Journal of Enterprise Information Management

A framework for Collaborative Planning, Forecasting and Replenishment (CPFR): State of the Art

Farhad Panahifar Cathal Heavey PJ Byrne Hamed Fazlollahtabar

Received 25 September 2014
Revised 5 January 2015
25 April 2015
Accepted 28 April 2015

A framework for Collaborative Planning, Forecasting and Replenishment (CPFR)

State of the Art

Farhad Panahifar and Cathal Heavey
Department of Design & Manufacturing Technology, University of Limerick, Limerick, Ireland
P.J. Byrne
Dublin City University Business School, Dublin City University, Dublin, Ireland, and
Hamed Fazlollahtabar
Department of Industrial Engineering, Iran University of Science and Technology, Tehran, Iran

Abstract

Purpose – Although many papers purport the significant value attributable to supply chain performance from the use of Collaborative Planning, Forecasting and Replenishment (CPFR), the question of "what are the main constructs and efficient framework for successful implementation of CPFR?" remains largely unanswered. This question will be addressed by identifying and analysing the main constructs for successful implementation of CPFR. The purpose of this paper is to attempt first to seek answers to this question. Second, to review the scope and value of CPFR using a devised state-of-the-art taxonomy for the classification of selected bibliographical references and third, to develop a conceptual framework by identifying areas which need more research.

Design/methodology/approach – The method underlying this paper followed the steps of a systematic literature review process outlined by Soni and Kodali (2011). The review is based on a total of 93 papers published from 1998 to 2013 on CPFR.

Findings – Four main constructs for successful implementation of CPFR have been identified: CPFR enablers, CPFR barriers, trading partner selection and IA. The findings indicate that there is a need for better understanding of the amount and level of information sharing as an important function of CPFR implementation. The paper also illustrates a number of shortcomings in the current literature and provides suggestions to guide future research on implementing CPFR in different industries.

Practical implications – This paper is of interest to both academicians and practitioners as it helps to better understand the concept and role of CPFR in supply chain integration and its implementation results, enablers and inhibitors. The proposed framework in this paper can be used to give insight for future research and practice.

Originality/value – The paper offers a framework for the review of previous research on CPFR and identifies the most important shortcomings that need to be addressed in future research. In addition, this review is both greater in scope than previous reviews and is broader in its subject focus.

Keywords Supply chain management, Information sharing, CPFR implementation, Collaboration, Collaborative Planning, Forecasting and Replenishment (CPFR), CPFR barriers

Paper type Literature review

Journal of Enterprise Information Management
Vol. 28 No. 6, 2015
pp. 838-871

1741-0398
DOI 10.1108/JEIM-09-2014-0092

1. Introduction

By focusing only on competitive relationships with others, companies are increasingly realizing that this isolated focus is making it difficult to maintain and/or grow market share. Modern companies face a myriad of different challenges such as globalization,

supply chain risk management, rapid development in technology, increasing costs, problems concerning demand uncertainty, enhancing the delivery of products or services, and the need to improve customer service and quality on an ongoing basis (Fisher, 1997; Stevenson, 2002; Brindley and Ritchie, 2004; Hsu and Wang, 2004; Briscoe *et al.*, 2004; Colicchia and Strozzi, 2012; Irani and Kamal, 2014). As pointed out by Branska and Lostakova (2011), one very powerful way to overcome some of these challenges is the integration of business logistics systems with logistics systems of suppliers and customers using collaboration approaches such as Collaborative Planning, Forecasting and Replenishment (CPFR). Collaboration and integration in the context of supply chains has been widely discussed in recent years (Chandra and Kumar, 2000; Byrne and Heavey, 2006; Holmström *et al.*, 2006; Jiao *et al.*, 2008; Liston *et al.*, 2008; Jain *et al.*, 2009; Wang *et al.*, 2010; Derrouiche *et al.*, 2010; Sundram *et al.*, 2011; Kamal and Irani, 2014).

CPFR is a technological innovation tool that was first registered as a trademark by the Voluntary Interindustry Commerce Standards (VICS) Association (1998) and is defined by VICS as a collection of new business practices that leverage the internet and EDI in order to achieve two goals: radically reduce inventories and expenses while improving customer service. A number of subsequent definitions and explanations of CPFR have been presented in the literature and under analysis can be seen to have derived from the VICS definition. For example, Fliedner (2003) defines CPFR as a web-based approach which can coordinate the diverse process of supply chain management including production and purchasing planning, demand forecasting and inventory replenishment. Skjoett-Larsen *et al.* (2003, p. 532) define CPFR as "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". CPFR as a practice-based technique originates from the launch of a comprehensive cooperative plan, then termed Collaboration Forecasting and Replenishment between Wal-Mart and Warner-Lambert in 1995 (Cooke, 1998). This two-year project was supported by IT companies SAP and Manugistics, as well as the consulting firm Benchmarking Partners. As part of this cooperation, Wal-Mart and Warner-Lambert independently calculated their demand six months in advance and collectively compared forecasts and resolved contradictions on a weekly basis. The project was monitored by VICS in order to develop an appropriate model to solve the collaborative forecasting (CF) problems, which was subsequently converted into CPFR (Seifert, 2003).

Also in 1998 the first CPFR guidelines were published by VICS and two entities: the Europe Efficient Consumer Response (ECR) and ECR organization of each country. This document included a nine-step process model as a guideline for CPFR implementation (Voluntary Interindustry Commerce Standards (VICS) Association, 1998). One-year later VICS organized the collaborative model for CPFR partners, absorbing distribution planning, exceptional treatment, multi-level collaboration, synchronization and other business conceptions. By the beginning of 2000, the CPFR approach was considered "best practice". In 2003, using feedback from a number of different companies that had launched a CPFR pilot, VICS published a new CPFR guide which improved upon the previous model (Stoll, 2010).

From a perusal of the literature, it is evident that a comprehensive review on CPFR is lacking. Only two published papers have been found which review the CPFR literature (Kubde and Bansod, 2010; Min and Yu, 2008), but both have limitations. Kubde and Bansod (2010) focus on the activities of collaborative planning (CP) and then

introduce CPFR as a technique which can cover all the functional areas of firms. The main focus of Min and Yu (2008) is the provision of an overview of CPFR for the purpose of comparison with other alternative forecasting techniques such as agent-based forecasting and focused forecasting. Although not being a comprehensive literature review, this paper includes a partial review of previous CPFR papers.

Although many papers purport the significant value attributable to supply chain performance from the use of CPFR (Sherman, 1998; de Paula *et al.*, 2004; Smith, 2006), its implementation rate has been much lower than what was expected (Frantz, 1999; Andraski and Haedicke, 2003; Småros, 2003; Büyüközkan and Vardaloglu, 2012). Based on this identified deficiency, this paper sets out to identify, through the implementation of a systematic literature review and the use of an efficient framework, the required elements for successful implementation of CPFR. The main contribution of this paper is therefore to classify and categorize recent CPFR literature in terms of concepts and factors in the form of a framework for successful CPFR implementation. The purpose of this paper is then threefold. The first objective is to develop a framework for conducting a comprehensive CPFR literature review. The second objective is to use this framework to review the current positioning of CPFR from a scope and value perspective. The third objective is to identify areas of concern for CPFR in the future and to propose directions for future research and practice.

This paper is organized as follows: In Section 2, the research methodology is explained. This is followed by Section 3 which consists of the review taxonomy with the remainder of the paper describing different facets of CPFR using this taxonomy. Therefore, Sections 4-6 review CP, CF and collaborative replenishment, respectively. Finally, practical implementation enablers, inhibitors, partner selection and incentive alignment (IA) are reviewed in Section 7 with a comparison drawn between CPFR and other techniques in Section 8. In Section 9, the findings, implications and suggestions for future research are discussed. Finally, conclusions and limitations are drawn.

2. Research methodology

In addressing the gap identified, a systematic literature review was undertaken in CPFR. The review included both empirical and non-empirical studies using a literature review methodology (Figure 1) proposed by Soni and Kodali (2011). The steps of the applied methodology are outlined as follows.

Step 1. Selection of assessment time period. The first CPFR pilot project, which took place in 1995, involved the retailer (Wal-Mart) and one of its manufacturers (Warner-Lambert) (Cooke, 1998). This is widely accepted as the starting point of CPFR and its publication year, 1998, has thus been selected as the starting point for this study. Therefore the assessment period was defined in this study as 16 years inclusive of the years 1998-2013 and the analysis of papers published on the topic in this timeframe.

Step 2. The papers were collected from four main online databases consisting of ISI Web of Science®, Taylor & Francis, Google Scholar™ and Emerald as well as an additional search of PhD dissertations, projects and other relevant publications through a broader web search. These databases are widely accessible in academic institutions and have been used in many previous studies.

Step 3. The key words "CPFR", "collaborative planning", "collaborative forecasting", "collaborative replenishment" and "collaboration" were searched for in the article title of each database. In this step, papers which were available online but not formally published (e.g. "In Press") in any volume up until the end of 2013 were also considered.

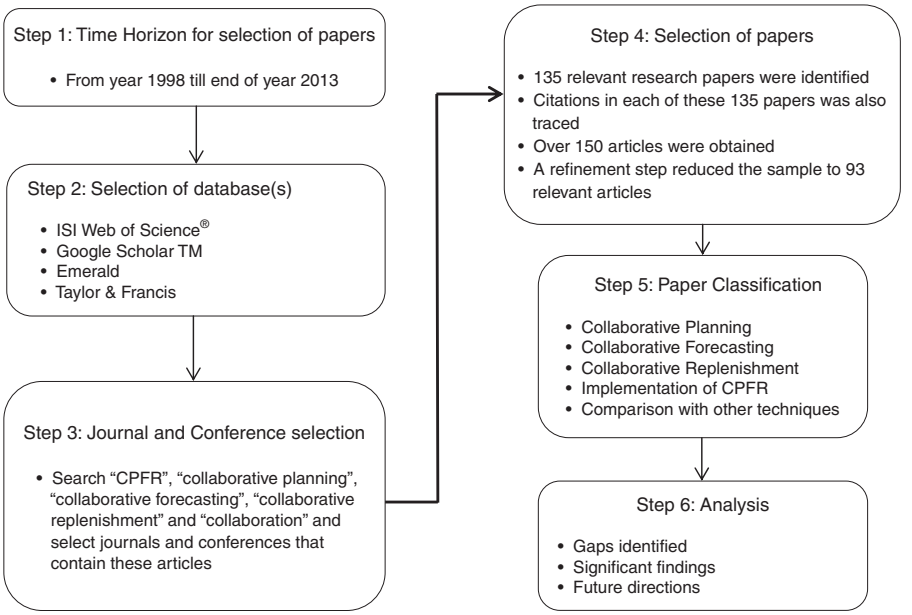

Figure 1.
The steps of research methodology

Step 4. Based on this described criteria, 135 relevant research papers were identified for the 16-year time period. To increase the reliability of the research, citations in each of these 135 papers was also traced, as a secondary source. This reverse literature search identified 15 additional papers. This process was repeated on all newly selected papers. In addition, an online search was also conducted on the web site of journals which were identified in the citation analysis and which were not represented in one of the four original databases. As a result, a total of just over 150 articles were obtained. Each of these papers were then reviewed in order to eliminate those articles which were not specifically related to CPFR. In other words, articles which very briefly mentioned CPFR but were not relevant to the general topic and to this study were eliminated from the sample. This refinement step reduced the sample to 93 relevant articles.

Step 5. Each of these 93 articles was then comprehensively assessed using descriptive analysis by examining: which dimensions of CPFR were addressed; and which methodology had been applied in the article. For the classification, each article was assigned to one of five possible dimensions consisting of: CP; CF; collaborative replenishment; implementation of CPFR; and comparison of CPFR with other collaborative techniques. The selection of these five dimensions and subsequent analysis is described in later sections. A discussion on this classification will be presented in the following section where the taxonomy of the research is presented.

Step 6. The classified papers are then critically analysed to identify research gaps in the area of CPFR and to present important findings of existing research, thus enabling readers to better understand the concept and role of CPFR in modern supply chain management.

Application of statistical methodologies tends not to be appropriate for papers that are dominantly descriptive (Soni and Kodali, 2011). As the objective of this paper is descriptive in nature, statistical methodologies were not used for deducing or for any inferential purpose using hypothesis testing. A categorization of the bibliographical

references in this study shows that (82.8 per cent) were obtained from journals, (9.7 per cent) conferences (3.2 per cent) web portals (2.1 per cent) published PhD dissertations and (2.1 per cent) books. Table I presents the most prevalent journals for CPFR paper publication. When the distribution of published CPFR research papers has been considered, it is found that 50 different journals had published CPFR papers from 1998 to 2013 – which equals 1.5 papers on average in each publishing journal over the time span. Approximately 50.6 per cent of the papers had been published in 11 journals, and five journals, *Supply Chain Management: An International Journal*, *International Journal of Physical Distribution & Logistics Management*, and *International Journal of Electronic Business Management*, *Production Planning & Control: The Management of Operations* and *International Journal of Electronic Business Management* had each published four to six papers: in totalling 22 papers.

3. Taxonomy

In order to be able to perform a classification analysis, a taxonomy according to which the papers will be classified is required. The content of this taxonomy depends on the research question to be addressed during the literature review. The taxonomy developed for this study is loosely based on what was proposed by Min and Yu (2008). In their taxonomy they identified three dimensions for classification: the problem scope; the methodology; and the implementation status. This paper uses the implementation status ("implementation of CPFR") as one of its classifications but adds four more dimensions, three of which are based on the VICS's guideline of "CP", "CF" and "collaborative replenishment". Table II presents these three major components and the nine main steps of CPFR according to the VICS guidelines. The fifth and final classification is a comparison of CPFR with alternative collaborative programmes and techniques "comparison with other techniques". Table III presents this classification, the articles that fall within these classifications and the methodologies used in these publications. The number of publications both annually and in total is specified in relation to each of the five dimensions of the taxonomy (Table IV). As illustrated there

Table I.
Publication in the CPFR publishing journals

Sl. no.	Journal	Years	Number of published papers	%
1	*Supply Chain Management: An International Journal*	1999; 2002; 2004; 2006; 2007; 2009	6	7.7
2	*International Journal of Physical Distribution & Logistics Management*	2001; 2002; 2003; 2006	4	5.2
3	*International Journal of Electronic Business Management*	2003; 2004(2); 2009	4	5.2
4	*Production Planning & Control: The Management of Operations*	2005; 2006; 2012; 2013	4	5.2
5	*Supply chain management review*	2003(2); 2006; 2007	4	5.2
6	*International Journal of Production Economics*	2012; 2010; 2008	3	3.9
7	*Management Science*	2001; 2005; 2007	3	3.9
8	*Journal of Business Forecasting*	2005; 2010(2)	3	3.9
9	*Business Process Management Journal*	2000; 2007; 2008	3	3.9
10	*European Journal of Operational Research*	2010; 2011	2	2.5
11	*International Journal of Production Research*	2006; 2007	2	2.5
	Other journals	1998-2013	39	51.9
	Sum		77	100

Type of action	Step
Planning	Develop front-end agreement
	Create joint business
Forecasting	Create sales forecast
	Identify exceptions to sales forecast
	Resolve exceptions to sales forecast
	Create order forecast
	Identify exceptions to order forecast
	Resolve exceptions to order forecast
Replenishment	Generate order

Table II. The CPFR nine-step process

is a reasonable spread of papers over the time horizon, albeit at low publication rates in general ranging from two to 12 papers in any given year. From a general trend perspective it can be seen that there are more publications on the topic in more recent times when analysing the peak publication years (> 8 publications) which include 2003, 2006, 2007, 2008. It can also be seen that the "implementation of CPFR" has dominated the research landscape over this time horizon with 50 of the reviewed papers focusing on this dimension.

4. Collaborative planning

Research evidence indicates that CP is a fundamental part of supply chain management. As summarized by Cassivi (2006), CP is the first step of CPFR with two fundamental stages: front-end agreement and joint business plans (see Table II). This phase is critical as partners develop collaboration initiatives and terms. On the counter, according to the research of Attaran (2004), a lack of CP leads to significant negative impacts on supply chain performance. Barratt (2003) investigated the role of CP in the grocery and consumer packaged goods industries. Although the research explains the concepts and benefits of CP, it does not address how they can implement CP in order to have an integrated supply chain.

Stadtler (2009) presents a new framework of CP with a specific emphasis on model-based decision support at the operational planning level of the supply chain. This framework allows for the contrasting and clustering of various contributions in CP. A study undertaken by Petersen *et al.* (2005), surveyed purchasing managers of firms involved in CP to investigate different factors that reinforce effective CP and its effects on the buying firm's performance. The results clearly illustrate that trust as a behavioural element and the quality of information shared between companies has a significant impact on effective CP and the performance of a supply chain. Similar to research reported by Wang *et al.* (2005), this study emphasizes the importance of IT infrastructure for effective CP with suppliers, however with the caveat that "technology cannot be the complete solution", a finding which has recently been echoed by Panahifar *et al.* (2014).

In confirming the importance of behavioural elements, Kilger *et al.* (2008) report that management of individuals is an important step in CP schemes. They have presented a different approach to CP in their study with CP embedded in the CPFR approach. They believe that "CPFR addresses collaborations among manufacturers and retailers in general, while our focus is on collaborative planning issues among arbitrary business partners" (Kilger *et al.*, 2008, p. 271). In order to find the main enablers to launch

Research classifications	References	Methodology
Collaborative planning	Stadtler (2009), Kilger *et al.* (2008), Zhang *et al.* (2011)	Modelling
	Barratt and Oliveira (2001), Cassivi (2006), Ramanathan and Gunasekaran (2012)	Survey
	Barratt (2004a), Danese (2011)	Case study
Collaborative forecasting	Raghunathan (1999), Aviv (2001), Aviv (2004), Aviv (2007), Huang *et al.* (2008), Wang (2011), Jiang and Liu (2012)	Modelling
	Kahn *et al.* (2006)	Survey
	McCarthy and Golicic (2002), Småros (2003), Chang *et al.* (2007), Voudouris *et al.* (2008), Chang and Wang (2008)	Case study
	Sherman (1998), Holmström *et al.* (2002)	Conceptual model
	Poler *et al.* (2008)	Simulation
	Helms *et al.* (2000)	Literature review
Collaborative replenishment	Chen and Chen (2009)	Case study
	Fu *et al.* (2000), Thron *et al.* (2006), Lyu *et al.* (2010)	Simulation
	Esper and Williams (2003)	Conceptual model
Implementation of CPFR	Johnson (1999), Fang and Meng (2010), Lin and Ho (2012)	Modelling
	Stank *et al.* (1999), Noekkentved (2000), Skjoett-Larsen *et al.* (2003), Fu *et al.* (2010), Branska and Lostakova (2011), Büyüközkan and Vardaloglu (2012), Panahifar *et al.* (2013)	Survey
	Lin *et al.* (2003), Steermann (2003), Zin (2003), Luh *et al.* (2004); Lin *et al.* (2004), Danese *et al.* (2004), Chung and Leung (2005), Wang *et al.* (2005), Danese (2006), Cederlund *et al.* (2007), Bayazit (2007), Pecar and Davies (2007), Msanjila and Afsarmanesh (2007), D'Aubeterre *et al.* (2008), Ghosh and Fedorowicz (2008), Du *et al.* (2009), Kim and Mahoney (2010), Lehoux *et al.* (2013), Yao *et al.* (2013), Thomassen *et al.* (2013)	Case study
	Schenck (1998), Frantz (1999), de Paula *et al.* (2004), Fliedner (2003), Seifert (2003), Andraski and Haedicke (2003), Simatupang and Sridharan (2005), Attaran and Attaran (2007), Derrouiche *et al.* (2008), Baumann (2010), Varma and Bansal (2010)	Conceptual model
	Kubde and Bansod (2010)	Literature review
	Attaran (2004), Ireland (2005), Smith (2006), Smith *et al.* (2010)	Industry report
	Caridi *et al.* (2006), Chen *et al.* (2007), Kamalapur (2013), Kazemi and Zhang (2013), Kamalapur *et al.* (2013)	Simulation
Comparison with other techniques	Sheffi (2002)	Case study
	Boone and Ganeshan (2000), Cigolini and Rossi (2006), Ryu (2006), Sari (2008), Sari (2010), Yuan *et al.* (2010)	Simulation
	Terwiesch *et al.* (2005), Aviv (2002)	Modelling
	Min and Yu (2008)	Literature review
	Hvolby and Trienekens (2010), Shu *et al.* (2010)	Conceptual model

Table III.
Reviewed classification of CPFR and related methodologies

Table IV.
Summary of the taxonomy of CPFR

Area of investigation	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Collaborative planning				1			1		1		1	1		2	1		8
Collaborative forecasting	1	1	1	1	2	1	1		1	2	4			1	1		17
Collaborative replenishment			1			1			1			1	1				5
Implementation of CPFR	1	3	1			7	5	4	3	6	3	1	7	1	2	7	51
Comparison with other approaches			1		2			1	2		2		4				12
Total	2	4	4	2	4	9	7	5	8	8	10	3	12	4	4	7	93

effective CP with trading partners, Kilger *et al.* (2008) emphasized the need to have a collaborative relationship with them. The impact of CP on successful collaboration has been analysed by Ramanathan and Gunasekaran (2012). They argued that there is a strong connection between CP with decision making and execution planning and, thus successful supply chains need to adopt planning, decision making and execution as key elements of collaboration.

5. Collaborative forecasting

In contrast with the other dimensions of CPFR, most of the articles related to CF have been approached from a variety of different aspects. In the area of CF, research has mainly focused on the CF process, the importance of information sharing (IS) and developing forecasts in a collaborative fashion, concept of collaboration between different internal parts of a company, especially in the area of forecasting, as well as the important organizational issues related to CF (Raghunathan, 1999; Fosnaught, 1999; Helms *et al.*, 2000; Wilson, 2001; Kahn *et al.*, 2006; Aviv, 2007). The extant papers show the importance of CF in relation to complex communications with different abilities such as reducing bullwhip effects and improving supply chain performance (Eksoz and Mansouri, 2012).

There are several studies that have investigated the objectives and benefits of CF. However, it appears that little academic research exists on how companies can implement forecasting collaboration in a supply chain. Raghunathan (1999) used the modelling approach to formulate the basic inventory management problem of CPFR and investigates the benefit of CPFR in the supply chain consisting of one manufacturer and two independent identical retailers. He also examined the impact of non-participants in CPFR on the performance of CPFR under two different scenarios of shortage allocation policies. The study found that CF enables the trading partners to improve accuracy of forecast and increase the quality of forecast information based on predictable order cycles.

According to Voudouris *et al.* (2008, p. 231), the overall objective of CF is "to synchronize service demand forecasts between all customers and suppliers". The authors believe that in this case, CF will be a solid foundation to collective planning processes which is a different understanding of CPFR, because in the term "CPFR", planning comes before forecasting. Increasing the accuracy of forecasts is the main objective of firms in CF implementation plans. Småros (2003) presents a case study to enhance the retailer's forecasting accuracy for new product introductions.

Aviv (2004) studied the potential benefits of CF and developed a descriptive dynamic model of a simple supply chain consisting of a single manufacturer and a retailer. His model evaluates the performance of a retailer in terms of inventory and shortage costs and the performance of supplier in terms of long-run average of composition of four scorecard components consisting of: inventory-holding cost; shortage cost; actual use of production capacity; and adherence to production plans.

Wang (2011) created a combination-forecasting model to improve forecasting accuracy. He used knowledge owned by manufacturers' data and market information sourced from retailers to create this model. The author believes that "the accuracy of collaborative forecasting can be determined by establishment of discrepancies standards and discrepancies handling".

What should companies do for successful implementation of a CF plan? Helms *et al.* (2000) in their studies have tried to answer this question. Their solution is to choose an appropriate team to implement the plan. CF needs a variety of personalities with different backgrounds to work together to create a forecast that can be used by the entire supply chain. According to a survey by McCarthy and Golicic (2002),

on successful implementation of CF, firms must fulfil their systematic, compatible and specific internal forecasting model. This system can improve the customer service and increase sales and decrease inventory of a company. However, there is a need for participatory decision making in this area. The importance of a relational approach in maximizing the benefits of collaborative demand forecasting has been stressed in Kahn *et al.* (2006). They argued that the relational dimension of collaboration appears to be more important than technology in facilitating supply chain performance, thus firms willing to adopt a collaboration approach like CPFR need to establish a relationship among key managers from both collaborating firms.

CF makes it possible to overcome inherent problems with traditional forecasting but achieving its benefits is not without challenges. Due to the complex nature of CF schemes, there are several challenges which are categorized by Voudouris *et al.* (2008) and Helms *et al.* (2000):

- challenges related to human interactions and biases;
- challenges due to traditional behaviours; and
- challenges in communication and defining accountability.

The importance of information technology to launch CF by partners has been addressed by many scholars (Sherman, 1998; Aviv, 2001, 2007; Småros, 2003; Vlachos and Bourlakis, 2006; Zhou and Benton, 2007). Sherman (1998) emphasized the role of information technology in implementing CF in CPFR. Aviv (2001) developed a sophisticated model to address CPFR based on different policies consisting of: baseline setting; local forecasting setting; and CF setting. This study was conducted based on a two-echelon supply chain with a single product. The results show that the marginal benefits of CF over local forecasting are more significant when forecasting capabilities are diversified.

The findings of the current research show (Figure 2) that most studies on the implementation of CF schemes have been carried out in retailing, high-tech industries, automotive industry, consumer goods, chemicals and apparel manufacturing sectors using case study and multiple-case study methods (see Figure 3). As already outlined, most of the research in the CF domain is conducted on two-echelon supply chain structures. In order to advance this field, future studies in CF should address this deficit and research plans that work well for more than two tiers, thus modelling more realistic supply chain structures in different industries.

6. Collaborative replenishment

As illustrated in Table II, the third stage of CPFR is collaborative replenishment, which includes making and fulfilling orders. Liu and Sun (2012, p. 351) stated that

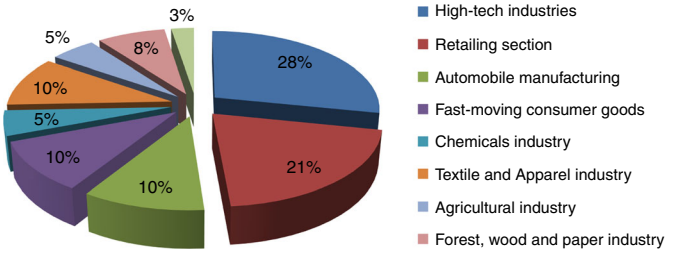

Figure 2.
Percentage of CPFR studies based on different industries

"in the replenishment stage, it is necessary to generate orders according to sales forecast", thus connecting collaborative replenishment directly to a forecasting activity. Collaborative replenishment spreads replenishment activities across the supply chain and facilitates collaborative inventory management in operations. The benefits reported by researchers include improved customer service levels, increased order accuracy and decreased inventory. As discussed by Lyu *et al.* (2010) in a study of the textile industry, it is important that the collaborative replenishment plan is examined collectively by the supplier and the retailer. Prior to the advent of CPFR, Vender-Managed Inventory (VMI), quick response and Continuous Replenishment (CR) were the techniques used for collaborative replenishment. VICS identified that transportation is also a key element in collaborative replenishment schemes. This was further analysed by Esper and Williams (2003) who reviewed collaborative transportation and its relationship to CPFR. They found that collaborative transportation management (CTM) requires a conversion of order forecasts developed via CPFR into shipment forecasts, and collaboratively insuring their accurate fulfilment. Chen and Chen (2009) examined how companies can combine CTM and CPFR to deeply integrate customer procurement forecast processes and logistics demands.

There is a tight relationship between CF and collaborative replenishment in the CPFR implementation process. In other words, better visibility of the retailers' sales and orders forecast helps suppliers to better plan their replenishment (Sheffi, 2002). Before collaborative replenishment can be enacted, general stock replenishment needs to be considered. CR is the most common solution in practice. This technique is based upon a business process announced by Procter and Gamble (P&G), and involves the continuous sharing of information through IT software. This business process produces several benefits for retailers and consumers such as improved service levels and reduced inventory. Today, this process and related software is a standard for the retail industry (Pfeifer *et al.*, 2008).

Thron *et al.* (2006) conducted a study to identify the critical factors affecting the successful adoption of collaborative replenishment between a manufacturer and its customers. They presented a delivery framework of two medium-sized food-manufacturers and their four major grocery retailers using discrete-event simulation. The results aim to help company managers to identify possible opportunities and threats within an expanding collaborative supply chain replenishment system. In a separate study also using simulation, Lyu *et al.* (2010) using a case study of a grocery company demonstrated how different replenishment scenarios can affect the supply chain performance.

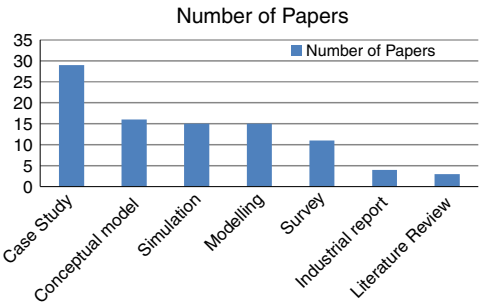

Figure 3.
Number of papers based on their methodology

7. Implementation of CPFR – different levels and context

Johnson (1999) believes that collaborative data modelling is a critical phase in the implementation stage of CPFR. He suggested that in order to succeed in implementing a collaborative process, firms need to design a data model based on the relationship between the trading partners rather than analysing the structure of both firms individually. According to Danese (2007), previous CPFR implementation cases confirmed that CPFR can take a number of different forms across supply chains. Also, Seifert (2003) claimed that different forms of CPFR collaboration exist among several partners such as customers and suppliers. However, advanced CPFR implementation is a challenging task and the rate of its adoption has been slower than expected (Frantz, 1999; Andraski and Haedicke, 2003; Småros, 2003). Skjoett-Larsen *et al.* (2003) classified CPFR into three levels – basic, developed and advanced – depending on the depth of collaboration. They argued that the basic CPFR is frequently the starting point for other collaborative initiatives.

In a study into "what factors lead firms to choose a precise collaborative planning initiative like CPFR?" Danese (2011) found that specific contextual conditions – i.e. goals of the collaboration, demand elasticity, product diversity and supply network spatial complexity, can affect the level of the collaboration in CP initiatives. Lin *et al.* (2003) reported the successful implementation of a pilot CPFR initiative between an optical disc and optical recording producer in Taiwan. The results identified the importance of collaborate demand forecasting in addition to the design of a data process for calculating on time delivery. Lin *et al.* (2004) proposed a methodology for the implementation of CPFR in the mechanical wood carving industry. In this study, a plan was adopted based on Critical Success Factor which included well-defined CPFR processes, trust between partners, investment in IT and commitment to practice. To evaluate the effects of various collaboration types in CPFR implementation, Danese (2006) using a multiple-case study method identified and analysed six types of collaboration. Such relationships can be defined based on the depth of the collaboration and the number of interacting units. Smith (2006) reported a very successful implementation of CPFR in West Marine, USA with significant results such as improved forecasting accuracy, reduced inventory and a notable improvement in the relationship with suppliers.

A number of studies have attempted to improve the process and outcomes of the traditional CPFR model by developing new models and frameworks. Caridi *et al.* (2006) proposed a new CPFR model with autonomous agents with different levels of "intelligence" and compared these with traditional CPFR models. This study shows better results when integrating CPFR with intelligent agents. Chen *et al.* (2007) used simulation to investigate four CPFR alternatives that are used in the adoption of collaboration strategies in industry. This study concluded that shifting the retailer (buyer-driven) collaboration to a manufacturer (supplier-driven) approach was a more viable option. D'Aubeterre *et al.* (2008) proposed an IT artefact to benefit organizations that are planning to adopt CPFR. They show how the security of CPFR business processes can be enhanced by incorporating roles and permissions needed in coordinating and executing secure business processes. Derrouiche *et al.* (2008) proposed a framework which helps to better characterize a CPFR strategy. The proposed framework shows how the nine steps of CPFR can be evaluated through examining the interactions between them.

In the area of CPFR implementation in a manufacturing environment, a research has been conducted by Chung and Leung (2005). They have applied the CPFR process in the Hong Kong electronics sector. The process of implementation in the mentioned case

study was initiated with one small supplier with increased benefits coming from the additional new partners and customers in implementing CPFR along the electronics supply chain. Wang *et al.* (2005) applied the CPFR concept in a Chinese retailer industry and analysed CPFR implementations in the Shanghai Maya Audio-Video Franchise Corporation. The successful adoption of CPFR in this firm was a facilitator for other Chinese companies. Benefits consisted of reduced costs, improved relationships with suppliers, and increased efficiency and revenue. Appling CPFR in Motorola was reported by Cederlund *et al.* (2007). According to this study, successful achievement of CPFR implementation in Motorola related to coordinated changes to the Motorola organizational structure and the business processes of its customers.

In the area of integrating CPFR with companies' current process, Baumann (2010) and Smith *et al.* (2010) developed new frameworks to link CPFR with Sales and Operation Planning. These studies emphasized the importance of technology in synchronizing this process. Research conducted by Thomassen *et al.* (2013) showed similar results in which information and communications technology affects CPFR by enhancing information flows and enabling process transformation.

In recent years, various efforts have been made to provide solutions for CPFR implementation in several industries. Two such studies, Du *et al.* (2009) and Fang and Meng (2010) modified CPFR process models and suggested frameworks for CPFR in the agricultural industry. Results from Fang and Meng (2010) indicate that the proposed model helps both buyers and sellers to minimize waste; reduce costs and risk; increase income; decrease inventory; improve return to assets; and improves the performance of the distribution system. Branska and Lostakova (2011) specified how to use CPFR methods in chains with continuous production, with a particular focus on the chemical-technological and metallurgy industries.

The current research shows that although most definitions of CPFR emphasize the possibility of collaboration between two or more parties in a supply chain, most of the cases study CPFR implementations between only one manufacturer and one or two retailers. Thus, it can be noted that CPFR is generally thought about as a technique for retailers in managing big promotions where these retailers directly communicate with manufacturers. In addition, this perception can also be traced back to the initial success stories of CPFR, which also fit this inference – e.g. cases like Wal-Mart (a retailer) and Warner-Lambert (a manufacturer). Table V presents detailed information on previous studies based on different industries. In the following subsections a brief explanation of the main areas of CPFR implementation consisting of: enablers; inhibitors; partner selection; IA; and results of implementing CPFR, are presented.

7.1 Implementation enablers

Successful collaboration schemes need many key enablers. These enablers for CPFR implementation vary due to the differences of industries and characteristics of the supply chain (Panahifar *et al.*, 2013). It is vital that managers of firms know these enablers before starting to launch CPFR with trading partners. There are some enablers that have been addressed by several studies which highlights their importance. The creation of a high level of trust (Humphreys *et al.*, 2001; Barratt and Oliveira, 2001; Fliedner, 2003; Petersen *et al.*, 2005; Monczka *et al.*, 1998; Ghosh and Fedorowicz, 2008; Fu *et al.*, 2010; Büyüközkan and Vardaloglu, 2012; Panahifar *et al.*, 2013) and the importance of information (Petersen *et al.*, 2005; Whipple *et al.*, 2002; de Paula *et al.*, 2004) are two of the most documented enables. In addition reduced information distortion in the supply chain is considered to be an important objective for

Research classification	Industry	References
Collaborative planning	Automobile manufacturing	Zhang *et al.* (2011), Danese (2011)
	Food industry	Danese (2011)
	Telecommunication section	Cassivi (2006)
	Retailing section	Barrat (2004a)
Collaborative forecasting	Fast-moving consumer goods	Boone and Ganeshan (2000), McCarthy and Golicic (2002), Småros (2003)
	Paper industry	Chang and Wang (2008)
	Retail section	Wang (2011), Chang *et al.* (2007)
	Automotive manufacturing	Jiang and Liu (2012)
	Semiconductor manufacturing	Terwiesch *et al.* (2005)
	Apparel manufacturing	McCarthy and Golicic (2002)
	Chemicals industry	McCarthy and Golicic (2002)
Collaborative replenishment	PC assembling	Fu *et al.* (2000)
	Retailing section	Stank *et al.* (1999)
	Textile industry	Lyu *et al.* (2010)
Implementation of CPFR	IT section	Chung and Leung (2005)
	Chemical and metallurgy industry	Branska and Lostakova (2011)
	Electronic industry	Cederlund *et al.* (2007), Chen and Chen (2009)
	Discs producer	Lin *et al.* (2003)
	Shoes industry	Luh *et al.* (2004)
	Forest and wood carving industry	Lin *et al.* (2004), Lehoux *et al.* (2013)
	Automotive	Danese *et al.* (2004)
	Agricultural industry	Du *et al.* (2009), Fang and Meng (2010)
	Retailing	Johnson (1999), Fu *et al.* (2010), Wang *et al.* (2005), Ghosh and Fedorowicz (2008)
	Medical devices industry and pharmacy	Sheffi (2002), Lin and Ho (2012), Thomassen *et al.* (2013)
	Apparel industry	D'Aubeterre *et al.* (2008)
	Fast-moving consumer goods	Kim and Mahoney (2010)
	Mobile phone manufacturing	Yao *et al.* (2013)

Table V. Reviewed classification of CPFR based on different industries

approaches like CPFR (Nishat Faisal *et al.*, 2007). Information as a key factor in the successful adoption of CPFR has been widely investigated in several different aspects such as: visibility – Petersen *et al.* (2005); accuracy – Whipple *et al.* (2002); timeliness and readiness – Zhu *et al.* (2003) and Panahifar *et al.* (2013); compatibility and availability across to users – Jain *et al.* (2009) and Whipple and Russell (2007); security – Attaran (2004). Also, as has been emphasized by some scholars, senior management support and commitment and a clear communication/business plan are two key prerequisites for successful collaboration (Humphreys *et al.*, 2001; McCarthy and Golicic, 2002; Ghosh and Fedorowicz, 2008; Panahifar *et al.*, 2013). Table VI provides an overview of the major potential enablers for implementing CPFR.

7.2 Implementation inhibitors

Significant inhibitors to the successful implementation of CPFR were identified by reviewing the selected papers. A comprehensive study on CPFR implementation

Dimension	Element	Sub element	Literature (reference)
Intra-company indicators	Technological	Technological capability	Fliedner (2003)
		Information visibility	Petersen *et al.* (2005)
		System compatibility	Fu *et al.* (2010), Büyüközkan and Vardaloğlu (2012)
		Amalgamation capability of technology	Fu *et al.* (2010)
		High internal service rate	Fang and Meng (2010)
		Information accuracy	Whipple *et al.* (2002)
		System function integrity	Fliedner (2003)
		Information technology service	Fliedner (2003)
	Non-technological	Willingness to collaborate	Seifert (2003)
		Information readiness	Zhu *et al.* (2003)
		Senior management support and commitment	McCarthy and Golicic (2002), Cederlund *et al.* (2007), Chen *et al.* (2007), Attaran and Attaran (2007)
		Cultural fits and collaborative culture	Wu *et al.* (2009), Barratt (2004b)
		Organizational innovation capability	Fu *et al.* (2010)
		Flexible organization	Wang *et al.* (2005), Attaran and Attaran (2007)
		Major change to operational process	Stank *et al.* (1999)
		Organizational size	Zhu *et al.* (2003)
		Internal alignment	Seifert (2003)
Inter-company indicators	Technological	Information security	Attaran (2004)
		Electronic data interchange	Fu *et al.* (2010), Fliedner (2003)
		Developing IT infrastructure	Wang *et al.* (2005)
		Compatibility of partners' abilities	Fliedner (2003)
	Non-technological	High level of trust	Humphreys *et al.* (2001), Fliedner (2003), Barratt (2004b), Petersen *et al.* (2005), Ghosh and Fedorowicz (2008), Büyüközkan and Vardaloglu (2012)
		Mutual agreed objectives	Sparks (1994), Barratt and Oliveira (2001)
		Clear communication plan	Büyüközkan and Vardaloglu (2012), Panahifar *et al.* (2013)
		Competition pressure	Zhu *et al.* (2003)
		Upfront planning	Lin and Ho (2012)

Table VI.
Potential enablers classification to CPFR implementation

barriers was reported by Barratt and Oliveira (2001). They presented several difficulties and obstacles in implementation such as, no shared targets; lack of demand variability; lack of budget for software; lack of partner trust; difficulties to calculate benefits; executive support obstacles; lack of real time coordination of information exchange; no adequate information technology and expertise. Undoubtedly, lack of partner trust is the most vital inhibitor and, if absent, remains the most obstructive

obstacle to the adoption of CPFR. Difficulties with real time coordination of information exchange is one of the main obstacles emphasized by Min and Yu (2008), McCarthy and Golicic (2002) and Barratt and Oliveira (2001). Despite the fact that the majority of companies claim that they are ready to collaborate, their trading partners doubt the willingness of these firms to exchange on time information which is considered as an artefact of lack of trust.

In a separate study, Chung and Leung (2005) stated that a lack of adequate collaborative software is one of the barriers to collaborative schemes. On the other hand, the fear of losing competitive information (financial reports, manufacturing schedules, inventory values, intellectual property issues and IS by adversaries), lack of technical expertise, the availability and cost of technology have been cited as some of the main obstacles to CPFR implementation (Schenck, 1998; Frantz, 1999; Cassivi, 2006). Attaran and Attaran (2007) divided CPFR challenges into fundamental and technical levels consisting of lack of trust, lack of mutual incentives and the need for security protocols in order to safeguard both buyers and sellers from leaks of proprietary information.

Various inhibitors associated with cultural and behavioural problems have been identified in this study. These have been classified into intra-/inter-company dimensions and consisting of: personal comfort zones – Seifert (2003); human resistance to change and training issues – Cassivi (2006); tunnel vision – Seifert (2003); lack of partners' trust – Barratt and Oliveira (2001) and Moberg *et al.*, 2003; poor communication – Cassivi (2006); and lack of commitment to share information – Seifert (2003); Table VII presents a full classification of CPFR implementation barriers. Technology is also no longer seen as a major inhibitor to successful implementation of CPFR and is now only considered a small part of the implementation challenge (Småros and Främling, 2001; Panahifar *et al.*, 2014). If companies can overcome these obstacles, CPFR offers significant benefits for the entire supply chain.

7.3 Partner selection

The importance of partner selection in successful collaboration has been widely expressed in the literature (Geringer, 1991; Nielsen, 2003; Todeva and Knoke, 2005; Emden *et al.*, 2006; Graddy and Chen, 2009). Partner selection is also introduced as a critical, complex and time consuming task in CPFR (Sheffi, 2002; Fu *et al.*, 2010). A review of the importance of partner selection in successful collaboration practices suggests that there is a strong correlation between partner selection and other main barriers to a successful collaborative approach which include: lack of trust – Min *et al.*, 2005; lack of compatibility of partners' abilities – Fliedner, 2003; cultural conflicts – Kelly *et al.*, 2002). For example, to successfully implement CPFR, there must be a certain degree of compatibly in the abilities of the supply chain trading partners (Fliedner, 2003). In general, improper partner selection is recognized as the main reason for bad performance of trading partners (Ireland *et al.*, 2002).

Chung and Leung (2005) present research on effective partner selection in CPFR implementation. They explored supplier selection criteria to implement CPFR in the copper clad laminate industry such as quality measures, costs, logistics, management skills and compatibility and design capability. As the importance of partner selection in collaboration is highlighted, there remains a substantive need to study the factors examined by trading partners in different industries before starting a CPFR project.

Dimension	Criteria	Sub-criteria	Literature
Intra-company	Managerial	No shared targets	Barratt and Oliveira (2001)
		Leadership	Seifert (2003)
		Internally focused organizational silos	Seifert (2003)
		Lack of promotions	Barratt and Oliveira (2001)
		Non-existent change management skills	Seifert (2003)
		Lack of financial resource	Cassivi (2006)
		Executive support obstacles	Barratt and Oliveira (2001)
		Change management	Frantz (1999)
		No budget for software	Barratt and Oliveira (2001)
		Lack of technical expertise	Schenck(1998), Fliedner (2003)
	Process	Demand variability	Barratt and Oliveira (2001)
		Lack of internal alignment	Seifert (2003)
		Cost of systems	Cassivi (2006)
		Internal restructuring	Cassivi (2006)
		Lack of forecasting processes and resources	Småros (2003)
		Legacy systems	Seifert (2003)
		Difficulties with information sharing process	Småros and Främling (2001)
	Cultural	Personal comfort zones	Seifert (2003)
		Human resistance to change and training issues	Cassivi (2006)
		Tunnel vision	Seifert (2003)
Inter-company	Technological	No adequate information technology	Barratt and Oliveira (2001)
		Inadequate collaborative software	Chung and Leung (2005), Min and Yu (2008)
		Technological reliability and dependencies	Cassivi (2006)
		The availability and cost of technology	Schenck (1998)
		Lack of security protocols	Attaran and Attaran (2007)
	Process	Benefits difficult to calculate	Barratt (2004b)
		Intensive nature of CPFR	McCarthy and Golicic (2002), Småros (2003)
		Lack of scalability of CPFR	Frantz (1999), McCarthy and Golicic (2002), Andraski and Haedicke (2003), Min and Yu (2008)
		Lack of promotions	Barratt and Oliveira (2001)
		Joint processes (Creating shared processes)	Småros and Främling (2001)
		Fear of losing competitive information	Frantz (1999), Cassivi (2006), Fliedner (2003)
		Difficulties with real time coordination of information exchange	Min and Yu (2008), McCarthy and Golicic (2002), Barratt and Oliveira (2001)

Table VII.
Classification of CPFR implementation inhibitors

(*continued*)

Dimension	Criteria	Sub-criteria	Literature
		Exception items in CPFR implementation process	Caridi *et al.* (2006)
	Cultural	Lack of commitment to share information	Seifert (2003)
		Poor communication	Cassivi (2006)
		Lack of partner trust	Seifert (2003), Frantz (1999), Ireland and Bruce (2000), Barratt and Oliveira (2001), Nesheim (2001), Moberg *et al.* (2003)

Table VII.

7.4 Incentive alignment

Incentive alignment (IA) has been defined as the process of sharing costs, risks and benefits among supply chain partners (Simatupang and Sridharan, 2005). Incentive misalignment problems may arise in implementing CPFR resulting in losing partners' commitment when partners' decisions are made corresponding to each partners individually, maximizing his/her own performance metrics. To avoid such an issue, companies first need to identify their own and familiarize themselves with their partners' important incentives allowing them to align in mutual manner. An "IA" of partners can keep partners loyalty to the implementation of CPFR. Incentive alignment is also used to ensure that trading partners make decisions that are appropriate and useful for the entire supply chain.

The importance of IA and compatibility as one of the main dimensions of collaboration is reflected in the literature (Simatupang and Sridharan, 2004; Cao *et al.*, 2010, Büyüközkan and Vardaloglu, 2012, Lehoux *et al.*, 2013). According to Simatupang and Sridharan (2004), collaborative systems require the three dimensions of IS, Decision Synchronization and IA, in order to facilitate the process of performance improvement within the supply chain. Cao *et al.* (2010) introduced IA as an interconnecting element in supply chain collaboration. Lehoux *et al.* (2013) report a case study of collaboration in the forest industry that shows the benefits of implementing coordination mechanisms such as CPFR as well as the necessity of using incentives to better share these benefits. The results of this study show how the use of an incentive based on CPFR savings can help to create a win-win collaboration and better share the collaboration benefits. The results revealed that if the incentives were correctly defined, they could increase the profit of all partners which results in a sustainable collaboration.

7.5 CPFR implementation benefits

Companies that have been involved in CPFR schemes have generally reported varying results in recent years (Andraski and Haedicke, 2003; Steermann, 2003; Smith, 2006; Cederlund *et al.*, 2007). Stank *et al.* (1999) believe that high levels of CPFR implementation are related to process changes and capability of information systems. There is a consensus concerning the long term benefits expected by CPFR adoption such as increasing responsiveness – McCarthy and Golicic (2002); increasing shareholder wealth – Boone and Ganeshan (2000); enhanced customer service quality – Lin and Ho (2012) and Du *et al.* (2009); increasing economic value added (EVA) – Boone and Ganeshan (2000); stronger relationship between partners – Smith (2006).

A categorization of CPFR implementation results is presented in Table VIII. This categorization consists of three main dimensions: information; service; and finance. The information dimension encompasses improvement of forecasting accuracy,

Dimension	Criteria	Literature
Information	Improvement of forecasting accuracy	Raghunathan (1999), Småros (2003), Ireland (2005), Smith (2006), Chang *et al.* (2007), Chang and Wang (2008), Wang (2011)
	Improved quality of exchanged information	Ghosh and Fedorowicz (2008)
	Reduce the bullwhip effect	Chang *et al.* (2007)
Service and functional	Increase responsiveness	McCarthy and Golicic (2002)
	Enhance customer service quality	Lin and Ho (2012), Du *et al.* (2009), Poler *et al.* (2008), McCarthy and Golicic (2002)
	Improved inventory management	Varma and Bansal (2010)
	Improved product offering	Varma and Bansal (2010)
	Operational efficiency	Kim and Mahoney (2010)
	Product availability assurance	McCarthy and Golicic (2002)
	Improving design process	de Paula *et al.* (2004)
	Stronger relationship between partners	Smith (2006), Varma and Bansal (2010)
	Decreasing supply chain cycle time	Boone and Ganeshan (2000)
	Increase customization capability	de Paula *et al.* (2004)
	Replenishment cycle time reduction	Varma and Bansal (2010)
	Promotional planning improvement	Andraski and Haedicke (2003)
Financial	Increase revenues and earnings	McCarthy and Golicic (2002)
	Increase margins	Boone and Ganeshan (2000)
	Increasing economic value added (EVA)	Boone and Ganeshan(2000)
	Increasing shareholder wealth	Boone and Ganeshan (2000)
	Decreasing cost of production, planning and deployment	Varma and Bansal (2010)
	Economic incentives	Kim and Mahoney (2010)
	Maximum efficiency of members	Shu *et al.* (2010)
	Reduce the inventory in the supply chain	Sherman (1998), Boone and Ganeshan (2000), Andraski and Haedicke (2003), Steermann (2003), Attaran (2004), Smith (2006), Chang *et al.* (2007), Du *et al.* (2009), Poler *et al.* (2008), Barrat (2004a), Jiang and Liu (2012)
	Decrease working capital	Boone and Ganeshan (2000)
	Reduce the production and inventory costs	McCarthy and Golicic (2002), Zhang *et al.* (2011)
	Reduced overall costs	Stank *et al.* (1999), Aviv (2001), Attaran and Attaran (2007)
	Increasing the sales of products	Sherman (1998), Barrat (2004a), Varma and Bansal (2010)
	Reduction in stock-outs	Varma and Bansal (2010)

Table VIII.
Potential benefits and results of implementing CPFR

reducing the amount of exchanged information and reducing the bullwhip effect. The second dimension involves more criteria including increased responsiveness, enhanced customer service quality, improved inventory management, improved product offering, operational efficiency, product availability assurance, improving design process, stronger relationship between partners, decreased supply chain cycle time, increased customization capability, reduced replenishment cycle time. The financial dimension is the most important objective for firms implementing CPFR. This covers several criteria

reported in the previous studies such as increased revenues and earnings, increased margins, increasing EVA, increasing shareholder wealth, decreasing cost of production, planning and deployment, maximum efficiency of members, a reduction of inventory in the supply chain, decreasing working capital, reduction in production and inventory costs, reduced overall costs, increasing the sales of products and reduction in stock-outs (Andraski and Haedicke, 2003; Småros, 2003; Attaran, 2004; Chang *et al.*, 2007; Jiang and Liu, 2012; Du *et al.*, 2009; Poler *et al.*, 2008; Kim and Mahoney, 2010; Varma and Bansal, 2010).

Other benefits have been reported in various industries in addition to those mentioned above (Voudouris *et al.*, 2008; Wang, 2011; Lyu *et al.*, 2010). For instance, many cases in the retailing and grocery section reported that CPFR could improve operational efficiency, reduce inventory variance, improve forecasting accuracy, enhance responsiveness, reduce running costs and develop new partnerships with customers or suppliers. Steermann (2003) considered a collaborative relationship based on CPFR between one manufacturer and one retailer which resulted in a 25 per cent reduction of inventories for both companies. In separate studies, Jiang and Liu (2012) and Zhang *et al.* (2011) investigated the benefits of collaborative schemes using a case from the automotive manufacturing industry. Improvement in the precision of demand prediction, a decrease in inventory of the supply chain and enhanced efficiency, a reduction in the production and inventory costs are their reported results. In separate studies conducted by McCarthy and Golicic (2002); Fu *et al.* (2010); and de Paula *et al.* (2004), increased responsiveness of partners, increased revenues and earnings, a reduction of replenishment frequency, increased customization capability have been reported. Although the benefits of CPFR implementation have been widely documented in the literature, there is a need for studies which empirically examine how some of the acclaimed benefits of CPFR were subjected to some of the key enablers/barriers common in its implementation. Table VIII shows several potential benefits and the results of CPFR implementations that have been reported in the literature.

8. Comparison of CPFR with other techniques

In this section, a comparison of CPFR with other techniques such as VMI, EDI and ROP will be discussed. Aviv (2002) compared traditional VMI and CPFR programmes in settings with different levels of intertemporal correlation in the demand process. The key differences are the consideration of the production environment of the manufacturer, and the explicit modelling and discussion of the internal service performance. The relationship between Agile Virtual Enterprise (AVE) and CPFR has been explored by Shu *et al.* (2010). They suggested an AVE-Based CPFR Mechanism and model. This model is composed of three stages: planning, forecasting and replenishment. This model defines relationship management in allied leaders of suppliers, manufacturers, distributors and retailers. A study undertaken by Sari (2008) aimed to help supply chain managers to specify a proper level of according to their particular business conditions. To achieve this goal, a simulation model representing two popular supply chain initiatives, including CPFR and VMI, was constructed. In addition, a traditionally managed supply chain is also included in the model as a benchmark. The results show that CPFR is more beneficial compared with VMI. The results of this research show that the value of CPFR is substantially greater under the market conditions where uncertainty in demand is high and replenishment lead times are longer. The result of this research helps firms' managers of supply chains to invest in CPFR instead of VMI. It is apparent that as a limitation for this study, the

results of this research should be examined for more than one member at each echelon. Comparing the results of two studies by using more cases can identify different dimensions of the CPFR. Sari (2010) also examined the effects of RFID technology on different supply chains when they are working based on a traditionally managed supply chain, VMI and CPFR. The results from a simulation model showed that integrating RFID technology within a supply chain provides significantly greater benefits when the level of collaboration is high. In other words, the performance of supply chain improves when it applies CPFR.

According to Terwiesch *et al.* (2005) in comparison with earlier EDI-based supply chain practices, CPFR is characterized as a much broader cooperative arrangement where trading partners jointly develop forecasts by sharing their strategic information like point-of-sale, inventory, promotions and production information. As described by Sheffi (2002), there are several differences between CPFR and other collaborative mechanisms; one major distinction is that under CPFR, both trading partners are aware of the probable exceptions which contribute to aim the collaborative activities for resolving these exceptions. Another difference is the capability of CPFR to indicate contradictions or exception handling (i.e. the management of specific cases that may arise in demand and order forecasts). In other words, when operating at scale or a large number of stores and many stock keeping units, CPFR can display and solve the discrepancies. The approach used to solve exceptions is an algorithm that minimizes a function cost (sum of transportation, set-up, inventory-holding costs, etc.), maximum capacity, minimum stock-in and inventory.

Along similar lines, Boone and Ganeshan (2000) carried out research on the forecasting aspect of CPFR and examined the impact of CPFR on business processes and system performance. Using simulation, they compared CPFR with the traditional ROP, on four performance metrics: fill rates, supply chain cycle time, supply chain inventory and shareholder value method. Although this research was done based on data from one product in one company in one industry, the results clearly illustrate that when compared to ROP, CPFR increases fill rates and shareholder wealth while decreasing supply chain inventory and cycle time. The applicability of these results should be analysed in other products and other industries. Like many other studies that emphasized the benefits of IS, this research has not considered the amount and level of IS.

Ryu (2006) compared CPFR with Consignment, VMI I and VMI II to assess their impacts on supply chain performance from the perspective of both academia and practice. According to this simulation-based analyses, CPFR achieves the most supply chain profit in comparison with others. The author claims that under CPFR, the buyer achieves higher profit than the traditional system, but less profit than VMI I, VMI II and Consignment. Also, CPFR significantly increases supplier's profit compared with any other systems. Overall, CPFR exhibits the best performance in terms of overall supply chain profit. Yuan *et al.* (2010) applied the simulation methodology to compare the performance of CPFR with VMI and jointly managed inventory (JMI) to manage the demand gap of high-tech industries when they are introducing a new product. The results of this study illustrate that the performance of CPFR is better than other strategies, but results were very similar to JMI. Hvolby and Trienekens (2010, p. 809) compared four main frameworks for inter-company relationships, namely, Supply Chain Operations Reference-model (SCOR), CPFR, standards for enterprise and manufacturing integration (ISA95) and Integration Specifications developed by Open Applications Group (OAG) and concluded that "SCOR focuses on the main company, integrating demand and supply; CPFR focuses on collaboration between buyer and

supplier; whilst ISA and OAG focus on integration (standards) between in-company management and manufacturing layers". Kazemi and Zhang (2013) compared CPFR with VMI using simulation and argued that by increasing two parameters, production cost and manufacturer's holding cost, CPFR still maintains higher overall profit, and lower retail price than those of VMI. A study conducted by Kamalapur *et al.* (2013) compared CPFR and VMI with a traditional supply chain and concluded that trading partners will achieve higher cost benefits by CPFR compared to VMI, when demand variability and backorder penalty cost are high, production capacity is low and delivery lead time is long.

9. Implications and future research recommendations

This paper offers new insights into the CPFR area. The findings of the paper and the gaps identified lead to a number of significant implications for theory and practice, which lead to important avenues for future research.

9.1 Implications for theory and practice

It is proposed that successful implementation and appropriate performance from a CPFR plan profoundly depends on four major factors consisting of: CPFR implementation enablers; CPFR implementation barriers; and partner selection, the various sub-factors; and IA. The importance of sub-factors varies from industry to industry. Thus, companies who wish to run a successful CPFR scheme need to take these factors into account when addressing collaboration.

The focus of research in CPFR appears to be limited to the importance of information and data sharing and the role of organizational behaviour, internal and external communication and cultural aspects of firms are mostly omitted in designing CPFR schemes. There is a real need to examine how companies can design a CPFR model with their partners while also including elements such as cultural aspects. These issues tend not to be included in the reported instances in the literature.

The results of this study highlights a lack of detailed information concerning enablers/barriers and their possible contribution to the reportedly slow progress for CPFR adaptation. As most companies suffer from scarce resources, the identification of the most dominant enablers/barriers allows them to assign those scarce resources on the most important factors. Although, the enablers/barriers vary due to the differences between industries and supply chains, it is essential that companies be aware of these factors before starting to adopt CPFR with trading partners.

The results of this paper illustrate that a number of main barriers to CPFR implementation such as compatibility of partners' abilities, lack of trust and cultural conflicts occur through the wrong selection of partners. It is also recognized as one of the most prevalent reasons for failure in collaboration. Thus, the selection of appropriate partners is introduced as the third construct for the successful implementation of CPFR. For retailers, partner selection is a harder decision. They may have many thousands of suppliers and cannot adopt CPFR with all of them. They need to be selective and so the criteria may be quite rigorous. However, the criteria that a supplier adopts appear to vary by industry and the relative power of the players and the structure of the various markets. For instance, in fast-moving consumer goods sector, there are many suppliers and few retailers and it is therefore largely the retailers who choose their CPFR partners. The situation is different in the high-tech sector where there are few suppliers and many retailers are looking for new products.

The literature review on CPFR shows that there is a large gap in previous research identifying and classifying significant incentives and motives for partners in implementing CPFR. While CPFR is a method by which manufacturers and retailers mostly collaborate, it is important to identify and classify their individual and mutual incentives in collaboration.

9.2 Identified gaps and future research directions

This paper found that most implementations have occurred in the high-tech, retailing and grocery sectors. CPFR as a technique has wider applicability and this research would encourage its use beyond this traditional domain. There is a need for a comprehensive and a streamlined set of guidelines based on the features of various industries which provide a strong insight into the context of CPFR.

Although most of the papers have addressed the advantages of CPFR implementation phases in varying industries, it is not well documented in the literature how other companies from similar or even the same industries can follow the reported approaches in a structured manner. For instance, although enablers and barriers to successful CPFR implementation vary from industry to industry, previous studies that have identified and ranked CPFR enablers and barriers have not taken the context into consideration.

Most CPFR efforts have concentrated on relationships between two partners (e.g. one supplier and one buyer). There are few examples reported of multi-tier implementation efforts, however its value lies in its collaborative ability thus opening opportunities for extending future research of CPFR in a multi-tier environment.

This review of the literature illustrates the fact that the importance of cultural problems has been emphasized repeatedly by research on CPFR implementation inhibitors. However, the influence of its significant sub-elements such as trust and partners' behaviour and habits on different types of collaborative schemes has not been investigated. As Table VII shows, CPFR can fail at both inter-company and intra-company level. Developing a framework for the identification of potential failures and mitigation strategies needs further research. This has the potential of enhancing the rate of successful implementations of CPFR.

A major difficulty for implementing CPFR is the management of exception items in the fulfilment process. It is argued that a small number of studies have made attempts to resolve this issue based on a negation based approach. Further research is required to develop such solutions and their integration within the boundaries of CPFR.

Research on the comparison of CPFR with other techniques is still in its infancy. Further studies incorporating the relationships and the differences between CPFR and other techniques can help to identify further capabilities of CPFR. The integration of CPFR with continuous improvement techniques also presents future opportunities.

Seven research methodologies have been applied in CPFR studies: case study; modelling; survey; simulation; conceptual model; literature review; and industrial report. The results of this study clearly show that a significant body of research has been conducted using the case study method (see Figure 2). This would suggest a need for a broader approach in the analysis of CPFR in the future. One such technique which could add value in this domain is simulation modelling, as this is a technique which could be used to design, develop and test CPFR implementations prior to full implementation.

From this study, it can be seen that the majority of reviewed papers concentrated on CPFR implementation and CF with little attention on collaborative replenishment. As the three dimensions are critically important for CPFR, it is proposed that more

research is needed to consider models which also effectively conduct collaborative replenishment within CPFR. Additional research, determining the appropriate level of IS between partners based on the size of the companies would be worthwhile.

Although the literature on the results of CPFR implementation has focused more on presenting potential benefits, more research is needed to examine the relationship between contextual variables such as organizational size or employee involvement, and the magnitude of the expected and perceived benefits of CPFR.

10. Concluding remarks

It is generally accepted that the starting point of what we know today as CPFR began with a Collaboration Forecasting and Replenishment initiative between Wal-Mart and Warner-Lambert in 1995 (Cooke, 1998). Using 1998 as an appropriate starting point, a systematic literature study was carried out to explore the scope of CPFR and provides a framework and an overview on the state-of-the-art in the domain up until 2013. In carrying out this review a five dimension taxonomy was devised, which included the three primary dimensions of CPFR as defined by VICS, CP; CF and Collaborative Replenishment and in addition to this implementation of CPFR and a comparison with other approaches. From a general perusal of the findings (Tables III and IV) it can be seen that there has been a general increase in the number of papers addressing CPFR in the second half of the study period (e.g. 2006-2013) however it can also be noted that the majority of these studies have focused in on the dimension of implementation of CPFR (51 of 93 papers), with much less attention on the other four. This would suggest that researchers have tended to focus on the practical side of implementation, but have not paid sufficient attention to the constituent elements that are required for its successful implementation. As a testament to this, Table IV shows that eight, 17 and five papers, respectively, focused on CP; CF and collaborative replenishment in this 16-year time frame. It can also be seen (Figure 3) that the vast majority of studies were completed using the case study methodology, which again is a strong indicator as to the practical nature of CPFR research and in many instances entailing a research analysis of a post CPFR implementation project.

From an analysis of the literature four main constructs for successful implementation of CPFR have been identified: first, identifying and strengthening CPFR enablers; second, identifying and managing CPFR barriers; third, selection of appropriate trading partners; and fourth, IA of trading partners. In terms of CPFR enablers as presented in Table VI, it is evident from a basic understanding of CPFR that it is a practice that requires collaboration between at least two distinct parties. Based on this understanding, the literature can be seen to analyse enablers from both an intra-company perspective (e.g. getting your own organization prepared) and an inter-company perspective (e.g. the relationship), with both consisting of a technical and non-technical dimension. Inhibitors were also found to have an intra- and inter-company perspective (Table VII), with both process and cultural criteria being present in both perspectives. In addition the criteria of managerial in intra-company and technological in inter-company were also found to be present.

It is clear from this research that there are many documented CPFR successes in the literature and that as a technique CPFR still has a significant part to play in modern organizational management (Table VIII). However, what is also notable is the documented potential promise and the identified "failing" to meet this promise in the literature. To build on this promise there is a need for researchers to move away from simply analysing the implementation of CPFR to concentrate more on the individual

and collective components of CPFR. As is indicated in Table IV, almost no research attention has been given to CP and collaborative replenishment in the time horizon analysed. In addition more attention is required on the analysis of CPFR implementation enablers and also conversely inhibitors. To date, little research has focused on these and this paper calls for increased activity in these domains.

A number of limitations to this study are presented. The divided nature of the CPFR technique into discrete elements – e.g. CP, CF and collaborative replenishment makes sourcing a comprehensive set of literature on the entire schema complex. This limitation could lead to some missed works in the study. Moreover, another limitation is that although the identified institutions for CPFR implementation is proposed based on the empirical analysis of the literature, no primary research was conducted to test the proposed instructions including the importance of enablers and inhibitors. This area may require attention from academics and researchers in the future.

References

Andraski, J.C. and Haedicke, J. (2003), "CPFR: time for the breakthrough?", *Supply Chain Management Review*, Vol. 7 No. 3, pp. 54-60.

Attaran, M. (2004), "Nurturing the supply chain", *Industrial Management*, Vol. 46 No. 5, pp. 16-20.

Attaran, M. and Attaran, S. (2007), "Collaborative supply chain management: the most promising practice for building efficient and sustainable supply chains", *Business Process Management Journal*, Vol. 13 No. 3, pp. 390-404.

Aviv, Y. (2001), "The effect of collaborative forecasting on supply chain performance", *Management Science*, Vol. 47 No. 10, pp. 1326-1343.

Aviv, Y. (2002), "Gaining benefits from joint forecasting and replenishment process: the case of auto-correlated demand", *Manufacturing and Service Operations Management*, Vol. 4 No. 1, pp. 55-74.

Aviv, Y. (2004), *Collaborative Forecasting and Inventory Management: Capacity Considerations*, St. Louis, MO, pp. 1-34.

Aviv, Y. (2007), "On the benefits of collaborative forecasting partnerships between retailers and manufacturers", *Management Science*, Vol. 53 No. 5, pp. 777-794.

Barratt, M. (2003), "Positioning the role of collaborative planning in grocery supply chains", *The International Journal of Logistics Management*, Vol. 14 No. 2, pp. 53-66.

Barratt, M. (2004a), "Understanding the meaning of collaboration in the supply chain", *Supply Chain Management: An International Journal*, Vol. 9 No. 1, pp. 30-42.

Barratt, M. (2004b), "Unveiling enablers and inhibitors of collaborative planning", *The International Journal of Logistics Management*, Vol. 15 No. 1, pp. 73-90.

Barratt, M. and Oliveira, A. (2001), "Exploring the experiences of collaborative planning initiatives", *International Journal of Physical Distribution & Logistics Management*, Vol. 31 No. 4, pp. 266-289.

Baumann, F. (2010), "The shelf-connected supply chain: strategically linking CPFR with S&OP at the executive level", *Journal of Business Forecasting*, Vol. 29 No. 4, pp. 21-28.

Bayazit, O. (2007), "An examination of current collaborative supply chain practices", *International Journal of Business Innovation and Research*, Vol. 1 No. 3, pp. 253-266.

Boone, T. and Ganeshan, R. (2000), "CPFR in the supply chain: the new paradigm in forecasting", *School of Business College of William and Mary*, Williamsburg, VA, pp. 1-14.

Branska, L. and Lostakova, H. (2011), "CPFR method application in supply chain involving continuous productions", *20th International Conference on Metallurgy and Materials*, Vol. 18 No. 22, p. 5.

Brindley, C. and Ritchie, B. (2004), "Chapter 1: introduction", *Supply Chain Risk* (ISBN 9780754639022), Ashgate Publishing Ltd, Aldershot and Hampshire.

Briscoe, J., Lee, T.N. and Fawcett, S.E. (2004), "Benchmarking challenges to supply-chain integration: managing quality upstream in the semiconductor industry", *Benchmarking: An International Journal*, Vol. 11 No. 2, pp. 143-155.

Büyüközkan, G. and Vardaloglu, Z. (2012), "Analyzing of CPFR success factors using fuzzy cognitive maps in retail industry", *Expert Systems with Applications*, Vol. 39 No. 12, pp. 10438-10455.

Byrne, P.J. and Heavey, C. (2006), "The impact of information sharing and forecasting in capacitated industrial supply chains: a case study", *International Journal of Production Engineering*, Vol. 103 No. 1, pp. 420-437.

Cao, M., Vonderembse, M.A., Zhang, Q. and Ragu-Nathan, T.S. (2010), "Supply chain collaboration: conceptualisation and instrument development", *International Journal of Production Research*, Vol. 48 No. 22, pp. 6613-6635.

Caridi, M., Cigolini, R. and De Marco, D. (2006), "Linking autonomous agents to CPFR to improve SCM", *Journal of Enterprise Information Management*, Vol. 19 No. 5, pp. 465-482.

Cassivi, L. (2006), "Collaboration planning in a supply chain", *Supply Chain Management: An International Journal*, Vol. 11 No. 3, pp. 249-258.

Cederlund, J.P., Kohli, R., Sherer, S.A. and Yao, Y. (2007), "How motorola put CPFR into action", *Supply Chain Management Review*, Vol. 11 No. 7, pp. 28-35.

Chandra, C. and Kumar, S. (2000), "An application of a system analysis methodology to manage logistics in a textile supply chain", *Supply Chain Management: An International Journal*, Vol. 5 No. 5, pp. 234-245.

Chang, K.K. and Wang, F.K. (2008), "Applying six sigma methodology to collaborative forecasting", *The International Journal of Advanced Manufacturing Technology*, Vol. 39 Nos 9-10, pp. 1033-1044.

Chang, T.H., Fu, H.P., Lee, W.I., Lin, Y. and Hsueh, H.C. (2007), "A study of an augmented CPFR model for the 3C retail industry", *Supply Chain Management: An International Journal*, Vol. 12 No. 3, pp. 200-209.

Chen, M.C., Yang, T. and Li, H.C. (2007), "Evaluating the SC performance on IT based inter-enterprise collaboration", *Information and Management*, Vol. 44 No. 6, pp. 524-534.

Chen, M.K. and Chen, Y.C. (2009), "The survey of collaborative commerce implementation in Taiwan", *International Journal of Electronic Business Management*, Vol. 7 No. 1, pp. 45-56.

Chung, W.C. and Leung, S.W. (2005), "Collaborative planning, forecasting and replenishment: a case study in copper clad laminate industry", *Production Planning and Control: The Management of Operations*, Vol. 16 No. 6, pp. 563-574.

Cigolini, R. and Rossi, T. (2006), "A note on supply risk and inventory outsourcing", *Production Planning and Control*, Vol. 17 No. 4, pp. 424-437.

Colicchia, C. and Strozzi, F. (2012), "Supply chain risk management: a new methodology for a systematic literature review", *Supply Chain Management: An International Journal*, Vol. 17 No. 4, pp. 403-418.

Cooke, J.A. (1998), "VMI: very mixed impact?", *Logistics Management & Distribution Report*, Vol. 37 No. 12, pp. 51-54.

Danese, P. (2006), "Collaboration forms, information and communication technologies, and coordination mechanisms in CPFR", *International Journal of Production Research*, Vol. 44 No. 16, pp. 3207-3226.

Danese, P. (2007), "Designing CPFR collaborations: insights from seven case studies", *International Journal of Operations & Production Management*, Vol. 27 No. 2, pp. 181-204.

Danese, P. (2011), "Towards a contingency theory of collaborative planning initiatives in supply networks", *International Journal of Production Research*, Vol. 49 No. 4, pp. 1081-1103.

Danese, P., Romano, P. and Vinelli, A. (2004), "Managing business processes across supply networks: the role of coordination mechanisms", *Journal of Purchasing and Supply Management*, Vol. 10 No. 5, pp. 165-177.

D'Aubeterre, F., Singh, R. and Iyer, L. (2008), "A semantic approach to secure collaborative inter-organizational ebusiness processes (SSCIOBP)", *Journal of the Association for Information Systems*, Vol. 9 No. 3, pp. 231-266.

de Paula, M., Oliveira, J., Souza, J.M. and Strauch, J. (2004), "Improving design with collaborative planning, forecasting and replenishment through knowledge management and CSCW", *Computer Supported Cooperative Work in Design, Proceedings. The 8th International Conference, IEEE*, Vol. 2, pp. 534-539.

Derrouiche, R., Neubert, G. and Bouras, A. (2008), "Supply chain management: a framework to characterize the collaborative strategies", *International Journal of Computer Integrated Manufacturing*, Vol. 21 No. 4, pp. 426-439.

Derrouiche, R., Neubert, G., Bouras, A. and Savino, M. (2010), "B2B relationship management: a framework to explore the impact of collaboration", *Production Planning and Control: The Management of Operations*, Vol. 21 No. 6, pp. 528-546.

Du, X.F., Leung, S.C., Zhang, J.L. and Lai, K.K. (2009), "Procurement of agricultural products using the CPFR approach", *Supply Chain Management: An International Journal*, Vol. 14 No. 4, pp. 253-258.

Eksoz, C. and Mansouri, A. (2012), "A conceptual framework for collaborative forecasting in the UK food supply chain", *Annual Conference, Chicago, IL, 20-23 April*.

Emden, Z., Calantone, R.J. and Droge, C. (2006), "Collaborating for new product development: selecting the partner with maximum potential to create value", *Journal of Product Innovation Management*, Vol. 23 No. 4, pp. 330-341.

Esper, T.L. and Williams, L.R. (2003), "The value of collaborative transportation management (CTM): its relationship to CPFR and information technology", *Transportation Journal*, Vol. 42 No. 4, pp. 55-65.

Fang, L. and Meng, X. (2010), "Research on information collaboration of agricultural supply chains based on CPFR", *Education Technology and Computer Science (ETCS), Second International Workshop on, IEEE, Wuhan*, Vol. 3, pp. 794-797.

Fisher, M.L. (1997), "What is the right supply chain for your products?", *Harvard Business Review*, Vol. 75 No. 2, pp. 105-117.

Fliedner, G. (2003), "CPFR: an emerging supply chain tool", *Industrial Management and Date System*, Vol. 101 No. 1, pp. 14-21.

Fosnaught, K. (1999), "The strategic power of consensus forecasting: setting your organization up to win", *Journal of Business Forecasting Methods and Systems*, Vol. 18 No. 3, pp. 3-7.

Frantz, M. (1999), "CPFR pace picks up", *Consumer Goods*, available at: www.consumergoods.com/ archive/JanFeb99

Fu, H.P., Chu, K.K., Lin, S.W. and Chen, C.R. (2010), "A study on factors for retailers implementing CPFR – a fuzzy AHP analysis", *Journal of Systems Science and Systems Engineering*, Vol. 19 No. 2, pp. 192-209.

Fu, Y., Piplani, R., de Souza, R. and Wu, J. (2000), "Multi-agent enabled modelling and simulation towards collaborative inventory management in supply chains", *Proceedings of the 2000 Winter Simulation Conference*, Vol. 2, pp. 1763-1771.

Geringer, J.M. (1991), "Strategic determinants of partner selection criteria in international joint ventures", *Journal of International Business Studies*, Vol. 22 No. 1, pp. 41-62.

Ghosh, A. and Fedorowicz, J. (2008), "The role of trust in supply chain governance", *Business Process Management Journal*, Vol. 14 No. 4, pp. 453-470.

Graddy, E.A. and Chen, B. (2009), "Partner selection and the effectiveness of interorganizational collaboration", in O'Leary, R. and Bingham, L.B. (Eds), *The Collaborative Public Manager: New Ideas for the Twenty-First Century*, Georgetown University Press, Washington, DC, pp. 53-70.

Helms, M.M., Ettkin, L.P. and Chapman, S. (2000), "Supply chain forecasting – collaborative forecasting supports supply chain management", *Business Process Management Journal*, Vol. 6 No. 5, pp. 392-407.

Holmström, J., Främling, K., Kaipia, R. and Saranen, J. (2002), "Collaborative planning forecasting and replenishment: new solutions needed for mass collaboration", *Supply Chain Management: An International Journal*, Vol. 7 No. 3, pp. 136-145.

Holmström, J., Korhonen, H., Laiho, A. and Hartiala, H. (2006), "Managing product introductions across the supply chain: findings from a development project", *Supply Chain Management: An International Journal*, Vol. 11 No. 2, pp. 121-130.

Hsu, H.M. and Wang, W.P. (2004), "Dynamic programming for delayed product differentiation", *European Journal of Operational Research*, Vol. 156 No. 1, pp. 183-193.

Huang, C.F., Chen, Y.S. and Chung, Y.K. (2008), "An autonomous collaborative forecasting system implementation – the first step towards successful CPFR System", *World Academy of Science, Engineering and Technology, TechnoL*, Vol. 2 No. 11, pp. 117-126.

Humphreys, P.K., Shiu, W.K. and Chan, F.T. (2001), "Collaborative buyer-supplier relationships in Hong Kong manufacturing firms", *Supply Chain Management: An International Journal*, Vol. 6 No. 4, pp. 152-162.

Hvolby, H.H. and Trienekens, J.H. (2010), "Challenges in business systems integration", *Computers in Industry*, Vol. 61 No. 9, pp. 808-812.

Irani, Z. and Kamal, M.M. (2014), "Intelligent systems research in the construction industry", *Expert Systems With Applications*, Vol. 41 No. 4, pp. 934-950.

Ireland, R. (2005), "ABC of collaborative planning forecasting and replenishment", *Journal of Business Forecasting*, Vol. 24 No. 2, pp. 1-3.

Ireland, R. and Bruce, R. (2000), "CPFR: only the beginning of collaboration", *Supply Chain Management Review*, Vol. 4 No. 4, pp. 80-88.

Ireland, R.D., Hitt, M.A. and Vaidyanath, D. (2002), "Alliance management as a source of competitive advantage", *Journal of Management*, Vol. 28 No. 3, pp. 413-446.

Jain, V., Wadhwa, S. and Deshmukh, S.G. (2009), "Revisiting information systems to support a dynamic supply chain: issues and perspectives", *Production Planning and Control: The Management of Operations*, Vol. 20 No. 1, pp. 17-29.

Jiang, G. and Liu, Y. (2012), "Research on Collaborative Forecasting Model Based on CPFR", in Wu, Y. (Ed.), *Software Engineering and Knowledge Engineering*, Springer-Verlag Berlin Heidelberg, AISC 114, Berlin, pp. 523-529.

Jiao, Y.Y., Du, J., Jiao, R.J. and Butler, D.L. (2008), "Operational implications of early supplier involvement in semiconductor manufacturing firms: a case study", *Journal of Manufacturing Technology Management*, Vol. 19 No. 8, pp. 913-932.

Johnson, M. (1999), "Collaboration data modeling: CPFR implementation guidelines", *Annual Conference Proceedings of the Council of Logistics Management*, Chicago, IL.

Kahn, K.B., Maltz, E.N. and Mentzer, J.T. (2006), "Demand collaboration: effects on knowledge creation, relationships, and supply chain performance", *Journal of Business Logistics*, Vol. 27 No. 2, pp. 191-221.

Kamalapur, R. (2013), "Impact of forecast errors in CPFR collaboration strategy", *American Journal of Industrial and Business Management*, Vol. 3 No. 4, pp. 389-394.

Kamalapur, R., Lyth, D. and Houshyar, A. (2013), "Benefits of CPFR and VMI collaboration strategies: a simulation study", *Journal of Operations and Supply Chain Management*, Vol. 6 No. 2, pp. 59-73.

Kazemi, Y. and Zhang, J. (2013), "Optimal decisions and comparison of VMI and CPFR under price-sensitive uncertain demand", *Journal of Industrial Engineering and Management*, Vol. 6 No. 2, pp. 547-567.

Kelly, M.J., Schaan, J.-L. and Joncas, H. (2002), "Managing alliance relationships: key challenges in the early stages of collaboration", *R&D Management*, Vol. 32 No. 1, pp. 11-22.

Kilger, C., Reuter, B. and Stadtler, H. (2008), "Collaborative planning", in Stadtler, H. and Kilger, C. (Eds), *Supply chain Management and Advanced Planning*, Springer Berlin Heidelberg, New York, NY, pp. 263-284.

Kim, S.M. and Mahoney, J.T. (2010), "Collaborative planning, forecasting and replenishment (CPFR) as a relational contract: an incomplete contracting perspective", *International Journal of Learning and Intellectual Capital*, Vol. 7 No. 3, pp. 403-428.

Kubde, R.A. and Bansod, S.V. (2010), "Collaborative planning, forecasting and replenishment: a state of the art", *Asian Journal of Industrial Engineering*, Vol. 2 No. 3, pp. 89-104.

Lehoux, N., D'Amours, S. and Langevin, A. (2013), "Inter-firm collaborations and supply chain coordination: review of key elements and case study", *Production Planning and Control: The Management of Operations*, Vol. 25 No. 10, pp. 1-15.

Lin, J.T., Yang, C.H. and Lin, T.M. (2004), "A CPFR implementation methodology study – a carpenter mechanical industry case study", *International Journal of Electronic Business Management*, Vol. 2 No. 3, pp. 172-178.

Lin, J.T., Chang, P., Chen, J.H. and Xin, W.X. (2003), "KPI with data flow analysis for CPFR: a CMC case study", *International Journal of Electronic Business Management*, Vol. 1 No. 3, pp. 110-119.

Lin, R.H. and Ho, P.Y. (2012), "The study of CPFR implementation model in medical SCM of Taiwan", *Production Planning & Control: The Management of Operations*, Vol. 25 No. 3, pp. 1-12.

Liston, P., Byrne, J., Heavey, C. and Byrne, P.J. (2008), "Discrete-event simulation for evaluating virtual organisations", *International Journal of Production Research*, Vol. 46 No. 5, pp. 1335-1356.

Liu, X. and Sun, Y. (2012), "Information Integration of CPFR in inbound logistics of automotive manufacturers based on internet of things", *Journal of Computers*, Vol. 7 No. 2, pp. 349-355.

Luh, Y.P., Chang, S.C. and Su, T.C. (2004), "Manufacture's ordinary implementation and operation of CPFR – a case study of shoes industry", *International Journal of Electronic Business Management*, Vol. 2 No. 4, pp. 210-218.

Lyu, J.J., Ding, J.H. and Chen, P.S. (2010), "Coordinating replenishment mechanisms in supply chain: from the collaborative supplier and store-level retailer perspective", *International Journal of Production Economics*, Vol. 123 No. 1, pp. 221-234.

McCarthy, T.M. and Golicic, S.L. (2002), "Implementing collaborative forecasting to improve supply chain performance", *International Journal of Physical Distribution and Logistics Management*, Vol. 32 No. 6, pp. 431-454.

Min, H. and Yu, W. (2008), "Collaborative planning, forecasting and replenishment: demand planning in supply chain management", *International Journal of Information Technology and Management*, Vol. 7 No. 1, pp. 4-20.

Min, S., Roath, A.S., Daugherty, P.J., Genchev, S.E., Chen, H., Arndt, A.D. and Richey, R.G. (2005), "Supply chain collaboration: what's happening?", *International Journal of Logistics Management*, Vol. 16 No. 2, pp. 237-256.

Moberg, C.R., Speh, T.W. and Freese, T.L. (2003), "SCM: making the vision a reality", *Supply Chain Management Review*, Vol. 7 No. 5, pp. 34-39.

Monczka, R.M., Petersen, K.J., Handfield, R.B. and Ragatz, G.L. (1998), "Success factors in strategic supplier alliances: the buying company perspective", *Decision Sciences*, Vol. 29 No. 3, pp. 553-577.

Msanjila, S.S. and Afsarmanesh, H. (2007), "Modelling trust relationships in collaborative networked organisations", *International Journal of Technology*, Vol. 6 No. 1, pp. 40-55.

Mustafa Kamal, M. and Irani, Z. (2014), "Analysing supply chain integration through a systematic literature review: a normative perspective", *Supply Chain Management: An International Journal*, Vol. 19 Nos 5-6, pp. 523-557.

Nesheim, T. (2001), "Externalisation of the core: antecedents of collaborative relationships with suppliers", *European Journal of Purchasing and Supply*, Vol. 7 No. 4, pp. 217-25.

Nielsen, B.B. (2003), "An empirical investigation of the drivers of international strategic alliance formation", *European Management Journal*, Vol. 21 No. 3, pp. 301-322.

Nishat Faisal, M., Banwet, D.K. and Shankar, R. (2007), "Information risks management in supply chains: an assessment and mitigation framework", *Journal of Enterprise Information Management*, Vol. 20 No. 6, pp. 677-699.

Noekkentved, C. (2000), "Collaborative processes in e-supply networks", *European SAP Centre of Expertise, Price Water House Coopers*.

Panahifar, F., Byrne, P.J. and Heavey, C. (2014), "ISM analysis of CPFR implementation barriers", *International Journal of Production Research*, Vol. 52 No. 18, pp. 5255-5272.

Panahifar, F., Ghadimi, P., Azadnia, A.H., Heavey, C. and Byrne, P.J. (2013), "A study on CPFR implementation critical factors for the automotive spare part industry", *Proceedings of the 2013 8th EUROSIM Congress on Modelling and Simulation IEEE Computer Society*, pp. 1-6.

Pecar, B. and Davies, B. (2007), "A new technology paradigm for collaboration in the supply chain", *International Journal of Services Operations and Informatics*, Vol. 2 No. 3, pp. 300-314.

Petersen, K.J., Ragatz, G.L. and Monczka, R.M. (2005), "An examination of collaborative planning effectiveness and supply chain performance", *The Journal of Supply Chain Management*, Vol. 41 No. 2, pp. 14-25.

Pfeifer, C., Hensolt, J., Wolfinger, K., Kornas, N. and Erath, S. (2008), "Investigation of opportunities that exist within the automotive supply chain for collaborative planning forecasting and replenishment", available at: www.vics.org (accessed 10 November 2013).

Poler, R., Hernandez, J.E., Mula, J. and Lario, F.C. (2008), "Collaborative forecasting in networked manufacturing enterprises", *Journal of Manufacturing Technology Management*, Vol. 19 No. 4, pp. 514-528.

Raghunathan, S. (1999), "Interorganizational collaborative forecasting and replenishment systems and supply chain implications", *Decision Sciences*, Vol. 30 No. 4, pp. 1053-1071.

Ramanathan, U. and Gunasekaran, A. (2012), "Supply chain collaboration: impact of success in long-term partnerships", *International Journal of Production Economics*, Vol. 138 No. 2, pp. 215-241.

Ryu, C. (2006), "An investigation of impacts of advanced coordination mechanisms on supply chain performance: consignment, VMI I, VMI II, and CPFR", Doctoral dissertation, State University of New York at Buffalo.

Sari, K. (2008), "On the benefits of CPFR and VMI: a comparative simulation study", *International Journal of Production Economics*, Vol. 113 No. 2, pp. 575-586.

Sari, K. (2010), "Exploring the impacts of radio frequency identification (RFID) technology on supply chain performance", *European Journal of Operational Research*, Vol. 207 No. 1, pp. 174-183.

Schenck, J. (1998), "CPFR: a glimpse into retail's future", *Automatic ID News*, Vol. 14 No. 12, pp. 51-54.

Seifert, D. (2003), *Collaborative Planning, Forecasting and Replenishment: How to Create a Supply Chain Advantage*, AMACOM, American Management Association, pp. 27-40.

Sheffi, Y. (2002), "The value of CPFR", *RIRL Conference Proceedings*, *Lisbon*, *13-16 October*.

Sherman, R.J. (1998), "Collaborative planning, forecasting & replenishment (CPFR): realizing the promise of efficient consumer response through collaborative technology", *Journal of Marketing Theory and Practice*, Vol. 6 No. 4, pp. 6-9.

Shu, T., Chen, S., Xie, C., Wang, S. and Lai, K.K. (2010), "AVE-CPFR working chains on the basis of selection model of collaborative credit-granting guarantee approaches", *International Journal of Information Technology & Decision Making*, Vol. 9 No. 2, pp. 301-325.

Simatupang, T. and Sridharan, R. (2005), "An integrative framework for supply chain collaboration", *International Journal of Logistics Management*, Vol. 16 No. 2, pp. 257-274.

Simatupang, T.M. and Sridharan, R. (2004), "A benchmarking scheme for supply chain collaboration", *Benchmarking: An International Journal*, Vol. 11 No. 1, pp. 9-30.

Skjoett-Larsen, T., Thernøe, C. and Andresen, C. (2003), "Supply chain collaboration: theoretical perspectives and empirical evidence", *International Journal of Physical Distribution & Logistics Management*, Vol. 33 No. 6, pp. 531-549.

Småros, J. (2003), "Collaborative forecasting: a selection of practical approaches", *International Journal of Logistics Research and Applications: A Leading Journal of Supply Chain Management*, Vol. 6 No. 4, pp. 245-258.

Småros, J. and Främling, K. (2001), "Peer-to-peer information systems – an enabler of collaborative planning, forecasting and replenishment", *Logistics Research Network Conference*, *Edinburgh*, *September*.

Smith, L. (2006), "West marine: a CPFR success story", *Supply Chain Management Review*, Vol. 10 No. 2, pp. 29-36.

Smith, L., Andraski, J.C. and Fawcett, S.E. (2010), "Integrated business planning: a roadmap to linking S&OP and CPFR", *Journal of Business Forecasting*, Vol. 29 No. 4, pp. 4-13.

Soni, G. and Kodali, R. (2011), "A critical analysis of supply chain management content in empirical research", *Business Process Management Journal*, Vol. 17 No. 2, pp. 238-66.

Sparks, L. (1994), "The logistic information of British retailing concepts and questions", *The International Journal of Logistic Management*, Vol. 5 No. 2, pp. 53-62.

Stadtler, H. (2009), "A framework for collaborative planning and state-of-the-art", *OR Spectrum*, Vol. 31 No. 1, pp. 5-30.

Stank, T.P., Daugherty, P.J. and Autry, C.W. (1999), "Collaborative planning: supporting automatic replenishment programs", *Supply Chain Management: An International Journal*, Vol. 4 No. 2, pp. 75-85.

Steermann, H. (2003), "A practical look at CPFR: the sears-michelin experience", *Supply Chain Management Review*, Vol. 7 No. 4, pp. 46-53.

Stevenson, W.J. (2002), *Operations Management*, 7th ed., McGraw-Hill/Irwin, New York, NY.

Stoll, R.G. (2010), "Collaborative planning, forecasting and replenishment (CPFR): successful implementation attributes", Doctoral dissertation, Cleveland State University.

Sundram, V.P.K., Ibrahim, A.R. and Govindaraju, V.G.R. (2011), "Supply chain management practices in the electronics industry in Malaysia: consequences for supply chain performance", *Benchmarking: An International Journal*, Vol. 18 No. 6, pp. 834-855.

Terwiesch, C., Ren, Z.J., Ho, T.H. and Cohen, M.A. (2005), "An empirical analysis of forecast sharing in the semiconductor equipment supply chain", *Management Science*, Vol. 51 No. 2, pp. 208-220.

Thomassen, M.K., Dreyer, H. and Jonsson, P. (2013), "Exploring the impact of ICT in CPFR: a case study of an APS system in a Norwegian pharmacy supply chain", in Emmanouididis, C., Taisch, M., Kiritsis, D., O'Leary, R. and Bingham, L.B. (Eds), *Advances in Production Management Systems. Competitive Manufacturing for Innovative Products and Services*, Springer, Berlin and Heidelberg, pp. 120-127.

Thron, T., Nagy, G. and Wassan, N. (2006), "The impact of various levels of collaborative engagement on global and individual supply chain performance", *International Journal of Physical Distribution & Logistics Management*, Vol. 36 No. 8, pp. 596-620.

Todeva, E. and Knoke, D. (2005), "Strategic alliances and models of collaboration", *Management Decision*, Vol. 43 No. 1, pp. 123-148.

Varma, A.K. and Bansal, S.K. (2010), "Implications of an augmented CPFR model in supply chain management", *TECNICA Journal of Management Studies*, Vol. 5 No. 1, pp. 32-46.

Vlachos, I.P. and Bourlakis, M. (2006), "Supply chain collaboration between retailers and manufacturers: do they trust each other?", *Supply Chain Forum: An International Journal*, Vol. 7 No. 1, pp. 70-80.

Voluntary Interindustry Commerce Standards (VICS) Association (1998), "CPFR voluntary guidelines", available at: www.vics.org/committees/cpfr/ (accessed October 2010).

Voudouris, C., Owusu, G., Dorne, R. and Lesaint, D. (2008), *Service Chain Management: Technology Innovation for the Service Business*, Springer, Berlin, pp. 1-14.

Wang, K.J., Jha, V.S., Gong, D.C., Hou, T.C. and Chiu, C.C. (2010), "Agent-based knowledge management system with APQP: implementation of semiconductor manufacturing services industry", *International Journal of Production Research*, Vol. 48 No. 10, pp. 2913-2936.

Wang, W. (2011), "Combination-forecasting modeling for CPFR collaboration", *International Conference on E-Business and E-Government (ICEE)*, *Shanghai*, pp. 1-4.

Wang, W., Yuan, Y., Archer, N. and Guan, J. (2005), "Critical factors for CPFR success in the Chinese retail industry", *Journal of Internet Commerce*, Vol. 4 No. 3, pp. 23-29.

Whipple, J.M. and Russell, D. (2007), "Building supply chain collaboration: a typology of collaborative approaches", *The International Journal of Logistics Management*, Vol. 18 No. 2, pp. 174-196.

Whipple, J.M., Frankel, R. and Daugherty, P.J. (2002), "Information support for alliances: performance implications", *Journal of Business Logistics*, Vol. 23 No. 2, pp. 67-82.

Wilson, N. (2001), "Game plan for a successful collaborative forecasting process", *The Journal of Business Forecasting*, Vol. 20 No. 1, pp. 3-6.

Wu, W.Y., Shih, H.A. and Chan, H.C. (2009), "The analytic network process for partner selection criteria in strategic alliances", *Expert Systems with Applications*, Vol. 36 No. 3, pp. 4646-4653.

Yao, Y., Kohli, R., Sherer, S.A. and Cederlund, J. (2013), "Learning curves in collaborative planning, forecasting, and replenishment (CPFR) information systems: an empirical analysis from a mobile phone manufacturer", *Journal of Operations Management*, Vol. 31 No. 6, pp. 285-297.

Yuan, X., Shen, L. and Ashayeri, J. (2010), "Dynamic simulation assessment of collaboration strategies to manage demand gap in high-tech product diffusion", *Robotics and Computer-Integrated Manufacturing*, Vol. 26 No. 6, pp. 647-657.

Zhang, G., Shang, J. and Li, W. (2011), "Collaborative production planning of supply chain under price and demand uncertainty", *European Journal of Operational Research*, Vol. 215 No. 3, pp. 590-603.

Zhou, H. and Benton, C. (2007), "Supply chain practice and information sharing", *Journal of Operations Management*, Vol. 25 No. 6, pp. 1348-1365.

Zhu, K., Kraemer, K. and Xu, S. (2003), "Electronic business adoption by European firms: a cross-country assessment of the facilitators and inhibitors", *European Journal of Information Systems*, Vol. 12 No. 4, pp. 251-268.

Zin, W.T. (2003), "CPFR platform design and analysis", Department of Information Application, National Tsing Hua University, thesis, Beijing.

Further reading

Bates, J.M. and Granger, J. (1969), "Combination of forecasts", *Operations Research*, Vol. 20 No. 4, pp. 451-468.

ECR Europe (2002), *European CPFR Insights*, ECR Europe (facilitated by Accenture), Brussels.

About the authors

Farhad Panahifar has completed a PhD in Industrial Engineering and Operations Management at the University of Limerick. He holds BSc and MSc Degrees in Industrial Engineering. His research interests include supply chain design and planning, simulation modelling, fuzzy logic, operation research and management, and strategic planning. Farhad has published in *International Journal of Production Research, Production Planning & Control*, and *Industrial Management & Data Systems*. Farhad Panahifar is the corresponding author and can be contacted at: farhad.panahifar@ul.ie

Cathal Heavey is an Associate Professor of Operations Management in the Department of Design and Manufacturing Technology at the University of Limerick. He is an Industrial Engineering Graduate of the National University of Ireland (University College Galway) and holds a MEngSc and PhD from the same university. He has published in the areas of queuing and simulation modelling. His research interests include simulation modelling of discrete-event systems, modelling and analysis of supply chains and manufacturing systems, process modelling, component-based simulation and decision support systems.

Dr P.J. Byrne is an Associate Professor of Operations/Supply Chain Management in Dublin City University Business School and the Head of the Management Group in the school. His research interests include supply chain design, analysis and optimization, cloud based simulation, discrete event simulation, industrial applications of simulation modeling for the manufacturing and services sectors and business process optimization.

Hamed Fazlollahtabar is an Assistant Professor at the Faculty of Management and Technology of the Mazandaran University of Science and Technology, Babol, Iran. He has graduated in BSc and MSc of Industrial Engineering at the Mazandaran University of Science and Technology, Iran. Hamed received PhD in Industrial and Systems Engineering from the Iran University of Science and Technology in 2014. His research interests are mathematical modeling, optimization in knowledge-based systems and manufacturing systems. He has published over 190 research papers in international book chapters, journals and conferences. He also published five books which three of them are internationally distributed to the academicians.

This article has been cited by:

1. SalamAsif Asif Salam Asif Salam is an Associate Professor of Marketing and Supply Chain Management in Ted Rogers School of Management at the Ryerson University of Toronto. He is a Doctorate in Business Administration in Supply Chain Management from the Thammasat University, Thailand. His research interests include interdisciplinary issues in marketing and supply chain management, supply chain collaboration, supply chain integration, healthcare logistics, lean and agile logistics, and humanitarian disaster logistics. PanahifarFarhad Farhad Panahifar Farhad Panahifar is an Assistant Professor of Industrial Engineering and Operations Management at Shahid Beheshti University. His research interests include supply chain design and planning, simulation modelling, fuzzy logic, operation research and management, and strategic planning. Farhad has published in International Journal of Production Research, Production Planning & Control, and Industrial Management & Data Systems. ByrneP.J. P.J. Byrne P. J. Byrne is an Associate Professor of Operations/Supply Chain Management in Dublin City University Business School and the Head of the Management Group in the school. His research interests include supply chain design, analysis and optimization, cloud based simulation, discrete event simulation, industrial applications of simulation modeling for the manufacturing and services sectors and business process optimization. Faculty of Economics and Business Administration, King Abdulaziz University, Jeddah, Saudi Arabia Design and Manufacturing Technology Department, University of Limerick, Limerick, Ireland and Information Technology Department, Management and Accounting Faculty, Shahid Beheshti University, Tehran, Iran Business School, Dublin City University, Dublin, Ireland . 2016. Retail supply chain service levels: the role of inventory storage. *Journal of Enterprise Information Management* **29**:6, 887-902. [Abstract] [Full Text] [PDF]
2. Nasrin Asgari, Ehsan Nikbakhsh, Alex Hill, Reza Zanjirani Farahani. 2016. Supply chain management 1982–2015: a review. *IMA Journal of Management Mathematics* **27**:3, 353-379. [CrossRef]
3. T.-M. ChoiIntroduction 1-8. [CrossRef]
4. Farhad Panaihfar Department of Design & Manufacturing Technology, Enterprise Research Centre, University of Limerick, Limerick, Ireland Cathal Heavey Department of Design & Manufacturing Technology, Enterprise Research Centre, University of Limerick, Limerick, Ireland PJ Byrne Business School, Dublin City University, Dublin, Ireland . 2015. Developing retailer selection factors for collaborative planning, forecasting and replenishment. *Industrial Management & Data Systems* **115**:7, 1292-1324. [Abstract] [Full Text] [PDF]