collaboration is simply a sort of data communication. Indeed, parties neither coordinate nor synchronise business, sales or order forecast plans.

Limited collaboration differs from communication by taking the collaboration a little further than mere data exchange. Parties must also synchronise their plans and manage exceptions. Central company B, for example, receives data on stock levels and sales forecast plans from the DCs. On the basis of this data the central system proposes the replenishment plans, suggesting dates to the central company for the deliveries of final products to each distribution centre. The deliveries are decided in order for the stock level at the DCs’ facilities to fall within a jointly established range (called “VMI min-max” range). Replenishment plans have then to be confirmed by the planners within both the central company and the DCs. If a DC does not confirm the plans, new replenishment plans are proposed. Moreover, if a DC asks for additional orders that fall within the frozen planning horizon, the central company can propose – on the basis of a what-if analysis – alternative delivery plans by estimating the impact of any order time/volume change on the plans of the downstream supply network members.

Compared to limited CPFR collaboration, full CPFR collaboration is characterised by an increased number of areas in which companies collaborate. The collaboration includes the synchronisation and coordination of business, sales and order forecast plans, as suggested by VICS model (Figure 1). For example, central company F collaborates with its suppliers in defining, as well as order forecast plans, joint business and sales forecast plans, thanks to the exploitation of the technology offered by the WorldWide Retail Exchange – considered one of the most important internet-based business-to-business exchanges in the retail e-marketplace.

It is worth noting that in two cases – B and C – the central company collaborates differently in the upstream and downstream networks (Figure 2). For instance, central company C collaborates with the DCs on a limited collaboration level, while its collaboration with the other production/packaging plants currently consists in just the exchange of data/information on stock levels and available capacity (i.e. communication level).

Finally, the arrows in Figure 2 highlight that certain changes are taking place (or going to take place) in the way central firms are implementing (or going to implement) CPFR. Central companies E and F intend to extend collaboration to several customers and suppliers, respectively. Moreover, company A is planning to align and synchronise its replenishment plans with those of the DCs, through an approach that is able to make its supply chain more responsive. This explains the arrow shifting the CPFR collaboration between company A and its DCs from types 6 to 4. Finally, until only a

few years ago, central company B simply communicated its raw material order forecast plans to a few suppliers (i.e. communication level). Recently, it has begun to collaborate through a “VMI min-max approach” with its active agent supplier. In future years, company B intends to extend this type of collaboration to several other suppliers.

Contingent factors influencing the depth of the collaboration

By comparing the seven cases, it emerges that companies implement CPFR for two main reasons. In some cases central companies aim to reduce costs (e.g. investments in stocks) without penalising service levels (strategy of efficiency); in others the main purpose is to make the supply network more reactive to demand changes (strategy of responsiveness).

For instance, before implementing CPFR, central company A, that produces its products following a make-to-stock (MTS) approach, estimated the demand for starter batteries on the basis of past deliveries. Moreover, it did not know DC stock level data. Overall, supply network inventories were high, and huge investments in stocks were justified by the principle of “protection”, i.e. the desire to protect company A against downstream fluctuation in demand and DCs against stock-out risk (Christopher, 1992). The CPFR project, launched in 2000, contributed to reduce significantly inventory levels in the downstream network, whereas company A’s service level even improved (from 65 to 87 per cent). As for the future, company A intends to intensify the collaboration with DCs for making the supply network more reactive too, also satisfying unexpected demand fluctuations (see the arrow in Figure 3).

Also company D collaborates with its customers with the aim of reducing inventory costs, while simultaneously maintaining a high service level. Interestingly, products sold to OEMs are produced to order, as just raw materials/components are built before receiving customers’ orders. Thus, the aim of the collaboration with OEMs is to use customers’ data to accurately forecast future sales, thus minimising raw material/component stock levels. Company D demonstrates that even if a company produces following a make-to-order (MTO) approach, but purchases raw materials/components before receiving customers’ orders, CPFR can be a useful approach to improve performance.

	RESPONSIVENESS	EFFICIENCY
FULL COLLABORATION	Company E – customers Company F – suppliers	
LIMITED COLLABORATION	Company G – customers Company B – DCs Company B – suppliers ← Company C – DCs Company A – DCs	
COMMUNICATION		Company B – suppliers Company D – customers Company A – DCs Company C –subcontractors/MU

Figure 3.
Relationship between the
depth of the collaboration
and the CPFR goals

In other cases, the main objective of CPFR is to increase responsiveness to demand changes. For example, the scope of the collaboration between company B and its DCs is to contain investment in stocks, while simultaneously making the supply network more responsive. In the last decade, company B has decided to re-configure its supply network, with the aim of exploiting production scale economies. The supply network re-configuration led to the closing of several production plants and centralisation of injectable cephalosporin production in the Italian plant. This limited flexibility to switch the production of the drug from one plant to another in an emergency. To solve this problem, company B decided to manage DCs' deliveries following the "VMI min-max" approach, that allows company B to react in case of unexpected DCs' requests (cf. previous section).

By simultaneously considering the CPFR goals (i.e. responsiveness or efficiency strategy) and the depth of the collaboration, i.e. one of the variables determining the CPFR collaboration, an interesting relation seems to emerge (Figure 3).

In particular, the cross-case analysis suggests that when an efficiency strategy prevails, a collaboration based on the mere communication of data suffices to guarantee the achievement of the goals. In case D, for instance, the communication of customers' order forecast plans contributes to achieve an 18 per cent reduction in raw material/component stock investments. On the contrary, when a company decides to collaborate to make its supply network more responsive, a deeper collaboration is then necessary. In case B, for example, the adoption of the "VMI min-max" approach to solve "exceptions" (e.g. additional DCs' requests in the frozen period) makes the supply network more responsive to demand changes, thus leading to significant improvements in DCs' service level. To give an example, the service level of the Italian DC is currently about 96 per cent.

A rationale for the relation between CPFR goals and depth of the collaboration is found in the light of existing literature on CPFR. Indeed, research findings partially comply with the results of Larsen *et al.* (2003) stating that the collaboration goals lead to different types of CPFR, with distinctions made for the number of business processes involved (e.g. business plan, sales, order forecast definition) and the level of integration (e.g. shared information, degree of discussion, coordination/synchronisation, etc.). The cross-case analysis demonstrates that CPFR goals influence the depth of the collaboration and, in particular, the level of integration (i.e. if companies simply exchange information/data or also synchronise their plans and solve exceptions). Nevertheless, given the CPFR goals, it seems that other factors play a crucial role in choosing the business processes that are to be involved in the collaboration. Figure 3 does not in fact help to justify why some companies (E and F) choose to collaborate on a full rather than limited collaboration level.

As well as CPFR goals, differences in product/market characteristics and in the supply network's physical structure can help us better understand this (Figure 4).

The cross-case comparison shows that in both collaborations between company E and its customers and company F and its suppliers, the companies involved in the collaboration have in-depth knowledge of the final market, inasmuch as they sell and market the same products and operate in well-specified geographic areas. Central company E, located in Brussels, for instance, sells and markets consumer and soft goods to retailers located in Belgium who then distribute the products in the Belgian area. Thus, the spatial complexity – i.e. the geographic distances between companies

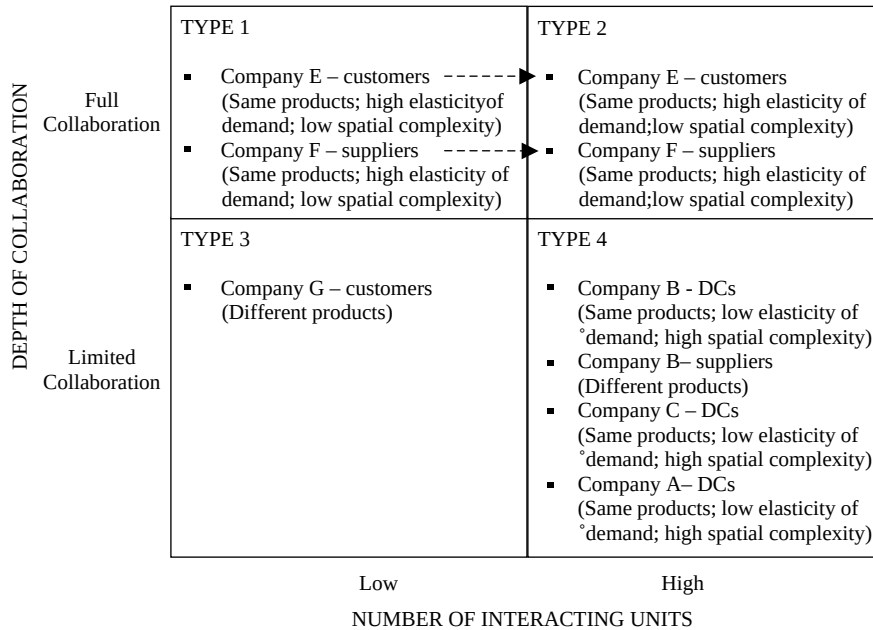


Figure 4.
Relationship between
product/market
characteristics, the supply
network's physical
structure and types of
CPFR collaboration

involved in CPFR collaboration – is indeed low. The same considerations can be drawn for the collaboration between company F and its suppliers. Managers within company F's DC – located in Belgium – collaborate with local suppliers to define promotions and the sales forecast plans of company F's supermarkets located in Belgium, on the basis of which order forecast plans are established.

From managers' interviews, it seems that the contribution of members positioned upstream in the network to defining promotional and sales forecast plans is significant only when they have a thorough knowledge of market dynamics, as in the cases discussed above. Conversely, central company B does not collaborate with its DCs in jointly defining promotional plans and sales forecasts. In fact, in the managers' opinion, this would not offer particular benefits. The DCs, located worldwide, do in fact have the possibility to collect information and data on the market they serve and to elaborate accurate sales forecasts without collaborating with the central company, located far from the DCs it replenishes.

Moreover, unlike cases E and F, it is worth noting that in two cases – i.e. in the collaborations between company G and its customers and company B and its suppliers – companies involved in the collaboration sell and market different products. This seems to limit the opportunity for joint promotional and sales forecast plans to be established. Central company G produces and sells corrugated cardboards while its customers produce and sell food; company B produces and sells medicines, its suppliers raw materials, such as the active agent and packaging materials. In such situations, it is unfeasible for members positioned upstream in the network to participate in the definition of the promotional and sales forecast plans of its customers.

A further distinguishing feature of the collaborations between company E and its customers and company F and its suppliers concerns the elasticity of final market demand in case of price variations. Product shelf prices can significantly influence customer behaviour hence demand elasticity is very high. In company F's stores, volumes can increase by up to 300 per cent during a promotion; in the stores of company E's customers it varies between 200 and 300 per cent. In these cases, therefore, the impact of promotional plans must be accurately estimated to ensure the manufacturer is able to satisfy the increased demand for a product. Lee (2002) states that demand uncertainty in the food industry is low. Nevertheless, as a result of events such as promotions, there is a high level of demand fluctuation and this can lead to significant waste and losses within the supply network. Through collaboration on sales and promotional plans, supply chain efficiency and responsiveness can significantly improve. In case F, for instance, the joint definition of promotional and sales forecast plans, and the cooperation in identifying and resolving exceptions contributed to improve forecast accuracy – and thus to reduce stock investments – and made possible a 25 per cent improvement in stores' service level during promotions.

In short, the following two propositions summarise the relationship between CPFR goals, product/market characteristics, the supply network's physical structure and the depth of the collaboration:

- P1. The depth of the collaboration depends on the CPFR goals. In particular:
 - P1a. When the CPFR collaboration's objective is efficiency, companies tend to limit the collaboration to data exchange (i.e. communication level).
 - P1b. When the CPFR collaboration's objective is responsiveness, companies tend to collaborate on a full or limited collaboration level.
- P2. The adoption of the limited or full collaboration level in performing CPFR depends on the product/market characteristics and the supply network's physical structure. In particular:
 - P2a. Companies tend to collaborate on a limited collaboration level when they market and sell different products or when demand elasticity in case of price variations is low or spatial complexity is high.
 - P2b. When companies market and sell the same product, demand elasticity in case of price variations is high and spatial complexity is low, they can collaborate on a full collaboration level.

Contingent factors influencing the number of interacting units

The comparison of the seven cases shows that the number of units with which the central company decides to collaborate is closely related to its supply network's relational structure. In fact, the cases demonstrate that central companies chose the partners to involve in the CPFR program depending on the nature of the relationship with customers and suppliers. Existing integration practices – such as the existence of collaborative/long-term buyer-supplier relationships, or SCM initiatives (e.g. adoption of systems to monitor supplier performances, involvement of suppliers/customers in process/product improvements or in quality management) – seem to have profoundly

influenced central company selection choices. In some cases, the partners selected for CPFR collaboration are even vertically integrated: central companies B and C, for instance, own the DCs they supply; central company A owns both the central DCs and some local ones.

This research finding complies with the results of several authors (Heide and John, 1990; Mohr and Spekman, 1994; Dyer, 1997) that good relationships increase continuity expectations, which in turn increase the level of cooperation (joint action, coordination, participation, joint problem solving, etc.). Furthermore, the research results are also consistent with literature on SCM in finding a relation between high levels of trust between partners and good relationships. Mohr and Spekman (1994), Dyer (1997) and Monczka *et al.* (1998) all found trust an important factor contributing to collaboration success. In the analysed cases, the trust between collaborating partners, developed thanks to existing integration practices, has largely facilitated the implementation of successful CPFR programs. The ECR Guide (2002, p. 42) reports:

[...] Since, a healthy relationship already existed between the pilot companies and the previous collaboration project, setting up the collaboration framework is a simple matter. Consensus was already reached between the trading partners as collaboration improves the business processes between the companies in terms of efficiency, accuracy and effectiveness.

The case Condis-Henkel-Packaging Supplier – described in the ECR Guide (2002) – confirms this statement. The implementation of the CPFR process between Henkel and Condis evolved from an existing collaboration. After the implementation of the distribution requirements planning (DRP) module from the Manugistics software, the project entered into a CPFR collaboration including sales/order forecast creation and promotional planning processes.

Thus, on the basis of the nature of relationships existing within the supply network, the central company identifies a certain number of potential partners to involve in the CPFR program. It might be expected that this drives the number of interacting units with whom the central company will collaborate. Figure 5 helps to clarify the relation between the number of interacting units in CPFR collaborations and the number of potential partners.

This table suggests that when the number of potential partners is low (i.e. less than 4), the number of interacting units is also low. In addition, it emerges that a high number of potential partners is a necessary, but insufficient, condition for collaboration with several units. Indeed, in two cases, i.e. the collaboration between company E and its customers, and between company F and its suppliers, despite the number of potential partners being high (i.e. more than 20), the number of interacting units is low. In fact, besides the number of potential partners, another variable can influence the number of interacting units: namely the CPFR development stage (Figure 5). According to the ECR Guides (2001, 2002) and the VICS Guide (1998), before full implementation of a CPFR collaboration form, a preliminary period, fundamental to “customising” the CPFR process on the basis of company requests, is usually necessary. During this initial stage of development, CPFR projects typically involve only a few members or a limited section of the supply network. Over this period, for instance, decisions have to be made as to the frequency of contact, format of the data to be exchanged, ways of collaborating, timing of plans, etc. In cases E and F the collaboration with customers and suppliers, based on a full CPFR collaboration level, is still in the testing phase (i.e. initial stage of development). Thus, central companies E and F have decided to limit

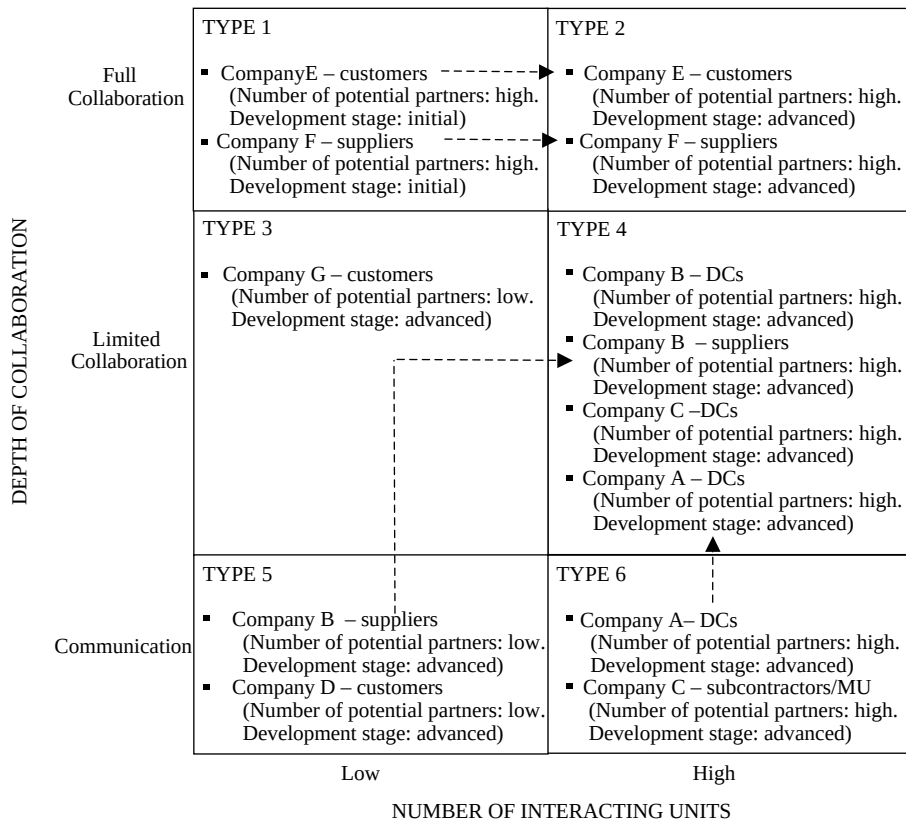


Figure 5.
Relationships between the number of interacting units, the number of potential partners and the CPFR development stage

their collaboration to only a few supply network members. In the future the collaboration will be extended to include several other partners within the supply network. Again, the collaboration between central company B and its suppliers, based on the limited collaboration level, is in the early stages of development. Thus, although the number of potential suppliers with whom central company B could have collaborated over recent years has significantly increased, the number of interacting units is currently low. In years to come, company B intends to collaborate with several other suppliers using the “VMI min-max” approach. A further example is provided by company A which is planning to enhance the collaboration with its DCs by synchronising replenishment plans and jointly managing order forecast exceptions. To begin with, this new project will include only a few DCs but as infrastructure and experience is acquired, it will be extended to several other DCs.

To sum up, the supply network’s relational structure influences the number of potential CPFR partners, and thus the number of interacting units. Moreover, the CPFR development stage (i.e. initial or advanced) can affect the number of interacting units. In particular, we have seen that when the number of potential partners is low, or CPFR is in its early stages of development, the number of interacting units is low. In other cases, it can be high:

- P3.* The number of potential CPFR partners depends on the supply network's relational structure because central companies choose the CPFR partners on the basis of the nature of the relationships with customers or suppliers (e.g. existence of collaborative/long-term buyer–supplier relationships, of SCM initiatives or vertical integration).
- P4.* The number of interacting units depends on the number of potential CPFR partners and on the CPFR development stage. In particular:
 - P4a.* A high number of potential CPFR partners and an advanced stage of CPFR development are essential conditions for collaboration with a high number of units.
 - P4b.* When the number of potential CPFR partners is low or the CPFR is in its early stages of development, the number of interacting units is low.

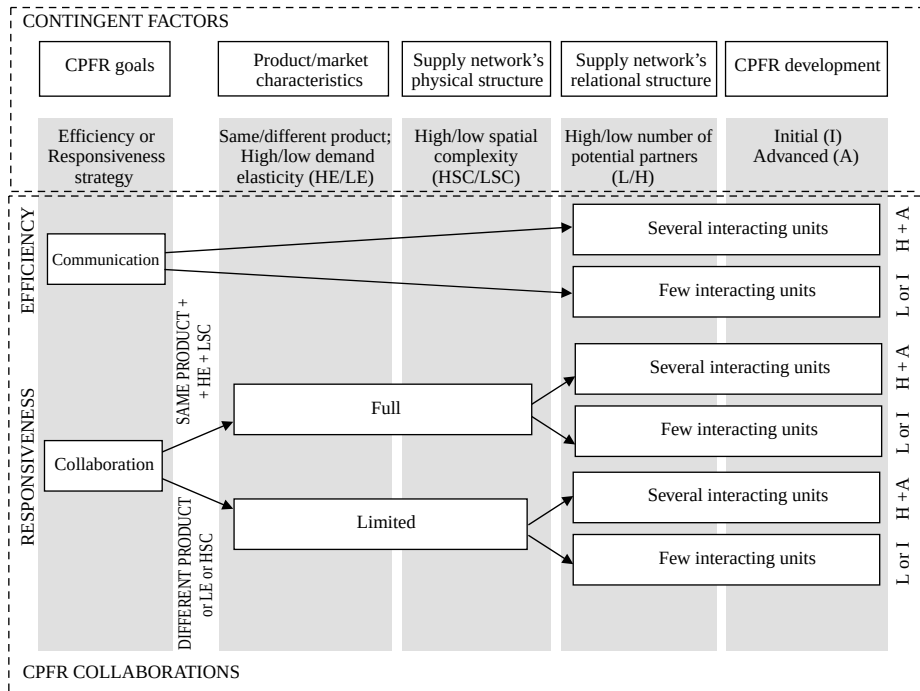
Conclusions

Using data from seven case studies of supply networks, this study proposes a contingency model designed to explain differences in CPFR collaborations across networks. CPFR collaborations, differentiated by depth of collaboration and number of interacting units, are related to some important contingency factors – i.e. CPFR goals, characteristics of products and markets in which they are sold, supply network's structure (physical and relational) and CPFR development stage. In particular, this research accounts for differences in depth of the collaboration by referring to the CPFR goals, the product/market characteristics and the peculiarities of the supply network's physical structure. Furthermore, it maintains that the number of companies involved in the CPFR process depends on the supply network's relational structure and the CPFR development stage (Figure 6).

From this it can be seen that when companies implement CPFR with the aim of reducing costs (e.g. inventory costs), the collaboration is limited to data communication – e.g. companies exchange data on order forecast plans, stock levels, sales plans, etc. Instead, if companies collaborate with the aim of making the supply network more responsive to demand changes, then as well as exchanging data, they synchronize their plans and manage exceptions. The number of processes involved in the collaboration depends on the product/market characteristics and the supply network's physical structure. Companies can collaborate on a full collaboration level (i.e. companies jointly develop the business plan and manage sales and order forecasts) when they sell and market the same products, demand elasticity in case of price variation is high, and spatial complexity among CPFR partners is low. These are all necessary conditions for collaborating on a full collaboration level. If one of these conditions is not satisfied, the collaboration will be limited to simply managing order forecasts. Finally, with regard to the number of interacting units, this research suggests that a company can collaborate with several units when the number of potential CPFR partners is high and CPFR is at an advanced stage of development. The number of potential partners depends on the nature of the company's relationships with customers and suppliers, as high trust is recognised as a fundamental precondition for successfully implementing CPFR (ECR Europe, 2002).

These research findings may offer an original contribution to the debate on CPFR from both academic and managerial perspectives.

Figure 6.
Relationships between
contingent factors and
different types of CPFR
collaboration



From an academic point of view, this research might contribute to advancing theory on CPFR in two ways:

- (1) by proposing a CPFR model, including the variables and relationships among them; and
- (2) by explaining the rationale behind the managerial choices that lead companies to implement different CPFR collaborations.

Most of the studies on CPFR focus on identifying the advantages and future developments of CPFR or explaining CPFR implementation phases. In doing so, few authors devote their attention to rigorously defining CPFR variables or proposing relationships among variables and measures. This research, instead, aims to clarify differences in CPFR by analysing the different forms of CPFR collaborations and the context in which CPFR is implemented, thus contributing to the definition of measures for these variables. Moreover, it seeks to explain differences in CPFR collaborations by looking at the relationships between the different types of collaborations and several important contextual factors, thus contributing to the advance of substantive research on CPFR.

In addition, research is still at an early stage of investigating the reasons behind different CPFR collaborations. In the literature on CPFR, one widespread theory used to explain differences in CPFR implementation states that implementation options vary according to the CPFR development stages (ECR Europe, 2001, 2002; Larsen *et al.*, 2003; Seifert, 2003). There is no reason to disagree with this theory. Moreover, this

study demonstrates that the number of interacting units depends on the CPFR development stage. Nevertheless, several other variables emerge from this research as also being important in explaining different CPFR options, such as product/market characteristics, supply network peculiarities and CPFR goals.

The theoretical development presented here also has interesting practical implications as it may help managers in the decision-making process to select the most appropriate action to be taken to implement CPFR.

In particular, one simple, but important implication of the research findings is that CPFR collaboration is characterised by two dimensions – the depth of the collaboration and the number of interacting units. Several authors – such as Larsen *et al.* (2003) – focus only on analysing how companies collaborate, without looking at the number of companies involved in the collaboration. However, according to Seifert (2003) and the interviewed managers, this variable represents a fundamental decision in CPFR implementation, as it can profoundly influence the adoption of technical solutions supporting the CPFR process.

A second implication of the research is that it provides managers with a framework for anticipating changes in CPFR collaborations by anticipating changes in the company's environment and strategy. The proposed relationships are in fact dynamic relationships given that linkages between the contextual factors and the CPFR collaborations can, not only vary across cases, but also change over time within each CPFR collaboration.

In conclusion, it is important to discuss the generalisability of the research. In case-based studies the issue of generalisability is relevant given the absence of any statistical inference. However, a lack of generality may be balanced by a more thorough understanding of the context. In this research, reasoning about contextual factors helped the researcher understand to what extent the research findings might be transferable to other contexts. For the purposes of theory development, the field of application of the results is delimited to:

- supply networks where CPFR leader companies (i.e. the companies proposing and coordinating the CPFR) operate following a MTS, assemble-to-order (ATO) or MTO approach; and
- CPFR collaborations where formalised supply network performance measurement systems are adopted.

As to the first point, it is a truism that sales and order forecast plans are essential if a company produces following a MTS or ATO approach. In all the analysed cases, except for case D, central companies operate following a MTS approach. However, company D demonstrates that even if a company produces following a MTO approach, sales/order forecast plans may be important both for purchasing raw materials before receiving customer orders and for planning capacity requirements. In other cases (e.g. buy-to-order or engineer-to-order contexts) strategies and tools, other than CPFR, should be developed and used to improve supply network performances.

In addition, the validity of the relationships that emerge from this research seems to be linked to a fundamental factor: the existence of formalised supply network performance measurement systems allowing companies to evaluate the impact of CPFR on supply network performances. This boundary condition is indeed consistent with all the cases that guided the within-case and cross-case analysis. If companies

were unable to accurately understand the impact of the undertaken collaboration on supply network performances, they would lack an essential piece of information when deciding how to collaborate. For instance, with no information on the impact of CPFR, some companies might decide to implement a full collaboration with the aim of improving supply network efficiency. However, this study demonstrates that this approach is more suitable to improving supply network responsiveness.

As well as these considerations, further research developed in other contexts may help confirm or refine the domain of applicability of the research findings. Moreover, given the specific nature of the studied cases, it may also be useful to verify the relationships which this study seems to suggest exist between the different forms of CPFR collaboration and the context in which CPFR is implemented.

The analysed case studies are in fact limited to a relatively small sample and only a few industries. Future research should evaluate a wider sample of networks involving both large and small companies in several industries via case-based and/or survey-based research designs. Indeed, although research findings are encouraging, the opportunity to use the relationships found in this research as a managerial tool calls for the testing of research findings within larger samples of firms, representative of a broader range of industries.

Moreover, it is worth remembering that these research findings reflect a contingency approach. Nevertheless, while the CPFR goals, product/market characteristics, supply network peculiarities and CPFR development stage appear to be meaningful contingency factors explaining the different forms of CPFR collaborations, other important variables undoubtedly exist. Hence, further research opportunities lie in the exploration of other contingent factors.

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Further reading

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