Maria Kollberg Thomassen

Exploring Information and Communications Technology in Collaborative Supply Chain Planning

Thesis for the degree of Philosophiae Doctor

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Norwegian University of Science and Technology
Faculty of Engineering Science and Technology
Department of Production and Quality Engineering

NTNU – Trondheim
Norwegian University of
Science and Technology

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ABSTRACT

This thesis deals with the role of information and communications technology (ICT) in supply chain settings where partners collaborate on planning and control. Recent ICT developments offer numerous opportunities to handle information between partners in supply chains. Collaborative planning, forecasting and replenishment (CPFR) is a collaboration concept that is often associated with ICT. However, since its introduction in the US in the mid 1990s, its implementation has been slow in practice and large-scale implementations have been scarce. Moreover, most literature on CPFR has been published by industry organizations or has been written by practitioners and there are only a few research studies that focus on ICT in CPFR.

Therefore, this work seeks to develop more structured and detailed insights to characteristics of ICT supported CPFR which can help companies to better exploit the great potential of ICT in CPFR. Its purpose is to explore how ICT can support CPFR in order to develop a framework for ICT supported CPFR. The investigation is concentrated to four research questions; 1) How are ICT capabilities applied to support CPFR? 2) How does ICT affect CPFR processes? 3) How does ICT affect the quality of information in CPFR? and 4) What are major conditions for ICT supported CPFR?

A qualitative approach and an iterative theory development process characterized by continuous combinations of empirical evidence and literature studies were adopted. An empirical single case study was carried out of a CPFR initiative of a wholesaler and a pharmacy retailer, with focus on an advanced planning and scheduling (APS) system that supported the initiative.

The thesis defines characteristics of ICT supported CPFR by comparing case evidence with literature. Results show that ICT is especially important in CPFR for processing and exchanging large information volumes and for facilitating collaborative actions. Moreover, ICT with automatic features has a significant role for increased cost efficiency, for enhanced quality of information and increased information exchange and for implementing a joint planning and control approach. The collaborative relationship and the integration and standardization of partners' existing ICT systems are also important for ICT supported CPFR.

A framework for ICT supported CPFR is developed that can be used to characterize and analyze CPFR initiatives in view of their appropriateness for ICT support and their degree of ICT exploitation. Characteristics related to the collaborative relationship, the ICT integration and standardization, as well as information volumes are expected to determine to what extent a CPFR initiative is especially suitable to be supported by ICT. Characteristics related to automatic information handling, exchange and processing of information, cost efficiency, information improvements and joint planning and control approach are expected to determine to what extent partners make productive use of ICT to support a CPFR initiative.

In addition to that the thesis summarizes and structures current knowledge on characteristics of ICT supported CPFR, it also provides further insights into how ICT can support CPFR that have not earlier been addressed in literature. In ICT supported CPFR, collaborative actions are necessary to establish joint rules and procedures for information handling, especially when information is handled automatically. ICT is further important in order to centralize the ordering activity to ensure that information is up-to-date and information from various sources is combined and to implement a joint planning and control approach. Automatic features of ICT are also necessary to handle large information volumes as well as to improve information quality in information exchange. Joint ownership relations can facilitate ICT supported CPFR and the integration and standardization of partners' existing ICT systems is also important, especially when ICT is used for automatic information handling.

The primary target group for this research are academics in the field of collaborative supply chain planning and control with a particular interest in the role of ICT in inventory management, especially related to fast-moving consumer goods (FMCG) industries. The framework for ICT supported CPFR and related propositions of this study may be used as a starting point for further investigations on the topic.

Results are further expected to be valuable for managers, especially in the pharmacy or in other FMCG industries, who consider implementing or have already implemented CPFR with ICT support. Managers can use the framework for ICT supported CPFR to characterize and analyze their CPFR initiatives with regard to ICT appropriateness and degree of ICT exploitation. Finally, the practical recommendations provide guidance on how to exploit the potential of ICT in CPFR.

SAMMENDRAG

Denne avhandlingen tar for seg rollen til informasjons- og kommunikasjonsteknologi (IKT) i verdikjeder hvor partnere samarbeider om planlegging og styring. De seneste årenes raske IKT-utvikling har innebåret mange nye muligheter til å håndtere informasjon mellom partnere i en verdikjede. Samarbeid om planlegging, prognoser og forsyning (CPFR) er et samarbeidskonsept som ofte innebærer bruk av IKT. Et bredt spekter av CPFR-piloter ble iverksatt etter introduksjonen i USA på midten av 1990-tallet. Imidlertid har den praktiske implementeringen av CPFR vært langsom og større prosjekter har sjelden vært implementert. I tillegg er litteraturen om CPFR i hovedsak publisert av bransjeorganisasjoner eller skrevet av praktikere og det er kun få studier publisert med forskningsresultater om IKT i CPFR.

Derfor har denne studien som hensikt å bidra til en mer strukturert og detaljert innsikt om karakteristikken ved IKT-støttet CPFR som kan hjelpe bedrifter til å utnytte det store potensialet til IKT i CPFR bedre. Formålet er å utforske hvordan IKT kan støtte CPFR for å utvikle et rammeverk for IKT-støttet CPFR. Undersøkelsen er konsentrert til fire forskningsspørsmål; 1) Hvordan brukes IKTs ulike muligheter for å støtte CPFR? 2) Hvordan påvirker IKT prosessene i CPFR? 3) Hvordan påvirker IKT informasjonskvaliteten i CPFR? og 4) Hva er viktige forhold for IKT-støttet CPFR?

Studien er basert på en kvalitativ tilnærming og en iterativ prosess for å utvikle teori som er preget av en kombinasjon av empiri og litteraturstudier. En studie ble utført av et CPFR-initiativ mellom en grossist og en apotekdetaljist som hadde tatt i bruk et avansert planleggingssystem (APS) for å støtte sitt initiativ.

Studien definerer karakteristikker ved IKT-støttet CPFR gjennom å sammenligne funnene fra den empiriske studien med litteraturen. Resultatene viser at IKT er særskilt viktig i CPFR for å prosessere og utveksle store informasjonsmengder og for å gjøre det lettere å gjennomføre felles oppgaver. Videre viser studien at IKT med automatiske egenskaper har en viktig rolle for økt kostnadseffektivitet, for forbedret informasjonskvalitet og økt informasjonsutveksling og for å implementere en felles tilnærming til planlegging og styring. Samarbeidsrelasjonen, integrasjon og standardisering av eksisterende IKT-systemer til partnerne er også viktige for IKT-støttet CPFR.

Et rammeverk for IKT-støttet CPFR presenteres som kan brukes for å beskrive og analysere CPFR-initiativer ut fra deres egnethet til å bruke IKT og deres utnyttelse av IKT. Karakteristikk ved samarbeidsrelasjonen, integrasjonen og standardiseringen av eksisterende IKT i partnerbedriftene, og informasjonsvolumene forventes å påvirke i hvilken grad et CPFR-initiativ er spesielt egnet for IKT-støtte. Karakteristikk ved automatisk håndtering av informasjon, utveksling og prosessering av informasjon, kostnadseffektivitet, informasjonsforbedringer og felles tilnærming til planlegging og styring forventes å påvirke i hvilken grad partnerne kan dra produktiv nytte av IKT i et CPFR-initiativ.

I tillegg til at studien sammenstiller og strukturerer eksisterende kunnskap om karakteristikken for IKT-støttet CPFR, gir den videre innsikt i hvordan IKT kan støtte CPFR som ikke tidligere har vært adressert i litteraturen. I IKT-støttet CPFR er felles oppgaver nødvendige for å etablere felles regler og prosedyrer for informasjonshåndtering, særskilt når informasjonen håndteres automatisk. IKT er videre viktig for å sentralisere ordreaktiviteten for å sikre oppdatert informasjon og at informasjon er kombinert fra ulike kilder og for å implementere en felles tilnærming til planlegging og styring. Automatisk funksjonalitet ved IKT er også nødvendig for å håndtere store informasjonsmengder og for å forbedre informasjonskvaliteten ved utveskling av informasjon. Felles eierrelasjoner kan gjøre det lettere å innføre IKT-støttet CPFR og integrasjon og standardisering av partnernes eksisterende IKT-systemer er viktig, spesielt når IKT brukes for automatisk informasjonshåndtering.

Den primære målgruppen for avhandlingen er akademikere innenfor samarbeid i verdikjeder rundt planlegging og styring og med en spesiell interesse for IKTs rolle i planlegging og styring av lager, spesielt knyttet til forbruksvarer med høy omløpshastighet. Rammeverket for IKT-støttet CPFR og relaterte påstander kan brukes som utgangspunkt for videre undersøkelser av temaet.

Resultatene forventes også å være verdifulle for ledere, særskilt innenfor apotekbransjen eller andre bransjer for forbruksvarer med høy omløpshastighet, som vurderer å innføre eller som alle rede har innført CPFR støttet av IKT. Ledere kan bruke rammeverket for IKT-støttet CPFR for å beskrive og analysere sine CPFR-initiativer ut fra deres egnethet å bruke IKT og deres utnyttelse av IKT. Til slutt kan de praktiske anbefalingene gi veiledning for hvordan de kan utnytte potensialet av IKT i CPFR.

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Trondheim, January 2013

Maria Kollberg Thomassen

ABBREVIATIONS

APICS	Association for Operations Management
APS	Advanced planning and scheduling
ARP	Automatic replenishment programs
CPFR	Collaborative planning, forecasting and replenishment
CRP	Continuous replenishment programs
CSCMP	Council of Supply Chain Management Professionals
DSS	Decision support systems
ECR	Efficient consumer response
EDI	Electronic data interchange
EOQ	Economic order quantity
ERP	Enterprise resource planning
FMCG	Fast-moving consumer goods
FTE	Full time employee
ICT	Information and communications technology
IS	Information system
IT	Information technology
MIS	Management of information systems
OM	Operations management
OTC	Over-the-counter
POS	Point of sales
QR	Quick response
RFID	Radio frequency identification
RX	Prescription drug
SCM	Supply chain management
SCOR	Supply chain operations reference
SKU	Stock keeping unit
USB	Universal serial bus
VICS	Voluntary Interindustry Commerce Solutions
VMI	Vendor managed inventory
XML	Extensible mark-up language

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1. INTRODUCTION

The chapter gives an overview of the research area of interest. It presents the motivation for conducting this study and defines the purpose and research questions of the study. Next, the scope of the research is described, followed by a presentation of expected contributions. An outline of the chapters of the thesis is also presented.

1.1 BACKGROUND

This research deals with the role of information and communications technology (ICT)[1] in supply chain settings where partners collaborate on planning and control[2]. The theme has been chosen because there is a need to increase knowledge of how ICT can support collaborative approaches to planning and control and especially of characteristics[3] of collaborative planning and control that is supported by ICT.

ICT has been assigned an important role of supporting planning and control activities within companies (e.g. Vollmann et al., 2005). Since the 1990's, enterprise resource planning (ERP) systems have been used to support a wide range of decisions for matching of demand and supply related to production capacity scheduling, shop floor execution, demand planning and so on (e.g. Vollmann et al., 2005).

During the 1990's, the concept of supply chain management (SCM) gained increased support, suggesting that business competition takes place between supply chains rather than individual companies (e.g. Cooper et al., 1997, Mentzer et al., 2001). SCM is about efficient integration of suppliers, manufacturers, warehouses and stores so that goods are produced and distributed at the right quantities, to the right location and at the right time in order to minimize system wide costs while satisfying service level requirements (Simchi-Levi et al., 2003).

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[1] ICT represents technology such as computers, telecommunications, printing, audio and video, with the purpose of collecting, processing and disseminating information to aid in planning, decision-making and control of organizations (The Association for Operations Management, APICS, 2004).

[2] The term planning and control is used in the thesis and refers to planning and control of operations or operations planning and control.

[3] Characteristics here refer to distinguishing traits, qualities or properties (Merriam-Webster, 2011).

As a consequence, joint or collaborative planning and control approaches for matching demand and supply in supply chains have been developed (e.g. Stadtler & Kilger, 2008). These joint approaches have had major implications for the complexity of planning and control tasks; as the scope of operations expands from being concentrated to one single company to include operations of several companies in a supply chain, planning and control activities, information flows, decisions and so on, need to be coordinated between multiple partners.

Recent ICT developments offer numerous opportunities to handle information between partners in a supply chain (see for instance Turban et al., 2010). ICT serves as an enabler for gathering and analyzing information of several partners to create supply chain visibility and to improve planning and control in order to make decisions that optimize supply chain performance (Chopra & Meindl, 2007). ICT further supports the capturing of information related to market, end-user demand and inventory in an accurate and timely manner in addition to the creation of more accurate forecasts and plans and of more effective communication of information (Keil, et al. 2001).

Despite the major potential associated with ICT to support planning and control in supply chains, empirical research reveals that ICT issues are a major challenge for companies when implementing collaborative approaches to planning and control (Fraser, 2003, Stoll, 2010, Büyüközkan & Vardaloğlu, 2012).

1.2 RESEARCH MOTIVATION

Collaborative planning, forecasting and replenishment (CPFR)[4] is a general approach to collaboration that combines the intelligence of multiple trading partners in planning and fulfilment of customer demand (Skjøtt-Larsen et al., 2003, VICS Association, 2004) that often involves ICT (e.g. VICS, 1999, 2002, Ireland & Crum, 2005). CPFR encompasses business planning, sales forecasting, and all operations required to replenish raw materials and finished goods (Blackstone, 2010).

[4] CPFR® is a registered trademark of the Voluntary Interindustry Commerce Solutions (VICS) Association. Even though the term collaborative planning is sometimes used as a synonymous to CPFR (see for instance Barratt, 2004, Blackstone, 2010), the term CPFR is used here to emphasize that the collaborative planning activities of interest are related to the replenishment of goods.

The CPFR approach emerged in the US in the mid 1990s and the Voluntary Interindustry Commerce Solutions (VICS) Association published its first CPFR voluntary guidelines in 1998, with the consumer packaged goods industry as the primary target group (Seifert, 2003, Ireland & Crum, 2005). Even though a wide range of CPFR pilots were implemented during the next years, its adoption[5] has been slow in practice and large-scale implementations have been scarce (Fraser, 2003, Barratt, 2004b, Olhager & Selldin, 2004).

Considering that ICT has great potential of supporting CPFR and that this kind of collaboration is limitedly deployed in industry, this is an important topic that needs further attention in research. There are also several limitations in current research that need to be addressed. In brief, there is a general lack of systematic research addressing ICT supported CPFR; only a few empirical research studies have been identified that deal with the topic. Also, limited insights are provided regarding how ICT can support joint planning and control approaches and conditions for ICT supported CPFR. Current research further provides limited practical advice on how to manage ICT in CPFR. These limitations are further described next.

Most literature on CPFR has been published by industry organizations (e.g. VICS Association, 1999, 2002, ECR Europe, 2001, 2002), or has been written by practitioners (e.g. Seifert, 2003, Ireland & Crum, 2005, Smith, 2006) with practitioners as the primary audience. With regard to ICT support, these works largely provide insights to ICT issues based upon own experiences from specific industry cases. There is hence a limited representation in literature of structured knowledge on ICT issues in CPFR that has been systematically generated by academic researchers with an academic audience as the primary target group. Considering the increasing interest for CPFR in industry and that it is closely related to the use of ICT (e.g. VICS Association, 1999, 2002, Ireland & Crum, 2005), it is surprising that only a few empirical studies have been identified that focus on ICT support in CPFR (see studies by Stank et al., 1999, Barratt & Oliveira, 2001, Holmström et al., 2002, Danese, 2006a).

[5] The term adoption here refers to taking up and use (Merriam-Webster, 2011). In view of ICT management, similar terms are implementation and utilisation.

Practical advice related to ICT is provided in literature via the large amount of guidelines for how to succeed with CPFR implementation (e.g. Seifert, 2003, Ireland & Crum, 2005, VICS Association, 1999, 2002, ECR Europe, 2001, 2002).[6] However, these works provide limited insights to how ICT can support planning and control activities and conditions for implementing ICT. In addition, there is limited research on how to manage ICT in practice, although several researchers stress the need for managers to consider ICT for implementing CPFR (e.g. Barratt & Oliveira, 2001, Stoll, 2010).[7]

To conclude, this study is conducted because more structured knowledge is needed on the role of ICT support in CPFR. With an improved understanding of how ICT can support CPFR, companies are expected to be better prepared for exploiting the potential of ICT in this kind of collaboration.

1.3 PURPOSE AND RESEARCH QUESTIONS

Even though literature recognizes ICT as a major enabler for CPFR, current knowledge of ICT supported CPFR is not systematically structured nor developed in any large detail. The purpose of the thesis is therefore to:

> *...explore how information and communications technology (ICT) can support collaborative planning, forecasting and replenishment (CPFR) in order to develop a framework for ICT supported CPFR.*

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[6] For example, the Global commerce initiative recommended CPFR guidelines (VICS Association, 2002) present detailed technical specifications with regard to data format standards, transport protocols and data flow models. ECR Europe (2001) gives an overview of ICT systems and functional architecture requirements for large scale CPFR. The VICS Association (1999) provides a detailed step by step roadmap for developing CPFR where ICT is dealt with on a broad level.

[7] For example, Barratt and Oliveira (2001) broadly call for a CPFR friendly environment which is based upon trust and technology and state that any long-term expansion of CPFR must be supported by a consistent ICT development. They do this without providing any further details on what this actually means in practice. Likewise, Stoll (2010) suggests that an assessment of ICT and information exchange is needed in CPFR implementations without giving any further details regarding the form, content or purpose of such assessment.

This study intends to reduce the knowledge gaps that have been identified in literature. Even though several characteristics of ICT supported CPFR are revealed in literature, the understanding of what characterizes ICT supported CPFR needs to be developed in terms of more structured and detailed insights in order to give companies better opportunities for achieving benefits of ICT in CPFR. Therefore, this study aims to contribute to the development of further insights to the topic with regard to improved structure and details by defining characteristics of ICT supported CPFR. Focus is on four perspectives that are recognized in current literature including ICT capabilities, the impact of ICT on processes and on information quality and conditions for ICT supported CPFR.

Considering the large variety of ICT that can support CPFR it is assumed that ICT can have several different roles in CPFR. In literature, ICT support is for instance associated with sharing and analyzing information (e.g. Chopra & Meindl, 2007). Moreover, ICT is typically related to forecasting in CPFR (Barratt & Oliveira, 2001) and to large scale CPFR (e.g. ECR Europe, 2001, Seifert, 2003, Ireland & Crum, 2005). This study aims to provide further insights to how ICT is able to support CPFR by defining characteristics of different ICT capabilities[8].

With regard to the potential benefits of ICT in CPFR, literature suggests for instance that ICT increases efficiency (e.g. Smith, 2006) and enhances information in CPFR (Ireland & Crum, 2005). By investigating how CPFR processes are affected by ICT, this study intends to define characteristics of the impact of ICT on CPFR processes.

Research further proposes that ICT has an overall positive impact on the quality of information in CPFR (Stank et al., 1999, Petersen et al., 2005), which is especially related to operational information (Moberg et al, 2002). Also, it suggests that the collaborative relationship is important for information quality improvements from ICT (Jonsson & Gustavsson, 2008). To improve the understanding of the connection between ICT and information quality in CPFR, this study seeks to define characteristics of the impact of ICT on information quality.

[8] The term capability here refers to the quality or state of being able (Merriam-Webster, 2011). The term capability is similar to property, aspect, capacity, attribute, feature and ability.

Moreover, research suggests that the implementation of ICT supported CPFR relies upon several general conditions[9] such as the collaborative relationship (e.g. Barratt & Oliveira, 2001, Danese, 2006b), existing ICT and standardization (Seifert, 2003, Barratt, 2004b). By exploring what is essential to the implementation of ICT to support CPFR, this study aims to define characteristics of conditions for ICT supported CPFR.

In the following sections, the four views are dealt with in more detail.

1.3.1 Application of ICT capabilities

In literature, ICT is often recognized as important for collaboration. For example, CPFR may be referred to as an ICT tool itself (e.g. Fliedner, 2003, Simchi-Levi et al., 2003), some authors consider ICT as an enabler of CPFR (e.g. Sherman, 1998, Ireland & Bruce, 2000), and ICT can be recognized as a critical factor for success (Büyüközkan & Vardaloğlu, 2012).

Others claim that ICT is not a major obstacle to CPFR and that its role may be overstated (e.g. McCarthy & Golicic, 2002, Småros, 2007). Industry examples show how both simple ICT tools can be used and how more advanced technologies such as advanced planning and scheduling (APS) systems, which are computer programs that use advanced mathematical algorithms or logic to perform optimization or simulation (Blackstone, 2010), may help to increase efficiency in CPFR (Smith, 2006, Cederlund et al., 2007). It may be possible to implement CPFR with manual means (e.g. ECR Europe, 2001, Seifert, 2003), but ICT is necessary for scaling up and increase the level of detail (Ireland & Crum, 2005).

This picture coincides with research dealing with adoption of ICT also in other forms of collaboration. Several studies have shown that successful collaboration does not necessarily have to be based upon heavy ICT investments but can be based on less costly traditional means of communication (Holmström, 1998, Waller et al., 1999, Frankel et al., 2002, Barratt, 2004a, Carr & Kaynak, 2007, Vigtil, 2007). Rather than discussing whether ICT is necessary or not in CPFR settings, it is more relevant to redirect focus to how, why and in what situations ICT is used in this type of collaboration.

[9] The term condition here refers to something essential to the appearance or occurrence of something else (Merriam-Webster, 2011), i.e. something that is essential to ICT supported CPFR.

A common view in literature is that the need for ICT increases as CPFR initiatives become more developed or advanced and that various tools are used in different processes (ECR Europe, 2001, Danese, 2006b). Furthermore, literature reveals a wide range of ICT applications and systems available to support CPFR initiatives (ECR Europe, 2001, 2002, Smith, 2006, Cederlund et al., 2007). Some examples are forecasting applications, collaboration software, communication technology, automated replenishment systems, data warehouses, ERP and APS systems (Ireland & Crum, 2005). CPFR may also be based upon less sophisticated ICT such as fax and/or e-mail and EDI, and more sophisticated ICT such as for instance APS systems and internet based CPFR solutions (Danese 2006a, b).

Literature mainly deals with ICT for sharing information such as EDI and ICT for analyzing information such as decision support systems (DSS) (Shapiro, 2001, Chopra & Meindl, 2007). However, research dealing with ICT to support information sharing is dominating (e.g. Walton & Gupta, 1999, Hill & Scudder, 2002, Leonard & Clemons Davis, 2006), and there are few studies only that investigate the analytical sides of ICT in collaboration scenarios (e.g. Achabal et al., 2000, Akkermans et al. 2004).

Only few empirical studies investigate how ICT is applied in CPFR. Barratt and Oliveira (2001) show that software is most important in sales forecasting and order forecasting and less important in the earlier phases of CPFR, such as activities related to the front-end agreement and joint business plan. They also suggest that the need for ICT depends on the extent that activities are performed to establish agreement and the level of automation. Danese (2006a) found that low sophistication ICT was used when there were only few interacting units, independently of the depth of collaboration, while more sophisticated ICT was used when the number of interacting units was high and the degree of sophistication increased with the depth of collaboration.

To conclude, literature suggests that ICT is used differently in various processes (Barratt & Oliveira, 2001, Barratt, 2004b). It is assumed that ICT is more associated with the forecasting activities of CPFR compared to business planning and joint agreement activities (Barratt & Oliveira, 2001). Moreover, it is expected that ICT is mainly used for sharing and analyzing information in collaborative approaches (e.g. Chopra & Meindl, 2007). It is further expected that less sophisticated ICT is applied in situations with few partners while more advanced ICT is needed to support collaboration with several partners (Danese, 2006a). Literature also proposes that ICT is primarily necessary for efficiency reasons and its importance is related to more developed and large scale CPFR (e.g. ECR Europe, 2001, Seifert, 2003, Ireland & Crum, 2005).

Despite that literature reveals several sides of the application of ICT in CPFR, there is lack of systematic research addressing different capabilities of ICT and their relation to various joint activities. This study is expected to reveal more details and bring further structure with regard to ICT capabilities in CPFR settings. The intention is to investigate how ICT is applied in CPFR to define characteristics of ICT capabilities, which leads to the first research question:

Research question 1: How are ICT capabilities applied to support CPFR?

1.3.2 Impact of ICT on processes

The second research question has its starting point in the discussion on the contribution of ICT to supply chain performance. There is a significant stream of empirical research investigating the contribution of ICT to supply chain performance (see for instance literature review by Zhang et al., 2011). A common view in literature is that ICT has major positive implications for supply chains and is associated with major potential benefits (Simchi-Levi et al., 2003, Chopra & Meindl, 2007). However, empirical research provides a more nuanced picture of reality; some researchers find a positive and direct relationship between ICT and supply chain performance, while others show a more questionable relationship or no relationship at all (Zhang et al., 2011).

With regard to the implementation of different collaboration forms in industry, companies express a cautious attitude towards establishing collaborative initiatives. Several empirical studies confirm that the majority of companies are in early development phases and that large-scale implementations of collaborative practices are scarce (Fawcett & Magnan, 2002, Olhager & Selldin, 2004, Bagchi et al., 2005, Bagchi et al., 2007, Småros, 2007). Also, only simpler forms of ICT such as e-mail are widely used to support collaboration, while more advanced ICT such as APS systems are less frequently implemented (Olhager & Selldin, 2004).

As mentioned above, CPFR initiatives may be implemented without ICT, but ICT can also imply the realization of considerable potential benefits. Even though several successful CPFR pilots with ICT support have been reported on (e.g. ECR Europe, 2002), studies providing detailed insights to ICT benefits are scarce. Literature highlights for instance that ICT is important to increase efficiency (e.g. Smith, 2006, Cederlund et al., 2007), especially when dealing with large volumes of information (Barratt, 2004a) and that ICT may enhance scalability and the level of detail in collaboration (Ireland & Crum, 2005).

Benefits of ICT in collaboration are usually outlined in general terms in literature including for instance increased supply chain integration and communication, enhanced speed of information flows, lower barriers between companies, increased usefulness of data flows (e.g. Mentzer et al., 2000). Increased service levels were also identified in a study with focus on the implementation of a decision support system (DSS) in a VMI setting (Achabal et al., 2000). Since ICT tends to be critical for implementing collaborative business models (Sherman, 1998, Mentzer et al., 2000), it is expected that ICT contributes to the redesign of business processes also in CPFR settings (e.g. Davenport, 1993).

To conclude, literature suggests that ICT increases efficiency in CPFR (e.g. Smith, 2006), enhances information, including for instance in terms of scalability and level of detail (Ireland & Crum, 2005) and that large volumes of information is important for realizing benefits of ICT (Barratt, 2004a).

Even though literature points to several sides of ICT effects, there is limited empirical evidence to help draw strong conclusions about the consequences of ICT in collaborative planning and control settings. More systematic investigation is needed to structure the wide range of positive effects that ICT may cause. This research is expected to provide further details and structure to the topic. Characteristics of the impact of ICT on processes are defined by exploring how ICT affects CPFR processes, which is done by the second research question:

Research question 2: How does ICT affect CPFR processes?

1.3.3 Impact of ICT on information quality

The third research question of this study deals with information quality, a topic that is especially relevant with regard to ICT in CPFR. In general, ICT may help to make information useful in decision making by improving its quality, for example with regards to accuracy, accessibility and validity, (e.g. Chopra & Meindl, 2007). However, surprisingly, research dealing with information quality in CPFR is scarce. Additionally, among those relevant studies that deal with information quality, only few investigate its relation to ICT.

Results of a survey by Stank et al. (1999) demonstrate that ICT mainly helps to enhance information quality in high levels of CPFR implementation. Another survey reveals major variations in how information quality in different collaborative contexts is affected by ICT depending upon to what extent processes can be characterized as structured, definite, regular, frequent and objective (Petersen, 1999). The study by Moberg et al. (2002) shows that ICT is primarily used for increasing information quality of operational information exchange and that ICT also may help to enhance the quality of strategic information. Petersen et al. (2005) found that advanced ICT used for exchanging planning information had a positive impact on information quality across all investigated processes and that ICT enhances information sharing between partners by improving speed and accuracy and simplifying the sharing of large amounts of data. Sandberg (2007) found that ICT is important when it comes to the frequency of transfer of information but not to the degree of adjustment of the information content. Another survey shows a positive impact of ICT on the quality of information used in forecasts and that the collaborative relationship is important for the contribution of ICT (Jonsson & Gustavsson, 2008).

To conclude, while there is an increasing interest for information quality in research on collaborative planning and control approaches, only few studies investigate the relation between ICT and information quality in CPFR settings. Research proposes that ICT has an overall positive impact on the quality of information (Stank et al., 1999, Petersen et al., 2005). It is also expected that ICT is primarily used for increasing information quality of operational information and may help to enhance strategic information (Moberg et al, 2002). Another assumption is that the collaborative relationship is important for the impact of ICT on information quality (Jonsson & Gustavsson, 2008).

Even though previous empirical research has provided firm evidence to several sides of the relationship between ICT and information quality, detailed insights to the connection between ICT and information quality are limited in literature. The study therefore seeks to define characteristics of the impact of ICT on information quality by exploring how ICT affects information quality, which leads to the third research question:

Research question 3: How does ICT affect the quality of information in CPFR?

1.3.4 Conditions for ICT supported CPFR

As a consequence of the limited amount of literature dealing with ICT issues in CPFR, studies addressing conditions for ICT supported CPFR are underrepresented in literature. Yet, a few ICT related conditions are identified.

Barratt and Oliveira (2001) suggest that an adequate environment for CPFR is founded on ICT and trust and that these concepts are co-dependent. In a contingency CPFR implementation framework, Danese (2006b) outlines a number of factors that are important for ICT supported CPFR. She suggests that goals, product characteristics, spatial complexity, relational structure, development stage determine the type of information processing implemented, which in turn influences ICT. Providing a general orientation of relevant factors, she also calls for further empirical research to make the linkages more precise. Seifert (2003) proposes that ICT implementation in CPFR depends upon readiness of partners' systems architecture, industry standards, and redefinition of business processes and emphasizes that standardization is important with respect to the scalability and information exchange of CPFR initiatives.

The collaboration literature also suggests that the partner relationship is important for ICT in collaborative settings, claiming that ICT reinforces and stabilizes already existing collaborative structures and arrangements (Chae et al., 2005) and that high levels of trust and information transparency combined with hard work are important for ICT support (Akkermans et al., 2004).

To conclude, it is assumed that the collaborative relationship is important for ICT supported CPFR (e.g. Barratt & Oliveira, 2001, Danese, 2006b) and that ICT strengthens existing collaborative relations (Chae et al., 2005). Literature also proposes that existing ICT is important to support integration of processes and information flows (Seifert, 2003, Barratt, 2004b), especially ERP systems (Chopra & Meindl, 2007) and that industry standards and standardization is important (Seifert, 2003).

Even though literature recognizes several factors that may influence the adoption of ICT in CPFR, research provides only limited detailed insights to what is essential to the implementation of ICT support. This study therefore seeks to define characteristics of conditions for ICT supported CPFR, which leads to the fourth research question:

Research question 4: What are major conditions for ICT supported CPFR?

1.4 RESEARCH SCOPE

This study deals with collaboration in a planning and control perspective. This means that emphasis is on joint activities that involve matching of supply and demand rather than alliances or partnerships in supply chains in general.

Planning and control systems of companies are based upon several parts including for instance processes, activities, tasks, decisions and methods (Vollmann et al., 2005). Due to that ICT support is especially related to information flows of processes, focus in this study is on the processes and activities of planning and control and their related information flows. This means that other parts of planning and control, for instance planning and control methods are not considered.

The type of collaboration of interest for this study, CPFR, was selected among several initiatives for collaboration that are traditionally associated with the retail industry. It is characterized by intensive collaborative efforts, high demands on relationship quality, and high demands on quality and intensity of information exchange (Seifert, 2003). Compared to other alternatives such as VMI and continuous replenishment programs (CRP), CPFR is based on even closer relationships and information exchange (Barratt, 2003). CPFR is also often associated with ICT to support the flows of information in these exchanges.

With regard to supply chain scope, CPFR is about collaboration on planning and control with the purpose to replenish downstream inventories. Replenishment refers to the process of moving or re-supplying inventory from an upstream storage location to a downstream storage/picking location, or to another mode of storage in which picking is performed (CSCMP, 2010). Replenishment typically involves the retailing and distribution stages of a supply chain (Chopra & Meindl, 2007) but is not necessarily limited to these stages since replenishment also can be carried out by suppliers and manufacturers.

The main supply chain processes in this research are shown in view of the supply chain operations reference (SCOR) model in Figure 1-1. These are primarily related to planning, sourcing and delivering between supply chain partners. This means that customer sourcing activities and supplier delivering activities are considered together with related planning activities.

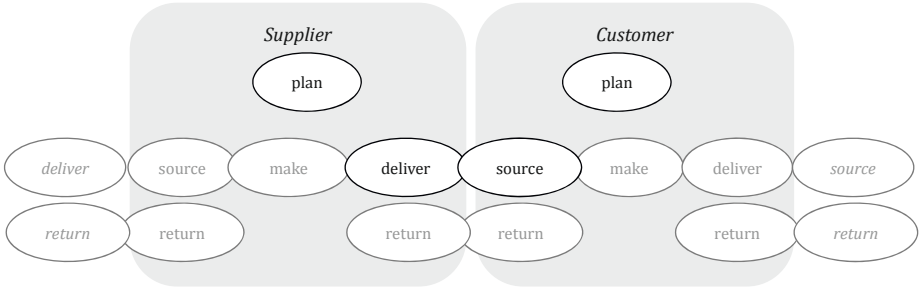

Figure 1-1 Main supply chain processes of the study (based on Bolstorff & Rosenbaum, 2003)

The pharmacy industry in Norway is selected as empirical setting for this study. This industry has undergone major transformations since the new pharmacy law came into force in 2001. New competitive requirements with regard to sales and distribution have thus opened for new collaboration opportunities between wholesalers and retailers. Today, the market primarily consists of three major company groups where operations of standardized pharmacy chains are closely integrated with wholesale operations. The requirements on the logistics system in this industry are similar to those of several other retailing and fast-moving consumer goods (FMCG) industries, characterized by short lead times, high efficiency, high service levels and high flexibility.

CPFR is often defined as an initiative encompassing all jointly managed planning processes and shared information (Seifert, 2003) or as a business practice that combines the intelligence of multiple trading partners in the planning and fulfilment of customer demand (VICS Association, 2004), for example. The CPFR frameworks developed by the VICS Association have been used to structure the investigation of processes and related activities (see for instance VICS Association, 2004). The scope of collaboration encompasses four main processes; strategy and planning, demand and supply management, execution and analysis (see Figure 1-2).

ICT is dealt with as an overall concept that includes different types of applications and systems. Even though there is focus on an APS system in the case other types of ICT are also investigated, including for instance ERP systems and intranet solutions, due to the interdependence between systems. The intention has been to deal with ICT in an overall perspective to include several types of ICT that work together to support CPFR, rather than only dealing with a single type of ICT.

Current literature has been used to define relevant perspectives of ICT supported CPFR for this study. Overall perspectives of this study that are also dealt with in literature concern in which CPFR settings it is more or less appropriate to adopt ICT (e.g. ECR Europe, 2001, Barratt, 2004b, Danese, 2006a) and how the potential of ICT is exploited in CPFR (e.g. Stank et al., 1999, Barratt & Oliveira, 2001, Ireland & Crum, 2005, Petersen et al., 2005). On a more detailed level, focus of the study is on four views that are recognized in literature including ICT capabilities (e.g. Barratt & Oliveira, 2001, ECR Europe, 2001, Seifert, 2003), the impact of ICT on processes (e.g. Ireland & Crum, 2005, Smith, 2006) and on information quality (e.g. Stank et al., 1999, Moberg et al, 2002, Petersen et al., 2005) and conditions for ICT supported CPFR (e.g. Barratt & Oliveira, 2001, Barratt, 2004b, Danese, 2006b).

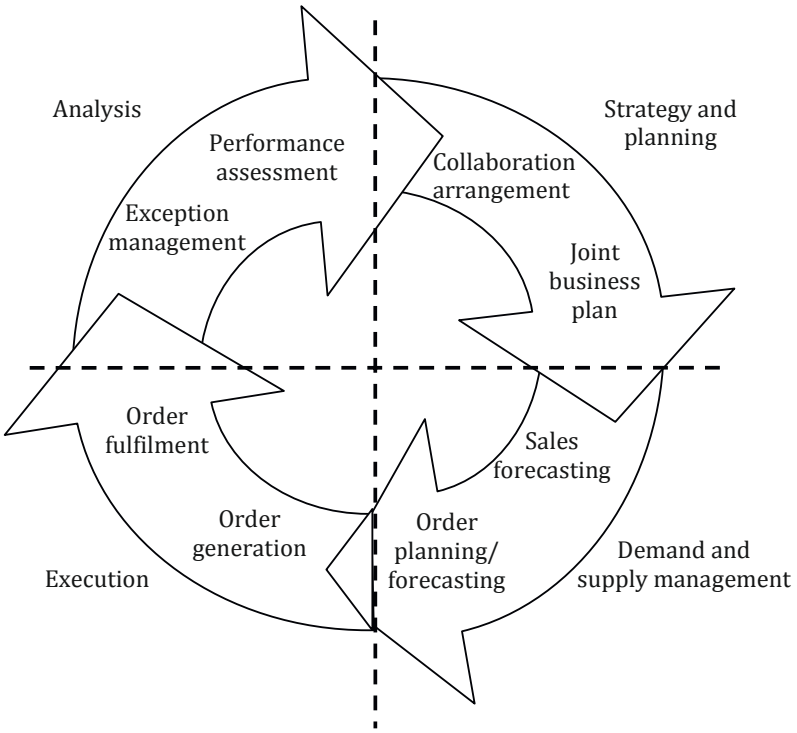

Figure 1-2 A conceptual model of CPFR processes (based on VICS Association, 2004)

1.5 EXPECTED CONTRIBUTIONS

An underlying assumption for this research is that ICT has major implications for how CPFR initiatives are designed and operated. However, characteristics of ICT supported CPFR are dealt with only to a limited extent in previous literature. These characteristics need to be further defined in order to give companies better opportunities to exploit the potential of ICT. Due to major potential benefits associated with ICT, this study is expected to challenge the relevance of establishing CPFR initiatives without taking ICT support into consideration.

This study is expected to bring further structure and increase the level of detail to the topic by increasing the understanding of characteristics of ICT supported CPFR, with focus on ICT capabilities, the impact of ICT on processes and information quality and conditions. The main product will be a framework for ICT supported CPFR that highlights relevant characteristics. A set of practical recommendations for how to exploit the potential of ICT supported CPFR will also be presented.

The primary target group is academics in the field of collaborative planning and control in supply chain contexts and with a particular interest in topics related to ICT. The thesis is also intended for academics interested in the role of ICT in collaboration on distribution and inventory management, especially related to fast-moving consumer goods (FMCG).

The results are expected to have practical relevance for the discussion in industry on how to exploit benefits of ICT to support collaboration in planning and control with supply chain partners. Therefore, managers who consider adopting ICT to support CPFR initiatives, especially in wholesaler and retailer companies in the pharmacy industry, will find this work interesting.

1.6 THESIS OUTLINE

The thesis i organized in the following chapters:

Chapter 1 Gives an overview of the research area of interest and the motivation for this research. Here, the definition of the purpose and research questions is made. Research scope and expected contributions are also described.

Chapter 2 Presents the methodological considerations. Describes the choices that were made and how the research was conducted with regard to research strategy, data collection and data analysis. The quality of research is also discussed.

Chapter 3 Defines the theoretical foundation of the research. Concepts related to planning and control in supply chains are defined, followed by a definition of CPFR with focus on processes and information flows. Describes ICT types typically used to support CPFR activities. A research framework for exploring ICT supported CPFR is also developed.

Chapter 4 Presents empirical information collected from the investigated case setting. Describes the CPFR initiative of interest, ICT capabilities and conditions and describes major changes in processes and information quality that ICT has contributed to.

Chapter 5 Empirical findings from the case with focus on the four research questions are presented and discussed in view of literature. Characteristics are defined and related propositions are stated. Presents a framework for ICT supported CPFR together with a set of propositions.

Chapter 6 Presents practical recommendations for how to exploit the potential of ICT supported CPFR based upon the results.

Chapter 7 Presents the main conclusions of the study. Its main contributions are specified and suggestions for future research are also given.

2. METHODOLOGY

This chapter presents the methodological considerations of the research. It describes choices that are made and how the research is conducted. The research strategy and design are discussed followed by a presentation of tactics and procedures for data collection and analysis. The quality of the research is also discussed.

2.1 RESEARCH STRATEGY

This research deals with the role of ICT in planning and control in a supply chain perspective. Since planning and control constitutes the primary field, this research is mainly based upon the operations management (OM) field. The OM research field is an applied field with managerial character, dealing with real world issues and problems, of a cross-disciplinary nature where new practices continuously emerge (Karlsson, 2009, Voss, 2009). Since the theme also involves ICT in a supply chain perspective, the study relates to the research fields of supply chain management (SCM) and management of information systems (MIS).

With regard to ICT supported CPFR, literature highlights several relevant characteristics. However, systematically developed knowledge of ICT in CPFR settings is limited. The research intends to contribute to enhanced level of detail and bring further structure to the topic exploring how ICT can support CPFR in order to develop a framework for ICT supported CPFR based upon relevant characteristics.

The study relies upon a qualitative research approach with a highly iterative knowledge development process. A qualitative approach is preferred because focus is on exploring how ICT can support CPFR with the intention to provide rich and detailed insights to relevant characteristics. With a quantitative approach, the study would have had a stronger focus on strict measurement and analysis of causal relationships between variables in terms of quantity, amount, intensity or frequency (see for instance Denzin & Lincoln, 1994). However, this research is carried out as an in depth investigation in order to reveal characteristics of ICT supported CPFR in its context based on qualitative measurements.

Another relevant feature is that a qualitative approach permits close access to the empirical field. Since the study seeks to investigate ICT supported CPFR and its context, it is important that the author has a close access to the study object in its natural setting in order to bring further understanding to events based upon people's own perceptions (e.g. Denzin & Lincoln, 1994, Bryman & Bell, 2003).

With regard to theory development a highly integrated and iterative approach is adopted where new knowledge is created through continuous interplay between theory and empirical observation (see Dubois & Gadde, 2002). The combining approach ensures the development of understanding of both theoretical and empirical phenomena as the author combines studies of real life settings and literature throughout the entire research process.

The initial foundation of the theory building process is further based upon empirical observation rather than theoretical hypotheses i.e. this research is closer to an inductive than a deductive theory-testing approach. With a deductive approach, this study would have typically sought to test a set of concepts that were developed in preceding theoretical work and had a stronger focus on generalization of findings (Bryman & Bell, 2003). Instead of confirming existing theory, the study seeks to summarize and structure characteristics of ICT supported CPFR and to discover important features that are not previously dealt with in literature.

In order to meet its objectives this study is based upon an overall qualitative approach and a highly iterative theory development process characterized by continuous combinations of empirical evidence and literature studies of characteristics of ICT capabilities, of the ICT impact on processes and information quality and of conditions for ICT supported CPFR. The methodological considerations are in focus in the remaining part of this chapter.

2.2 CASE STUDY RESEARCH

In order to enhance the level of detail and bring further structure to the research topic, a case study design is chosen. A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident (Yin, 2003b). The closeness of the case study to the real-life situations and its richness of details are important to provide a nuanced view of reality and to contribute to learning processes based on concrete and context-dependent experience (Flyvbjerg, 2006).

A case study design is especially appropriate for this research because (see Benbasat et al., 1987, Yin, 2003b);

- three out of four research questions deal with "how"-questions seeking to explain in what way ICT capabilities are applied and how processes and information quality are affected by ICT and such questions typically imply the investigation of links that need to be traced over time
- the author is considered to have limited control over events occurring related to ICT supported CPFR
- focus is on the current phenomenon of ICT supported CPFR in real life settings
- it allows the author to investigate ICT supported CPFR in its natural setting, learn about the state of the art and generate theories from practice
- it allows the author to understand the nature and complexity of events and processes taking place

Explorative case studies are appropriate for providing in depth insights into a little known phenomenon (Ellram, 1996). This research is of explorative nature because only few previous research studies have systematically dealt with issues of ICT supported CPFR. Even though literature recognizes ICT as a major enabler for CPFR, current knowledge of how ICT can support is not systematically structured nor developed in any large detail.

This case study is further designed for developing theory by forming a framework based upon characteristics of ICT supported CPFR that can be further investigated in later research (Eisenhardt, 1989, Dubois & Gadde, 2002, Yin, 2003a).

2.2.1 Single case design

The study is based upon the single-case design. This particular design is selected due to its appropriateness for in depth investigations (e.g. Voss, 2009). The single case design has permitted capturing details, describing the complexity of interdependent factors and taking contextual factors into consideration to a larger extent compared to when using multiple cases.

A major strength with single case design is that it ensures a high level of depth and detail of observation. In this respect, a single case study can be compared to a single self-contained experiment (Ellram, 1996); for a given set of available resources, the fewer the case studies the greater the opportunity for depth of observation (Voss, 2009). When only one case is investigated, focus is on ensuring the depth of study under resource constraints. In contrast, if a multiple case design would have been adopted, the study would have allowed less rich and less in depth case details as a consequence of that the level of detail decreases with the increasing number of cases due to limited resources.

The level of detail was especially important in this research as the scope of the study was broad. The purpose was to explore how ICT can support CPFR and the research questions aimed to reveal further details to the topic in view of four major perspectives of ICT capabilities, ICT impact on processes and information quality and conditions for ICT support. To ensure that enough detailed and in depth insights were gained about both current events and events that had occurred in the past, an iterative data collection process was necessary that extended over several years where data was combined from multiple sources. By concentrating the investigation to one single case, the necessary level of depth and detail of insights could be ensured.

A single case design is also especially appropriate for cases that are extreme, rare or unique (Yin, 2003b). Due to the generally limited adoption of advanced ICT in CPFR contexts, the case investigated represents a rather unusual situation.

A weakness with single case studies is that they have limitations to the generalizability of results; multiple case study results are usually more generalizable than the results of a single case study (Ellram, 1996, Voss, 2009). It is also argued that a single case study cannot contribute to scientific knowledge because one cannot generalize from a single case (see for instance discussion in Flyvbjerg, 2006).

However, Yin (2003b) provides support for theory development from case studies. He suggests that the concept of generalizability can have different forms and meanings and refers to analytic and statistical generalization (2003b, p. 10); *"the case study, like the experiment, are generalizable to theoretical propositions and not to populations or universes [...] the case study, like the experiment, does not represent a "sample", and in doing a case study your goal will be to expand and generalize theories (analytical generalization) and not to enumerate frequencies (statistical generalization)"*.

With regard to generalization, this case study is primarily designed to support analytic generalization as it seeks to contribute to theory development in a way that permits further replication in future studies, comparing empirical results with previously developed theory.

2.2.2 Case selection

In order to identify and select an appropriate case for this study, a set of criteria were applied.

The case had to incorporate a CPFR approach characterized by collaborative features including a high degree of trust and commitment, information-sharing, mutuality, openness and communication (see Tyndall et al., 1998, Barratt, 2004). CPFR is generally based upon closer relationships and information exchange compared to other alternatives such as VMI and continuous replenishment (CR) (e.g. Barratt, 2003) and is often associated with ICT to support the flows of information in these exchanges.

The case had to represent a functioning CPFR initiative that incorporated a wide range of products and involved collaboration on several processes rather than a minor pilot. This was important to ensure investigation of a large scale CPFR initiative in real life.

The case should involve two or more companies in a supply chain to ensure investigation in view of multiple partners rather than of a single focal company. This would ensure that the views of several partner companies were included in the study. Since CPFR generally involves collaboration on replenishment activities, it was preferable that the case represented two or more actors in a supply chain involved in replenishment of goods or raw materials.

Another criterion was that the CPFR activities had to be supported by ICT. In addition to ICT for information exchange, it was preferable that more advanced types of ICT supporting information analysis such as advanced planning and scheduling (APS)[10] or SCM systems was represented in the case, to ensure investigation of ICT that was used for analyzing information.

It was important that the case reflected a setting where the adoption of ICT had met expectations with regard to its support to CPFR activities. This was important to ensure investigation of a CPFR initiative supported by ICT that was functioning and up and running.

[10] APS systems are computer programs that use advanced mathematical algorithms or logic to perform optimization or simulation (Blackstone, 2010).

The Alliance Boots supply chain in Norway was selected as the case for this study. The case encompasses the perspective of two companies of this supply chain including the wholesaler Alliance Healthcare and the Boots retailer with 145 pharmacies. The primary study object is ICT that is used to support CPFR processes. Focus in the case is on an APS system that was specifically implemented to support the CPFR initiative.

A major strength of the Alliance Boots case is that it represents a setting where ICT has been widely adopted to support a joint planning and control approach and that the ICT investment had met expectations. This is based upon the case companies' own experiences and their internal evaluation of the ICT investment project. The ICT supported CPFR initiative is also considered an achievement in the international Boots company group and experiences from the CPFR initiative in Norway is used to improve the implementation of similar initiatives throughout the international operations of the group. To the knowledge of the author the investigated CPFR initiative is the only initiative that has been implemented with advanced ICT despite several attempts to implement similar solutions in other companies in the pharmacy industry in Norway.

That the companies are part of the same company group and thereby are related by a common ownership has been important for implementing ICT in the CPFR initiative. The joint ownership structure has ensured long term commitment to the initiative, which has facilitated the joint ICT investment as well as organizational and process adjustments.

It is an asset that the CPFR initiative is up and running and supported by advanced ICT to support information analysis at a rather large scale. The features regarding scale of implementation and level of ICT advancement are distinctive for the case in view of that the adoption of CPFR has been slow in practice and large-scale implementations have been scarce (Fraser, 2003, Barratt, 2004b, Olhager & Selldin, 2004).

As mentioned before, a particular weakness with the case with regard to generalizability is that it represents a rather unique case. A unique case may limit the generalizability of results to other collaborative settings. This means that if this study were based upon a more typical CPFR case, results might have been more representative for other settings where ICT is adopted to support collaborative initiatives. However, case findings were compared with previously developed theory to ensure generalizability of results to other CPFR contexts.

In this respect, the specific joint ownership feature may constitute a limiting factor for generalizability as this is not a distinct characteristic of CPFR. Instead, collaboration can be established between autonomous partners that operate independently of each other (e.g. Lambert & Cooper, 2000, Simatupang & Sridharan, 2005) and there are several examples of CPFR initiatives of autonomous partners that include ICT (e.g. Ireland & Crum, 2005). This means that a joint ownership is not a prerequisite but can facilitate ICT supported CPFR. The generalizability limitations of the study are further discussed in section 2.5.

2.3 EMPIRICAL DATA COLLECTION

This section describes how empirical materials were gathered. The principles of data collection applied mainly rely upon typical qualitative techniques. The information collected was also mainly of qualitative nature; only a few pieces of quantitative information were collected related to the impact of ICT on processes.

This PhD project was carried out as part of a larger research project at SINTEF between 2005 and 2008, which sought to improve the flow of goods in the entire supply chain from producers to pharmacy customers by developing a new automatic replenishment concept. The participation in the project was not critical for conducting this study but it permitted the author to become familiar with the industry context, to gain a thorough pre-understanding of planning and control practices and to discuss empirical insights from the case with other researchers who were involved in the same project.

2.3.1 Collection approach

This study is based on combinations of methods for collecting data from multiple sources. Data was collected from different sources within the case companies based on field observations, interviews and written internal documentation as well as from written published sources.

A variety of empirical sources and multiple collection methods was important to obtain a rich set of information surrounding the specific research object as well as to capture the contextual complexity. This ensures a high reliability of results (Yin, 2003b). It also means that data collecting activities were not only directed towards the search for specific data but also for discovering new dimensions of the research problem (Dubois & Gadde, 2002).

A flexible data collection approach permitted access to information with as much depth as possible to reflect the uniqueness of individual cases (Eisenhardt, 1989). This ensured that the scope could be continuously adjusted and narrowed during data collection and analysis.

In order to have high availability of detailed empirical information, it was important to have close access to the empirical setting. Access to broad and in depth knowledge about the case was ensured as company representatives showed an open attitude to visits and interviews and a willingness to contribute to the study. The author's interactions with the company were concentrated to information collection purposes. This means that the author was not involved in the daily activities carried out internally in the case companies, nor has influenced the development of the CPFR initiative.

2.3.2 Selection of sources and methods

In a supply chain perspective, it was important that data sources represented several different perspectives of both partner companies. Since the case involves the perspective of an entire supply chain of two companies, and not only of one focal firm, data was collected related to the operations of both the wholesaler and retailer with a particular focus on the collaborative approach.

The systematic combining approach implied that the data collection process was carried out in parallel with data analysis and literature studies. This permitted a flexible approach where data collection activities stretched over several years. This also facilitated the adjustment of data collection during the research process to include an appropriate mix of sources and methods.

Interviews were organized to ensure overlap of data collected from different interviewees. This was important to ensure high reliability of data. An overview of the data collection scope and roles of interviewees is presented in Table 2-1.

Among the 145 Alliance Boots pharmacies, one pharmacy was selected as the primary case pharmacy, Alliance Apotek Valentinlyst (Ladejarlen), to exemplify a typical situation of an Alliance Boots pharmacy. This pharmacy was recommended by one of the informants at Alliance Healthcare. This was selected because it represented one of the first pharmacies that had started with replenishment via the new APS system. This ensured that the pharmacy personnel had enough familiarity with the system in order to share their experiences and perceptions both from before and after the system implementation during interviews.

Table 2-1 Thematic scope and roles of interviewees

	Roles of interviewees					
Data collection scope	Retailer managers	Wholesaler managers	Pharmacy managers	IT Director	Director Wholesale	Replenishment manager
Major conditions	x			x	x	
Collaboration	x	x			x	x
Functionality of the APS system		x				x
ICT impact on information quality			x	x		x
ICT impact on processes	x	x	x	x	x	x
ICT systems, structures and functionalities	x	x		x		
Pharmacy operations	x		x			
Planning and control/information flows	x	x	x	x	x	x
Warehouse operations		x				

In order to complement information collected from the primary case pharmacy (Ladejarlen), information was also collected at a second pharmacy, Lise pharmacy (Liseapoteket Nesbru). This was an independent pharmacy that had a partner agreement with Alliance Healthcare. The Lise pharmacy was selected because it represented a situation where replenishment was carried out in a traditional manner without support from the APS system. Data from the secondary case pharmacy was used to reflect the situation in Alliance Boots pharmacies before the APS system was implemented. The Lise pharmacy was recommended by an informant at Alliance Healthcare, who also provided contact details to the pharmacy owner.

With regard to data reflecting past events, it was important to complement the data collected from field visits, interviews and observations of the primary case pharmacy with data collected from a field visit, interview and observations at the secondary pharmacy and from written material describing earlier processes to strengthen data reliability.

A main difference between the primary and secondary case pharmacy was the level of dependency. The secondary case pharmacy (Lise) was highly independent since it was owned by a pharmacist while the primary case pharmacy (Ladejarlen) was part of the Alliance Boots chain organization. Data from the secondary pharmacy was used to supplement data collected in the primary pharmacy. This means that in the empirical description, data from the secondary case pharmacy was used to support the description of the situation before the APS system was implemented in the primary case pharmacy.

2.3.3 Collection process

Interviews were carried out with individuals in order to get direct answers from interviewees. A total of 18 interviews were carried out with 12 interviewees between 2006 and 2009 (an overview of interviews is presented in Appendix 1). Each interview lasted for one to three hours. Most interviews were carried out with one respondent at a time. Only one of the interviews was carried out with two respondents present. Telephone was used for follow-up questions in cases when details in the data material needed to be further clarified.

All interviews were carried out during face-to-face meetings. Some of the interviews were conducted in parallel with site visits. Most interviews took place in the premises of Alliance Healthcare. The interviews with interviewees of the Boots administration were carried out at the joint headquarters in Oslo. Two interviews were carried out at the premises of the Norwegian University of Science and Technology and SINTEF[11] in Trondheim. Two interviews were also carried out in pharmacies.

As support for the interviews, an interview guide was developed and adjusted for each interview (examples of questions are presented in Appendix 2). The interviews were concentrated to the individuals' own descriptions of the application of ICT capabilities, conditions for ICT supported CPFR and changes in processes and information quality caused by the APS system implementation. Focus was on changes in CPFR processes and information flows i.e. on how activities were carried out today, how they used to be carried out before the APS system was implemented and on how processes and information had been affected by the APS system implementation. Open-ended questions were used at the start. More focused questions were posed as data collection proceeded.

[11] SINTEF is the largest independent research organization in Scandinavia with head office located in Trondheim in Norway.

In addition to interviews, several site visits were carried out at the two companies. These visits have permitted direct observation of planning and control practices and of physical pharmacy and warehouse operations. In addition to interviews and site visits, an internal weekly meeting was attended. This gave further insights to critical issues and work routines related to the APS system, among other things.

The analysis of empirical material was based on a comparison of CPFR processes before and after the APS system was implemented. This before and after comparison permitted the identification of process changes. In order to capture both before and after perspectives, interviewees were selected who had in depth insights to how processes were carried out after the APS system implementation as well as before. In this respect, it was important that respondents had experienced the transition themselves and could answer questions about before and after the APS system was implemented.

Most interviewees also had experience from pharmacy wholesale and retail operations including both traditional practices and activities with the new APS system. Interviewees were further selected based on their working position in the companies in the supply chain; they had to be involved in investigated processes that were carried out in a collaborative manner and with support from the APS system.

The Director Wholesale and the Replenishment Manager were principal informants during the data collection procedure. They assisted in the organization of interviews and provided contact information to most interviewees.

As suggested by for instance Voss (2005) and Yin (2003b), all interviews were carefully documented and archived. Interview write-ups were produced right after the interviews. All original interview notes were also archived together with printed copies of interview guides and records in addition to electronic copies.

With regard to written documentation, evidence was collected from unpublished internal materials including internal presentations, Alliance Healthcare partner concept description, pharmacy and replenishment performance assessment reports, organizational charts, overview of technical infrastructure, description of the flow of goods in pharmacy operations, instructions on pharmacy forecasting and ordering procedures in FarmaPro, documentation on the APS system investment evaluation, examples of e-mail communication with pharmacy assortment updates, student manual for the APS system, and lecturing notes for master students at the Norwegian University of Science and Technology.

Externally published written information directly related to the organizations of the studied supply chain was collected from their corporate web-pages.[12]

External information was also used to form the description of the industry and market context. Data was collected from several publicly available electronic sources such as web-pages and industry reports published by the Association of the Pharmaceutical Industry in Norway[13], the Norwegian Pharmacy Association[14] and the Norwegian Medicines Agency[15], for instance.

2.4 DATA ANALYSIS

The study relies upon a systematic combining approach, which has the objective to discover new things rather than test theoretical models (Dubois & Gadde, 2002). The approach, which is illustrated in Figure 2-1, stresses continuous interplay between theory and empirical observation meaning that theoretical frameworks, empirical fieldwork and case analysis evolve simultaneously (Dubois & Gadde, 2002). In view of theory-building case study research, the analysis of empirical data overlapped with data collection and was also carried out in a highly iterative way (Eisenhardt, 1989).

[12] Examples of corporate web-pages that were used include www.holtung.no, www.alliance-healthcare.no, www.boots.com, and www.boots.no.

[13] Legemiddelindustriforeningen, LMI

[14] Apotekforeningen

[15] Statens legemiddelverk

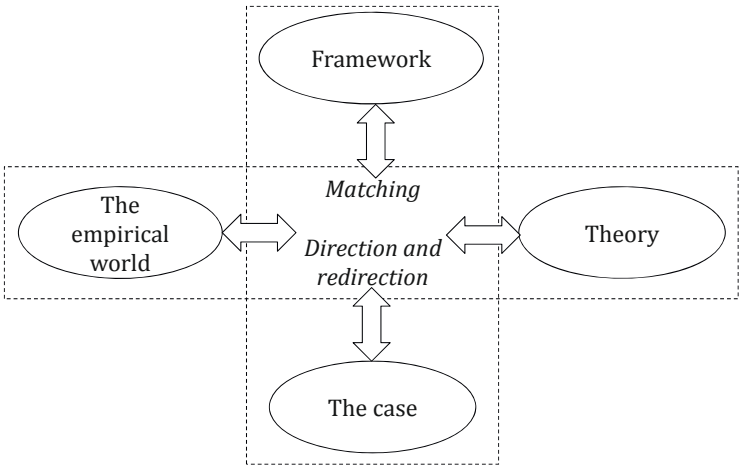

Figure 2-1 The systematic combining approach (Dubois & Gadde, 2002)

The approach is about matching between theory and reality and direction and redirection of the study i.e. going back and forth between framework, data sources and analysis. This means that theory and the empirical world were continuously confronted during the research process through an evolving research model and evolving case. The approach permitted a high level of flexibility where literature helped to guide the scope of the empirical study and vice versa.

A theoretical framework was continuously developed during the research process (see chapter 3). The evolving framework was important to ensure theoretical flexibility as the need for theory was created throughout the research process (Eisenhardt 1989, Dubois & Gadde, 2002). The initial version of the framework was developed based upon preconceptions to define an initial scope for the empirical study. The original framework was successively modified as a result of unanticipated empirical observations and of theoretical insights gained during the process.

The empirical investigation and the theoretical framework were continuously and mutually adjusted throughout the process. One example is the standardising capability of the investigated APS system that was observed during the empirical data collection and analysis. This observation inspired to further literature studies on the subject that led to adjustments in the research model to also include this capability, which had not been identified in literature at the start of the investigation.

Literature searches and reviews were carried out in parallel with empirical data collection and analysis to continuously give support to and develop the research model. Continuous searches also permitted incorporation of newly published works and studies. The literature primarily included text books and articles in academic journals found via the search engines of the university library information system and databases[16]. Terms used for searches included various combinations of relevant concepts such as supply chain collaboration, ICT capabilities, APS systems, CPFR, collaborative planning and control and information quality.

2.4.1 The case description

The empirical study resulted in a detailed description (chapter 4). This description was based upon information collected from a mix of sources including interviews, documentation, field visits and observations. The case is presented as an aggregated picture where no specific distinction is made between different information sources.

The written description follows the form of a classic or traditional single-case study proposed by Yin (2003b) where a narrative including figures and tables was used to describe and analyze the case. The detailed case study write-up was central to the generation of insight since it helped to organize the large volume of data early in the analysis process and gave the author rich familiarity with the case (Eisenhardt, 1989).

The purpose of the case description is to present detailed empirical evidence in an organized and structured format. The theoretical framework has constituted a support for organizing the data in the presentation. As suggested for instance by Eisenhardt (1989), contextual data was also included in the presentation to provide a good understanding of the conditions and circumstances that could explain occurrence of events.

To create this description, a number of steps were taken. Transcripts of interviews were gathered together with additional documents and other materials. These were further organized and analyzed to form a case description. Detailed process illustrations were developed to support the description in the text.

[16] Examples of search engines and databases that were used include Science Direct, ProQuest ABI/Inform and SCOPUS.

A few quotations are presented in the description. These were selected from interview materials and reconstructed from detailed transcripts based on notes taken during interviews. Since the interviews were not recorded, the quotations are approximate as they do not correspond word by word to interviewees' statements. However, it was possible to reconstruct statements from the detailed notes that were taken during all interviews.

2.4.2 Developing the framework for ICT supported CPFR

A framework for ICT supported CPFR was developed in this study (see section 5.5). The framework summarizes the main results regarding characteristics of ICT supported CPFR that are defined based upon empirical evidence and literature studies.

The framework was developed based upon the characteristics defined related to the four research questions. These were in turn defined by gathering and organizing results of the four research questions on relevant characteristics. The analyses related to the research questions followed a highly iterative process; data analysis was carried out in parallel with both data collection and literature studies. This permitted adjustments of the focus in the empirical inquiry as well as scope of literature studies.

In order to further clarify the contribution to theory development of this research, a set of propositions were also developed (suggested by for instance Eisenhardt, 1989 and Yin, 2003b). Propositions were developed both for each research question and for the summarizing framework. The framework and propositions intend to constitute a starting point for further research in which assumptions may be further verified and refined.

While the data collection approach was similar for the four research questions, different analytical approaches have been applied to define characteristics of ICT capabilities, of the impact of ICT on processes and information quality and of conditions for ICT supported CPFR. These approaches are described in more detail next.

With regard to the first research question dealing with ICT capabilities, empirical evidence was collected from the case companies and a theoretical framework was developed based upon literature studies. The framework was initially used to structure the empirical investigation and was developed as further empirical insights were gained. Five different ICT capabilities dimensions were defined in the framework. Empirical observations were categorized according to these dimensions by a qualitative evaluation in terms of their importance for supporting the joint initiative and of how they were related. Relevant characteristics of ICT capabilities were identified in the case based upon the categorization. These were compared to current literature in order to define characteristics of ICT capabilities and a set of propositions.

The analysis of the second research question on the impact of ICT on CPFR processes started with the collection of empirical case evidence and the identification of an appropriate three-dimensional theoretical framework in literature. The impact of ICT on processes was identified based upon case evidence on process changes combined with data on processes before and after the APS systems was implemented. The empirical evidence was classified according to the categories of the framework based upon a qualitative evaluation in terms of nature and importance. Relevant characteristics were identified based upon the categorization and findings were compared to current literature. This led to the definition of characteristics of the ICT impact on CPFR processes and a set of propositions.

In order to answer the third research question, a theoretical framework of five information quality attributes was developed based on literature. The framework was used to define the scope of data collection from the case and to categorize empirical evidence. Information quality changes were identified by comparing information quality before and after the APS system was implemented. Changes were qualitative evaluated in terms of how information quality changes were related to ICT support. Relevant characteristics were identified based upon the categorization and empirical findings were compared to current literature. This led to the definition of characteristics of the ICT impact on information quality and a set of propositions.

With regard to the fourth research question, literature was used to define major conditions for ICT supported CPFR. Empirical evidence was collected from the case and evaluated in terms of how these conditions were related to ICT and their importance for implementing ICT to support CPFR activities. Focus was on identifying relevant characteristics of these conditions. Findings were discussed in view of current literature. This led to the definition of characteristics of conditions for ICT supported CPFR and a set of propositions.

2.5 RESEARCH QUALITY

In order to ensure reliability, the data collected was carefully organized and documented throughout the research process. For each interview, the interview transcript, interview guidelines, original notes, documents and other empirical evidence were systematically filed to facilitate review and replication of research.

To ensure construct validity, multiple sources of evidence were used and empirical data was collected from overlapping sources including interviews, observations, field visits and written documentation. Data sources represented different perspectives of the topic to ensure overlap of data. Case insights were continuously discussed with fellow researchers who had experience from the empirical setting. Also, several draft versions of the case study description were reviewed by informants.

It was expected that the collection of data on processes and information quality before the APS system was implemented was going to be a challenge due to risk of limitations of respondents' ability to remember details of past events. Therefore, the majority of interviewees selected had practical experiences from the situation before as well as after and could therefore provide in depth insights to these situations.

In order to limit the delay of data collection from the occurrence of earlier events, several interviews were conducted during the autumn of 2006, which was close in time to the roll-out of the new APS system. To further ensure validity of historical evidence representing the past situation, data from interviews was combined with written documentation and data was also collected at an independent pharmacy.

A highly iterative process was applied in data collection, with regard to the number and content of the interviews to ensure that enough detailed insights to the topic could be captured. Empirical investigation was initially broad in scope and the scope was narrowed down as new insights were gained: late phases in data collection were more focused on obtaining targeted information, filling gaps and confirming previously collected data. This means that only a few data sources were defined at the start of data collection and that more sources were added continuously in parallel with data analysis.

Moreover, as the data collection process proceeded, the empirical data collected at the later stages became more and more overlapping with previous interviews. Later interviews could therefore be concentrated to revealing details and gaining more and more in-depth insights to the topic. As the level of repetitions of insights increased in the data collection process and a thorough understanding was developed, the further need for collecting more empirical evidence was reduced.

The empirical data could not reveal that ICT had had any major negative impact in the case. A possible reason for this is that interviewees were convinced of the major benefits of the new ICT system and consciously avoided speaking about any drawbacks, in order to reduce the risk of paying too much attention to any negative implications. Even though the ICT system would have implied some negative consequences, it can be assumed that these would be of minor importance compared to the significance of positive benefits that were identified. Literature that discusses negative consequences of ICT supported CPFR have not either been identified.

As mentioned earlier results that are based upon a single case study limits the transferability of results to other contexts (e.g. Yin, 2003b). This means that the results of this case study are generalizable only to contexts that are similar to the one investigated in the case, and that further studies are needed before results can be validated in other contexts. However, in order to ensure validity of results in other contexts, the findings of this study were compared to current literature. The generalizability of results is expected to depend upon specific features of the case that limits or facilitates generalization to other settings.

It is expected that the results are valid for other industries that have similar requirements on the logistics system as the pharmacy industry. The logistics requirements of the investigated case are characterized by short lead times, high efficiency, high service levels and high flexibility. Another industry specific characteristic is the frequency of ordering and deliveries, which in the case is high with daily deliveries and daily ordering. Several of these characteristics are similar to those of other retailing and FMCG industries. Results are therefore representative for other settings in the pharmacy industry as well as other FMCG industries.

Results are expected to be valid for collaboration initiatives for moving goods downstream in a supply chain, either between wholesaler and retailer stages or between producer and retailer stages. This is because collaboration forms on replenishment of finished goods are assumed to have similar characteristics regardless of whether goods are replenished to a retailer from an inventory of a producer or a wholesaler.

It is expected that results are valid for settings where other types of analytical ICT are adopted and not only limited to the type of APS system that was investigated in the case. A specific feature of APS systems is that they use advanced mathematical algorithms or logic to perform optimization or simulation and thus hold a strong analyzing capability. It is therefore suggested that results are valid for settings where other types of APS systems are adopted.

Another feature that is specific for the case setting is the ownership structure. This is not a distinct characteristic of CPFR. Even though results are based upon a case where ownership relations have facilitated ICT supported CPFR it is expected that results are also valid for CPFR initiatives between more autonomous partners.

To conclude, several tactics have been applied to ensure the quality of this research. Data has been carefully organized and documented throughout the research process to ensure reliability. Construct validity has been ensured by adopting a highly iterative process in data collection to capture enough detailed insights to the topic. Moreover, empirical evidence has been based upon a combination of multiple sources that were also overlapping and upon multiple data collection methods including interviews, observations, field visits and written documentation. Generalizability is often recognized as a major research quality challenge to single case studies. By continuously comparing empirical findings to current literature, results are expected to be generalizable to other contexts.

3. FRAME OF REFERENCE

This chapter defines the theoretical foundation of the research. The frame of reference is divided into three major parts. The first section defines relevant terms and concepts related to planning and control of operations in supply chains. Next, the concept of CPFR is defined with focus on processes and information flows. ICT related concepts are defined and a research framework for exploring ICT supported CPFR is also presented in the third section.

3.1 A SUPPLY CHAIN PERSPECTIVE ON PLANNING AND CONTROL

This research deals with the role of ICT in planning and control in a supply chain perspective. Focus in this section is on clarifying relevant concepts and terms that the investigation is based upon.

3.1.1 Replenishment in supply chains

A supply chain perspective of material flows and physical operations is applied in this study. The choice of adopting the scope of a supply chain instead of a single company is the supply chain management (SCM) concept suggesting that business competition takes place between supply chains rather than individual companies (e.g. Cooper et al., 1997, Mentzer et al., 2001). SCM is about efficient integration of suppliers, manufacturers, warehouses and stores so that goods are produced and distributed at the right quantities, to the right location and at the right time in order to minimize system wide costs while satisfying service level requirements (Simchi-Levi et al., 2003). The APICS further defines SCM as the design, planning, execution, control and monitoring of activities in a supply chain with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronizing supply with demand and measuring performance globally (Blackstone, 2010).

The SCM perspective in this study implies that focus is on the matching of supply and demand across the entire supply chain, as a global system, rather than sub-optimization of individual companies based on a local interest.

The supply chain concept

There are several definitions of the supply chain concept in literature. This study is based upon the definition of a supply chain by the Council of Supply Chain Management Professionals (CSCMP, 2010):

"1) starting with unprocessed raw materials and ending with the final customer using the finished goods, the supply chain links many companies together,

2) the material and informational interchanges in the logistical process stretching from acquisition of raw materials to delivery of finished products to the end user. All vendors, service providers and customers are links in the supply chain."

This definition highlights several components that are of interest for this study; the flow of materials and information, a logistics perspective, linkages between suppliers and customers and several companies involved in providing goods to a final customer. It is also simple and is often referred to in literature. In addition, since the CSCMP is dedicated to the advancement and dissemination of research and knowledge on supply chain management and has over 8500 partners (CSCMP, 2011), the views and definitions that it communicates are representative for both supply chain academics and practitioners.

A conceptual view of a simplified supply chain is shown in Figure 3-1. It shows that supply chains usually involve several companies that are related via flows of products and services, information and money that typically go in both directions.

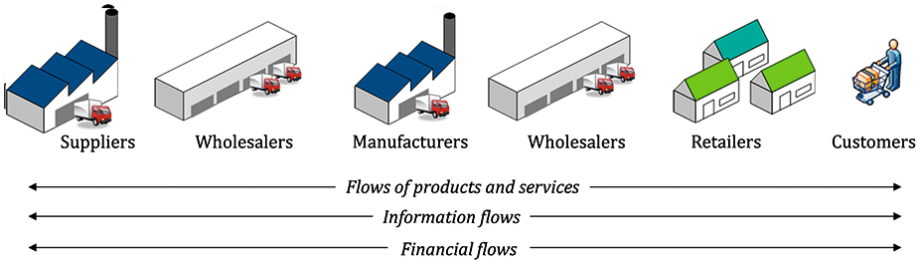

Figure 3-1 A conceptual view of a supply chain (based on Coyle et al., 2009)

In general, the physical material flows downstream i.e. towards the demand side of the supply chain, from the manufacturer to the final user or consumer while the information flows in an upstream direction i.e. towards the supply side of the supply chain including suppliers who provide goods and services to the organization needed to satisfy demands which originate at point of demand or use (CSCMP, 2010). Examples of flows that usually go in reverse direction are the upstream flow of returned goods and downstream flow of shipping information.

The scope of a supply chain may include either the entire chain or smaller parts of the entire entity. A common approach is to consider supply chains in a dyadic perspective; a dyadic supply chain refers to a party's or company's linkages to another immediate party either one stage upstream or one stage downstream (Cooper et al., 1997). Supply chains may also be investigated from the perspective of one single company or a focal company and its relations to customers and suppliers. This study has a collaborative view on supply chains where focus is on the relationship between two or more partners. This means that an overall view of the supply chain consisting of several companies is taken into consideration as a whole, rather than studying the supply chain from the perspective of a single focal company.

This perspective implies that processes of several partners in a supply chain are taken into consideration. The supply chain operations reference (SCOR) model defines five standard business processes of supply chains including plan, source, make, deliver and return (see for instance Bolstorff & Rosenbaum, 2003 and Jonsson, 2008). The SCOR processes in a supply chain involving a customer and a supplier are shown in Figure 3-2. They are also briefly described below.

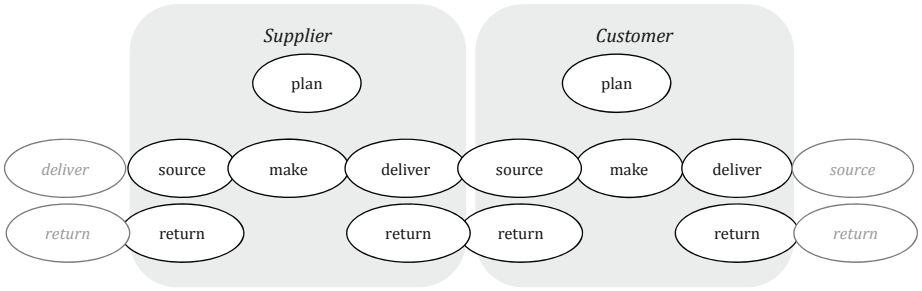

Figure 3-2 SCOR based on five standard processes (based on Bolstorff & Rosenbaum, 2003, Jonsson, 2008)

- Plan: Processes that balance aggregate demand and supply to develop a course of action which best meets sourcing, production, and delivery requirements.
- Source: Processes that procure goods and services to meet planned or actual demand.
- Make: Processes that transform product to a finished state to meet planned or actual demand.
- Deliver: Processes that provide finished goods and services to meet planned or actual demand, typically including order management, transportation management, and distribution management.

- Return: Processes associated with returning or receiving returned products for any reason including post-delivery customer support.

The replenishment concept

In this study, focus is primarily on distribution and replenishment of goods rather than on manufacturing operations. Distribution refers to activities associated with moving materials from source to destination (CSCMP, 2010). Distribution typically implies the downstream movement of goods, from a supplier stage (e.g. manufacturer or distributor) to a customer stage (e.g. customers or retailers) or other secondary warehousing or distribution points (Slack et al., 2001, Chopra & Meindl, 2007, CSCMP, 2010).

Replenishment constitutes a part of distribution. Replenishment refers to the process of moving or re-supplying inventory from a reserve (or upstream) storage location to a primary (or downstream) storage/picking location, or to another mode of storage in which picking is performed (CSCMP, 2010). This means that replenishment is not limited to only moving goods from a distributor to a retailer. The term can be used for the transfer of goods between other stages in a downstream direction, for example from a manufacturer to a distributor or to a retailer.

According to CSCMP (2010), a retailer is an organization which purchases products from a manufacturer or distributor and resells them to the ultimate consumer. Moreover, a wholesaler (or a distributor) is a business which acts as a third party local representative and distribution point for manufacturing firms and generally provides a buffer for finished goods. Wholesalers typically purchase goods in quantity from manufacturers and ship to customers in smaller quantities.

A conceptual view of the material flow related to distribution in a wholesaler and retailer supply chain is shown in Figure 3-3.

Distribution usually involves the handling, storage and transportation of goods (Jonsson, 2008). Wholesale operations take place in a warehouse and retail operations in stores. Warehouse operations include handling and storage of goods; receiving inventory, storing it, assembling (picking and packing) it into complete orders and making customer shipment (Bowersox et al., 2007). Transportation is carried out to move goods between geographically separated locations in the supply chain by using different traffic modes (Jonsson, 2008). In retail stores, operations typically include receiving goods, storing them and selling them to consumers.

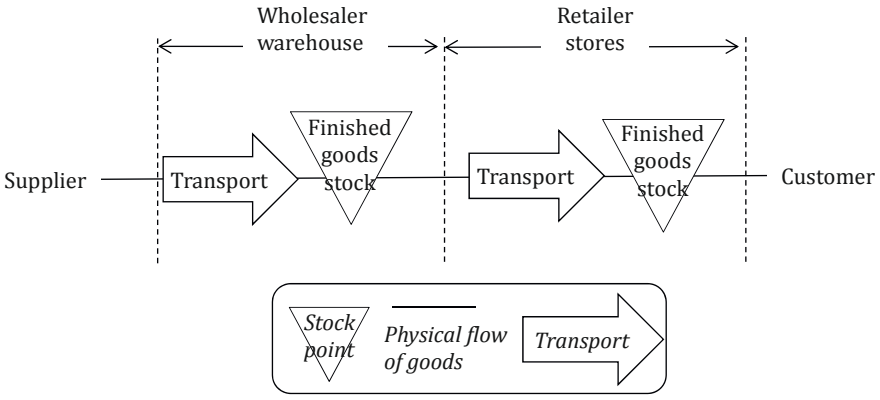

Figure 3-3 An example of a material flow in a wholesaler and retailer supply chain (based on Jonsson, 2008)

Inventories are associated with the physical storage of goods. An inventory encompasses all components, raw materials, work in process, finished goods and supplies within a supply chain (Chopra & Meindl, 2007, CSCMP, 2010). The term inventory may also refer to the number of units and/or value of the stock of goods held by a company (CSCMP, 2010).

In order to manage operations in a supply chain, administrative planning and control activities are carried out. These activities can be carried out jointly between the partners in a supply chain. The concept of planning and control related to replenishment is further defined next.

3.1.2 Planning and control of replenishment

As stated earlier planning and control is a challenge for many companies as it involves a wide range of decisions spanning from long term strategic to more short term operational perspectives, related to for instance demand and resources planning, production scheduling, sales and operations planning and capacity planning (Vollmann et al., 2005). Furthermore, joint planning and control approaches for matching demand and supply in the supply chain, have emerged along with SCM (Stadtler & Kilger, 2008).

The administrative activities that are carried out to ensure the flow of materials and information in a supply chain often refer to operations management (OM). According to the APICS OM is about "*planning, scheduling, and control of the activities that transform inputs into finished goods and services"* (Blackstone, 2010). OM is also about managing operations processes to create outputs of goods and services which satisfy customer needs (Slack et al., 2001).

In contrast to OM, which primarily is concentrated to internal day-to-day operations in a single company perspective, the concept of SCM comprises the management of operations that involve several stages in a supply chain.

The concept of planning and control

In this study, the main principle of planning and control is to ensure the running of operations to produce and distribute products and services according to customer demand, i.e. matching of demand and supply (e.g. Slack et al., 2001; Vollmann et al., 2005).

There is a slight distinction of what is planning and what is defined as control (Slack et al. 2001); planning is a formalization of what is intended to happen at some time in the future and activities could include loading, sequencing and scheduling while control is the process of coping with changes in these variables. These activities are therefore related to more immediate actions and interventions required for the execution of planned activities such as monitoring and surveillance. In this thesis however, no specific distinction is made between the two terms and the term planning is also sometimes used when referring to planning and control.

Literature propose several frameworks for defining planning and control in manufacturing environments including for instance the manufacturing planning and control (MPC) framework by Vollmann et al. (2005) and the supply chain planning matrix in Stadtler and Kilger (2008). Even though they are mainly focused on manufacturing operations, these frameworks constitute an appropriate foundation for defining characteristics of planning and control that are relevant also for other companies, besides manufacturers. For example, distribution and demand planning activities in a manufacturing company are assumed to be similar to activities of a wholesaler.

Planning and control is assumed to constitute a part of SCM, with as specific focus on activities carried out for matching supply and demand. While SCM comprises all types of administrative processes necessary to ensure the flow of goods in a supply chain, the planning and control perspective implies a specific focus on ensuring that the operations' processes run effectively and efficiently and produce products and services as required by customers (Slack et al., 2001).

Planning and control activities are usually related to different types of operations. In a distribution setting planning deals with inbound and outbound transportation, warehouse management, setting inventory levels, put-away and picking, packaging and loading, and various administrative functions (CSCMP, 2010). Distribution capacity planning is about ensuring that needed resources such as distribution centre capacity and transportation vehicles, are available at the right time and place to meet logistics and supply chain needs (CSCMP, 2010).

The planning and control scope in this study primarily includes the administrative tasks required for moving inventory downstream in a supply chain, with focus on demand planning and replenishment planning. Demand planning is the process of identifying, aggregating, and prioritizing, all sources of demand for the integrated supply chain of a product or service (CSCMP, 2010). Forecasting often constitutes a critical component in demand or sales planning activities (e.g. Fleischmann et al., 2008); while the forecast refers to the demand pattern and the plan constitutes the company's response to the forecast (e.g. Vollmann et al., 2005).

Replenishment planning is the process of identifying, prioritizing, and aggregating all sources of supply that are required for replenishing a downstream inventory from an upstream storage location (CSCMP, 2010). Replenishment planning typically deals with (Slack et al., 2001, Ross, 2004, Chopra & Meindl, 2007);

- the selection of the inventory ordering policies (how to control the system) that are to guide the determination of what products needs to be ordered,
- when orders should be released (timing or when to order) and
- what should be the order quantity (volume or how much to order)

Replenishment planning and control is important for meeting required demand at a minimum cost. This is often done by optimizing customer service, inventory costs and operating costs (Wild, 2002).

Replenishment tasks and decisions

When planning and control related tasks are discussed in literature, they are often seen in view of different planning levels including strategic, tactical and operational, depending on the time horizon (Fleischmann & Meyr, 2003, Chopra & Meindl, 2007, Fleischmann et al., 2008, CSCMP, 2010);

- For a long-term perspective, the design or structure of the physical distribution in the supply chain is typically defined for the next several years.
- Decisions are considered to be of a tactical nature when the time frame considered is between strategic and operational i.e. from monthly or quarterly to yearly. Tactical decisions typically deal with defining quantities and timing of flows and resources within the supply chain and establishing policies for distribution and inventory operations.
- Operational planning, involves establishing detailed instructions for immediate execution and control.

Typical characteristics of decision-making in the three different planning levels are (Fleischmann & Meyr, 2003, Chopra & Meindl, 2007);

- The level of uncertainty in planning activities; the longer planning horizon, the higher is the uncertainty.
- Frequency in planning activities is considered to vary with the length of the planning horizon.
- Planning tasks on different planning levels need a different degree of aggregation in terms of time, place, products and resources.
- Decisions are of different importance and need to be made by decision maker with more or less responsibility and influence; the longer the impact of a decision can be noticed, the higher rank of the decision maker in the organizational hierarchy and the more the decision is prepared and or made by a centralized instead of a decentralized planning unit.

In a replenishment setting, a wide range of decisions need to be dealt with at different planning levels, see typical examples of decisions in Table 3-1.

Even though the three-folded structure is rather clear-cut, the different planning levels are often overlapping and there are often major variations in time horizons related to the levels. For example, Jonsson (2008) pointed out that it is sometimes difficult to make a clear distinction between decisions at different levels because the levels interact; a decision in a certain context can be of an operative nature although it can have a strategic importance in another context.

There can also be confusing overlaps between tactical and operational planning tasks and decision-making. Tactical planning can for example be defined as the process of systematic determination and scheduling of immediate or short-term activities required to achieve the objectives of the organizations strategic plan (CSCMP, 2010) and the operational level can include both mid-term and short-term planning (Stadtler & Kilger, 2008).

In addition, the time horizon associated with the different levels can vary between different settings; a supply chain with daily deliveries can have shorter decision-making time frames for all three levels while a supply chain with monthly deliveries may operate with longer overall time frames across the three levels. This means that the time horizons of different planning levels are assumed to be relative rather than absolute i.e. what may be a long-term time horizon in one setting may correspond to a mid-term time horizon in another. There is thus no clear distinction between different levels. The three-folded structure still gives a general indication to the character of different types of planning decisions.

Table 3-1 Examples of inventory decisions at various planning levels (based on Fleischmann & Meyr 2003, Ross, 2004, Chopra & Meindl, 2007)

Planning level	**Examples of inventory related decisions**
Long-term	Aggregate sales forecast Aggregate inventory level Physical structure: number and sizes of warehouses and cross docking points and related transportation links
Mid-term	Sales forecast on product group level Necessary inventory levels and transportation
Short-term	Detailed sales forecast or customer orders Detailed replenishment plan: daily quantities per item Fulfilment of replenishment orders and monitoring status of items

The table shows a wide range of decisions related to inventory management at different planning levels. In a supply chain perspective, partners may choose to collaborate on these decisions. When collaboration concerns decisions related to replenishment, it is especially important that partners also agree upon a joint sales forecast based upon information of historical sales and predictions of future customer demand related to planned sales and marketing activities (e.g. Helms et al., 2000).

Planning and control methods for replenishment

Methods for planning and control of replenishment are related to the planning and control processes investigated in this study. These methods are not in focus in the study and are therefore not subject to further investigation. The term method is used and it may also refer to models, techniques, mechanisms, principles and procedures (e.g. Ross, 2004, Vollmann et al., 2005).

In general, the objective of replenishment methods is to ensure that the optimum inventory level for each item is maintained at a targeted service level (Ross, 2004). Methods are thus usually based on the optimization of customer service, inventory costs and operating costs (Wild, 2002).

There are a large amount of methods that can support decision making related to inventory planning and control. Examples are order point methods and distribution requirements planning methods. Recent operations research progress and advances in ICT developments have created new opportunities for the development of more sophisticated and efficient inventory control methods (Axsäter, 2006). ICT has helped to set inventories based on historical demand and desired service levels; ICT allows the analysis for a large number of SKUs and for the inventory levels to be recalculated as demand changes (Chopra & Meindl, 2007). Modern inventory control thus involves advanced and complex mathematical and computerized decision methods that typically require considerable computations efforts (Ross, 2004, Axsäter, 2006). This means that ICT is assigned a particular role in inventory planning and control providing support to advanced and complex mathematical replenishment planning methods.

3.2 COLLABORATIVE PLANNING, FORECASTING AND REPLENISHMENT

CPFR, or collaborative planning, is the collaborative planning and control setting that is in focus in this study. A broad definition of CPFR is adopted; CPFR represents a general approach that combines the intelligence of multiple trading partners to coordinate the planning and fulfilment of customer demand (Skjøtt-Larsen et al., 2003, VICS, 2004). According to the APICS, CPFR encompasses business planning, sales forecasting, and all operations required to replenish raw materials and finished goods (Blackstone, 2010).

The CPFR concept was selected because it is generally characterized by intensive collaborative efforts, high demands on relationship quality, and on quality and intensity of information exchange (Seifert, 2003). Moreover, CPFR is usually associated with ICT although it is not necessarily dependent upon ICT (e.g. VICS, 1999, 2002, Ireland & Crum, 2005, Chopra & Meindl, 2007).

This section defines supply chain collaboration and the concept of CPFR. It also describes processes, activities and information flows that are in focus in the study.

3.2.1 Collaboration in supply chains

The concept of collaboration

Relationships between customers and suppliers in supply chains may take different forms (e.g. Jagdev & Thoben, 2001, Soosay et al., 2008). The majority of business transactions take place in arm's-length relationships, which represent the traditional way of doing business, building on short-term arrangements (Hoyt & Huq, 2000, Simchi-Levi et al., 2003). These relationships also refer to open-market negotiations where customers and suppliers are independent and the relationship connections are mainly concentrated to price discussions and where there is basically no real integration between the trading companies (Tyndall et al., 1998).

When relationships are based upon some form of formal agreements, one may speak of supply chain alliances (Hoyt & Huq, 2000). Alliances are typically of strategic character and reflect multifaceted, goal-oriented, long-term customer-supplier partnerships in which both risks and rewards are shared (Simchi-Levi et al., 2003).

Collaboration is a broad and encompassing term associated with relationships based upon trust and mutual commitment (Hoyt & Huq, 2000). Collaborative relationships incorporate the goal of working together in some mutually defined ways by a formal agreement (Kilger et al., 2008). In this study, supply chain collaboration refers to a relationship between partners in a supply chain that is based upon a formal mutual agreement and incorporate joint work and communication to achieve a common business goal or to develop a common and mutually agreed plan (Kilger et al., 2008, CSCMP, 2010). In this study, the term collaboration is used referring to supply chain collaboration.

Two terms that are often associated with collaboration in literature, include coordination and cooperation (e.g. Tyndall et al., 1998). Collaboration involves cooperation between partners, in the overall sense that partners make a common effort (Soosay et al., 2008, Merriam-Webster, 2011). A supply chain is coordinated when decisions are aligned to accomplish overall objectives (Sahin & Robinson, 2002). Collaboration reflects a higher level of integration and relationship intensity compared to coordination and cooperation and is characterized by a high degree of trust, commitment, information-sharing, mutuality, openness and communication (Tyndall et al., 1998, Barratt, 2004).

Another related concept is supply chain integration. Even though the integration concept lacks a clear definition and understanding (e.g. Fabbe-Costes & Jahre, 2008), it is often used in literature for describing the nature of various links or relationships that are established between companies in a supply chain based upon processes, information, organisations and technologies, for instance (Stevens, 1989, Bagchi & Skjøtt-Larsen, 2002, 2003, Lee et al., 2004). Compared to the coordination and cooperation concepts collaboration is the level that best corresponds to high supply chain integration (Tyndall et al., 1998).

Examples of collaboration concepts

Collaboration can take different forms in practice (e.g. Skjøtt-Larsen et al., 2003, Småros, 2003, Holweg et al., 2005) and include various dimensions such as collaborative performance system, information sharing, decision synchronization, incentive alignment, and process integration (Simatupang & Sridharan, 2005).

There is a wide span of collaboration concepts related to inventory replenishment in literature. A basic feature of these concepts is that the supplier takes replenishment decisions based on information regarding product usage and inventory levels that is provided by the customer (Ellinger et al., 1999, Raghunathan & Yeh, 2001, Angulo et al., 2004). A brief overview of collaboration concepts is given next.

The quick response (QR) concept, which was developed in the apparel industry, is based on that activities are primarily linked to customers' needs and behaviours through information exchange and that material flows are synchronised to consumer demand (Sabath et al., 2001, Mattsson, 2002). QR is primarily applied between manufacturers, wholesalers and retailers in consumer goods industry, and especially in distribution of final goods (Mattsson, 2002).

The efficient consumer response (ECR) concept is more extensive compared to QR as it besides synchronised and demand driven replenishment, also involves some tactical and strategic elements for the introduction of new products, promotion and marketing, assortment control and category management (Mattsson, 2002, Sabath et al., 2001). ECR is primarily used between producers, wholesalers and retailers in grocery distribution (Mattsson, 2002).

Vendor managed inventory (VMI), which is also known as supplier-managed inventory, mainly originates from QR and ECR (Waller et al., 1999). In VMI, replenishment is triggered by sales data provided to the supplier by the customer and the supplier has the main responsibility for replenishment (Sabath et al., 2001). As responsibility is transferred to the supplier in VMI, the customer is responsible for ensuring that information regarding current inventory levels and demand information such as current sales figures, forecasts, delivery plans is transferred to the supplier (Mattsson, 2002). VMI is widely practiced in the retail industry applied by manufacturers such as Kraft Foods, Procter and Gamble and retailers such as Wal-Mart (Ganeshan, 2001).

Continuous replenishment programs (CRP) are similar to VMI as replenishment is triggered by sales data provided to the supplier by the customer. However in CRP, the customer makes the replenishment decisions (Sabath et al., 2001)

Automatic replenishment programs (ARP) is an umbrella concept for initiatives such as ECR, QR, CRP and VMI where replenishment is triggered by actual sales figures rather than on forecasts and safety stock buffers (Sabath et al., 2001).

3.2.2 A CPFR framework

CPFR characteristics

CPFR is an evolution and refinement of the original ECR concept that is characterized by intensive collaborative efforts, high demands on relationship quality and intensity and quality of information exchange (Seifert, 2003). CPFR may also refer to collaborative planning (Blackstone, 2010).

CPFR involves the alignment of plans and forecasts of individual partners. Collaborative forecasting is about developing and using common and agreed forecasts that are used as a basis for planning activities and operations in partner organizations (Helms et al., 2000, Jonsson, 2008). In contrast to traditional forecasting methods where each trading partner developed its own forecast for an item and each forecast was different for each partner, CPFR allows partners to agree to a single forecast for an item where each partner translates this forecast into a single execution plan (Coyle et al., 2009).

The concept was originally developed as industry standards by the Voluntary Interindustry Commerce Solutions (VICS) Association (Ireland & Crum, 2005). However, the CPFR concept represents a more general approach in this study (e.g. Skjøtt-Larsen et al., 2003). The reason for this is that companies can establish CPFR initiatives, without explicitly following the industry standards suggested by the VICS Association. The intention of this study is to investigate the general approach of CPFR rather than limiting the study to CPFR initiatives that are based upon he VICS standards only. Nevertheless, the VICS standards are used for defining an appropriate scope for the investigation especially related to processes and information flows.

Pramatari et al. (2002) suggest that the implementation scope of CPFR can be characterized according to four dimensions including place, product, time and information sharing, see Table 3-2. A limitation with the framework in view of this study is that the ICT dimension is not taken into consideration.

Table 3-2 A framework for characterizing implementation scope of CPFR initiatives (Pramatari et al., 2002)

Dimensions	Description
Place	CPFR principles may be applied for the replenishment of a retail distribution centre (DC) or at a store level. CPFR may also be applied up-stream in the value chain, focusing on the replenishment of the DC of a manufacturer.
Product	CPFR projects may cover only products from non-regular lines (e.g. seasonal items, promotional items and new products), all the products of a specific category, or all the products supplied.
Time	CPFR initiatives may be based upon different time horizons of a sales/ or order forecast and the frequency of collaboration. Time horizons of a monthly, weekly or daily basis may be applied.
Information sharing	CPFR may be based on different types of information shared among the collaborating partners. Typical examples of information that are shared are POS data and promotional plans. Other information, such as stock levels information, may also be exchanged when there is focus on the replenishment process.

Processes and activities

This section defines typical planning and control processes and activities of CPFR based upon literature. It aims to present the general theoretical foundation of CPFR that is used for guiding the investigation.

The CPFR framework provided by the VICS Association is selected as a general framework for defining main processes and activities of CPFR. References from the VICS Association (2002, 2004) and ECR Europe (2001, 2002) are applied for describing these processes unless other is stated.

CPFR is based upon four major processes, see Figure 3-4, and partners may choose to collaborate along only one, several or all processes (VICS, 2004, Chopra & Meindl, 2007).

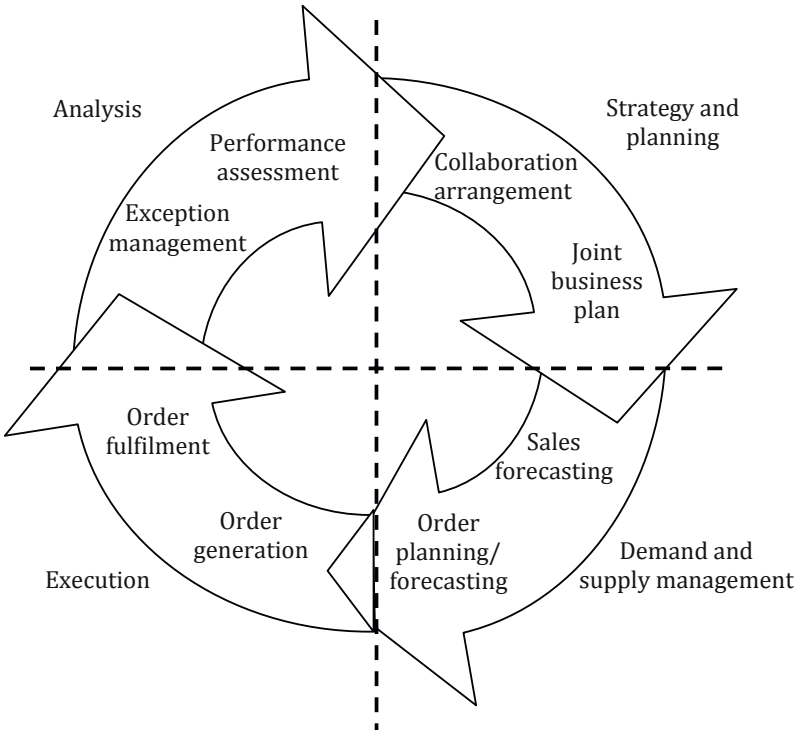

Figure 3-4 A conceptual model of CPFR processes (based on VICS, 2004)

In the strategy and planning process, partners establish the basic rules for the collaboration relationship, define product mix and placement and develop event plans for the period. This process includes two main activities that require active involvement of both partners including the overall collaboration arrangement and the joint business plan.

Collaboration arrangement is the activity where partners establish the overall business goals for the relationship and define the scope of collaboration and assign roles, responsibilities, checkpoints and procedures for escalation. Technological requirements, performance metrics and expectations of confidentiality are also defined (Fliedner, 2003). Improvement suggestions from the performance assessment are used for continuously revising the collaboration arrangement.

The joint business plan activity is established based on the input of the overall arrangement conditions. It identifies the significant events that affect supply and demand in the planning period such as promotions, inventory policy changes, store openings/closings, and product introductions. This includes joint assortment decisions and joint identification of changes, promotions and seasons (Småros, 2007). The business plan is typically developed in quarterly partner meetings. The plan serves as input to the demand and supply management process.

In the demand and supply management process, partners project consumer demand (POS) and order and shipment requirements over the planning horizon. This process comprises two primary activities; sales forecasting and order planning/forecasting. A cornerstone in CPFR is a collaborative or consensus based forecasting approach, which helps to ensure that all functions are operating together using a single plan (Helms et al., 2000, Fliedner, 2003).

The sales forecasting activity aims at projecting consumer demand at the point of sales (POS) based upon the business plan. More specifically, it includes joint creation of overall sales plan, joint examination of sales plan and exceptions and joint creation of store level sales plan (Småros, 2007). The sales forecast is typically established by the customer on a weekly basis based upon input information regarding the impact of influential factors on future sales from both partners. The generated sales forecast is often communicated to the supplier and further collaborated upon before it is used as foundation for the creation of the order forecast.

The order planning/forecasting activity aims at determining future product ordering and delivery requirements based upon the sales forecast, inventory positions, transit lead times, and other factors. The order forecast is typically generated on a weekly basis by the supplier based on input information from both partners with regard to changes that may affect the forecast such as promotional events, new products and store openings.

The execution process includes order generation and order fulfilment based on the order forecast from the demand and planning process. The order generation activity translates forecasts into demand. The time fence applied for generating orders is defined in the collaboration arrangement. Released and confirmed orders are then fulfilled. The order is typically generated on a daily basis by the supplier. The order fulfilment activity includes tasks carried out to execute released orders and to ensure deliveries by preparing shipments, transporting, receiving goods and installing them in retailer store shelves. Order fulfilment exceptions are also identified and resolved.

In the analysis process, partners monitor planning and execution activities for exception conditions, aggregate results and calculate performance metrics, share insights and adjust plans for improved results. This process comprises the exception management and performance assessment activities. In exception management, planning and operations are actively monitored to detect exceptions. In performance assessment, metrics are calculated to evaluate business goals achievement, uncover trends or develop alternative strategies. Metrics are defined in the collaboration arrangement. Performance assessment typically takes place after that operations have been completed and exceptions have been resolved.

Roles and responsibilities

An overview of how roles and responsibilities can be distributed between CPFR partners is briefly presented here. With regard to processes and activities, it is relevant to look at which partner is involved in different activities, which partner is in charge of activities and which partner carries out various activities in order to develop a thorough understanding of the CPFR setting. However, roles and responsibilities are not in focus in the analysis of the study.

Since there are large variations in the scope and intensity of collaboration involvement in practice, the distribution of roles and responsibilities between partners depends upon available competencies, resources and systems. An overview of activities that are typically carried out in collaboration and activities that are separately carried out is shown in Table 3-3.

Table 3-3 CPFR activities typically carried out by customer, supplier or in collaboration (VICS 2004)

Process	Customer activities	Collaboration activities	Supplier activities
Strategy and planning	Vendor management Category management	Collaboration arrangement Joint business plan	Account planning Market planning
Demand and supply management	POS forecasting Replenishment planning	Sales forecasting Order planning/ forecasting	Market data analysis Demand planning
Execution	Buying/re-buying Logistics/distribution	Order generation Order fulfilment	Production and supply planning Logistics/ distribution
Analysis	Store execution Supplier scorecard	Exception management Performance assessment	Execution monitoring Customer scorecard

The collaborative approach implies that partners collaborate in order to generate the order that initiates the physical flow of goods from the supplier to the customer. The partners still have separate operations but collaborate to generate the order quantity and timing that is optimal for the operations of the two partners weighed together.

Even though focus here is on collaborative activities, there may be dependencies between the collaborative activities and separately performed activities. Collaborative activities may be considered to serve both as a substitute or complement to existing activities in partner companies. This is because collaboration may imply that some existing activities are substituted such as the development of one single forecast, and others are more integrated with collaborative activities such as when a retailer provides demand data to the wholesaler to be used in distribution planning.

The collaborative responsibilities can be either mainly allocated to one partner or be shared, i.e. the customer or the supplier may have the primary responsibility or responsibilities could be mixed between partners. In a collaborative activity, one partner may for example take the final ownership although both partners contribute with input. Examples of how leading roles may be distributed between a customer and supplier in CPFR are shown in Table 3-4.

Table 3-4 Alternative leading roles of partners in CPFR (VICS, 2002, 2004)

Alternative leading roles	**Sales forecasting**	**Order planning/ forecasting**	**Order generation**
Customer	Customer	Customer	Customer
Supplier	Supplier	Supplier	Supplier
Mixed	Customer	Customer or Supplier	Supplier

The customer or the supplier may take an overall leading role in all forecasting and replenishment activities. Another alternative is to mix responsibilities between partners so that the customer has a leading role in sales forecasting, the supplier in order generation and the order forecasting activity is led either by the customer or supplier. The table shows a few examples of how responsibilities may vary and other alternatives are of course also possible. For example, the customer may have a leading role in order forecasting while the supplier leads the sales forecasting activity (Fliedner, 2003).

An overview of how roles and responsibilities are typically distributed between partners in CPFR is shown in Table 3-5.

Table 3-5 Typical distribution of roles and responsibilities in CPFR (based on VICS 2002)

	Customer	**Supplier**
Joint business planning	Both partners are responsible. Category buyer and planner are involved in quarterly meetings.	Both partners are responsible. Sales team manager, analyst or category manager is involved in quarterly meetings.
Sales forecasting	Forecasting analyst is responsible for generating weekly sales forecast. Input information from category buyer, planner and new store planner	Input information from sales team manager and analyst.
Order forecasting	Input information from category buyer and planner, forecasting analyst, inventory buyer and logistics planner.	Sales team analyst and forecasting manager are responsible for generating weekly order forecast. Input information from sales team manager, analyst and forecasting manager

3.2.3 Information flows

This section defines typical information flows related to planning and control in CPFR initiatives based upon literature. It aims to present a general theoretical foundation of CPFR that is used for guiding the investigation related to information flows. References from the VICS Association (2002, 2004) and ECR Europe (2001, 2002) are applied for describing information flows unless other is stated.

In general, information is necessary because it makes the supply chain visible to managers and enables them to make decisions to improve the performance of supply chain operations (Chopra & Meindl, 2007). Information is thus crucial to decision making and the main role of ICT is also to handle this information to create visibility and provide decision support (Chopra & Meindl, 2007). Information is also assigned an important role in replenishment contexts; information can help to reduce inventory in a supply chain by reducing order variability, improving forecasts of suppliers, improving the coordination of manufacturing and distribution systems, reducing lead times and so on (e.g. Chopra & Meindl, 2007).

Types of information

CPFR processes and activities are related to different types of information see Figure 3-5. These information types are further described in Table 3-6.

The overviews show information types that are typically associated with CPFR and interlink different CPFR activities. However, these information types are not necessarily exchanged between partners. The exchange of information in CPFR is dealt with next.

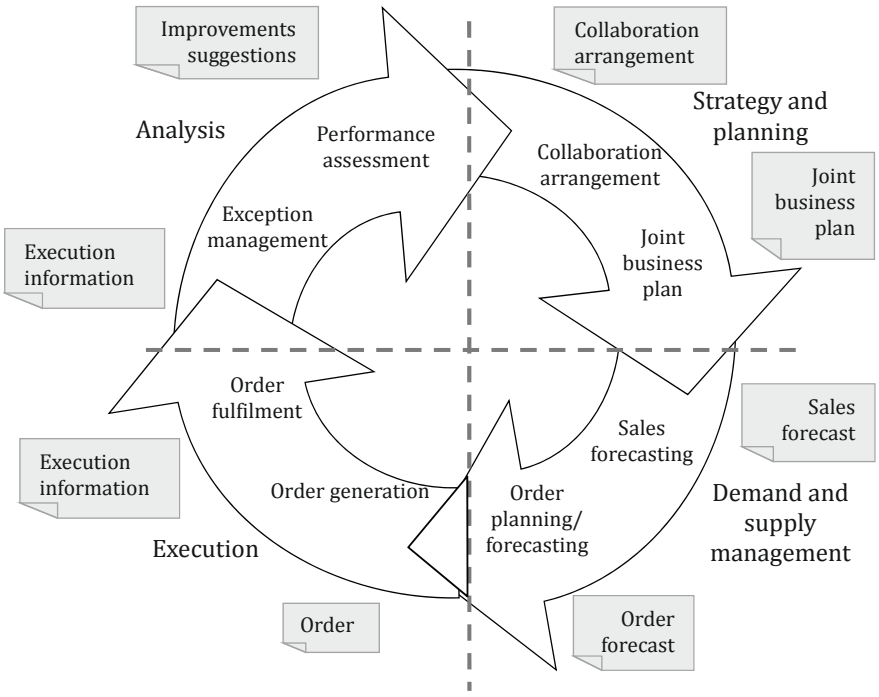

Figure 3-5 A conceptual model of information types of CPFR processes (based on VICS, 2004)

Table 3-6 Information types in CPFR (VICS 2002, 2004)

Type of information	Description
Collaboration arrangement	Defines overall guidelines and rules for the relationship, with regard to goals and scope of collaboration, mission statement, roles and responsibilities, and performance measurement
Joint business plan	Defines overall strategies and tactics for the replenishment items with regard to promotions, inventory policy changes, store openings and closings, production introductions Comprises category and promotional plans and item management profiles (order minimums and multiples, lead times, order intervals, frozen time fence and safety stock rules)
Sales forecast	A projection of future retail sales for a given time period and location. Joint exception management and resolution based on exception criteria.
Order forecast	Forecast of anticipated orders. Joint exception management and resolution based on exception criteria.
Order	Defines quantities of items to be delivered to a specific location.
Execution information	Data of current events and results of the order fulfilment activity. Physical flow transactions data generated as a result of execution.
Improvement suggestions	Based upon the analysis of results of performance measurements related to operations.

Information exchange

Because the responsibility of collaborative activities in CPFR is often distributed between partners and activities depend upon input information from both customers and suppliers, CPFR involves the exchange of information between partners. Exchange of information is necessary to establish joint plans and forecasts to be used for generating replenishment orders. Exchange of information refers to the transfer of information between partners i.e. external or inter-organizational information sharing.

Figure 3-6 gives an overview of information flows in CPFR. It shows how the information types described above including collaboration agreement, business plan and so on serve as linkages between joint activities. This means for instance that the order is generated based upon the order plan/forecast which in turn is generated based upon the sales forecast. With regard to information exchange, partners also provide information input such as overall business conditions, historical sales data, events plans and so on to the joint activities for establishing joint plans and forecasts. Information types that are typically exchanged in CPFR are further described in Table 3-7 .

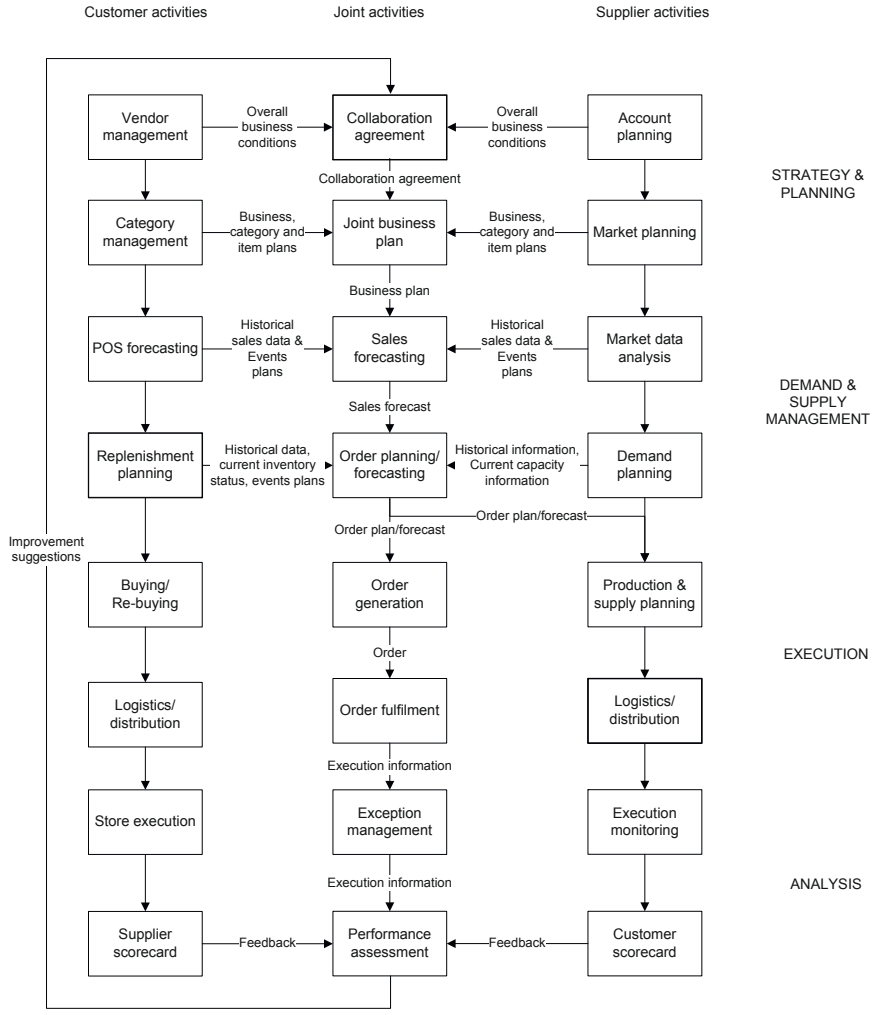

Figure 3-6 Information inputs and outputs in CPFR activities (based on VICS, 2002, 2004)

Table 3-7 Information typically exchanged in CPFR (VICS, 2002, 2004, Fliedner, 2003)

Joint plans and forecasts	**Input of information to joint activities**	
	From customer	**From supplier**
Collaboration arrangement	Business goals and metrics Forecasting exception criteria information Information on competencies, resources and systems Historical sales and shipment information Information sharing needs Commitments and responsibilities	
Business plan	Business goals, strategies and objectives for defining joint partnership strategy Category roles, objectives and goals for specific categories of items for defining a joint category and promotional plan Item management information e.g. order minimum and multiples, lead times, order intervals, frozen time fence and safety stock rules, for defining joint item management profiles	
Sales forecast	Historical sales data e.g. POS data Events information e.g. new product introductions, promotions and store openings and closings	Historical sales data e.g. warehouse withdrawals Events information e.g. new product introductions, promotions and store openings and closings
Order forecast	Historical sales data e.g. POS data Events information e.g. new products and store openings and closings Inventory strategies including seasonality Current inventory position	Historical demand information Historical shipments information Capability limitations Order filling and shipment execution information Production and capability plan

In CPFR, information is exchanged both in jointly performed processes, when activities involve both partners as well as in separately performed processes when a single partner has the main responsibility. The exchange of information between partners implies that information is transferred either from the customer or from the supplier, depending on which partner has the leading role for establishing the joint plan or forecast.

3.3 ICT SUPPORT IN CPFR

In CPFR ICT has an important role by enabling joint planning and forecasting based on various types of demand information, including for instance sales plans and forecasts, campaign and promotional plans and historical sales information (Seifert, 2003, Chopra & Meindl, 2007).

This section defines ICT and information and outlines different types of ICT typically associated with CPFR. A set of ICT capabilities, categories of the impact of ICT on processes, information quality attributes and conditions categories are also defined that are used for guiding the investigation related to the four research questions. A research framework for exploring ICT supported CPFR is also presented.

3.3.1 The concept of ICT

ICT and information

Information and communications technology (ICT) is usually considered an enabler of effective supply chain management (Simchi-Levi et al., 2003, Chopra & Meindl, 2007). Broadly speaking, ICT refers to the collection of computing systems used by an organization (Turban et al., 2006). In this study ICT represents technology such as computers, telecommunications, printing, audio and video, with the purpose to collect, process and disseminate information to aid in planning, decision-making and control of organizations (APICS, 2004). This definition is chosen because it emphasizes the use of ICT to deal with information to support planning and control.

The term ICT is synonymous with information technology (IT). The term ICT is chosen because it is more used than IT in relevant literature. The information system (IS) concept is also closely related to ICT. An IS manages the flow of information in an organization in a systematic, structured way to assist in planning, implementing, and controlling (CSCMP, 2010). ICT here represents the computer-based or technology component of an information system. The term ICT is applied throughout the study to emphasize the technological sides of handling of information flows.

The concept of information is closely related to ICT. Information represents data that has been interpreted and that meets the need of one or more users (APICS, 2004). The concept of information is used in the thesis. One exception is the use of "POS data", which is a specific term widely applied in literature.

The concepts of data, information and knowledge are closely related; information is produced from data and the recipient's prior knowledge through interpretation for a certain period of time (Langefors, 1980). In this study, data is a type of information and no specific distinction is made between data, information and knowledge.

Examples of ICT in CPFR settings

Examples of different types of ICT that are usually associated with CPFR are outlined here in order to give a brief overview of relevant systems and applications. Classifying ICT systems is challenging due to several reasons. There is a large amount of ICT available, there is a rapid ICT development and several types of ICT can be used for several different purposes such as EDI and the internet. Moreover, more complex ICT solutions such as ERP systems or APS systems may have overlapping functionality and are therefore sometimes difficult to categorize.

Literature proposes several ways of classifying and conceptualizing ICT in supply chain contexts. A basic classification is the division between ICT that is used for gathering information and for analyzing information, i.e. between the transactional and analytical sides of ICT (Shapiro, 2001, Chopra & Meindl, 2007);

- Transactional ICT (such as EDI) facilitates communication and is concerned with acquiring, processing, and communicating raw data and with the compilation and dissemination of reports summarizing these data.
- Analytical ICT (such as DSS) constitutes links between various databases, supports supply chain decision-making and evaluation of planning problems based on models.

These two sides of ICT are interdependent; transactional ICT usually provides information (either as input or output) related to decision-making supported by analytical ICT. Moreover, several types of ICT such as ERP systems and radio frequency identification (RFID) systems may combine transactional and analytical elements.

An overview of typical ICT applications in a company is shown in Figure 3-7[17]. The illustration shows one way of classifying various types of ICT according to planning levels and processes within a company. However, it does not show how ICT of a company are typically integrated with ICT of customers and suppliers.

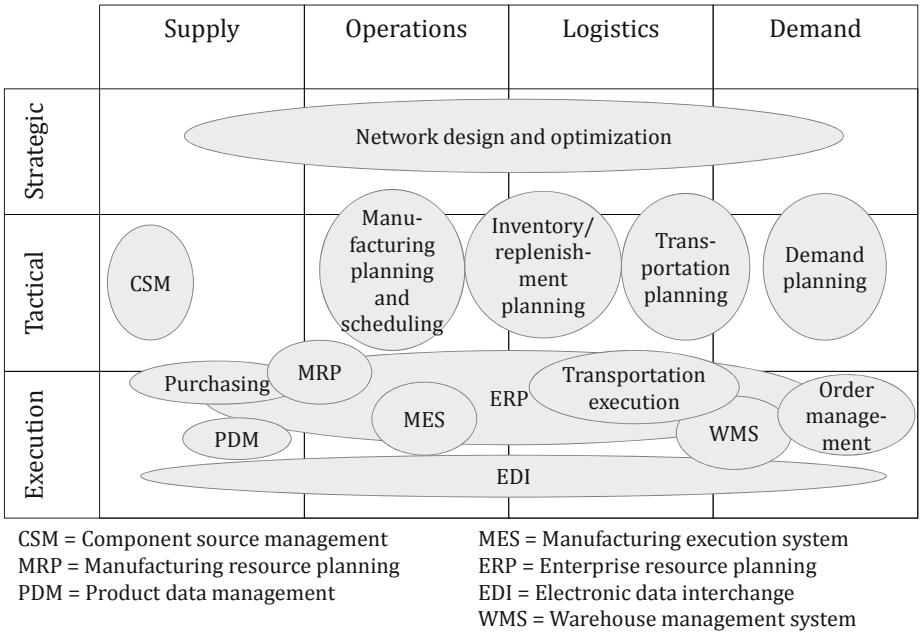

Figure 3-7 Overview of types of ICT that are typically applied in a company (in Stock & Lambert, 2001)

The overview provides one way of categorizing important ICT systems in a planning perspective. Focus in this study is on ICT that supports inventory/replenishment planning and its relation to surrounding planning systems, such as ERP systems.

[17] The overview is presented by Mary Lou Fox, Senior Vice President of Product and Industry Marketing, Manugistics, Inc., 1999 (in Stock & Lambert, 2001).

As mentioned earlier, ICT has an important role in CPFR by enabling joint planning and forecasting based on various types of demand information, including for instance sales plans and forecasts, campaign and promotional plans and historical sales information (Seifert, 2003, Chopra & Meindl, 2007). Literature points to a wide range of ICT applications and systems that can be used to support CPFR (e.g. Smith, 2006, Cederlund et al., 2007, ECR Europe, 2001, 2002). Forecasting applications, collaboration software, communication technology, automated replenishment systems, data warehouses, ERP and APS systems, are a few examples (Ireland & Crum, 2005). CPFR may also involve both less sophisticated technology including fax and/or e-mail and EDI, as well as more sophisticated ICT solutions such as APS systems (e.g. Danese, 2006a, b).

A selection of ICT types that are often associated with CPFR in literature are briefly outlined next. The description is based on textbooks of Turban et al., (2006), Chopra & Meindl (2007) and Jonsson (2008) unless other is stated.

Communication systems relate to different methods aimed at communicating or exchanging information between companies. Electronic data interchange (EDI) is a communication standard that supports direct computer-to-computer communication in a predefined and standardised format so that the receiving system can interpret and process the information. EDI may further enable automatic generation, transfer and reception of information. Extensible Mark-up Language (XML) is another technology for file transfer and a more flexible alternative, which may be used for substituting or complementing EDI. XML is a language for creating web pages that is platform independent. EDI and XML are typically related to the exchange of forecast information, inventory information and POS data in CPFR (VICS, 2002, Danese, 2006a).

Internet technology is often associated with information transfer between partners in supply chains, offering a worldwide network of computers. For example, in web-based EDI, internet is used for transferring messages between computers. Extranet solutions can also be used by companies to communicate information to other partners. CPFR may also be based upon internet technology, so called internet based CPFR solutions (Fliedner, 2003, Danese, 2006a).

An Enterprise Resource Planning (ERP) system comprises a database and a collection of software programs providing and processing information required for administrative management and control of activities in a company. The planning and control system of manufacturing companies is typically embedded in an ERP system (Vollmann et al., 2005). ERP systems usually have an internal company focus and are mainly concentrated to the integration and control of business processes in a single company perspective. In CPFR, they are typically used for providing historical information about business transactions, costs and financial performance.

In order to meet the increasing needs for processing information, more specialized planning and execution systems such as advanced planning and scheduling (APS) systems have emerged as an analytical complement to ERP systems. Even though there is no clear distinction between ERP systems and APS systems, they are often associated with distinguishing properties; ERP systems generally cover a full range of manufacturing sales and accounting software sufficient to perform all of the transactions required by a company, while APS systems tend to be more oriented to specific logistics functions with specialized applications devoted to demand planning, production planning and scheduling, transportation planning and distribution planning (Green, 2001).

A frequently applied definition of APS systems is given by the APICS (Blackstone, 2010); an APS system is a *"computer program that uses advanced mathematical algorithms or logic to perform optimization or simulation on finite capacity scheduling, sourcing, capital planning, resource planning, forecasting, demand management, and others"*. Moreover, APS techniques "*simultaneously consider a range of constraints and business rules to provide real-time planning and scheduling, decision support, available-to-promise, and capable-to-promise capabilities*".

APS systems that are applied in supply chain contexts are sometimes referred to as supply chain management (SCM) systems. These are concentrated to decision making, optimization and analysis to support specific segments of the supply chains (Turban et al., 2006, Meyr et al., 2008b, Turban et al., 2010). Since there are many diverse systems available, these systems are difficult to characterize in a uniform way (Green, 2001). As mentioned earlier, APS systems refer to more sophisticated or advanced ICT (Danese, 2006a) and examples of providers are AspenTech, Oracle, SAP and JDA Software[18].

3.3.2 ICT capabilities

In order to answer the first research question, a number of ICT capabilities are defined that are used for guiding the investigation of how ICT is applied in CPFR. The term capability refers to the quality or state of being able (Merriam-Webster, 2011). Similar terms are properties, aspects, capacities, attributes, features, abilities and characteristics. A framework is developed in order to explore the application of ICT capabilities in a structured way.

The main capabilities selected include the analyzing, connecting, communicating, creating and standardizing capabilities, see Table 3-8. The selection is based on a brief literature review with the aim to identifying relevant capabilities for CPFR settings. Since there was no classification framework for ICT capabilities found in literature, this new framework was developed by combining relevant ICT capabilities that were identified. Capabilities are further described in more detail below.

The framework does not intend to represent an exhaustive collection of capabilities. Instead it is based upon a selection of five capabilities that are relevant for exploring the application of ICT capabilities in CPFR settings.

[18] JDA Software has acquired several well-known APS providers during the last decade including i2 Technologies in 2010, Manugistics in 2006 and E3 in 2001 (JDA Software. 2010. *Company homepage: Major JDA Acquisitions* [Online]. Available: http://www.jda.com/company/company-index/ [Accessed 2011-01-14].).

Table 3-8 A research framework for exploring ICT capabilities in CPFR

Capability	Description	Literature applied
Analyzing	The ability of ICT to analyze information to support decision-making	Huber (1990), Shapiro (2001), Chopra & Meindl (2007)
Connecting	The ability of ICT to support collaboration and cooperation between partners in supply chains	Benjamin & Scott Morton, (1986), Dewett & Jones (2001), Mulligan (2002)
Communicating	The ability of ICT to communicate input or output information between partners	Benjamin & Scott Morton (1986), Huber (1990), Shapiro (2001), Mulligan (2002)
Creating	The ability of ICT to create or produce new input information in processes, either by capturing new information or by refining existing information.	Shapiro (2001), Chopra & Meindl (2007)
Standardizing	The ability of ICT to support standardized processes and centralized control.	Hammer (1990), Davenport (1993, 1998)

The analyzing capability relates to the ability of ICT to assist in decision-making and evaluation by analyzing information. This capability also involves processing, encoding, reconfiguration, combination, compilation, storage and retrieval of information (see for instance Huber, 1990, Shapiro, 2001, Chopra & Meindl, 2007). APS systems and SCM systems are examples of ICT associated with this capability.

The connecting capability corresponds to the ability of ICT to support collaboration and cooperation between partners in supply chains. This capability reflects the ability of ICT to improve interconnection between people, organizations and processes (Benjamin & Scott Morton, 1986), to support organizational dependencies (Mulligan, 2002) and to allow cooperation and collaboration between individuals or groups (Dewett & Jones, 2001).

The communicating capability corresponds to the ability of ICT to communicate input or output information between partners. This capability reflects the ability of ICT to provide information access to people, organizations and processes (Benjamin & Scott Morton, 1986) and comprises ways of distributing output information as well as receiving input information (Mulligan, 2002). This also includes printing, transmitting, transferring and disseminating information (e.g. Huber, 1990, Shapiro, 2001). EDI, XML, intranets and e-mail are examples of ICT associated with this capability.

The creating capability reflects the ability of ICT to generate or produce new input information in processes. This capability relates to ICT's ability to generate input information including collecting, gathering, acquiring, recording and capturing information (e.g. Shapiro, 2001, Chopra & Meindl, 2007). Moreover, it reflects the use of ICT for capturing and generating raw data and generating new information based upon existing information. RFID tags and barcodes are examples of ICT associated with the generation capability due to their use in capturing and producing new information.

The standardizing capability corresponds to the ability of ICT to support standardized processes and centralized control. It is related to the use of ICT in business process reengineering (BPR) (e.g. Hammer, 1990, Davenport, 1993, 1998). In literature on ERP systems, the standardizing capability of ICT for integration of processes and data primarily within companies but also in supply chains has been discussed (Davenport, 1998). ERP systems, for example, permit seamless integration of all the information flowing through a company by involving the centralization of control over information and the standardization of processes (Davenport, 1998).

The ICT capabilities are interdependent in several ways. This is because most types of ICT are expected to encompass several capabilities; they can be used for several purposes, for generation and processing of information, for instance. Capabilities are also expected to be sequentially dependent. For example, information must have been generated before it can be processed or communicated.

The connecting and standardizing capabilities are also different from the other three since they have a wider scope; while the connecting capability focuses on connections between organizations and the standardizing capability on processes and centralized control, the other three are mainly focused to actual information handling.

3.3.3 The impact of ICT on CPFR processes

In order to answer the second research question, a set of categories for classifying how ICT affects processes i.e. the impact of ICT. The term impact refers to a significant or major effect (Merriam-Webster, 2011). The impact is explored by identifying process changes caused by ICT and related effects.

Literature provides several multidimensional frameworks for measuring the business value of ICT in organizations (see for instance literature reviews by Dewett & Jones, 2001 and Blankley, 2008). Since the ICT impact on processes is in focus in the investigation, a process-oriented framework developed by Mooney et al., (1996) is selected. It assumes that ICT creates business value through its intermediate impact primarily on business processes. The framework is a simple three-folded structure that can easily be used for organizing process changes and effects.

A wide range of effects can be expected from implementing ICT to support CPFR including increased efficiency (e.g. Smith, 2006, Cederlund et al., 2007), enhanced scalability and increased level of detail in collaboration (Ireland & Crum, 2005). In general ICT may also lead to increased supply chain integration and communication, enhanced speed of information flows, lower barriers between companies, increased usefulness of information flows and increased service levels in collaboration (e.g. Achabal et al., 2000, Mentzer et al., 2000).

The investigation of ICT impact on processes has a specific focus on information flows. This is an appropriate scope since information flows constitute an essential foundation in CPFR. Due to the use of ICT to handle information, the impact of ICT on CPFR processes is closely related to the flows of information in these processes.

The categories selected for exploring the impact of ICT on CPFR processes are based upon the framework of Mooney, et al. (1996), see Table 3-9.

Table 3-9 A research framework for exploring the impact of ICT on CPFR processes (based on Mooney, et al. 1996)

Category	Definition	Examples of typical performance metrics
Automational impact	Reflects the use of ICT as a means to directly substitute labour.	Employee productivity, information processing cost, cost of goods sold, utilization of resources, total supply chain management costs.
Informational impact	Reflects the use of ICT to facilitate the use of information.	Delivery performance, product quality, information quality, inventory performance.
Transformational impact	Reflects the use of ICT to facilitate and support process innovation and transformation.	Delivery flexibility and frequency, product flexibility, responsiveness to urgent deliveries, range of inventory and products, cycle times, response times and lead times.

The automational impact is related to the use of ICT as a means to directly substitute labour and the category primarily reflects the use of ICT to increase efficiency. While the use of ICT for eliminating human labour may be directly associated with mechanization of current ways of doing business, leaving existing processes intact (Hammer, 1990), automation may be considered also to be combined with other process changes such as more structured and streamlined processes, due to improved continuity and control with ICT (Davenport, 1993, Venkatraman, 1994).

The automational impact is generally measured in terms of efficiency enhancements, labour savings, cost reductions, reduced administrative costs, employee productivity, resource and capability utilization, production and distribution costs, information processing cost and cost of goods sold.

The informational impact is related to the use of ICT to facilitate the use of information. The category reflects the use of ICT to collect, store, process and disseminate information (Mooney et al., 1996) and to capture information about process performance for purposes of understanding, closely monitoring of process status and objects, analyzing information and decision-making, and capturing and distributing intellectual assets (Davenport, 1993). The category further reflects the use of ICT to develop new intellectual skills and to "informate" as processes, objects, behaviours and events are translated into and made visible as explicit information (Zuboff, 1991).

The informational impact is generally measured in terms of improved decision quality, employee empowerment, decreased use of resources, enhanced organizational effectiveness and better quality of products or services delivered, delivery performance, customer service levels, forecast accuracy, inventory costs, levels and turns, and product quality.

The transformational impact is related to the use of ICT to facilitate and support process innovation and transformation (Mooney et al., 1996). This category is related to re-engineered processes and redesigned organizational structures with ICT (e.g. Hammer, 1990, Davenport, 1993) and to business transformation at different levels such as internal integration, redesign of business processes and networks, and redefinition of entire business scopes (Venkatraman, 1994). This impact is further related to elimination of intermediaries from a process, coordination of processes across distances and between tasks and processes, and enabling changes in the sequence of processes or transformation of a process from sequential to parallel (Davenport, 1993).

Examples of measures of the transformational impact of ICT are reduced cycle times, improved responsiveness, downsizing, service and product enhancement, delivery flexibility and frequency, product flexibility, responsiveness to urgent deliveries, range of inventory and products and lead times.

The three categories are interdependent; improved information usage can for instance lead to increased process efficiency and process transformation can be necessary for achieving these benefits. There is thus a risk that effects identified may refer to several categories. However, the strength of the selected categories is that they constitute an effective and simple instrument for distinguishing between different types of ICT impacts.

3.3.4 ICT and information quality

In order to answer the third research question, a set of attributes for classifying changes in information quality were defined to guide the investigation with regard to how information quality is affected by ICT. Information quality constitutes a relevant concept for investigating the impact of ICT, which is specifically related to planning and control information.

Information quality is a general concept for determining the fitness of use of information (Wang & Strong, 1996). Furthermore, it is highly multidimensional as it refers to a wide range of various attributes or dimensions (for an extensive overview of possible variables, see for instance DeLone & McLean, 1992). There is however no common definition of the concept or of which dimensions to include. It is therefore suggested that it should be adjusted to the actual use of information in specific contexts (Wand & Wang, 1996).

A brief literature review was carried out to identify a set of relevant information quality attributes for CPFR contexts. The review revealed a wide range of quality attributes in supply chain contexts, see Table 3-10.

Table 3-10 Examples of studies applying information quality attributes in supply chain contexts

Study	Attributes applied	Context
Petersen (1999), Petersen et al. (2005)	Currency, completeness, accuracy, compatibility and convenience of access.	Joint planning and decision making processes in supply chains.
Moberg et al. (2002)	Accuracy, timeliness and formatting.	Supply chain information exchange.
Li & Lin (2006)	Timely, accurate, complete, adequate and reliable.	Supply chain management.
Forslund & Jonsson (2007)	In time, accurate, convenient to access and reliable.	Forecast information in supply chains.
Forslund (2007)	In time, accurate, convenient to access and reliable.	Exchange of order and forecast information in supply chains.
Jonsson & Gustavsson (2008)	Complete, concise, reliable, timely, valid and credible.	Forecast information in collaboration using automatic communication and registration.
Claassen et al. (2008)	Accuracy, timely, completeness, adequacy and reliability.	Information sharing in vendor managed inventory.
Sellitto et al. (2007)	Timeliness, currency, frequency, visibility, accuracy, actionable, completeness, accessibility, persistency, specificity, relevancy, customised and authenticating.	The use of RFID in retail store supply chains.

Since the review of literature could not identify a ready set of attributes that are expected to be especially relevant for CPFR settings, a new framework is developed see Table 3-11. This is based on a combination of common attributes that are often dealt with in literature in settings related to collaborative planning and control in supply chains. The definition of attributes is based upon a combination of literature sources.

Table 3-11 A research framework for exploring the information quality impact of ICT

Attribute	Definition	Applied literature
Accuracy	The extent to which information is correct, reliable and credible.	Wang & Strong (1996), Closs et al. (1997), Forslund & Jonsson (2007), Jonsson & Gustavsson (2008)
Completeness	The extent to which information is applicable, adequate and relevant.	Wang & Strong (1996), Jonsson & Gustavsson (2008)
Timeliness	The extent to which information is up-to-date and timely.	Lee & Billington (1992), Wang & Strong (1996), Closs et al. (1997), Mason-Jones & Towill (1997), Boyson et al. (2004), Forslund & Jonsson (2007), Jonsson & Gustavsson (2008), Gustavsson & Wänström (2009)
Conciseness	The extent to which information is concise, in a proper format and easily understood.	Wang & Strong (1996), Jonsson & Gustavsson (2008), Gustavsson & Wänström (2009)
Accessibility	The extent to which information is available and convenient and easy to access.	Wang & Strong, (1996), Closs et al. (1997), Forslund & Jonsson (2007), Gustavsson & Wänström (2009)

The accuracy attribute reflects the extent to which information is correct, reliable and credible. Generally, it reflects to what extent the values of information are in conformance with actual or true values (Wang & Strong, 1996). Information is considered to be correct when it is error free (Closs et al., 1997) and does not contain any obvious mistakes. Information might be impaired by obvious mistakes and must be corrected before being used (Forslund & Jonsson, 2007). Reliability is reflected by the probability that information will remain unchanged (Forslund & Jonsson, 2007, Jonsson & Gustavsson, 2008). Credibility reflects the perceived trust in the information from the user's perspective (Jonsson & Gustavsson, 2008), which includes that information is believable and trusted (Wang & Strong, 1996).

Completeness reflects the extent to which information is applicable, adequate and relevant. In general, it reflects the appropriateness of information in its context, i.e. to what extent information is applicable to or pertains to the task of the information user (Wang & Strong, 1996). Completeness reflects the degree of which information contains all necessary information for being used (Jonsson & Gustavsson, 2008) and includes the extent to which information is of appropriate amount and of right kind (Wang & Strong, 1996).

The timeliness attribute reflects the timely aspects of information including speed of transfer and updating frequency, for instance. It refers to the extent to which information is up-to-date (current) and timely i.e. that it is provided within the agreed time (Closs et al., 1997, Forslund & Jonsson, 2007, Jonsson & Gustavsson, 2008). Timeliness is closely related to the appropriateness of information in its context and reflects the degree to which the age of the information is appropriate for the task at hand (Wang & Strong, 1996) and reflects the extent to which information is delivered in time and at correct intervals (Gustavsson & Wänström, 2009). The notion of real-time information, information that flows without or with minimum delay, also relates to timeliness (e.g. Lee & Billington, 1992, Mason-Jones & Towill, 1997, Boyson et al., 2004).

Conciseness refers to the format and meaning of information (e.g. Wang & Strong, 1996). It reflects the extent to which information is concise, in a proper format and easy to understand. Conciseness relates to the ease of accessing information without further processing, adaptation or manual intervention (Jonsson & Gustavsson, 2008). The degree of proper format of information reflects to what extent the information can be used directly, or to what extent further reworking, conversion or translation is required before it can be used (Gustavsson & Wänström, 2009). Ease of understanding reflects the degree that information is clear without ambiguity and easily comprehended (Wang & Strong, 1996). It further reflects the degree to which information is in appropriate language and units and the information definitions are clear (Wang & Strong, 1996, Jonsson & Gustavsson, 2008).

The accessibility attribute reflects the manner of accessing information, the extent to which information is available and convenient and easy to access. Accessibility reflects that information is available or easily and quickly accessible when and where desirable or required (Closs et al., 1997, Gustavsson & Wänström, 2009, Wang & Strong, 1996) and that information can be accessed without further processing (Forslund & Jonsson, 2007).

3.3.5 Conditions for ICT supported CPFR

In order to answer the fourth research question, categories for conditions were defined to guide the investigation with regard to conditions for ICT supported CPFR.

A large number of enablers and obstacles to CPFR are often pointed to in literature; lack of trust, availability and cost of ICT, fragmented information standards and scalability and getting critical mass are a few examples (e.g. Barratt & Oliveira, 2001, Fliedner, 2003). Only a few authors recognize essential conditions for ICT supported CPFR. Examples of such conditions include trust (Barratt & Oliveira, 2001), common goals, product characteristics, spatial complexity, relational structure, development stage (Danese, 2006b), readiness of partners' systems architecture, industry standards, and redefinition of business processes (Seifert, 2003).

A brief review of literature dealing with conditions for ICT adoption in collaboration in general reveals that conditions related to technology and relationships are often put forward. Other conditions are related to industry and market (e.g. Sriram & Stump, 2004, Dehning et al., 2007, Yao et al., 2007), supply chain structure and orientation (Yao et al., 2007, Welker et al., 2008), and management and organization (e.g. Byrd & Davidson, 2003, Yao et al., 2007).

The technological and relational categories are selected for this study. This is because these two perspectives are often dealt with in literature and because they are assumed to be especially relevant for ICT supported CPFR. A framework for exploring conditions for ICT supported CPFR including relational and technological categories is presented in Table 3-12.

Table 3-12 A research framework for exploring conditions for ICT supported CPFR

Category	Examples in literature	Applied literature
Relational: conditions related to collaborative relations between partners	The nature of relationship; trust, inter-dependence, long-term orientation and commitment and information-sharing; collaboration goals and development stage; collaboration implementation scope and business processes involved; level of trust and information transparency.	Akkermans et al. (2004), Chae et al. (2005), Danese (2006), Dehning et al. (2007)
Technological: conditions related to ICT used for supporting collaborative efforts	Data consistency and cross functional systems integration; level of ICT usage; readiness of partners' systems architecture and industry standards.	Sanders & Premus (2002), Seifert, (2003), Rai et al., (2006)

3.3.6 A research framework for exploring ICT supported CPFR

The purpose of this chapter has been to define a theoretical foundation of the thesis. In order to guide and structure the empirical investigation, a research framework for exploring ICT supported CPFR is developed based on literature, see Table 3-13.

Table 3-13 A research framework for exploring ICT supported CPFR

Research question	Sub-frameworks	Dimensions
1. How are ICT capabilities applied to support CPFR?	A research framework for exploring ICT capabilities in CPFR.	Analyzing Connecting Communicating Creating Standardizing
2. How does ICT affect CPFR processes?	A research framework for exploring the impact of ICT on CPFR processes.	Automational Informational Transformational
3. How does ICT affect the quality of information in CPFR?	A research framework for exploring the information quality impact of ICT in CPFR.	Accuracy Completeness Timeliness Conciseness Accessibility
4. What are major conditions for ICT supported CPFR?	A research framework for exploring conditions for ICT supported CPFR.	Relational Technological

The research framework summarizes the sub-structures that were developed in view of the four research questions. The framework was developed in parallel with the empirical investigation. It was used to define an appropriate scope for the empirical study and to guide and structure the investigation throughout the entire research process. It was also used to categorize empirical information in chapter 5.

4. CASE DESCRIPTION

In 2006, the wholesaler Alliance Healthcare and the retailer Boots established a new CPFR initiative. The initiative was closely linked to the implementation of a new APS system called Evant. This chapter presents the empirical information that was collected during the investigation in the two companies. An overview of the Alliance Boots supply chain is given as a background together with a brief presentation of the CPFR initiative, the Evant system and its context. Major changes that Evant has contributed to are presented next. Changes are identified by describing processes and information quality characteristics before and after the implementation of Evant.

The case description aims to present empirical evidence related to the CPFR initiative of two partner companies Alliance Healthcare and Boots.[19] Focus is on reporting on how processes and information quality have changed from the use of an APS system, which was implemented to support the new initiative. Contextual considerations are also taken into account in order to provide insights to the background and environment of the CPFR initiative.

The presentation of empirical information is structured into four main parts. First, the Alliance Boots supply chain is described. The new CPFR initiative is presented next. This is followed by a description of major process changes. Changes in information quality are also described.

4.1 THE ALLIANCE BOOTS SUPPLY CHAIN

In order to give a background to the case investigated in this study, the Alliance Boots supply chain is presented here. Its members are described followed by a presentation of the physical flow of goods and main operations. The market structure of the Norwegian pharmaceuticals distribution is also presented.

[19] The initiative is considered to represent CPFR although the CPFR concept was not explicitly applied by the partner companies. The investigated initiative combines the intelligence of the two partners in business planning, sales forecasting, and all operations required to replenish raw materials and finished goods. Moreover, it is based upon close relationships and information exchange and involves ICT.

4.1.1 Supply chain members

Alliance Boots Limited is an international health and beauty group based in the UK with over 100 000 employees in 15 countries, and primary operations located in Europe. The two core businesses of the group are pharmaceutical wholesaling and pharmacy retailing and it incorporates 3000 pharmacies and 400 wholesale distributors.

In Norway, operations are carried out in two companies; the wholesaler Alliance Healthcare Norge[20] (Alliance Healthcare) and the retail company, Boots Norge[21] (Boots), which includes the 145 pharmacies[22] with the Alliance and Boots brands (Alliance Boots pharmacies). The two companies are fully owned by the international company group, Alliance Boots Limited, see Figure 4-1.

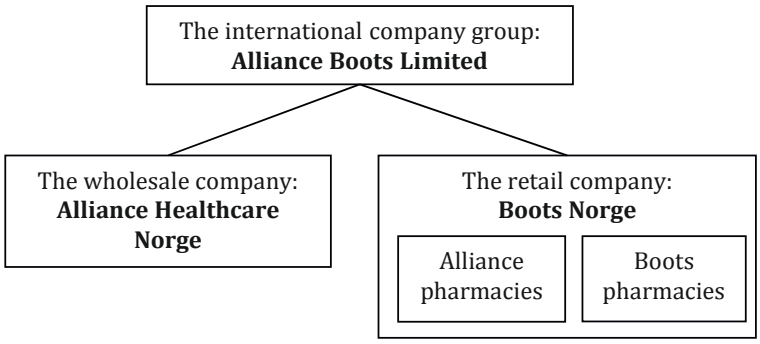

Figure 4-1 Company structure of the partners in the case

Alliance Healthcare has about 120 employees and about 1250 persons are employed in the Alliance Boots pharmacies. Another 80 employees work at the Boots administration with tasks related to pharmacy management and operations, supplier negotiations, marketing and sales. An overview of main responsibilities that are shared and distributed between the two companies is shown in Table 4-1.

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[20] In March 2009 the wholesale company changed name from Holtung AS to Alliance Healthcare Norge AS.

[21] In March 2010 the retail company changed name from AllianceUnichem Norge AS to Boots Norge AS.

[22] Figures by 2010-08-10 (Apotekforeningen, 2010).

Table 4-1 Shared and distributed responsibilities in the case companies

Responsibilities of Alliance Healthcare	**Shared responsibilities**	**Responsibilities of Boots**
Distribution logistics Purchasing and replenishment Warehouse logistics Pharmacy customer support	ICT Human resources Finance Business development	Marketing and commercials (incl. sales, communications, category and product management) Professional pharmaceutical services Pharmacy sales and operations

4.1.2 Physical flow of goods and operations

An overview of the flow of goods in the Alliance Boots supply chain is shown in Figure 4-2. The flow of goods from Alliance Healthcare warehouse to the Alliance Boots pharmacies is the primary scope of this study.

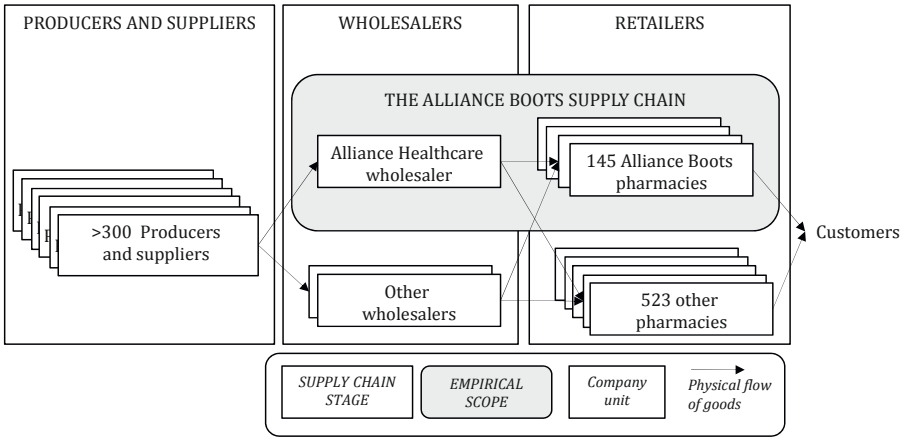

Figure 4-2 The physical flow of goods in the case companies

Alliance Healthcare is a full range distributor dealing with about 12 000 stock keeping units (SKUs)[23], including prescription drugs (RX), other drugs sold "over-the-counter" (OTC) and retail goods. Goods are purchased from more than 300 different producers and suppliers and a wide mix of brands is represented in the assortment, which also includes Boots' own branded products. These producers and suppliers also supply their goods to the other Norwegian wholesalers.

Alliance Healthcare constitutes the primary supplier of the Alliance Boots pharmacies and is also a supplier of independent pharmacies, institutions and bandage stores. Due to strong chain loyalty and commitment in the Norwegian market, the main flow of goods from the wholesaler goes to the pharmacies belonging to the same chain but pharmacies can also buy goods from other wholesalers if necessary. Major pharmacy customer groups are private consumers and professional customers, which include home nursing clients, veterinarians, medical centres, dentists, institutions and medical shops.

The Alliance Boots pharmacies represent about 50 percent of the total number of the customers of Alliance Healthcare. Deliveries to these pharmacies include 85 percent of the total number of order lines of Alliance Healthcare.

The two companies have different geographical locations. The Boots administration is located in Smestad in Oslo while Alliance Healthcare is located in Langhus, Ski in Akershus outside of Oslo. The Alliance Boots pharmacies are located across the country. The shared management team of Alliance Healthcare and Boots primarily operates in Smestad and is co-located with the Boots administration.

An overview of main operations related to the physical flow of goods from the Alliance Healthcare warehouse to Alliance Boots pharmacies is presented in Figure 4-3. Main administrative operations that are carried out are described in detail in section 4.3.

[23] A stockkeeping unit (SKU) here refers to an item at a specific location in pharmacy inventories (based on Blackstone, 2010).

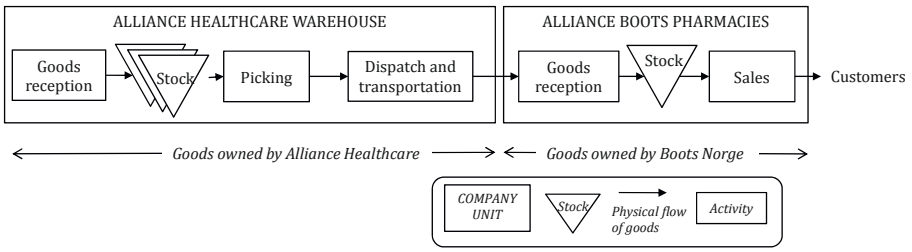

Figure 4-3 Main physical operations of the investigated case

In the warehouse, received goods are stored in various picking zones including a buffer zone, regular picking zone, bandage and high volume zone, cool/fridge and narcotics. Picking activities, which take place in the warehouse every working-day, are carried out in three batches according to geographical location of customers. Most products are picked in boxes circulating on a conveyor belt except for large volume products. After a final quality check boxes are marked with customer information, sealed and sent to the dispatch area. Goods are sent from the warehouse in Langhus by truck or car to the pharmacies by two different third-party transportation companies.

In the Alliance Boots pharmacies, goods are normally delivered at night or early mornings once per day between Tuesday and Saturday. Received goods are unpacked and products are placed into specific locations in the open customer areas and behind desk in designated racks and shelves. A planogram defines how and where products should be displayed in the pharmacy. Payment transactions are registered in the cash point system when products are sold.

Alliance Healthcare owns the goods in the warehouse. The ownership of products is transferred to Boots when goods are delivered in Alliance Boots pharmacies and sales transactions are registered.

4.1.3 Market structure

The Norwegian market for pharmacies and pharmaceuticals distribution has experienced a major transformation during the last decade. Before the new pharmacy law came into force, on March 1st 2001, the conditions regarding pharmacy ownership in the industry were strictly regulated. The new law led to a significant structural consolidation in the market as independent pharmacies were acquired and incorporated into more standardized pharmacy chains. There are still strict regulations regarding ownership and operation-integrations between producers and distributors of pharmaceuticals in Norway.

There are a total number of 668 pharmacies operating on the Norwegian market; 635 of them are privately owned, mainly by large company groups, and 33 are publicly owned hospital pharmacies.[24] Three European company groups dominate the market, see Table 4-2. Since they own both pharmacy chains and wholesalers, the industry is characterized by a high degree of vertical and horizontal integration, i.e. pharmacies are organized in pharmacy chains and these chains are further integrated with wholesale operations.

Table 4-2 The Norwegian pharmacy market structure

Owner	**Pharmacy chains**	**Wholesaler**	**Number of pharmacies**[25]
Tamro/Phoenix	Apotek1	Apokjeden Distribution	248
Celesio	Vitusapotek, Ditt Apotek	Norsk Medisinaldepot	222
Alliance Boots	Boots: Alliance apotek and Boots apotek	Alliance Healthcare	145

The new law constitutes a starting point for Alliance Boot Limited's investment in the Norwegian market. Boots Norge (formerly AllianceUnichem) was created in 2001. In order to increase the efficiency in pharmacy distribution, the company group acquired Alliance Healthcare in 2002. Alliance Healthcare thereby became the preferred logistics partner of Boots Norge. In 2004, a shared management team was established for Boots and Alliance Healthcare to further increase the integration between pharmacy and wholesale operations. The primary driver was to strengthen the position in the marketplace for sales and distribution of pharmaceuticals. In 2006, the former owner, AllianceUnichem, merged with the Boots Group Limited. Since then, Boots Norge and Alliance Healthcare have been owned by Alliance Boots Limited. This has among other things implied rebranding of Alliance pharmacies into Boots pharmacies.

[24] Apotekforeningen (2010). "Fakta om apotek." Retrieved 1 February, 2011, from http://www.apotek.no/fakta-og-tall/fakta-om-apotek.aspx.

[25] Figures by 2010-08-10 (ibid.)

4.2 THE CPFR INITIATIVE OF ALLIANCE BOOTS

The new CPFR initiative that was launched in 2006 is presented here. The way major roles and responsibilities were organized is described. Processes in the new initiative are also presented together with information flows. This is followed by a description of the ICT infrastructure in the supply chain with a specific focus on the APS system Evant.

Evant (or Evant Demand Planning and Replenishment) was implemented to support the CPFR initiative and plays an essential role in the investigated case. The system was initially provided by a company called Evant. Evant was later acquired by Manhattan Associates in 2005 (Manhattan Associates, 2010). Evant represents a specialized solution that can be classified as an APS system with a specific focus on demand planning and replenishment. Manhattan Associates is one of the major suppliers of APS software for supply chain management in the US together with suppliers such as SAP, Oracle, JDA Software and i2 Technologies (Trebilcock, 2010).

4.2.1 Characteristics of the CPFR initiative

In order to describe characteristics of the case initiative, the CPFR implementation scope framework by Pramatari et al. (2002) is used. This is based upon four dimensions including place, product, time and information sharing. The framework, which recognizes that there are different types of CPFR, is used here to characterize the CPFR initiative of the specific case, see Table 4-3.

Table 4-3 Characteristics of the investigated CPFR initiative (based on Pramatari et al., 2002)

Dimensions	Description	Characteristics of the case initiative
Place	CPFR principles may be applied for the replenishment of a retail distribution centre (DC) or at a store level, or on the replenishment of the DC of a manufacturer.	The case initiative was established for replenishment of pharmacy stores from a central warehouse, i.e. store level replenishment.
Product	CPFR projects may cover only products from non-regular lines, all the products of a specific category, or all the products supplied.	The case initiative included replenishment of close to all products (98 percent of active SKUs in pharmacies).
Time	CPFR initiatives may be based upon different time horizons of a sales/ or order forecast and the frequency of collaboration (monthly, weekly or daily basis).	The case initiative was based upon a daily basis due to the daily updates of the order forecast.
Information sharing	CPFR may be based on different types of information shared among the collaborating partners including POS data, promotional plans and other types of information such as stock levels information.	The case initiative involved information sharing related to POS data, promotional plans and inventory information.

4.2.2 Roles and responsibilities

When the Alliance Boots management team was established in 2004, a joint process started to further integrate the retail and wholesale operations in the two companies by implementing Evant. The aim was to improve the flow of goods from the Alliance Healthcare warehouse to Alliance Boots pharmacies by collaboration. After the test pilot was completed in January 2006, Evant was rolled out in all pharmacies during six months in 2006 and since the autumn the same year, all Alliance Boots pharmacies are replenished via Evant.

With the CPFR initiative, Alliance Healthcare and Boots together established a joint replenishment approach for Alliance Boots pharmacy inventories. It included the replenishment of about 98 percent of active SKUs in pharmacies, corresponding to the majority of number of order lines. The Alliance Boots pharmacies were still responsible for placing orders for a few SKUs that were considered to be unsuitable for being replenished via Evant due to occasional demand or large product or packaging sizes, for instance. Alliance Healthcare offered alternative solutions for receiving orders from other customers that did not participate in the initiative as well as for reception of additional orders and rush orders.

Customers that did not participate in the initiative sent their orders by fax or EDI or register orders via UniLink. Order information was then transferred to IMI Order, the Alliance Healthcare's ERP system. Alliance Boots pharmacies could also place orders via UniLink, Alliance Healthcare's web application for Alliance Boots pharmacies, or via phone to the Alliance Healthcare customer service team that registered the order information in IMI Order.

With the new approach, responsibilities for activities and tasks are distributed among three major organizational units, see Table 4-4. A coherent organizational structure of responsibilities, authorities and routines for the supply chain was developed to support coordination and collaboration between the two companies. A thorough understanding among employees of interdependencies between market, logistics and pharmacy operations and of consequences of actions was also developed.

Table 4-4 Responsibilities of organizational units in the case companies

Organizational units	**Description of responsibilities**
Alliance Boots management team	Defined the overall collaboration conditions and established long-term strategic plans and yearly budgets.
Boots administration	Sales forecasting, sales and promotional planning, negotiated with suppliers and producers.
Joint replenishment team	Replenished pharmacy inventories with Evant; defined the inventory control approach, forecasting profiles and order exception parameters; assortment control in pharmacies; demand forecasting and order generation; analyzed replenishment performance; adjusted parameters in close dialogue with pharmacies.

The joint management team operated on overall terms of collaboration and long-term plans. The Boots administration was responsible for planning of market activities, sales forecasting and negotiations with suppliers. The new replenishment team operated in the interface between the two companies. Its organizational affiliation was common and the unit was linked to both companies. The team was located at Alliance Healthcare and was primarily responsible for managing the Evant system. It consisted of a group of people with different competence profiles, combining market, logistics and pharmacy operations skills. Representing an appropriate mix of skills, the team was apt to solve complex and multi-disciplinary problems and to communicate with employees in various functions of the partner companies.

4.2.3 Processes and information flows

The main CPFR processes investigated in the Alliance Boots case include strategy and planning, demand and supply management, execution and analysis. An overview of their main characteristics is shown in Table 4-5. Further details on these processes are described in section 4.3.2.

Table 4-5 Characteristics of CPFR processes of the case companies

Categories	**Description per process**			
	Strategy and planning	**Demand and supply management**	**Execution**	**Analysis**
Activities	collaboration agreement joint business plan	sales forecasting order planning/ forecasting	order generation order fulfilment	exception management performance assessment
Decision-making level	strategic	tactical/ operational	operational	tactical
Frequency of activities	yearly	monthly, weekly, daily	daily	weekly
Information flows	agreement strategic plan sales plan/budget	sales forecast pharmacy planograms promotional plan assortment updates	POS data and inventory levels order and order confirmation measurements	measurements replenishment reports sales reports

The CPFR approach was based upon several flows of information that were necessary for ensuring the flow of goods from the Alliance Healthcare warehouse to the Alliance Boots pharmacies. An overview of information flows and how they were related to supplier and warehouse purchasing operations in the case is shown in Figure 4-4.

The customer order decoupling point was located at the warehouse stock. The main control principle applied in warehouse operations was pick-to-order. Replenishment orders were generated based on demand forecasting and safety stock principles. POS data and inventory information in pharmacies served as input to the forecast.

The overall strategic plan and sales budgets were established by the joint management team. These imposed the overall conditions of replenishment. The Boots administration established and distributed the promotional plan to the replenishment team and planograms to pharmacies. Also, pharmacy assortments were updated by the replenishment team. Replenishment orders for all pharmacies were automatically generated in Evant based on pharmacy POS data and inventory levels. Purchasing orders were in turn generated based on inventory information of the warehouse. These were sent to suppliers who in turn generated production or distribution orders for deliveries.

The various types of information incorporated in the CPFR initiative are described in Table 4-6 with a focus on their time perspective.

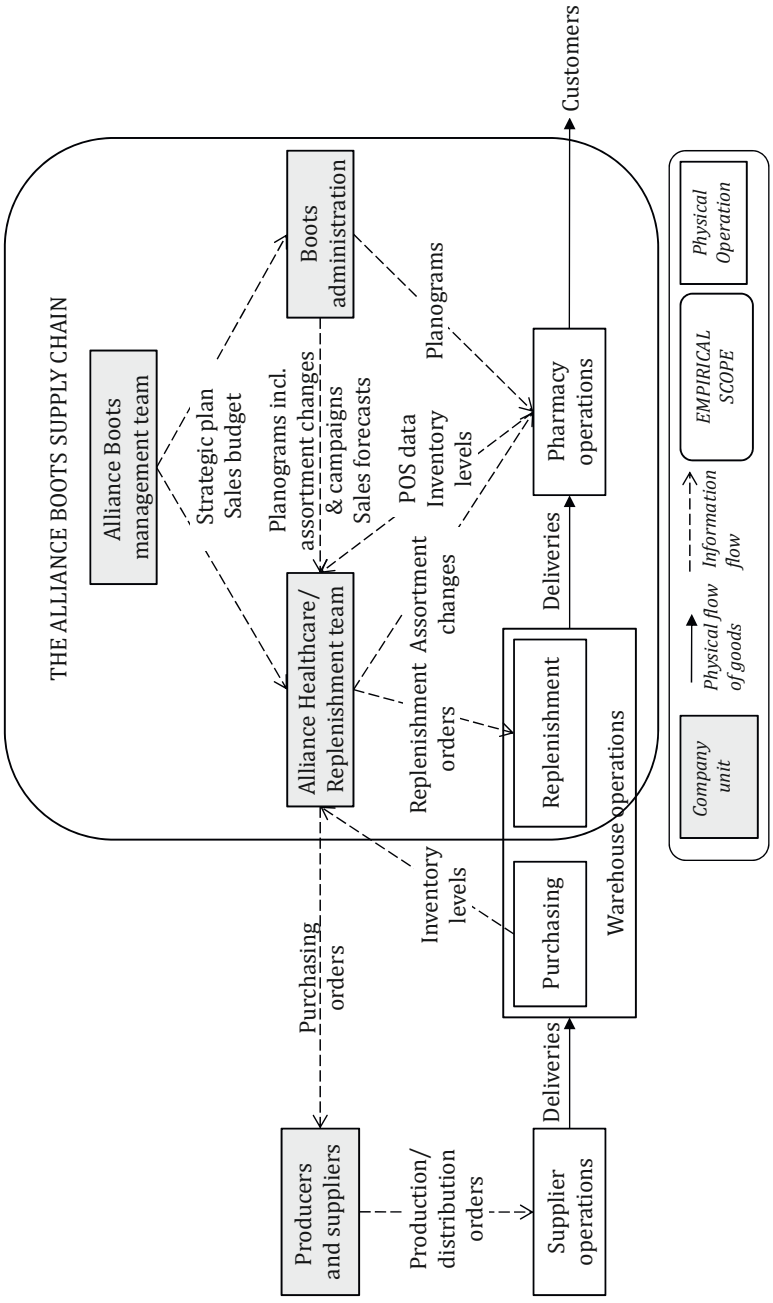

Figure 4-4 Information flows of the case companies

Table 4-6 Description of information types of the case companies

Information types	Description
Collaboration agreement	Defined the overall conditions for collaboration; long-term, several years.
Strategic plan	The overall strategic plan, similar to the format of the yearly budget adding some long-term strategic perspectives; three year planning horizon, revised yearly, yearly period.
Sales budget	Defined expected yearly sales including effects of market activities and campaigns; yearly plan, revised every six months, monthly period.
Sales forecast	Reflected the expected size of the total market demand based on aggregated historical sales; yearly forecast, revised every six months, monthly period.
Planogram	Defined the assortment and location of SKUs per category in pharmacy shelves; monthly plan, weekly period.
Promotional plan	Defined the promotions to be carried out in pharmacies; monthly plan, weekly period.
Evant forecasting profiles	Defined the demand profiles per SKU or SKU group, based on 4 years historical sales; seasonal per SKU and day-of-week; weekly/daily period, revised weekly.
Order forecast	Stated the quantities and expected future replenishment per SKU; weekly forecast, daily period, updated daily.
Evant order exception parameters	Defined the exception values of generated orders per pharmacy; defined once, revised daily.
Assortment updates	Detailed information to update assortments in pharmacies; transferred and updated daily.
POS data and inventory information	Detailed information on sales transactions and inventory levels per SKU and per pharmacy; transferred and updated daily.
Orders	Defined quantity and timing of SKUs to be picked in the warehouse every day; daily order, hourly period.
Measurements	Detailed information reflecting performance in operations execution; real-time, hourly, daily.

In view of information sharing, the CPFR initiative was based upon that four major information types are shared between the companies; planograms, the promotional plan, assortment updates and POS data and inventory information. Main characteristics of these types of information are described in Table 4-7.

Table 4-7 Characteristics of information exchanged between the case companies

Categories	**Description per information type**			
	planograms	**promotional plan**	**assortment updates**	**POS data and inventory information**
Decision support level	tactical	tactical	operational	operational
Sharing frequency	monthly	monthly	daily	daily
Means of sharing	intranet	e-mail	EDI	EDI
Adjustment	assumes manual handling the receiver	assumes manual handling by the receiver	manual handling only in case of exception	manual handling only in case of exception

4.2.4 Evant and its surrounding ICT infrastructure

The ICT infrastructure that supported the information flows in the supply chain was based upon an integrated network of systems. The philosophy behind the current infrastructure was to establish a solid foundation for automatic transactions and communication between systems, and to minimize manual interference. A "best-of-breed" strategy was applied to develop the infrastructure, which basically means that there was focus on integration of specialized software or modules. ICT integration was therefore a major focus in the ICT strategy of Alliance Boots. Since Boots and Alliance Healthcare did not have a common or shared ERP system, the individual systems of the two companies were linked to ensure seamless and automatic transfer of information.

The main systems supporting the collaborative initiative are briefly described in Table 4-8.

Table 4-8 ICT systems of the case companies

ICT systems	Description
Evant	The APS system that was used to support CPFR related to replenishment of pharmacy inventories, managed by the joint replenishment team.
IMI Order	Alliance Healthcare's ERP system, which constituted the core in planning and control of warehouse operations.
UniLink	Alliance Healthcare's web application that Alliance Boots pharmacies used to get access to delivery information.
Boots systems	Various systems in the Boots administration including for instance the financial system and SpaceMan, the planogram management software.
FarmaPro	Alliance Boots pharmacies' ERP system.
Internet/intranet	Pharmacy PC that was connected to the Boots intranet with internet access.

The way these systems were linked to each other is shown in Figure 4-5. The systems located at Alliance Healthcare including Evant, IMI Order and UniLink were tightly integrated. The tight integration between Evant, IMI Order and FarmaPro ensured automation in generating the replenishment orders.

In the Boots administration, a few specific systems were used including SpaceMan for establishing planograms, for example. Information in Boots systems was primarily transferred via e-mail in Excel format. All Alliance Boots pharmacies have a common ERP system called FarmaPro. This system is part of an industry standard and has been implemented in all Norwegian pharmacies.

Another industry standardization initiative is a common scheme for product item numbers on pharmaceuticals. FarmaPro is primarily a transaction and product management system that supports most pharmacy operations including for instance prescription management and arrangements with the social security office. FarmaPro also has a module for integration with the cash point system. The pharmacies had an intranet solution for accessing price adjustments from authorities or from the Boots administration. The computer used for the intranet also had regular internet access, which was used to access Alliance Healthcare's web application UniLink.

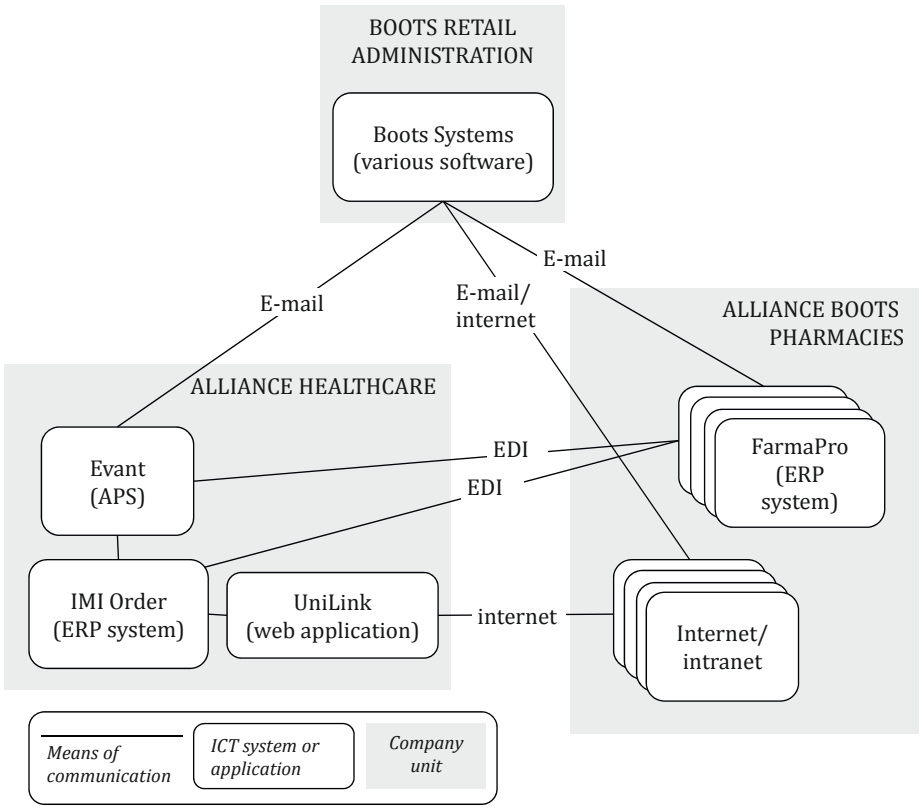

Figure 4-5 Linkages between ICT systems and applications of the case companies

The core system at Alliance Healthcare was the ERP system called IMI Order that supported the main operations in the warehouse including ordering, transportation, inventory management, picking operations, invoicing and so on. Alliance Healthcare also had a web application, UniLink, through which pharmacies could place orders and find information about products, previous orders, warehouse inventory information and delivery lead times.

Focus in this study is on the specific APS system called Evant, which was implemented to support the CPFR initiative. Evant was managed by the joint replenishment team, which was located at Alliance Healthcare. An overview of its main functionality is presented in Table 4-9.

Basically, Evant enabled automatic demand forecasting and order generation with exception management. This means that forecasts and orders could be automatically accepted within predefined limits and focus of the joint replenishment team was to deal with the exceptions. Functionality was further used to integrate control of planograms, campaigns, phasing in/out of SKUs related to parallel import/generic drugs, replacements and returns in the inventory control approach. In addition, Evant supported daily and automatic update of assortment information in Alliance Boots pharmacies. The information stored in the Evant database was further used for detailed analysis and follow-up on replenishment performance.

Table 4-9 Key functionality of Evant

Functions	Description
Demand forecasting	Forecasting of future demand per SKU and pharmacy based on up to four years of historical consumption data. Combining demand cleansing, day-of-week and seasonal profiling tools.
Assortment control	Automatic updating of assortment information in all pharmacies' SKU registers.
Order generation	Calculations of order quantities based on transaction costs in warehouse, inventory carrying costs, forecasted demand and SKU value. Included processing of POS data and inventory information that are transferred from all pharmacies.
Exception management	Automatic acceptance of orders within order exception limits defined.
Planogram control	Planogram considerations were incorporated in order generation and planograms were operated through Evant.
Campaigns control	Campaign considerations were integrated in order generation and were included in the planograms.
Control of parallel imports/generic drugs, replacements and returns of overstock	Integration of phasing in and phasing out of SKUs in order generation, including control of overstock returns.
Replenishment analysis	Detailed information on replenishment performance was available in the Evant database that was used for performance assessment.

4.3 PROCESS CHANGES AND EFFECTS OF ICT

Till now, focus has been on describing the CPFR initiative investigated. In order to identify changes in processes and effects caused by Evant, the processes and related information flows before Evant was implemented are described here followed by a description of the processes after the new APS system was implemented.

Evant was implemented at the same time as the new CPFR initiative was launched. The first part therefore reports on the processes before Evant was implemented and before the CPFR initiative was launched. The description of the second part represents the processes of the CPFR initiative, in which Evant is also included. An overview of the information flows before and after Evant was implemented is shown in Figure 4-6.

Briefly, before the new CPFR initiative and Evant, the two companies used to collaborate primarily on long term planning. Planograms and other relevant market directives used to be transferred to the Alliance Boots pharmacies from the Boots administration. Pharmacies were responsible for generating orders locally and for sending them to Alliance Healthcare. Decisions regarding order quantities and timing were carried out locally at the pharmacy.

4.3.1 Processes before implementation of Evant

An overview of processes and information flows before implementation of Evant is shown in Figure 4-7. The main activities are marked with numbers (1-8) and are also further described in the text below.

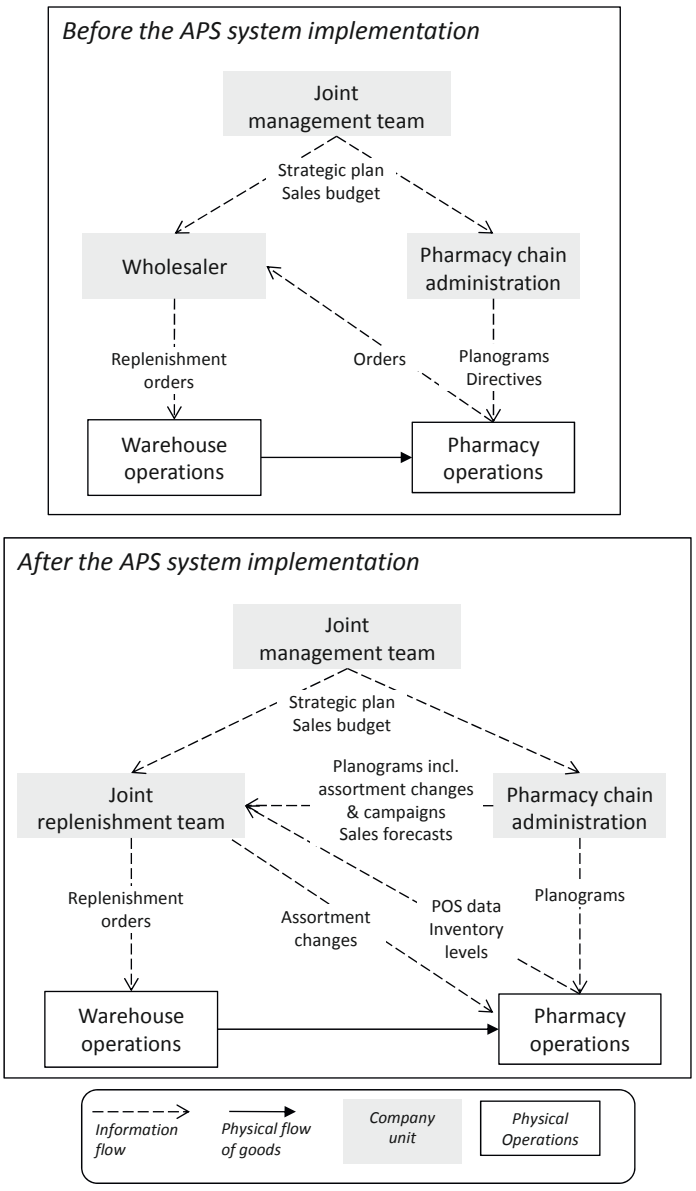

Figure 4-6 Information flows of the case companies - before and after Evant implementation

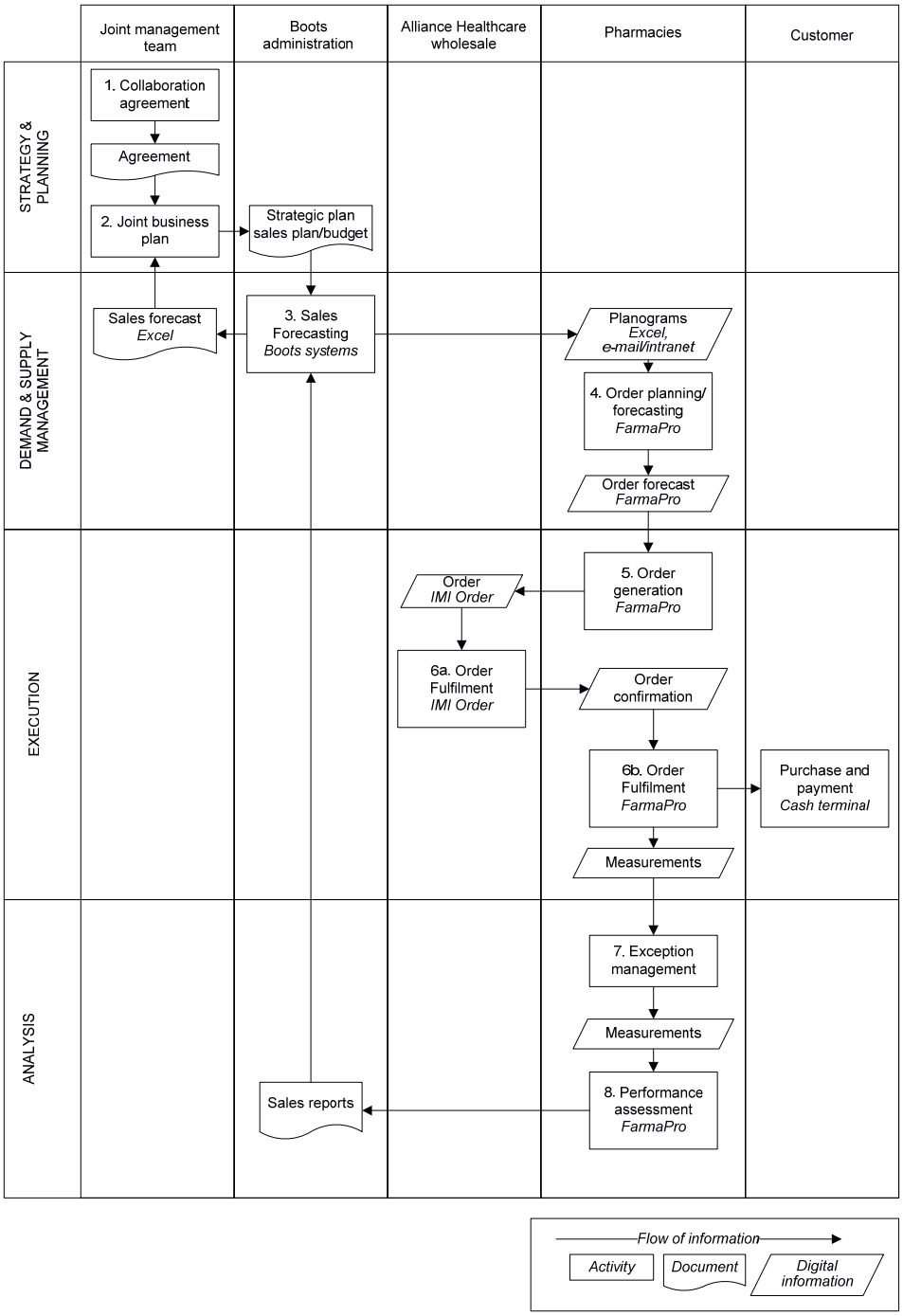

Figure 4-7 Processes and information flows of the case companies before Evant was implemented

Collaboration agreement and joint business plan (1 and 2)

Before Evant was implemented, the joint management team defined the overall guidelines and rules for the collaboration initiative in a long-term professional agreement. The business plan was mainly based upon a strategic plan of three years and a yearly budget. The budget was revised every six months with input from the sales forecast (3). The Boots administration provided input to the overall yearly targets including the monthly targets of pharmacies' service level and the monthly targets of total stock value in the warehouse and in pharmacies.

Sales forecasting (3)

The Boots administration established annual sales forecast in Excel format based on historical data of pharmacy sales. The sales forecast was established every six months. The forecast for campaigns and new SKUs was established continuously, also based on historical sales. The sales forecast served as input to the joint business planning activity (2).

The Boots administration was also responsible for defining the pharmacy assortment. This included planning of campaigns, shelf presentation using planograms, phasing in and phasing out of SKUs, replacements, parallel imports and generic drugs, and so on and required regular coordination with suppliers and pharmacies. Campaigns were planned for each month (with four weeks operational horizon) and campaign quantities were defined at an equal level for all pharmacies.

Planograms contained the information that was necessary for carry out planning locally in pharmacies. These were established in Excel format and were updated monthly.

Order planning/forecasting (4)

Planograms served as input to the order planning/forecasting activity, which was mainly carried out in the pharmacies. Planograms were transferred from the Boots administration by e-mail or via the pharmacy intranet. The Excel files were printed on paper and necessary adjustments and updates were manually registered in FarmaPro. Even though the overall settings were defined by the Boots administration, the final decisions regarding how to implement planograms, campaigns, assortment updates, and so on, were taken at a local level by the pharmacy personnel.

Pharmacies were responsible for set-up and configuration of profiles and parameters in FarmaPro based on historical data that were available in FarmaPro. Order proposals used to be calculated automatically in FarmaPro based on the order forecast. This was generated on a weekly basis and reflected sales for the next six days. The forecast was calculated based on exponential smoothing of historical demand data available in FarmaPro. If desired, the forecast could be overruled manually. Seasonal variations could also be taken into consideration in the forecast. A new forecast was generated for all new SKUs introduced in the assortment based on forecasts for SKUs that were expected to have similar demand patterns. The forecast was regularly reviewed for exceptions.

Order generation (B5)

Orders used to be generated in pharmacies based upon order proposals in FarmaPro. Changes and adaptations in FarmaPro proposals were made regularly. The FarmaPro ordering method used the desired service level to calculate safety stock levels, order quantities and reorder point levels. Orders were placed daily in IMI Order in Alliance Healthcare through the UniLink interface or via EDI. Order quantities calculations were based on the economic order quantity (EOQ) formula, which included both inventory and ordering costs. Campaign orders were placed separately in addition to ordinary daily ordering. Orders were automatically calculated in FarmaPro and reviewed manually to detect errors before they were placed via UniLink.

Order fulfilment (6a and 6b)

Orders registered in IMI Order served as input to the execution of orders which initiated distribution of the physical goods from the warehouse to the pharmacies. Order confirmations were automatically transferred from IMI Order to FarmaPro once every day. Order fulfilment activities included picking in the warehouse, shipping and transportation, goods reception in pharmacies, shelf filling into locations, and so on.

Exception management and performance assessment (7 and 8)

Measurements regarding operations performance were registered continuously and served as input to the analysis process. Information from execution of activities was also used to monitor and analyze current events and to deal with exceptions. Pharmacies used to evaluate their own performance with focus on sales once per week. Service level measurements were reported twice per year (according to legislation). The stock value was followed up on a weekly basis.

The information was primarily used for weekly follow-up on performance in pharmacies. Information from the pharmacies was also collected and put together by the Boots administration every month in order to permit analysis of the aggregate performance of all pharmacies.

4.3.2 Processes after Evant implementation

An overview of the information flows in the processes after Evant was implemented is shown in Figure 4-8. The main activities are marked with numbers (1-8) in the illustration and in the following text.

Collaboration agreement and joint business plan (1 and 2)

This activity was carried out in a similar way in which the activity used to be carried out before Evant was implemented (see section 4.3.1).

Sales forecasting (3)

The way this activity was carried out was similar to the way it used to be carried out before Evant was implemented (see section 4.3.1). However, there was an additional output from this activity since the Boots administration established a promotional plan in Excel format which was transferred to the replenishment team via e-mail.

Order planning/forecasting (4)

The joint replenishment team and the Boots administration met regularly to discuss shelf presentation stock, service level on promotions and supplier problems, for instance and to agree upon the promotional plan. The promotional plan was sent to the replenishment team in a planogram format that was similar to the pharmacy planograms.

In order to distinguish between the different types of planogram information that were shared, the information type that was sent from the Boots administration to the replenishment team is here referred to as the “promotional plan”.

This plan was established in Excel format by the Boots administration (3) and was transferred to the replenishment team via e-mail. They were distributed four weeks in advance and meetings were held two days after the information had been transferred. The replenishment team carried out a quality check of the plan to correct errors. The promotional plan encompassed up to more than one hundred planograms for the various SKU categories and campaigns.

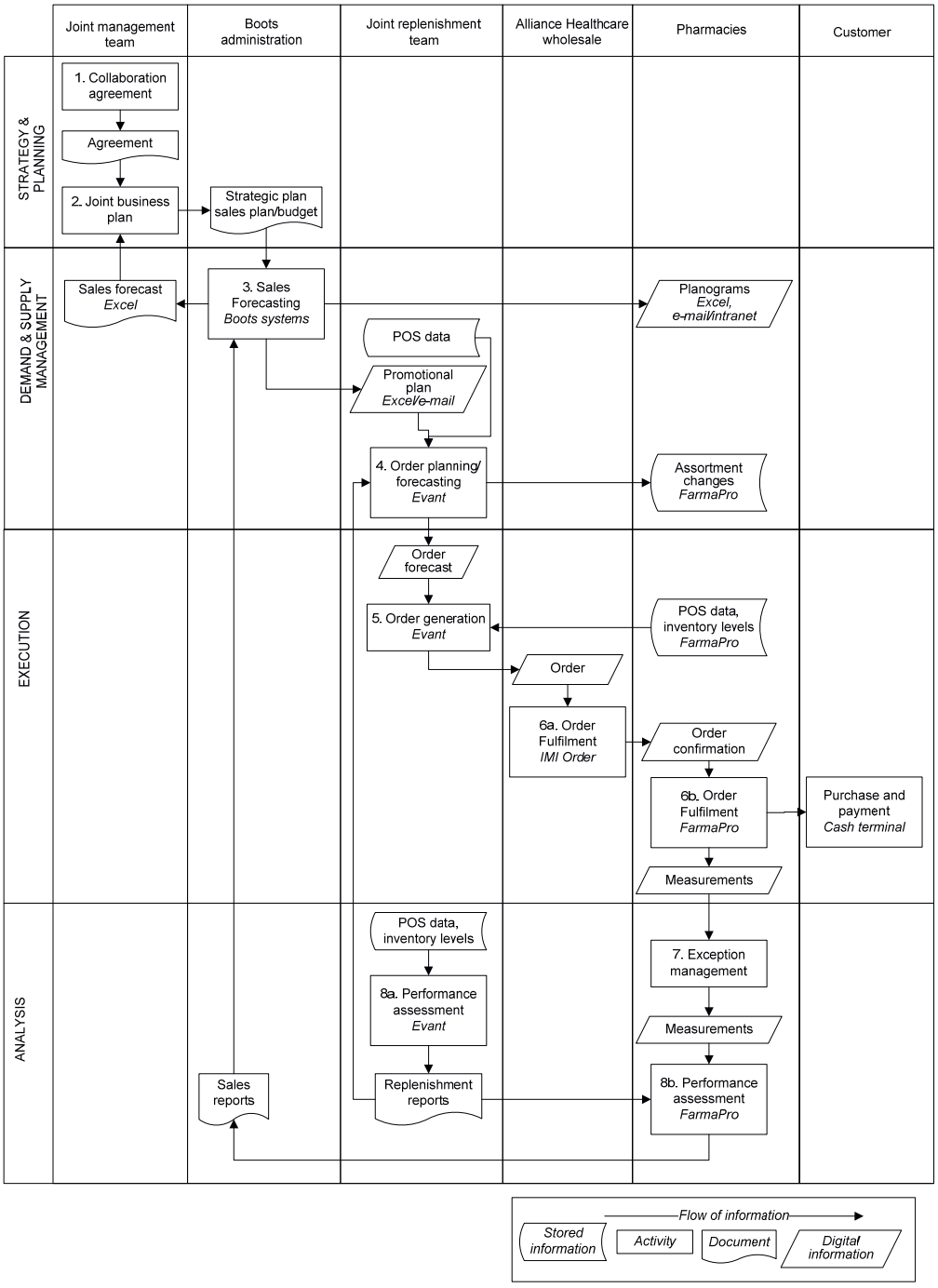

Figure 4-8 Processes and information flows of the case companies after implementation of Evant

The promotional plan also specified the product assortment in pharmacies and the minimum and maximum inventory level per shelf. This information was used to automatically update assortment information in FarmaPro. Evant was used to update pharmacy assortments every night. These updates comprised information of regular planograms, promotions/campaigns, parallel imports and generic drugs, replacements, shelf locations, and so on.

The order forecast was calculated in Evant based upon the forecasting profiles; the seasonal profile defined expected demand per week while the day-of-week profile stated the daily demand. Profiles were defined and adjusted by the replenishment team. As new SKUs or pharmacies were introduced, new profiles were developed based on characteristics of similar SKUs or pharmacies.

The forecast was an estimate of future demand per SKU for each pharmacy. Forecasting profiles were established per SKU and per pharmacy based on historical sales of four years.

While most of the SKUs were replenished through Evant, pharmacies were free to regulate order quantities for a small amount of SKUs that had specific characteristics.

SKUs were classified in ABC-categories based on the transaction cost per order line in the Alliance Healthcare warehouse. This permitted levelling out the work load in the warehouse along the week. The forecasting functionality in Evant enabled calculations based upon several forecasting methods. The forecast was updated once per week for all pharmacies based on the historical sales information of the week before, which was available in the Evant database. Forecast exceptions were reviewed every week and necessary corrections were made.

Orders were calculated in Evant based on service level, stock value, lead time and delivery frequency. The reorder point of products was defined based on parameters such as number of order lines, type of shelf, shelf capacity, demand pattern, presentation stock, lead time and size of the product. The replenishment team had regular contact with the pharmacies for tuning the minimum and maximum stock levels in Evant.

The replenishment team also defined order exception parameters. There were about one hundred different parameters to choose from such as order value, value per order line and inventory level. Order exception tactics were based on four main order categories: large, middle, small and early orders pharmacies (which are 15 to 20 pharmacies in the Oslo area).

Order generation (5)

Orders were generated based upon the weekly demand forecast, which was updated with POS data and inventory information from each pharmacy. Order proposals defined SKUs and quantities per pharmacy expected to be delivered from the warehouse the following day. The order generation method was based on the EOQ formula. The transactional costs in the warehouse were also included in calculations.

Evant recalculated SKU requirements by assessing the inventory requirements for every SKU using the daily update of POS data and inventory information from pharmacies. The suggested order quantity per SKU was determined by comparing the available quantity with demanded quantity. SKU requirements and orders were recalculated every day in Evant.

Evant was also used to manage exceptions in order proposals. This was done automatically based upon the defined order exceptions parameters. About 95 percent of all orders were automatically accepted. This means that about five percent of the total number of order proposals were outside the limits of the defined order exceptions parameters and needed to be checked. For each exception, the replenishment team took actions for extra reviewing and for making corrections. As orders were accepted, they were registered in IMI Order (6a).

Order fulfilment (6a and 6b)

The way this activity was carried out was similar to the way it used to be carried out before Evant was implemented (see section 4.3.1).

Exception management and performance assessment (7, 8a and 8b)

On a local level, each pharmacy evaluated its own sales performance and dealt with exceptions as they occurred based upon information in FarmaPro.

In addition, the replenishment team generated weekly reports on the replenishment performance of all pharmacies based upon information in the Evant database. This report was used to analyze the weekly development of stock value, revenues, stock days, service level, forecast accuracy and campaign revenues on an aggregate level. The replenishment performance information in Evant was also used to evaluate the performance of individual pharmacies. Detailed reports of planograms per category – including service level, revenues, stock value and representation stock, for instance - were also generated and assessed. Replenishment reports from Evant primarily served as input to tuning of profiles and parameters in Evant (4).

4.3.3 Identified process changes and effects

The implementation of Evant in the Alliance Boots supply chain led to several process changes and related effects. These are described next and are summarized in Table 4-10.

Collaboration agreement and joint business plan (1 & 2)

The collaboration agreement and the joint business plan were carried out in a similar way both before and after Evant implementation. No major changes were therefore identified related to these activities.

Sales forecasting (3)

One significant change related to sales forecasting was identified. It encompassed that the promotional plan was shared with the joint replenishment team prior to order planning/forecasting. In order to provide input to the order planning/forecasting activity, the Boots administration sent the promotional plan to the replenishment team in addition to the planograms that were sent to the pharmacies.

Order planning/forecasting (4)

Several major changes related to order planning/forecasting were identified.

The establishment of a joint replenishment team implied that the responsibility of the order planning/forecasting activity became centralized. Before Evant, order planning/forecasting was managed locally at the individual pharmacy with support in FarmaPro. The responsibility related to logistics and deliveries was moved away from pharmacies so that pharmacy employees could concentrate more on sales and marketing.

The new joint replenishment team with support from Evant facilitated a more integrated approach with respect to retail and wholesale planning. The team served as an important node in the supply chain with its interface with pharmacies, the retail administration and the wholesale business. In particular, the team had a close dialogue with pharmacies to jointly adjust and tune the configuration for order planning/forecasting in Evant since pharmacies could come up with suggestions for changes to the replenishment team regarding the set up configuration in Evant. In addition, the promotional plan was jointly agreed upon in regular meetings between the Boots administration and the replenishment team.

Table 4-10 Changes and effects identified in the case

Activity	Identified changes	Identified effects
1. Collaboration agreement **2. Joint business plan** **3. Sales forecasting**	no major changes/effects identified	
4. Order planning/ forecasting **5. Order generation**	automatic assortment updates automatic exceptions management automatic update of POS data and inventory information centralized and automatic order generation centralized responsibility of order planning/forecasting customized campaigns order calculations based upon combined costs of pharmacies and warehouse sharing of promotional plan substitution of pharmacy ordering and assortment control	higher forecast and order accuracy improved pharmacy inventory performance more formalized and standardized implementation of market plans more free space in pharmacies more integrated planning more opportunities for integrated planning more planning flexibility and standardization more standardized and varied assortment new competence requirements reduced costs and levelled out workload in warehouse reduced overtime in warehouse time savings in pharmacies
6. Order fulfilment **7. Exception management**	no major changes/effects identified	
8. Performance assessment	availability of historical sales information centralized assessment and reporting of replenishment performance	increased replenishment reporting new opportunities for assessment and reporting

One of the managers in the Alliance Boots management team commented upon the role of Evant in the integration process:

> *"Evant has helped to increase trust and promote collaboration and has served as an integrator in the integration process. It has opened up for dialogue in all directions, and for daily close collaboration between pharmacies and the wholesaler. Evant has had a major influence on the entire company."*

Moreover, two members of the replenishment team stated:

> *"Everyone works in a relay race and it is important to know when to hand over the baton to the next function… Responsibilities, authorities and organization need to correspond…we have a lot of work to do before we can call ourselves integrated."*

> *"Yes, there is more dialogue between wholesale and retail today… Logistics has been introduced in the market world. The situation is still not totally optimal; there is a major potential for more collaboration between the companies."*

The implementation of Evant also implied that new opportunities for integrated planning emerged. For example, it could be possible to include the package size in the warehouse when defining the planograms. This could be helpful to warehouse employees when packing the orders since they must split packages due to the mismatch in the sizes between actual wholesale packages and the retail packages that were defined in the planograms. Another example is that Evant served as enabler for a new initiative to develop a multi-echelon solution that would integrate the planning and control of the warehouse inventory with pharmacy inventories.

The implementation of Evant implied that new competence were required. The joint replenishment team needed excellent computer skills and a comprehensive understanding of dependencies between parameters in the ordering method in order to carry out their work. Tuning of parameters further required thorough understanding of conditions with respect to pharmacy operations and sales, as well as overall market and chain management. Team members should also be aware of the consequences of their actions when defining and adjusting the parameters.

This was a major difference to how it was before as pharmacy employees did not need extensive computer skills or thorough understanding of the underlying ordering method in FarmaPro to manage the local inventory. Still, pharmacy employees do not need any specifically extensive understanding of how Evant works as the replenishment team took over the responsibility for many of the decisions that used to be taken locally.

With regard to the skills necessary in pharmacies when replenishment was carried out with Evant, one of the members of the replenishment team commented:

> *"If they start with Evant they go from the stone age to NASA in two days… The pharmacies must understand that they should adopt a hands-off strategy."*

A major change was the assortment updates that previously used to be manually registered in each pharmacy became automatically updated in FarmaPro. The assortment updates generated by Evant included planogram control, promotions/campaigns, parallel imports and generic drugs, replacements, shelf locations, and so on. The daily transfer of assortment updates from Evant to FarmaPro enabled that SKU registers were up to date at any time. Before, the centrally defined plans served primarily as guidelines and decisions regarding assortments were made in each pharmacy. The centralization of assortment updates implied that the assortment primarily became more standardized. In addition, the assortment became more varied due to the introduction and deactivation of SKUs, which were made more often.

The assortment control functionality in Evant also implied improvements in replenishment performance of pharmacy inventories with improved fit between the quantity and variety of SKUs that were in stock and actual demand. Updates were generated based upon the promotional plan established by the Boots administration and later adjusted together with the joint replenishment team. The assortment update functionality in Evant further contributed to more free space in pharmacy shelves and drawers. Significant time savings in pharmacies were also identified since ten to twenty percent of the assortment was replaced every year. Earlier, updating of SKU numbers and shelf locations, phasing in of generic drugs and replacements of parallel imports, used to be managed manually in pharmacies.

The order planning/forecasting activity became more flexible and standardized after the implementation of Evant. This was because the Evant configuration could be easily adjusted to changing circumstances and changes were rapidly effectuated simultaneously in all pharmacies. Earlier, adjustments and changes were primarily managed locally in pharmacies and changes were often made in generated order proposals instead of directly in the configuration of profiles and parameters in FarmaPro.

Since assortment updates, campaigns and planograms were centrally operated through Evant, the rules and routines of implementing market plans in pharmacies became more formalized and standardized. Earlier, these plans were adjusted and implemented locally by pharmacy employees. With regard to this formalization, one of the members of the joint replenishment team stated:

> *"Evant is a tool that implies a new decision process that ensures that the rules are actually followed. The rules that were defined for the pharmacies before were not actually followed."*

The implementation of Evant implied that campaigns were included in daily ordering. This implied that the employees in the warehouse did not have to work overtime which lowered the cost since no overtime had to be paid. The campaign quantities were also customized to each pharmacy based upon historical sales information, which provided a better data support for campaign decisions. Earlier, campaign quantities were standardized for all pharmacies.

Seventh, the centralization of the forecasting activity supported by Evant implied that a single forecast for all pharmacies replaced the local forecasts in each pharmacy. This led to a higher accuracy in forecasted future demand per SKU and pharmacy. The forecasting function was more powerful and the forecast was established based on a combination of various forecasting methods and on historical sales information in the Evant database. The FarmaPro forecasting function was also based on historical information but offered only more basic functionality.

The use of a detailed day-of-week forecast in Evant led to that the weekly workload in the warehouse was levelled out. The forecast was used to plan the warehouse workload, distributing the workload more evenly and thereby avoiding potential daily peaks and declines. For example, if the forecast showed a peak in demand on a Friday, the warehouse operations plan could be adjusted and some of the surplus orders could be moved to other days the same week.

Order generation (5)

A major change related to the order generation activity was that it was centralized with Evant and orders were generated automatically. The replenishment team became responsible for ordering while the pharmacies had less liberty of action.

This led to significant time reductions in pharmacies that corresponded to 0.5 full time employees (FTE) per pharmacy. Before, about 125 pharmacy employees spent at least 1.5 hour per day on ordering via UniLink. The replenishment team implied four new FTEs; whereof two FTEs worked with direct operations and two FTEs with Evant development. While pharmacy employees used to change the local orders directly in the generated order proposals in FarmaPro, order changes in Evant were made by tuning the current configuration of the system. The replenishment team only had to spend a minor amount of time on actual order transactions as Evant carried out most things automatically and only exceptions needed to be manually handled.

Orders were generated based upon the forecast, which was automatically updated with POS data and inventory information. Thereby, a higher accuracy in order quantities, relative the forecast, was achieved. This improvement had a positive impact on the development of the pharmacy inventory performance in terms of service level, stock value, stock days and lost sales.

Another major change was that order calculations combined both inventory holding costs in pharmacies and warehouse ordering costs for order generation. This resulted in costs reduction and the workload was more evenly spread during the day in the warehouse.

Evant implied that all order proposals were automatically checked for exceptions. This reduced the risk of human errors and dependency on personnel. With the automatic exceptions management in Evant, unintended deviations and errors in order proposals were easily detected. This functionality avoided that potential errors could multiply and permeate further in the system. The order exception functionality in Evant was used to detect and handle potential errors. Before Evant, order quantities defined locally were often influenced by the intuition, experiences and preferences of individual employees and unintentional mistakes were more difficult to detect. The exception control functionality contributed to the higher order accuracy and to the improved performance of pharmacy inventory measured in terms of service level, stock value, stock days and lost sales.

Order fulfilment and exception management (6 & 7)

The order fulfilment and the exception management activities were carried out in a similar way both before and after Evant implementation. No major changes were therefore identified related to this activity.

Performance assessment (8)

A major change related to the performance assessment activity was the replenishment performance assessment and reporting that were centralized after implementation of Evant. This implied improvements in the replenishment performance. The Evant database constituted an essential information source for the evaluation of replenishment performance. Detailed information of historical sales for all pharmacies was easily available to the replenishment team and they had both detailed and up-to-date insights to pharmacy replenishment performance that could be used for further tuning of the configuration in Evant and further performance improvements. Some of the measures that the replenishment team used to evaluate the replenishment performance and adjust Evant parameters included service level, stock value, stock days, sales, forecast accuracy and campaign sales.

The availability of historical sales information implied an increased replenishment reporting. The Evant database offered a significant amount of information although Evant had limited reporting functionality. Development of additional reporting functionality however, helped the replenishment team to automatically generate new reports for centralized evaluation of pharmacy replenishment performance on both aggregate and detailed levels.

The implementation of Evant also implied the emergence of new opportunities for assessment and reporting. The daily updates of information in the Evant database created further opportunities for even more frequent evaluation. Evant also had additional reporting potential that could be exploited as reports that could be adjusted to specific needs of various stakeholders including individual or groups of pharmacies, suppliers and the Boots administration. There were hence an unexploited potential for further analysis and reporting of information in Evant but there was limited understanding of how this information could be used. Commenting upon the current limited understanding in the supply chain of how Evant information could be used, one of the members of the replenishment team said:

"Now the figures are available - what should we do with them?"

4.4 CHANGES IN INFORMATION QUALITY RELATED TO ICT

The CPFR initiative was based upon that assortment updates, the promotional plan, pharmacy planograms and POS data, and inventory level information that were exchanged between participants. This section presents empirical information related to quality characteristics of these information types in order to generate orders and to control pharmacy store presentation.

In order to identify changes, information quality characteristics for the information type that was shared from before Evant was implemented, the pharmacy planograms, are first described. This is followed by a presentation of information quality characteristics of information types that were exchanged after Evant had been implemented. Observations of changes in the quality of the exchanged information are then summarized. The information quality was implicitly determined by the information exchange conditions related to each information type. Therefore, information exchange practices are also described.

Before Evant was implemented, the only information type that was exchanged was pharmacy planograms. These planograms were also exchanged in the new CPFR approach supported by Evant. In addition, three new types of information, the promotional plan, POS data and inventory information, and assortment updates were also exchanged. These information flows are marked in bold in Figure 4-9. The figure is similar to the illustration in Figure 4-6, but it emphasizes information flows and ICT used to support the exchange of information between the partner companies.

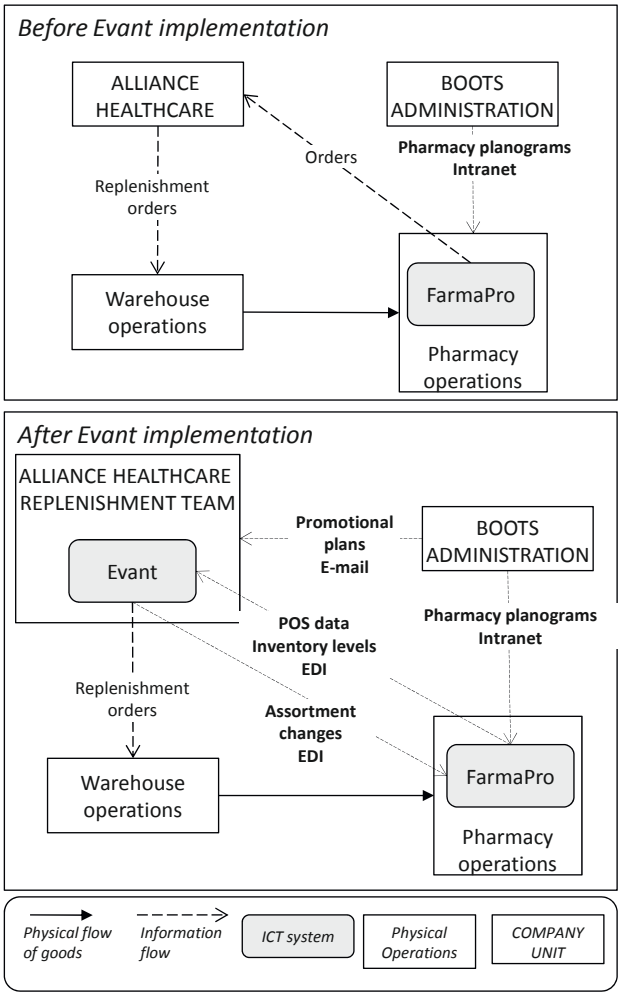

Figure 4-9 Main information types exchanged in the case companies, before and after Evant implementation

4.4.1 Quality of information before Evant implementation

Before Evant was implemented, pharmacy planograms was the primary information type exchanged between the partner companies. These were sent from the Boots administration to the pharmacies. The planograms also included information on assortment updates and used to serve as support in organizing shelves in the stores and in defining order points in FarmaPro. They were centrally defined by the Boots administration and an overview of the characteristics describing how pharmacy planograms used to be shared is presented in Table 4-11. There were no major issues related to the information exchange practices and the quality of pharmacy planogram information before Evant was implemented.

Table 4-11 Characteristics of the exchange of pharmacy planograms before Evant implementation

Categories	Description
Sender	Boots administration
Receiver	Alliance Boots pharmacy
Purpose of information	support to local decision-making for organizing shelves, assortment management and ordering
Decision-making level	tactical
Transfer frequency	1/month, 3/year
Means of transfer	intranet
Format	excel to paper print-out to FarmaPro
Manual handling by receiver	manual revision to identify changes, adjustments are made

Empirical information related to quality characteristics of pharmacy planograms information is presented next.

Quality of pharmacy planograms information

The pharmacies had access to planograms in excel format via the internal pharmacy intranet where they were made available by the Boots administration. Planograms were of two types: the standard assortment planograms that were updated and distributed three times per year and the new campaign planograms that were distributed every month. Planograms were normally printed out on paper before they were used for filling the shelves and for ordering in FarmaPro. The information was easily accessible right after Boots administration had made their changes and well in advance of when new planograms were supposed to be implemented.

A new set of valid planograms were distributed at each update to ensure that information was complete. Since changes were not separately marked out, the receiver reviewed the planograms manually, comparing updated planograms with older ones, to discover the changes that were necessary to implement.

Planograms were used for decisions about the physical presentation in the store (layout and shelf allocation) and decisions of how to implement planograms, campaigns and assortment updates were taken at the local pharmacy. At that time, shelves had not yet been standardised and there could be mismatches between planograms and actual shelves. Pharmacy personnel could experience difficulties when implementing planogram changes trying to fit the products into the shelves and there could be large variations in how products were being placed in the store. If there were any questions about the planograms, pharmacies could contact the Boots administration directly. Manual adjustments of the planogram information were still necessary in order to make it fit to local conditions.

Planograms were further used as input to ordering in the replenishment process. Since planograms contained information about the minimum quantities in the shelves, they were used as information input for defining the order points in FarmaPro. These changes were made manually in FarmaPro based on the planogram printouts.

Since there was a risk of mismatch between what was stated in the planograms and the actual layout of the pharmacy shelves, the information was primarily used as support both when filling the shelves and defining order points. It was also necessary to further convert and adapt the information to fit the local conditions in the pharmacy before it could be implemented. Planograms were primarily used as supportive instructions in local decision-making i.e. the pharmacy did not have to follow the directives to the letter and was allowed to make necessary individual adjustments regarding both shelves allocation and ordering.

4.4.2 Quality of information after Evant implementation

After Evant was implemented, four major information types were shared in the Alliance Boots supply chain. In a pharmacy perspective, main information types included pharmacy planograms received from the Boots administration and assortment updates from the replenishment team. In the replenishment team perspective, main information types received included the promotional plan from the Boots administration and POS data and inventory information from pharmacies.

An overview of characteristics describing how these information types are shared is presented in Table 4-12. There were no major issues related to the information exchange practices and the quality of information types after the implementation of Evant.

Empirical information related to quality characteristics of pharmacy planograms information is further presented next.

Quality characteristics of pharmacy planograms

Planograms in excel format were made available by the Boots administration via the internal pharmacy intranet. Updates were distributed three times per year for the standard assortment and every month for the campaign assortment. All valid planograms were distributed at each update to ensure that information is complete.

Planograms were primarily used for organizing the layout and for filling the shelves in the pharmacy. It could be printed out on paper if necessary serving as support for implementing suggested layout of the shelves. All planograms were sent at each update and were distributed well in advance of implementation. Planograms were manually checked to identify entries that had been changed compared to previous planograms as changes were not separately marked out.

The standardization of shelves in the pharmacies implied that there was an adequate fit between planograms and actual shelves appearance. The room for further local adaptation was limited and pharmacies were more or less obliged to implement the layout defined in the planograms. Planograms had a decisive role and served as a directive for store presentation in standard shelves. Besides defining the overall layout, which was primarily critical in an initial set up phase, planograms only had a supplementary role when filling up the shelves on a continuous basis. Due to reduced local decision-making, planograms were not further translated or converted to be used in ordering or assortment management.

Table 4-12 Characteristics of information exchange between case companies after Evant implementation

Category	**Description of characteristics per information type**			
	pharmacy planograms	**assortment updates**	**promotional plan**	**POS data, inventory information**
Sender	Boots administration	replenishment team (Evant)	Boots administration	Alliance Boots pharmacies (FarmaPro)
Receiver	Alliance Boots pharmacy	Alliance Boots pharmacy (FarmaPro)	replenishment team	replenishment team (Evant)
Purpose of information	definition of standard shelves set-up, supplement in continuous filling	update of pharmacy assortment	support to forecasting and creating assortment updates files	update of weekly forecast
Decision-making level	tactical	operational	tactical	operational
Transfer frequency	1/month, 3/year	daily	1/month	daily
Means of transfer	intranet	EDI	e-mail	EDI
Format	excel to paper print-out	data files readable by FarmaPro	excel to Evant	data files readable by Evant
Manual handling by receiver	manual revision to identify changes	no manual handling	manual quality check, physical meeting and adjustments	manual handling only if exceptions are detected

Quality characteristics of assortment updates

This information was updated automatically in FarmaPro on a daily basis. The file was used to centrally manage and control the assortment in pharmacies. It was sent from Evant to all pharmacies via EDI. Replenishment orders were also automatically generated without any intervention of the pharmacy. This means that pharmacy planograms were no longer used for manually implementing assortment updates and for ordering in FarmaPro. Information was directly implemented in FarmaPro without manual intervention. It was also customized and fully adjusted to each individual pharmacy.

Quality characteristics of the promotional plan

The replenishment team received the promotional plan in excel format by e-mail once per month from the Boots administration. The promotional plan was used to support the replenishment team in updating the demand forecast and assortment information. The replenishment team and the Boots administration also held regular so called "campaign meetings" to discuss and agree upon shelf presentation stock, service level on promotions and supplier problems, for instance. Representatives from both the replenishment team and Boots administration attended these meetings. The plan was distributed 4 weeks in advance of implementation and meetings were held about 2 days after the information had been transferred.

The replenishment team had to carry out a manual quality check of the promotional plan to detect and correct errors prior to meetings. The plan could include up to more than 100 different planograms for the various SKU categories and campaigns. After meetings, the promotional plan was manually adjusted according to decisions taken jointly during campaign meetings before changes were implemented in Evant. This planning information was also used to create the file with assortment updates that was automatically updated in the pharmacies.

Quality characteristics of POS data and inventory information

The replenishment team received POS data and inventory information from all Alliance Boots pharmacies. This information was transferred automatically from FarmaPro directly to Evant every day via EDI. It was critical since it was used to update the weekly demand forecast, which in turn was used to generate the replenishment order proposals. The information was directly and automatically transferred to Evant without any manual intervention, in a pre-defined format that was compatible with and readable by Evant. The daily updates ensured that information was up-to-date, fresh and flows with minimum delay. If the information contained any errors, these were detected in the automatic exception control in Evant.

4.4.3 Identified changes of information quality characteristics

The quality characteristics of different information types are summarized in Table 4-13.

One major change identified was that pharmacy planograms were more adapted to local conditions in the new CPFR approach compared to before. This adaptation was enabled by the introduction of standard shelves in pharmacies. It should also be noted that planograms were assigned a different role in the new approach since they were only used for organizing the store representation and no longer for updating the assortment or ordering decisions.

Another major change was that the CPFR approach implied that 3 new information types were shared. These were associated with different quality characteristics and thereby represent different properties. The POS data, inventory information and assortment updates, which were transferred automatically between FarmaPro and Evant, had similar quality characteristics while the promotional plan, which was transferred via e-mail, was associated with characteristics that were significantly different.

Table 4-13 Summary of quality characteristics per information type of the case companies, before and after Evant implementation

Information type	Description of quality characteristics
Pharmacy planograms (before Evant)	easily accessible via the intranet every month well in advance of implementation deadline printed on paper complementary contact between pharmacies and retail administration was sometimes needed manually adapted to local pharmacy conditions complete sets were sent at each update and manually reviewed
Pharmacy planograms (after Evant)	easily accessible via the intranet every month well in advance of implementation deadline printed on paper adapted to local pharmacy conditions complete sets were sent at each update and manually reviewed
Assortment updates (after Evant)	automatically and electronically transferred customized and adapted to local pharmacy conditions
Promotional plan (after Evant)	easily accessed via e-mail every month well in advance of implementation manual quality review manually adjusted to jointly agreed changes
POS data, inventory information (after Evant)	automatically and electronically transferred customized and fully adjusted

5. EMPIRICAL FINDINGS AND DISCUSSION

The case description presented how the partners in the Alliance Boots supply chain used ICT to support their new CPFR initiative. In this chapter, main findings from the case are presented and discussed. The discussion is structured based on the four research questions related to ICT capabilities, the impact of ICT on processes and information quality and conditions for ICT supported CPFR. Relevant characteristics identified in the case are discussed in view of literature to define a set of characteristics of ICT supported CPFR. These characteristics are used to form a framework for ICT supported CPFR.

This chapter presents the empirical findings related to the research questions and these findings are discussed in view of literature. The research framework for exploring ICT supported CPFR (Table 3-13) was developed in parallel with the empirical investigation to define an appropriate scope for the empirical study and to guide and structure the investigation throughout the entire research process. The framework was used to structure the empirical evidence

The chapter presents and discusses empirical findings related to;

- the application of the analyzing, connecting, communicating, creating and standardizing capabilities of ICT (section 5.1)
- the impact of ICT on processes with focus on information flows in view of automational, informational and transformational effects (section 5.2)
- the impact of ICT on information quality in terms of accessibility, accuracy, conciseness, completeness and timeliness with focus on information exchange (section 5.3)
- the conditions for adopting ICT with focus on relational and technological circumstances (section 5.4)

The chapter also presents a framework for ICT supported CPFR, which is developed by gathering and organizing relevant characteristics related to the research questions into a single structure (section 5.5).

In each section, main findings are presented and then discussed in view of literature. Defined characteristics are summarized in the end of each section.

When referring to the specific system implemented in the case, the general term "the APS system" is used in this chapter, substituting the specific term Evant that was used in the previous chapter.

5.1 RQ1: APPLICATION OF ICT CAPABILITIES

This section deals with the first research question. The ICT capabilities categories of the research framework are used to present the empirical findings with regard to how ICT capabilities were applied in the case. Empirical observations are categorized according to these categories by a qualitative evaluation in terms of their importance for supporting the joint initiative and of how they were related. Characteristics are identified based upon the categorization. Characteristics identified in the case companies are further compared to current literature. Based upon the discussion ICT capabilities characteristics are defined together with a set of propositions.

The research framework for exploring ICT capabilities (Table 3-8) is built upon five main capabilities;

- Analyzing capability: the ability of ICT to analyze information to support decision-making.
- Communicating capability: the ability of ICT to communicate input or output information between partners.
- Connecting capability: the ability of ICT to support collaboration and cooperation between partners in supply chains.
- Creating capability: the ability of ICT to create or produce new information into the processes, either by capturing new information or by refining existing information.
- Standardizing capability: the ability of ICT to support standardized processes and centralized control.

These capabilities express different sides of how ICT can be applied and should not be mixed up with the three categories, automational, informational and transformational changes that are used to categorize the process changes from ICT in section 5.2.

The set of capabilities aims to ensure harmonization to the description of the use of ICT. Rather than concentrating on the different ICT systems and applications that are used, the capabilities imply that focus is on different functionalities applied to support information flows. Besides the APS system, there are several other types of ICT represented in the case including ERP systems, a web application, internet and an intranet solution, EDI and various software applications (see section 4.2.4), and the use of the APS system depends upon several of these other types of ICT. The capabilities presented here represent the application of several types of ICT as a whole and not only the APS system functionality.

In addition, because the APS system is integrated with and dependent of several other surrounding ICT systems in order to support the CPFR initiative, the capabilities of the entire ICT solution that supports the CPFR initiative including the APS system plus the other ICT systems are taken into consideration.

5.1.1 Empirical findings on ICT capabilities

In the case ICT had a significant importance for the CPFR initiative, especially the new APS system. Different ICT functionalities were used, which could be related to various capabilities. The way these capabilities were applied is described next to identify characteristics of ICT capabilities in the case.

Analyzing capability

The ability of ICT to analyze information to support decision-making, may for instance involve processing, encoding, reconfiguration, combination, compilation and storage of information. In view of information analysis, ICT was primarily used by the case companies to;

- calculate order forecasts and orders based on historical sales information
- calculate the promotional plan and updates of POS data and inventory information
- calculate assortment updates based upon the promotional plan
- automatically make decisions based on various algorithms and methods in accordance with defined rules
- compile measurements information into replenishment reports based on pre-defined reporting formats
- to store measurement information and historical POS data and inventory information

The large amount of information had implications for how ICT was used for analyzing information. The capability was especially important for handling and utilizing the large amount of information that the CPFR initiative relied upon. Information was not only of a large amount in terms of size, it also represented a broad range of various information types, including promotional plans, forecasts and historical sales information, which implied a high level of complexity.

The automatic calculations of order forecasts and orders presumed that necessary historical POS data was stored and made available. Without this capability, it would have been difficult to make decisions automatically. It would also have been difficult to process and interpret such large amount of information.

Communicating capability

The communication of input or output information between partners is also related to the exchange and transfer of information. In view of communication ICT was primarily used in the case companies to;

- automatically transfer POS data and inventory information from pharmacies' ERP systems to the APS system
- automatically transfer assortment updates to the ERP systems of pharmacies and orders to the ERP system of Alliance Healthcare
- facilitate access to assortment updates in pharmacies and to POS data and inventory information in the joint replenishment team

This shows that by supporting information exchange, ICT contributed to increased visibility in planning and control between partners in the CPFR initiative. The APS system supported information exchange, especially as a sender and receiver of information. Even though the APS system was not explicitly used as a means of transfer, it had major importance for information exchange; it facilitated more communication between the companies by its linkages to surrounding ERP systems.

The CPFR initiative was based upon the exchange of a large amount of information, especially POS data, inventory information and assortment updates, which involved 145 pharmacies. Hereby, the use of ICT to support the automatic transfer of POS data and inventory information was especially important.

Connecting capability

This capability reflects the support of ICT in collaboration and cooperation between partners. In the case companies, ICT was used to facilitate collaboration in several ways;

- the joint replenishment team was organized around the APS system
- the campaign meetings were established where representatives of the replenishment team and the pharmacy chain administration met to agree upon the promotional plan that was later effectuated in the APS system
- the APS system provided a centralized platform, which integrated interests of both wholesale and retail businesses

The close integration between the wholesale and retail businesses was important for the CPFR initiative. In particular, the joint replenishment team, which was organized around the particular APS system, played a central part for establishing collaboration and coordination. The capability of ICT for providing a platform for the joint replenishment team and to facilitate collaboration on the promotional plan was important in the case.

Creating capability

This reflects the use of ICT to create or produce new information in processes, either by capturing new information or by refining existing information. In the case companies, ICT was used to;

- generate a joint order forecast and orders based upon processing of historical POS data, updates of POS data and inventory information and the promotional plan
- generate assortment updates based upon the promotional plan

In the investigated CPFR initiative, output information from the APS system served as input to the pharmacies' ERP systems and to Alliance Healthcare's ERP system. The ability of ICT to create output in turn depended upon input information sent from other sources. For example, the output information generated from the APS system relied upon input information from surrounding ERP systems.

The joint order forecast and orders were the cornerstones of the CPFR initiative, and the creating capability of ICT was significant for generating this information. The use of ICT to generate information about assortment updates was also important for ensuring efficient control of the pharmacy assortments.

Standardizing capability

This capability refers to the support of ICT to standardize processes and centralize control. In the case companies, the capability was used to;

- define a set of rules and procedures that were common for all pharmacies
- establish a common platform for information control and standardized processes and a joint frame of reference for replenishment decisions, defining the standards and rules for generating orders
- centralize order forecasting and ordering

In the CPFR initiative, conditions and routines for order forecasting and ordering were jointly established and adjusted by the joint management and replenishment teams. These conditions were mainly defined in the set up and configuration of the APS system. ICT thus ensured that order forecasts and orders for all pharmacies were based on centralized configuration and set up of common parameters and logics. This ensured that the commonly defined ordering routines were actually followed and that all orders were generated based on order forecasts. Within the commonly defined conditions, ICT supported customization of order forecasts and orders for campaign items to fit to the needs of individual pharmacies.

The standardizing capability of ICT was essential for centralizing the order forecasting and ordering function, which was important for the CPFR initiative. It was necessary to define a common set of rules and procedures for all pharmacies for handling the large amount of pharmacies involved and ICT facilitated this. The capability to centrally create a single order forecast and orders, in which all pharmacies follow the same rules, was especially important for the CPFR initiative.

Summary of findings

ICT was important for the automatic transfer of large amount of POS data and inventory information and assortment updates. This was in turn necessary for using ICT to process and organize this large amount of information and for automatic calculations of order forecasts and orders. These calculations were necessary for generating assortment updates, order forecasts, orders and replenishment reports. Related to these calculations, ICT was used for defining rules and procedures that were common for all pharmacies and for establishing collaboration and coordination on these common rules. The importance of ICT for the CPFR initiative particularly depended upon the large amount of POS data and inventory information and the large scale of the initiative involving 145 pharmacies.

ICT was also important for the assortment control and performance assessment. However, compared to the activities related to the order forecast and order these activities were less important for the CPFR initiative.

With regard to the application of ICT capabilities in CPFR, the following characteristics were identified in the case:

- ICT was mainly used for generating order forecasts and orders.
- In order to ensure this, ICT supported information processing which required efficient communication of POS data and inventory information.
- ICT was used to systematically structure joint rules and procedures and to facilitate collaborative actions.
- ICT was especially important when dealing with large amounts of information, with regard to both size and scope.

These findings are further discussed next to provide further insights regarding the characteristics of ICT capabilities in CPFR.

5.1.2 Discussion on characteristics of ICT capabilities

Processing and exchanging information for forecast and order generation

The case revealed that ICT was particularly important for processing information to create output in order planning/forecasting and order generation activities. ICT that performs calculations also seems to provide a platform for the implementation of jointly established rules and procedures.

Besides the importance of the analyzing capability, the case revealed that ICT also was significant for communicating information, especially POS data and inventory information, between partners. Different types of ICT was used to communicate information; e-mail was used to share the promotional plans an intranet was used for exchanging the pharmacy planograms while EDI was used to transfer POS data and inventory information from pharmacies to the joint replenishment team.

However, the importance for the CPFR initiative of different types of ICT differs significantly. The use of e-mail for exchanging the promotional plan is less important than the use of EDI for transferring POS data and inventory information, due to the high frequency or the short time intervals between updates, compared to the promotional plan. Moreover, while a promotional plan can be easily shared by e-mail or via a USB (universal serial bus) flash drive during a meeting, such tools seem to be less suitable for the exchange of POS data and inventory information.

ICT seems to ensure high efficiency in the exchange of information. Therefore, its importance seems to be specifically associated with high frequency transfers of information such as POS data and inventory information. This is because major efficiency gains can be expected from the use of ICT for the exchange of such information, compared to if the exchange includes manual steps.

ICT is primarily used for processing and exchanging information in CPFR, agree with the common view often put forward in literature (e.g. Seifert, 2003, Ireland & Crum, 2005).

Moreover, the findings that ICT is especially important in order planning/forecasting and order generation activities of CPFR is in accordance with the view that ICT use varies between processes; ICT is more important in sales forecasting and order forecasting and less important in the earlier phases of CPFR related to the front-end agreement and joint business plan (Barratt & Oliveira, 2001, Barratt, 2004b). An explanation to the high importance of ICT in the former activities may be related to the analyzing capability that was especially important in the case for supporting calculations based on POS data and inventory information.

Structuring joint rules and providing a platform for collaboration

The case showed how the standardizing and connecting capabilities of ICT were used to support the establishment of joint rules and procedures between the partners. By creating a jointly defined foundation the capabilities are also necessary for the analyzing and communicating capabilities. This means that ICT that is used to support joint planning and control is also accompanied by jointly defined rules and procedures that calculations are based upon. In order to use ICT to perform joint calculations, common rules and routines are necessary constituting a platform for joint planning and control.

In addition to that ICT is used for sharing and analyzing information in CPFR (e.g. Chopra & Meindl, 2007), these findings reveal that ICT has other capabilities supporting standardization of information and facilitating collaboration. The standardizing and connecting capabilities in CPFR have not been dealt with in earlier literature.

The amount of information

The case showed how ICT was especially important in activities involving large amounts of information. The amount of information seems to depend upon the intervals between information exchanges i.e. how often information is exchanged or frequency. This is in turn defined by the frequency of activities, how often forecasting and ordering is carried out, for example. The amount of information also seems to depend upon the scope of collaboration i.e. number of partners or replenishment points, as well as to the variety in information types, i.e. number of different sources of information. In the case companies ICT was used to carry out order calculations every day, which implied a daily exchange of POS data and inventory information and for exchanging information with, and calculate order forecasts and orders, for the 145 pharmacies.

The use of ICT to support efficient handling of large amounts of information was important for the case companies. Due to efficiency reasons, ICT seems to be especially important with regard to the exchange of information that needs to be transferred at high frequency. This means that the importance of ICT for information exchange in CPFR depends upon the frequency of transfer that is needed; the importance of ICT increases as time intervals between information exchanges decreases. The amount of information can further rely upon specific circumstances of the CPFR setting such as the frequency of activities and information exchange, the number of partners or replenishment points, the number of information sources and so on. These findings add further details to previous research suggesting that the degree of ICT advancement in CPFR is related to scope of collaboration and number of interacting units (Danese, 2006a).

Case findings on information volumes are further in accordance with literature suggesting that CPFR initiatives do not depend upon ICT but that ICT is necessary to develop and enhance the scalability of initiatives (ECR Europe, 2001, Seifert, 2003, Ireland & Crum, 2005, Chopra & Meindl, 2007) and that ICT is associated with large volumes of information (Barratt, 2004a).

Rather than distinguishing between large and small scale CPFR in view of number of partners, this study suggests that ICT is more important in initiatives that involve large amounts of information than in those of limited amounts of information. The relevance of distinguishing between large and small scale CPFR seems to be limited since also small scale CPFR in terms of number of partners, may involve large information volumes. It is suggested that the amount of information involved constitute a more distinct and relevant characteristic of CPFR initiatives with regard to ICT.

5.1.3 Characteristics of ICT capabilities

Based upon the discussion above, characteristics of ICT capabilities in CPFR are defined to give structured and detailed insights to how ICT can support CPFR (see Table 5-1). Since characteristics are defined by comparing the empirical findings with current literature, results are not only limited to the specific case setting but may be representative also for other CPFR initiatives that are supported by ICT.

Table 5-1 Characteristics of ICT capabilities in CPFR

Category	Description of characteristics
1. Information processing	ICT can support processing of information especially POS data and inventory information to generate orders and order forecasts.
2. Information exchange	ICT can support information exchange especially related to POS data and inventory information.
3. Amount of information	ICT can support processing, exchange and generation of large information volumes. Information volume can be related to frequency of activities, intervals of information exchange, number of partners, number of replenishment points, number of information sources, plus the breadth of information and level of detail.
4. Joint rules and procedures	ICT can facilitate collaborative actions that are necessary to establish joint rules and procedures for how to exchange, process and generate information.

The characteristics related to information processing, exchange and generation that were identified in the case are also supported in literature. However, the processing capability was especially significant in the case while literature has more focus on the use of ICT to support information exchange in CPFR. Moreover, identified characteristics related to the amount of information were supported in literature to some extent. Here, empirical findings provided further insights to determinants of large information volumes. The last category was significant in the case but is not dealt with in previous research. It is still expected that ICT can facilitate collaborative actions also in other CPFR settings.

Based on the results concerning how ICT capabilities are applied in CPFR, the following propositions are made;

1.1. ICT is expected to support information handling related to order forecasts and orders in CPFR initiatives to a greater extent compared to supporting front-end agreement and joint business planning activities.

1.2. ICT is expected to be more adopted in CPFR initiatives that involve large amounts of information compared to initiatives that are based upon smaller information volumes.

1.3. The total amount of information of CPFR initiatives is expected to depend upon the frequency of activities, intervals of information exchange, number of partners, number of replenishment points, number of information sources, plus the breadth and level of detail of information.

1.4. CPFR partners that use ICT extensively to support their initiatives are expected to carry out joint actions to a larger extent compared to partners with a more limited use of ICT.

5.2 RQ2: HOW PROCESSES ARE AFFECTED BY ICT

This section deals with the second research question. The empirical evidence of the impact of ICT on processes is classified according to the categories of the framework based upon a qualitative evaluation in terms of nature and importance.[26] Characteristics are identified based upon the categorization. Empirical findings on characteristics are compared to current literature. Based upon the discussion, characteristics of the impact of ICT on processes are defined together with a set of propositions.

Before reporting on how the identified changes relate to the three categories, the categories within the research framework for exploring the impact of ICT on processes (see Table 3-9) are repeated here;

- automational changes reflect process changes related to the use of ICT as a means for directly substituting labour
- informational changes reflect process changes related to the use of ICT for facilitating the use of information
- transformational changes refer to process changes related to the use of ICT for facilitating and supporting process innovation and transformation

These categories express the impact of ICT and should not be mixed up with the five different capabilities, analyzing, communicating, connecting, creating, and standardizing, used to categorize ICT capabilities in section 5.1.

5.2.1 Empirical findings on the ICT impact on processes

As stated in chapter 4, several changes and effects were identified from the APS system implementation in the investigated processes. In order to further describe and structure the various types of impact that ICT has had on the processes, identified process changes and effects are categorized here (see Table 5-1). While the process changes describe how activities and processes have been changed, the effects represent the outcomes or consequences of process changes.

[26] Focus is on describing and characterizing changes rather than quantifying and evaluating their size. Therefore, quantitative estimates that could be used to assess the importance of individual changes are left outside the scope.

Table 5-2 Categorization of identified process changes and effects in the case companies

	Process changes	**Effects**
Automa -tional	Substitution of pharmacy ordering and assortment control	Time savings in pharmacies
Informational	Automatic assortment updates Automatic exceptions management Automatic update of POS data and inventory information Availability of historical sales information Centralized and automatic order generation Centralized assessment and reporting of replenishment performance Customized campaigns Order calculations based upon combined costs of pharmacies and warehouse Sharing of promotional plan	Higher order and forecast accuracy Improved pharmacy inventory performance Increased replenishment reporting More formalized and standardized implementation of market plans More free space in pharmacies More planning flexibility and standardization More standardized and varied assortment New competence requirements Reduced overtime, costs and smoothed workload in warehouse
Transformational	Centralized and automatic order generation Centralized assessment and reporting of replenishment performance Centralized responsibility of order planning/forecasting	More integrated planning More opportunities for integrated planning More planning flexibility and standardization New opportunities for assessment and reporting

Automational impact

Time savings in pharmacies were achieved as the joint replenishment team with support from ICT substituted the forecasting and ordering functions as well as the updates of assortment registers that used to be carried out by pharmacy personnel. Thus, ICT was important for reducing the need for labour in pharmacies.

In the CPFR initiative, ICT had a more limited automational impact compared to its informational and transformational impact, although time savings in pharmacies had a high priority in the case companies.

Informational impact

The informational impact reflects how ICT facilitates the use of information by supporting the exchange of information, communication, calculations and refinement, information availability and storage, and so on. In the case, ICT had major implications for how information was used, especially through an increased and faster access to a larger amount of information in planning and control.

In particular, ICT had improved the accuracy in orders and order forecasts, which constituted essential information in the CPFR initiative. These information improvements were important for achieving improvements in pharmacy inventory performance. Improvements in orders and order forecasts mainly depended upon the centralized and automatic order generation and a single order forecast, the availability of information (especially the promotional plan, the stored historical sales information and the automatic update of POS data and inventory levels), automatic exceptions management and the centralized assessment and increased reporting of replenishment performance. New competence requirements were also necessary especially among the employees in the replenishment team, in order to make use of all the information available and to run the CPFR initiative efficiently.

ICT was also important for implementing a common model for planning and control of pharmacy inventories. Standardization was a prerequisite for automatic transfer of information. This was facilitated mainly by the centralization of the ordering function and the joint replenishment team, and that a large amount of information was made available that is related to all pharmacies. More standardized and varied assortments were supported by automatic assortment updates. The implementation of market plans was more formalized. Campaign assortments were also replenished in a standardized way, based upon historical sales data. The centralization with ICT and the joint replenishment team permitted more flexibility in planning within the jointly defined boundaries. Thus, ICT facilitated the implementation of a common planning and control approach, especially related to assortments changes and campaigns. This enhanced the flexibility related to the implementation of changes in market plan.

Reduced costs, overtime and more evenly spread workload in the warehouse were achieved because order calculations were based upon combined costs of pharmacies and warehouse; warehouse ordering costs replaced pharmacy ordering costs and were added with pharmacy inventory holding costs. Thus, ICT facilitated the implementation of an integrated warehouse-pharmacy approach in order calculations. These changes were mainly related to the way orders were structured. Hence, ICT did not imply that the order generation method changed; the reorder point method was used to issue orders both when orders were generated locally in ERP systems of pharmacies and with the new APS system.

Transformational changes and effects

In terms of process transformation, ICT had a fundamental importance with regard to the centralization of order planning/forecasting, order generation and performance assessment. The joint replenishment team, which was formed around the APS system, had the replenishment responsibility. The centralization implied more flexibility and standardization in order planning/forecasting. ICT also facilitated centralized assessment and reporting of replenishment performance.

There was a close integration and overlap between the collaborative planning and control approach of the CPFR initiative and ICT. Several transformational changes, especially centralization of order generation and centralized responsibility of order planning/forecasting, were necessary for implementing ICT. Others, such as centralized assessment and reporting and more opportunities for integrated planning were changes caused by ICT. Even though some transformational changes were tightly linked to and go hand in hand with ICT while others were results of ICT, ICT was important for these transformations.

ICT also affected the collaborative conditions in the CPFR initiative. Planning became more integrated between the partners from the establishment of the joint replenishment team and the APS system. ICT provided a joint frame of reference for a common understanding of processes and procedures. By its support in automatic information processing, ICT formalised, structured and standardized information flows in a way that supported collaboration. The fixed conditions of the planning and control approach that were implied by ICT further ensured that decisions that were agreed upon were actually followed. Moreover, the jointly performed promotional planning activities were important for reaching agreements as well as building and developing a collaborative relationship between the partners.

As said, ICT led to major information enhancements. However when the order was accepted in the APS system, it was transferred to the wholesaler ERP system and the order was executed in the same way as before the new CPFR initiative was implemented. ICT neither affected the way order fulfilment operations were carried out. This means that physical operations were mainly independent of the use of ICT in the case companies. In addition, the underlying ordering method was not changed while the forecasting approach was considerably changed in the case companies.

Summary of findings

In the investigated CPFR initiative, ICT reduced the need for labour in pharmacies. Major contributions of ICT were related to its informational impact, by improving the accuracy in orders and order forecasts, the facilitation of the implementation of a common planning and control model for pharmacy inventories and the combination of warehouse and pharmacy costs in order calculations. Because ICT was tightly integrated with the collaborative planning and control approach of the CPFR initiative, it facilitated the centralization of order planning/forecasting, order generation and performance assessment. Also, it improved the collaborative conditions in the CPFR initiative, by formalising, structuring and standardizing information flows and routines.

With regard to the impact of ICT on CPFR processes, the following characteristics were identified in the case:

- ICT primarily affected processes by generating time savings, enhancing information flows and by enabling process transformation.
- ICT facilitated major enhancements of information flows that contributed to improved planning and control. Automatic processing and exchange of information was important for the informational impact of ICT.
- ICT enabled major process transformations that were primarily related to the implementation of a joint planning and control approach.
- ICT mainly affected the planning and control by improving plans and forecasts used to generate orders and by facilitating the implementation of a joint approach.

These findings are discussed next to provide further insights regarding the impact of ICT on CPFR processes.

5.2.2 Discussion on the ICT impact on processes

Enhanced information flows and automatic features

The case showed how ICT affected processes by significantly enhancing information flows by providing an increased availability of more and better information that was used in planning and control. ICT thereby contributed to improved decisions by providing information faster and making information more available.

In view of literature emphasizing that ICT increases efficiency in CPFR (e.g. Smith, 2006) the study provides further details to additional benefits of ICT besides increased efficiency. Specifically it stresses the informational perspective of the efficiency concept which traditionally is limited to cost efficiency. ICT thus has major contributions to improved efficiency in terms of information enhancements, e.g. information efficiency. This finding also agrees with the view that ICT is necessary in terms of scalability and level of detail (Ireland & Crum, 2005).

Moreover, the case revealed that automatic processing and exchange of information, especially POS data and inventory information, was important related to the information contribution of ICT. When information is exchanged automatically, large amounts of detailed information may be exchanged rapidly, providing input to planning and control.

ICT was important for keeping plans and forecasts updated. In this respect, it provided fresh and updated information that was transmitted without delay to partners. This helped to keep plans, forecasts and orders up to date. POS data and inventory information, which reflected valuable demand information to partners, was important information in the case. ICT was thus important for ensuring that plans and forecasts were up to date. The automatic features of ICT were especially important for updating information.

Automatic features were also necessary for combining information from different sources to build up joint order forecasts and promotional plans for instance. ICT thus facilitated connectivity so that partners could share information and establish joint plans and forecasts that were necessary for issuing orders. This improved the plans upon which orders were generated.

Automatic features of ICT seem to be mainly associated with a cost efficiency perspective of ICT. The quality of information, which may reflect an information effectiveness perspective of ICT, will be discussed in more detail in section 5.3. Automatic operations are carried out to avoid time consuming manual tasks, and to ensure high efficiency in calculations and communications involving large information volumes. Automatic features are therefore necessary for ensuring efficient handling of large information volumes. This finding agrees with literature proposing that large volumes of information is important for achieving benefits of ICT (Barratt, 2004a).

Automatic features may reflect an "autopilot mode" in CPFR; ICT is important for executing businesses decisions that are collaborated and agreed to, and that collaborative activities can be concentrated to dealing with exceptions (e.g. Ireland & Crum, 2005). The importance of automatic features of ICT for achieving enhanced information flows in CPFR has however not been dealt with in previous research.

A joint and improved planning and control approach

The case showed that ICT facilitated that information used in planning and control actually reflected a joint approach to the collaboration and that it was based upon common rules and standards that were agreed upon. Fundamental to CPFR is the implementation of a joint planning and control approach between involved partners. A joint approach was accomplished because ICT was configured and set up according to these agreed rules. As information was dealt with automatically, these rules and routines had to be in place in advance and implemented in ICT systems to ensure the execution of agreed plans.

In the case companies, ICT also contributed to the centralization of the joint responsibility of order forecasting/planning and ordering. Thereby, ICT reinforced the implementation of a joint planning and control approach, especially in order planning/forecasting and order generation activities. ICT also facilitated that agreed routines and rules were formalized between partners, and thereby promoted collaborative actions.

In view of ICT as an enabler for implementing CPFR, ICT enabled process transformations implied by the CPFR approach in the case. At the same time, transformation was necessary also for realizing the potential of ICT.[27] ICT thus affected CPFR processes both by enabling and driving transformation; ICT was important for implementing CPFR and process adjustments were necessary for realizing the potential of ICT.

[27] This duality between ICT and process re-engineering is explained by Mooney et al. (1996, p. 10): "*IT is considered to be an enabler of process innovation, on the one hand, while process innovation is considered to be a catalyst for the realization of the business value of IT*".

In the case, a joint planning and control approach was established by the centralization and formalization of responsibilities and activities. ICT was used to frame joint planning and control activities. Planning and control approaches for manufacturing operations are generally associated with ICT but are mainly focused to single companies (e.g. Vollmann et al., 2005, Stadtler & Kilger, 2008). In CPFR, ICT can contribute to defining the scope of collaboration and facilitate that tasks of partners are merged into one joint planning and control approach.

The case further showed how ICT was used to improve methods for forecasting and ordering of the planning and control approach, but that it did not necessarily imply that underlying methods were changed. The planning and control approach was improved by ICT mainly via improved plans and forecasts that were used to generate orders and by facilitating the implementation of a joint and improved approach for order planning/forecasting and order generation. Its main contribution was thus related to improvements in how orders and forecasts were organized and structured. The entire forecasting method was also renewed in the new system while the method applied for generating orders was retained.

This means that ICT can help to renew the planning and control approach but does not necessarily have to imply changes in the underlying methods. A possible reason is that companies may prefer to adopt ICT for supporting current business practices rather than entirely transforming them. Methods may also be pre-determined by already existing ERP systems. Still, ICT may be used as a tool to further exploit the potential of modifying and improving planning and control methods.

The case recognized the high importance of ICT for establishing joint and improved planning and control approaches in CPFR. Its importance for the re-engineering of processes has been recognized in earlier literature (e.g. Sherman, 1998, Mentzer et al., 2000), but the ICT impact related to the joint planning and control approach of CPFR is not previously dealt with in literature.

5.2.3 Characteristics of the ICT impact on processes

Based upon the discussion above, characteristics of the impact of ICT on processes are defined to provide structured and detailed insights to how ICT can support CPFR (see Table 5-3). The characteristics were defined by comparing the empirical findings with current literature. This means that they are not only limited to the specific case setting but may be representative also for other CPFR initiatives that are supported by ICT.

Table 5-3 Characteristics of the impact of ICT on processes in CPFR

Dimension	Description of characteristics
1. Cost efficiency	ICT can increase cost efficiency by centralizing order planning/forecasting and ordering.
2. Information enhancements	ICT can enhance planning, forecasting and ordering information by ensuring that they are up-to-date and by combining information from various sources.
3. Joint planning and control approach	ICT can facilitate the implementation of a joint planning and control approach including common rules and standards and methods for order forecasting and ordering.
4. Automatic features	Major process improvements can be achieved by adopting ICT with automatic features to handle large amounts of information.

The characteristics related to cost efficiency and information enhancements that were identified in the case are also supported in literature. The case further added more details to these categories by emphasizing the importance of using ICT to centralize order planning/forecasting and ordering and to ensure that information is up-to-date and combined from various sources. With regard to the other two categories, empirical findings provided further insights both with regard to the importance of automatic features of ICT for improving CPFR processes and of ICT as a facilitator for establishing joint planning and control approaches in CPFR. Even though these categories are not dealt with in previous research, it is still assumed that automatic features of ICT can be important and that ICT can facilitate joint approaches, also in other CPFR settings.

Based on the results of the second research question, the following propositions are made;

2.1. CPFR partners that use ICT with automatic features to centralize order planning/forecasting and ordering activities are expected to achieve higher cost reductions compared to partners that adopt ICT without automatic features.

2.2. CPFR partners that use ICT with automatic features are expected to achieve more improved information compared to partners that use ICT without automatic features.

2.3. CPFR partners that use ICT with automatic features are expected to be able to implement a joint approach to planning and control more efficiently compared to partners that use ICT without automatic features.

5.3 RQ3: HOW INFORMATION QUALITY IS AFFECTED BY ICT

The third research question is dealt with in this section. The research framework of five information quality attributes is used to categorize the empirical evidence. Quality changes are identified by comparing information quality before and after the APS system was implemented. Changes are qualitative evaluated in terms of how quality changes are related to ICT support. Relevant characteristics are identified based upon the categorization and empirical findings are compared to current literature. Based upon the discussion, characteristics of the impact of ICT on information quality in CPFR are defined together with a set of propositions.

The quality of planograms, the promotional plan, assortment updates and POS data and inventory information are characterized in view of five attribute categories, accessibility, completeness, conciseness, timeliness and accuracy, that were defined in chapter 3 (in Table 3-11). Focus is on describing how quality characteristics have changed rather than evaluating their properties e.g. to what extent changes are of a positive or negative nature.

Before reporting the impact of ICT on information quality related to the five attributes, the attributes are repeated here;

- Accessibility: the extent to which information is available and convenient and easy to access.
- Accuracy: the extent to which information is correct, reliable and credible.
- Completeness: the extent to which information is applicable, adequate and relevant.
- Conciseness: the extent to which information is concise, in a proper format and easily understood.
- Timeliness: the extent to which information is up-to-date and timely.

5.3.1 Empirical findings on the impact on information quality

The case revealed that the quality of pharmacy planograms had changed after the APS system was implemented; planograms were more adapted to local conditions due to the introduction of standard shelves in pharmacies and they had a different purpose since planograms were no longer used for updating the assortment or ordering decisions but only for organizing the store representation.

Another change observed was that new information was shared in the CPFR initiative. This information was associated with different quality characteristics; the POS data, inventory information and assortment updates, which was transferred automatically between the ERP systems of pharmacies and the APS system, had similar quality characteristics while the promotional plan, which was transferred via e-mail, was associated with different characteristics.

In addition to these information types, higher accuracy of the order forecast and orders were also identified. Since focus was on the information types that were exchanged between partners to generate orders, the quality attributes of the forecast and order information were not in focus of the investigation.

In order to further characterize the quality of the information exchanged between the partners in more detail, it is further described in view of the five attributes of the research framework, see Table 5-4.

Accessibility. Planograms were easily accessible to the pharmacies via the intranet well in advance of implementation both before and after ICT was implemented. ICT thus primarily implied that the joint replenishment team got access to the promotional plan and that they also had quick and efficient access to POS data and inventory information. Moreover, pharmacies had quick and efficient access to assortment updates.

Accuracy. All the types of information were sent from a trusted source. ICT mainly implied that POS data, inventory information and assortment updates was of high accuracy. The promotional plan needed an additional manual review before it was implemented.

Completeness. Planograms used to be complete and manual reviews were required both before and after ICT was implemented. The pieces of information communicated in the promotional plan, POS data and inventory information and assortment updates were all complete. Also, POS data and inventory information as well as assortment updates were directly applicable in the APS system and ERP systems of pharmacies.

Conciseness. Planogram information was easily understood and in an appropriate format both before and after ICT was implemented. In the CPFR initiative, planograms no longer needed to be converted since they were not used for ordering. The promotional plan was easily understood and communicated in an appropriate format. ICT primarily implied that the information included in the POS data, inventory information and assortment updates was all symmetric and in a compatible format.

Timeliness. All investigated information types were updated on a regular basis. ICT especially implied that POS data, inventory information and assortment updates were updated frequently, on a daily basis.

Table 5-4 Categorization of information quality characteristics in the case

	Before ICT implementation	**After ICT implementation**			
Attribute	**Pharmacy planograms**	**Pharmacy planograms**	**Assortment updates**	**Promotional plan**	**POS data and inventory information**
Accessi-bility	easy to access in advance	easy to access in advance	quick and efficient access on time	easy to access in advance	quick and efficient access on time
Accuracy	trusted source	trusted source	accurate trusted source	trusted source manual review	accurate trusted source
Complete-ness	complete manual review	complete manual review	complete applicable	complete	complete applicable
Concise-ness	easily understood appropriate format conversion needed	easily understood appropriate format	symmetric compatible format	easily understood appropriate format	symmetric compatible format
Timeliness	regularly updated	regularly updated	frequently updated	regularly updated	frequently updated

The exchange of POS data and inventory information between the pharmacies and the joint replenishment team was important for the CPFR initiative. This information was automatically transferred from the pharmacy ERP systems to the APS system. A condition for automatic exchange of this information was that it was characterized by a certain quality so that it could be directly used by the APS system in order forecasts and order calculations, without manual conversion or interpretation.

The CPFR initiative presumed that information was highly accessible on right time and that information was complete, concise and accurate. The importance of ICT for the quality of information was especially associated with the automatic exchange of POS data and inventory information and assortment updates with pharmacies which was necessary to perform automatic calculations of order forecast and orders. In this respect, ICT was also important for establishing common rules and standards for how to automatically exchange the information in the CPFR initiative.

The exchange of assortment updates was not as important as the exchange of POS data and inventory information for the CPFR initiative. Yet, certain quality conditions were necessary also for this information since it was exchanged between the two systems in a similar way, but in the reverse direction, from the APS system to pharmacy ERP systems. The information was used to automatically update the assortment information in pharmacy ERP systems without manual involvement.

The APS system was a facilitator for automatic transfer of information by acting as a sender and receiver in "computer-to-computer" communication, although the APS system was not directly used for the actual transfer of information. Automatic exchange of especially POS data and inventory information was important for the CPFR initiative and ensured that the information met a certain quality level.

Automatic exchange of information was necessary for several reasons. The CPFR initiative relied upon large amounts of information and a high frequency in the exchange, which made an exchange with manual involvement highly inefficient. The importance of ICT for automatically calculating orders and assortment updates presumed that information that served as important input to or output from these calculations was dealt with automatically to ensure high efficiency.

With regard to the exchange of planograms and the promotional plan, the APS system was not directly used to support the transfer of this information. Planogram information was sent to pharmacies from the Boots administration, independently of the APS system. The quality changes were then mainly related to other changes of the CPFR initiative such as the introduction of standard shelves in pharmacies, rather than directly to ICT. The promotional plan was manually reviewed and uploaded in the APS system so that it could serve as input to calculations of the order forecast and assortment updates. ICT thus had a minor significance related to the quality of this information.

Summary of findings

The case showed how ICT implied several changes in the quality of the information exchanged in the CPFR initiative. ICT was mainly used for information processing in order planning/forecasting and order generation and new flows of information were established, including POS data, inventory information, promotional plan and assortment updates.

The quality of POS data, inventory information and assortment updates was substantially different from quality of the promotional plan. This was because this information was exchanged automatically between the pharmacies and the replenishment team and because it served as direct input or output to automatic calculations without manual involvement.

The automatic exchange of information, especially POS data and inventory information, had major implications for the information quality of the CPFR initiative. Automatic exchange was necessary for dealing with large amounts of information at high frequency, which was less suited for manual handling. This information provided input to the APS system in order forecast and order calculations, which were carried out automatically without manual conversion or interpretation.

Also, ICT was important for establishing common rules and standards for how to automatically exchange the information in the CPFR initiative, which were also related to the quality of information.

With regard to the impact of ICT on information quality, the case revealed the following characteristics:

- Besides that ICT facilitated an increased exchange of information, it also ensured an adequate quality level of the information that was exchanged.
- Information types were associated with major differences in quality.
- Automatic exchange of large amounts of information and at high frequency was especially important for information quality.
- Of particular importance were also the common rules and standards for automatic exchange defined in the joint planning and control approach.

These findings are discussed next to give further insights regarding the impact of ICT on information quality of CPFR.

5.3.2 Discussion on the impact on information quality

Adequate quality and automatic exchange of information

This case showed how ICT contributed to an increased exchange of information and ensured an adequate quality level of the information. Also, there were major quality variations between information types. The common rules and standards for automatic information exchange were also important for information quality.

It further showed how automatic features for exchanging large amounts of information at high frequency, typically POS data and inventory information, were especially important in view of information quality. Even though ICT may be used to transfer information with manual involvement, its major contribution to quality was mainly concentrated to automatic practices where information was exchanged between computers.

This means that ICT that supports automatic exchange of information between computer systems can have major significance for the information quality; ICT can be used to enhance the quality of information by automatic exchange of information. Automatic exchange seems to be mainly related to large amounts of information and high frequency, which typically includes POS data and inventory information. Consequently, it is suggested that ICT can be more important for ensuring the quality of this information, than for the quality of information that is transmitted in smaller amounts and less frequently and often involves manual steps.

Quality issues of information handled manually seem to be less important since such information often allows some room for adjustment by the receiver. Due to short time intervals and large volumes, the information transferred between computers needs to be of adequate quality from the start since there is often limited room for adjusting the information after it has been received. Potential quality failures in information that is automatically transferred may be detected in automatic exception control, and manual involvement may be needed to adjust detected mistakes. This speaks for that when ICT is used to automatically transfer information between computers it has more to say for the quality of information compared to when ICT is used for transferring information that also involves manual steps.

In the case ICT contributed to increased exchange of information and ensured an adequate quality level of the information. This finding agrees with the common view in literature suggesting that ICT has an overall positive impact on the quality of information exchanged in collaboration (e.g. Petersen, 1999, Stank et al., 1999, Petersen et al., 2005, Jonsson & Gustavsson, 2008).

The case finding that there were major quality variations between information types is in accordance with previous research pointing to that the quality impact of ICT differs between strategic and operational information (e.g. Moberg et al, 2002).

The importance of automatic exchange for information quality has not previously been dealt with in literature. This finding add further details to literature suggesting that ICT improves speed and simplifies the exchange of large amounts of data (e.g. Petersen et al., 2005). The case findings related to the importance of automatic features can also explain why ICT affects quality of information communicated in joint processes that are structured, definite, regular and objective (Petersen, 1999) and why ICT helps to deal with quality issues related to operational information, rather than strategic information (Moberg et al., 2002).

Common rules and standards defined in the joint planning and control approach

The case also highlighted the importance of the common rules and standards for automatic information exchange that were incorporated in the joint planning and control approach. The joint approach developed by collaborative actions between partners, constituted the foundation for automatic exchange, and thus for ICT's contribution to information quality.

Automatic exchange of information "between computers" in the case companies presumed that information was readable by the sending computer and could be used by the receiving system. This was why standards and rules for the automatic exchange had to be pre-defined and established in applied ICT systems. This ensured that information was transferred in an equal way each time it was exchanged and that the information followed the pre-defined rules for the exchange that were jointly agreed upon and were defined in ICT systems. Joint rules and standards also ensured an adequate quality of the information exchanged. This speaks for that the establishment of common rules and standards between partners is significant when information is automatically exchanged.

Establishing common rules for the exchange of information seems to be more important when information is exchanged automatically compared to more traditional or "manual" forms of electronic exchange such as e-mail or fax, for instance. It seems reasonable that agreement must be established also for non automatic exchange. However, the importance of agreeing to a common set of rules for the exchange of information becomes more important when automatically transferred between computers to ensure high efficiency.

The importance of common rules and standards and the joint planning and control approach for ensuring information quality was highlighted in the case. This adds further details to previous research recognizing that the collaborative relationship is important for information quality in automatic exchange (Jonsson & Gustavsson, 2008).

5.3.3 Characteristics of the impact of information quality

Based upon the discussion above, characteristics of the impact of ICT on information quality are defined to provide structured and detailed insights to how ICT can support CPFR (see Table 5-5). The characteristics are defined by comparing empirical findings with current literature. This means that they are not only limited to the specific case setting but may be representative also for other CPFR initiatives that are supported by ICT.

Table 5-5 Characteristics of the impact of ICT on information quality in CPFR

Category	Description of characteristics
1. Scope of information exchange	ICT can increase the exchange of information, both in terms of number of information types and amount of information.
2. Automatic features	ICT can help to improve information quality, especially when information is exchanged automatically.
3. Collaborative relationship	Collaborative actions are necessary to establish common rules and standards for automatic exchange of information with ICT support.

The characteristic related to scope of information exchange that was identified in the case mainly agrees with the common view in literature. Likewise, the importance of the collaborative relationship is also recognized in previous research. However, common rules and standards and the joint planning and control approach was emphasized in the case, providing further explanation to the importance of the collaborative relationship. In addition, the importance of automatic exchange for information quality has not previously been dealt with in literature and empirical findings thus provided new knowledge with regard to this characteristic. Even though these characteristics are not dealt with in previous research, it is assumed that automatic features of ICT and collaborative establishment of rules and standards for automatic exchange can be important for information quality also in other CPFR settings.

Based on the results of the third research question, the following propositions are made;

3.1. CPFR partners that use ICT with automatic features are expected to exchange information to a higher degree compared to partners that use ICT to support the exchange of information where also manual involvement is required.

3.2. Information quality benefits are expected to be more significant in CPFR initiatives that use ICT to exchange information automatically compared to initiatives where manual involvement is necessary to exchange information.

3.3. CPFR partners with high collaboration efforts are expected to achieve higher information quality benefits of ICT compared to initiatives with less joint actions.

5.4 RQ4: CONDITIONS FOR ICT SUPPORTED CPFR

This section deals with the fourth research question. Case observations of conditions are evaluated in terms of how these conditions are related to ICT and their importance for implementing ICT supported CPFR. Focus is on identifying characteristics of these conditions. Empirical findings are compared to current literature. Based upon the discussion, characteristics of conditions for ICT supported CPFR are defined together with a set of propositions.

The technological and relational categories were selected for this study. These two perspectives are often dealt with in literature and are therefore considered to be especially relevant for ICT supported CPFR. The categories for exploring conditions of ICT supported CPFR include (see Table 3-12);

- Relational conditions that are related to the collaborative relations between partners
- Technological conditions that are related to ICT used to support collaborative efforts

5.4.1 Empirical findings on conditions

Case findings with regard to major relational and technological conditions in the investigated CPFR initiative are presented here.

Relational conditions

The case showed how a working collaborative relationship was important for the CPFR initiative. This was facilitated by that the partner companies had a common owner with an explicit objective to integrate the wholesale and retail businesses. Thereby, strong top management support for the initiative and for ICT investments was ensured. Also, it ensured high trust and commitment, which was necessary to establish extensive information exchange.

Moreover, the establishment of an organizational structure based upon a joint management team and a joint replenishment team was especially important for implementing the initiative. The joint management team constituted a solid foundation for joint agreement and commitment to strategic long term decisions. The team ensured the definition of common objectives, management support and alignment of strategies and operations. It also ensured that organizations and processes were adapted to support information flows as well as roles, responsibilities and authority boundaries of the CPFR initiative were defined in jointly manner. The joint replenishment team ensured that established rules and policies of the common planning and control approach were actually followed by the use of the APS system.

Technological conditions

Several technological conditions were important for the CPFR initiative. Automatic information exchange was facilitated by the integration of the APS system with surrounding ICT systems, especially with ERP systems. Orders were automatically transferred to the wholesaler ERP system; assortment updates were sent to the pharmacy ERP systems; and POS data and inventory information was automatically transferred from the pharmacies' ERP systems to the APS system.

The initiative was further based upon the existing technological infrastructure with well functioning ERP systems of both partners that could support information exchange with the APS system. Major efforts were made for integrating ICT systems; interfaces between the APS system and surrounding systems were developed in order to establish an integrated solution that could facilitate automatic exchange of information. The integration of the APS system with existing infrastructure and ICT systems across the case companies was facilitated by the joint ownership of the two businesses.

Efficient and automatic exchange of information with pharmacies was also important for the CPFR initiative. A high degree of standardization was necessary to facilitate the pharmacy communication and several standardization initiatives among pharmacies facilitated this information exchange.

The reformation of the pharmacy industry in Norway was important as it facilitated the formation of Boots pharmacies into a pharmacy chain structure. This ensured coherence in processes, policies and routines across Boots pharmacies. The installation of the common pharmacy ERP system in Norwegian pharmacies also provided an infrastructure that facilitated the implementation of ICT and automatic information exchange in the case.

Without these standardization efforts, it would have been difficult to implement the current CPFR initiative; automatic exchange of information would have required the development of a set of different ICT interfaces adapted to each individual pharmacy. Now all the 145 pharmacies used the same ERP system and only limited effort was necessary to ensure the integration between the pharmacies' ERP systems with the APS system.

Summary of findings

In the case, several relational and technological conditions for ICT supported CPFR were identified. The collaborative relationship between the wholesale and retail businesses was facilitated by a common ownership ensuring trust and commitment to the initiative, especially for the exchange of information. The formation of a joint management team and a replenishment team also provided the organizational structure for developing the CPFR initiative and implied a distinct allocation of roles and shared responsibilities between the partners.

With regard to ICT, the integration between the APS system and existing ICT infrastructure, especially ERP systems in pharmacies and the wholesaler ERP system, was necessary for ensuring efficient automatic information exchange. In addition, standardization among pharmacies with the formation of a pharmacy chain structure at Boots, and especially the common ERP system that was installed in Norwegian pharmacies were important for the CPFR initiative.

With regard to the conditions for ICT supported CPFR, the following characteristics were revealed in the case:

- The collaborative relationship between partners was important for implementing ICT supported CPFR. Their relationship was related to the ownership relation, management support and organizational structures.
- The integration of pharmacies' ERP systems and the wholesaler ERP system with the APS system was important for automatic information exchange.
- The standardization of pharmacies' ERP systems was important for implementing ICT supported CPFR.

These findings are discussed next to give further insights regarding conditions for ICT supported CPFR.

5.4.2 Discussion on conditions

Collaborative relationship

The case showed that the implementation of ICT to support CPFR depended upon the collaborative relationship between partners, which was related to the ownership relation, management support and organizational structures. The relationship constituted an essential foundation for the overall CPFR initiative as well as for the particular ICT investment and the ICT implementation.

The general importance of partners' relations for ICT supported CPFR is recognized in previous research (Barratt & Oliveira, 2001, Danese, 2006b). Literature also confirms the importance of these relations for ensuring necessary process adaptations and organizational structures of ICT supported CPFR (Seifert, 2003). The importance of management support for CPFR in general is stressed in previous research (e.g. McCarthy & Golicic, 2002) and its importance for making joint ICT investments in CPFR was further highlighted in the case.

It is suggested that the relationship between partners is important for establishing CPFR, independently if ICT is adopted. However, the collaborative relations can be even more important in CPFR initiatives that involve ICT. This is because ICT may reflect a higher level of engagement since it is often associated with large scale or developed collaboration (e.g. Stank et al., 1999, Danese, 2006a) and because ICT tends to further reinforce and stabilize existing collaborative structures and arrangements between partners rather than creating new ones (Chae et al., 2005).

In the case, the ownership relation was especially important for the CPFR initiative. The joint ownership was not a direct prerequisite for ICT supported CPFR in the case but served as a major facilitator as it strengthened the collaborative relationship. This particular circumstance has however not been previously dealt with in research.

ICT integration

The case showed that the adoption of ICT depended upon technological integration with existing ICT systems and that the integration of new ICT with partners' ERP systems was of particular importance to facilitate automatic information exchange.

This finding is in line with current literature emphasizing the importance of the existing ICT, especially ERP systems, to support the integration of processes and avoid gaps in information flows (Seifert, 2003, Barratt, 2004b, Chopra & Meindl, 2007). The case also highlights the importance of automatic features for ICT integration to ensure seamless flows of information.

ICT standardization

The case showed that the adoption of ICT depended upon standardization to establish a joint ICT infrastructure across partner companies and that the standardization of pharmacies' ERP systems was important. This finding is in line with literature recognizing the importance of industry standards and that standardization is important to scalability and information exchange (Seifert, 2003).

It is therefore suggested that ICT supported CPFR depends upon the number of existing systems that new ICT needs to be integrated with; that the integration of new ICT is facilitated when it is only needed to be integrated with few different systems. Standardization is then important in initiatives involving information exchange with different ICT systems. This may imply that a consolidation of ICT infrastructure internally in partner companies can simplify the integration of ICT support by a more limited need for developing customized interfaces towards several different systems.

The case further showed how standardization was important for efficient automatic processing and exchange of large volumes of information between different ICT systems. While literature recognizes the importance of industry standards and that standardization is important to scalability and information exchange (Seifert, 2003), the case provides further details with regard to the particular importance of standardized ERP systems to facilitate technological integration and automatic information exchange.

5.4.3 Characteristics of conditions for ICT supported CPFR

Based upon the discussion above, characteristics of conditions for ICT supported CPFR are defined to provide structured and detailed insights to how ICT can support CPFR (see Table 5-6). The characteristics are defined by comparing the empirical findings with current literature. This means that the characteristics are not only limited to the specific case setting but may be representative also for other CPFR initiatives that are supported by ICT.

Table 5-6 Characteristics of conditions for ICT supported CPFR

Dimension	Description of characteristics
1. Collaborative relationship	Top management support and organizational structures formed to support collaborative actions are necessary for ICT supported CPFR. Joint ownership relations can also be an advantage.
2. ICT integration	The integration of ICT systems of partner companies, especially ERP systems, can facilitate automatic information exchange and processing of information.
3. ICT standardization	Standardized ICT systems of partner companies can facilitate automatic exchange and processing of information.

The characteristic related to collaborative relationship that was identified in the case mainly agrees with the common view in literature. The importance of collaborative relations for ensuring necessary process adaptations and organizational structures as well as of management support for ensuring CPFR in general was stressed in previous research. However, the importance of ownership relations for making joint ICT investments in CPFR was highlighted in the case. The importance of ICT integration and standardization is also recognized in previous research. The case further highlights the importance of ICT integration to ensure seamless flows of information as well as the significance of standardized ERP systems to facilitate technological integration and automatic information exchange. Even though these characteristics are not dealt with in previous research, it is assumed that they can be important for ICT support also in other CPFR settings.

Based on the results of the fourth research question, the following propositions are made;

4.1. ICT is more appropriate in CPFR initiatives that are supported by top management and where organizational structures are formed to support collaborative actions compared to initiatives where partners collaborate more sporadically.

4.2. CPFR partners that are interdependent by ownership relations are expected to adopt ICT to support their initiatives to a greater extent compared to when partners have no ownership relations.

4.3. CPFR partners with ICT systems that can be easily integrated are expected to adopt ICT to support automatic exchange and processing of information to a greater extent compared to when partners' systems are more difficult to integrate.

4.4. CPFR partners with ICT systems that are consolidated to a few different systems are expected to adopt ICT to support automatic exchange and processing of information to a greater extent compared to when partners apply a variety of systems.

5.5 A FRAMEWORK FOR ICT SUPPORTED CPFR

In this section, a framework for ICT supported CPFR is presented, see Table 5-7. It is developed by organizing the significant characteristics that were defined for each of the four research questions into a single structure. The aim is to contribute to theory development by highlighting more details and bring further structure to the topic.

The framework encompasses a set of characteristics that can be used for describing and analyzing CPFR initiatives that are supported by ICT. The framework is based upon two major dimensions;

- ICT appropriateness. This dimension encompasses characteristics reflecting the appropriateness of adopting ICT to support CPFR. These characteristics are expected to determine to what extent a CPFR initiative is especially suitable to be supported by ICT.
- Degree of ICT exploitation. This dimension encompasses characteristics reflecting the degree of exploitation of ICT in CPFR. These characteristics are expected to determine to what extent partners make productive use of ICT to support a CPFR initiative.

These overall dimensions have also been recognized in literature discussing in which CPFR settings it is more or less appropriate to adopt ICT (e.g. ECR Europe, 2001, Barratt, 2004b, Danese, 2006a) and how the potential of ICT is exploited in CPFR (e.g. Stank et al., 1999, Barratt & Oliveira, 2001, Ireland & Crum, 2005, Petersen et al., 2005).

The framework provides a structure that can be used for characterizing and analyzing CPFR initiatives in view of their appropriateness for ICT support and their degree of ICT exploitation. For example, it can be used as a tool for comparing different types of CPFR initiatives; the set of dimensions can then be used to gather and organize empirical data of CPFR initiatives and each dimension can be compared across different initiatives. Results of such analysis may reveal differences and similarities related to how appropriate CPFR initiatives are for ICT support and various levels of ICT exploitation.

Since the framework provides insights to how ICT can be used to support CPFR, it can also be used as a practical tool for evaluating current CPFR initiatives and for designing and developing CPFR initiatives with ICT support. For example, the framework can help to analyze how suitable a specific initiative is for implementing ICT support or the degree of exploitation of ICT in a specific CPFR initiative. In order to provide further detailed insights to how ICT can be used to support CPFR, a set of practical recommendations have been developed based upon the framework. These are presented in chapter 6.

Table 5-7 A framework for ICT supported CPFR

Dimen-sion	Category	Description of characteristics
ICT appropriateness	1. Collaborative relationship	Partners companies have joint ownership relations, management support and organizational structures are adjusted to collaboration.
	2. ICT integration	Partner companies' existing ICT systems, especially ERP systems, can be easily integrated with new ICT.
	3. ICT standardization	Partner companies' existing ICT systems are standardized and encompass a few different ICT standards.
	4. Information volumes	Partner companies handle significant information volumes, both with regard to details (depth) and variants (breadth).
Degree of ICT exploitation	5. Automatic information handling	ICT is used to handle information automatically.
	6. Exchange of information	ICT is used to support exchange of information, especially POS data and inventory information.
	7. Processing of information	ICT is used to support processing of information, especially POS data and inventory information, to generate orders and order forecasts.
	8. Cost efficiency	ICT is used to reduce costs.
	9. Information improvements	ICT is used to improve information, especially orders and order forecasts.
	10. Joint planning and control approach	ICT is used to establish a joint planning and control approach, especially related to order planning/forecasting and ordering.

To further clarify the contribution to theory development of this research, a set of propositions are developed based on the aggregate results of the study. The framework and propositions constitute a starting point for further researcher seeking to further verify and refine assumptions. The propositions are;

5.1. ICT support is more appropriate in CPFR initiatives where relations between partner companies are characterized by major collaborative efforts compared to initiatives with less collaborative efforts.

5.2. ICT support is more appropriate in CPFR initiatives where partners have a) joint ownership relations, b) management support and c) organizational structures adjusted to collaboration compared to initiatives with independent partners, limited management support and separated organizational structures.

5.3. ICT support is more appropriate in CPFR initiatives where partners' existing ICT systems a) can be easily integrated with new ICT and b) consolidated to as few types as possible and compared to initiatives where existing systems are less integrated and less standardized.

5.4. ICT support is more appropriate in CPFR initiatives where partners handle significant information volumes compared to initiatives where partners deal with few types of information at an aggregated level of detail.

5.5. CPFR partners are expected to achieve higher benefits of ICT in their initiatives when ICT is used to handle information automatically compared to when manual involvement is required to handle information.

5.6. CPFR partners are expected to achieve higher benefits of ICT in their initiatives when ICT is used to both exchange and process information compared to when ICT is only used for exchanging information.

5.7. CPFR partners who adopt ICT to support automatic information handling are expected to achieve larger cost reductions, more improved information and more integrated joint planning and control approaches compared to partners who adopt ICT without automatic features.

5.8. CPFR partners are expected to achieve higher benefits of ICT in their initiatives with extensive utilization of ICT compared to partners with more limited ICT utilization.

By bringing out significant characteristics for ICT supported CPFR, the framework is expected to be useful for both researchers and practitioners. Further details regarding the contributions related to this framework are presented in chapter 7.

6. PRACTICAL RECOMMENDATIONS

This chapter provides practical recommendations for ICT supported CPFR. The recommendations are developed based upon the results of the study and constitute its practical contribution.

6.1 INTRODUCTION

6.1.1 Purpose

Practical recommendations are presented here seeking to contribute to the development of more practical knowledge on ICT related characteristics in CPFR settings. Even though several researchers stress the need for managers to consider ICT for implementing CPFR (e.g. Barratt & Oliveira, 2001, Stoll, 2010) there is limited research on how to manage ICT in practice.

Practical advice related to ICT is provided in literature via the large amount of guidelines for how to succeed with CPFR implementation (e.g. Seifert, 2003, Ireland & Crum, 2005, VICS Association, 1999, 2002, ECR Europe, 2001, 2002). However, these works provide limited insights to how ICT can support planning and control activities and conditions for implementing ICT.

The recommendations presented here intend to provide further insights to characteristics of ICT supported CPFR. They should be seen as a complement or extension to existing CPFR guidelines provided the VICS Association (1999, 2002, 2004). While the CPFR guidelines by the VICS Association deal with how partners could succeed with CPFR in general, the recommendations presented here seek to provide practical advice on how to deal with ICT in CPFR implementation.

6.1.2 Scope and content

Recommendations are generated based upon the results of the study, which rely upon a combination of empirical insights from the case and literature studies. They constitute the practical conclusions of the results of this study. Readers who are interested in more information about the results are advised to take a look at chapter 5. An overview of how recommendations are related to the framework for ICT supported CPFR, which was presented in Table 5-7, is presented in Table 6-1.

Table 6-1 Recommendations related to the framework for ICT supported CPFR

<table>
<tr><th>Dimen-sion</th><th>Category</th><th>Recommendation</th></tr>
<tr><td rowspan="4">ICT appropriateness</td><td>1. Collaborative relationship</td><td>1. Ensure a reliable partner relationship</td></tr>
<tr><td>2. ICT integration</td><td>2. Establish a suitable ICT infrastructure</td></tr>
<tr><td>3. ICT standardization</td><td>3. Standardize internal ICT systems</td></tr>
<tr><td>4. Information volumes</td><td rowspan="5">4. Implement automatic features</td></tr>
<tr><td rowspan="5">Degree of ICT exploitation</td><td>5. Automatic information handling</td></tr>
<tr><td>6. Exchange of information</td></tr>
<tr><td>7. Processing of information</td></tr>
<tr><td>8. Cost efficiency</td></tr>
<tr><td>9. Information improvements</td><td>5. Use ICT to improve planning and control information</td></tr>
<tr><td>10. Joint planning and control approach</td><td>6. Use ICT to implement a joint planning and control approach</td></tr>
</table>

6.1.3 Use and target group

The recommendations aim to provide practical advice on how to deal with ICT in CPFR. They constitute a practical tool for managers who consider adopting ICT in CPFR settings and need better understanding of relevant characteristics that need to be considered for efficient implementation.

The recommendations further intend to give guidance on how to best or preferably manage ICT in CPFR. This means that companies by taking these recommendations into consideration are expected to be better prepared for exploiting the potential of ICT in CPFR.

Focus of the study has been on defining characteristics of ICT capabilities, the ICT impact on processes and information quality and conditions for ICT supported CPFR. Recommendations are expected to provide further insights to how to manage ICT to establish and design CPFR rather than how to select ICT solutions or how to implement CPFR in general. The intention of the recommendations is not to provide a complete guide to how to succeed with ICT in CPFR implementation.

The primary target group is managers in retail or wholesale businesses, who consider implementing CPFR with partners in their supply chain and think of using ICT to support this implementation. Recommendations are concentrated to collaboration on inventory management. Managers in manufacturing companies that also carry out distribution operations may therefore also find these recommendations useful.

The recommendations are especially developed for industries with similar characteristics as the pharmacy industry, including short lead times, high efficiency, high service levels and high flexibility, and with frequent ordering and deliveries. Since characteristics are similar to those of other consumer goods industries, recommendations are likely to be useful also for companies in other FMCG industries.

Recommendations may be used to further develop the CPFR guidelines by the VICS Association (1999, 2002, 2004) and be used as a starting point for other researchers seeking to develop more comprehensive methodologies for ICT supported CPFR.

6.2 RECOMMENDATIONS

6.2.1 Ensure a reliable partner relationship

Results showed that the collaborative relationship is important for agreeing on joint ICT investments, ensuring necessary organizational and process adaptations, as well as long term commitment to agreed rules and procedures. The collaborative relationship is also important for establishing common rules and standards for information exchange.

In the case, partners were owned by the same company group. Moreover, they had established a joint management team, which ensured close agreement between the partners on long term strategic planning. These conditions facilitated the adoption of ICT in the case companies.

This means that before starting a CPFR initiative, partners should make sure that their relationship is reliable to that it can support ICT based communication. It is important that efforts are put into developing the relationship before entering any discussions about ICT that can help to establish seamless flows of information.

Partners should thus first make sure that the relationship is reliable from the start. If not, efforts should be made to develop a reliable relationship. Then, partners should commit to further reinforce this relationship. Once partners have invested in establishing ICT linkages, these tend to strengthen the current relationship rather than restructuring or establishing new ones. It is thus more likely that ICT solutions will help to improve already reliable relationships than that a doubtful relationship will grow stronger from well developed ICT solutions.

The collaborative foundation is likely to be important to any CPFR initiative independently of ICT is used to support collaborative processes. However, when CPFR to a large extent relies upon ICT, existing collaborative connections are considered to be even more important. ICT linkages and related organizational integration may require significant investments and create inter-organizational connections that can be costly to disrupt if the collaboration is to be ended.

This means that partner companies should ensure that they have established a reliable relationship before initiating discussions of ICT solutions. Companies should also focus on using ICT to reinforce and develop already reliable relationships rather than to back up more uncertain ones. Companies should further prioritize partners with whom a reliable relationship is already established over partnerships with higher uncertainty for instance in recently developed partnerships or partnerships with limited experience.

6.2.2 Establish a suitable technological infrastructure

Results revealed that the integration with existing ICT, especially ERP systems, was important to enable automatic processing and exchange of information in ICT supported CPFR. In the case, it was important that the new APS system was integrated with existing ERP systems in pharmacies and with the wholesaler ERP system. This was necessary for ensuring efficient automatic information exchange.

This means that partners should make sure that necessary ICT systems are in place at the partner companies to be able to support the intended information exchange. ERP systems are especially important in this respect.

The current infrastructure is likely to be important for ICT supported CPFR because CPFR may serve as a complement to already existing planning and control practices and ICT solutions that intend to support CPFR are selected to fit into existing infrastructure rather than replace existing ICT. ICT solutions in CPFR also tend to rely upon existing data provided by current systems. This means that new ICT solutions for CPFR should not be considered as stand alone systems but rather as integrated entities of current ICT infrastructures.

Partner companies are recommended to make a thorough assessment of current ICT infrastructures to identify important systems and interfaces that are necessary to establish information flows in their CPFR initiative. Existing systems should for instance be able to provide necessary data input, receive information, process information, and allow for automatic processing and exchange of information. Partners should first concentrate on evaluating and improving current ICT infrastructure including ERP systems, POS system and so on in view of functionality and capacity needed to establish the CPFR initiative before considering investing in new ICT solutions. Any new applications to support the CPFR initiative should also be selected to fit with current ICT systems.

6.2.3 Standardize internal ICT systems

Results showed that ICT standardization facilitates the integration of new ICT with existing systems and that standardization is important for automatic processing and exchange of information. In the case, the standardization among pharmacies was important for efficient implementation of the CPFR initiative. This included both the formation of a pharmacy chain structure and the installation of a common ERP system in all Norwegian pharmacies.

When integrating information flows to support CPFR, partners should consider standardizing ICT systems and interfaces to facilitate this integration. Integration of various systems may be challenging, especially when several systems are to be integrated and when they require customized interfaces. This means that ICT integration with external partners in CPFR may be simplified by standardizing and integrating current internal systems to reduce the number of different interfaces required for establishing integrated external information flows. An example is when stores belonging to one retailer chain operate with different ERP systems or when a wholesaler operates with different ERP systems at different warehouse locations. The more different types of ICT are used, the more challenging will the integration be.

By establishing a consistent network of standardized ICT systems, with as few different interfaces as possible, partners will be able to facilitate the integration towards external partners in a CPFR initiative. This means that they should concentrate on consolidating or standardizing existing systems in their own companies to minimize the need for customizing technological interfaces towards systems of partner companies. Companies should further seek to streamline their own ICT systems internally before attempting to integrate ICT systems with an external partner. In particular, the implementation of a common ERP system in different units within the own company is likely to be a good investment for building CPFR based upon technological integration with future partners.

6.2.4 Implement automatic features

The study revealed that the frequency of transfer and amount of information were important for ICT supported CPFR. The use of ICT for automatic transfer was also important to the quality of information that is exchanged. Automatic features were also of major importance to how ICT affects processes.

The case companies used the APS system to generate order forecasts and orders based upon automatic processing and communication of information, primarily historical sales data, POS data and inventory information. Assortment information was also updated in pharmacies. Of particular importance was the use of the system to support daily calculations of orders and assortment updates. POS data and inventory information was also important for the daily updates of the order forecast and for creating orders.

It is recommended that partners agree upon the information flows that the CPFR initiative will be built upon and ICT efforts should be concentrated to these prioritized areas. This means that when partners consider what parts of the CPFR initiative that should be supported by ICT, primary focus should be on the information flows that support joint planning and control activities. Partners should identify information flows that are more or less suitable to be supported by ICT. ICT is especially appropriate when dealing with large amounts of information, typically involving several points of information transfer and/or exchange at high frequency. ICT may enhance efficiency in dealing with information; the more information is communicated and processed automatically, the more value can be created by ICT. This means that companies should use ICT to deal with information in situations where manual involvement is less preferable.

Because of a high frequency of exchange of POS data and inventory information combined with high frequency of processing of large amounts of information to generate order forecasts and orders, partner companies are recommended to consider adopting ICT to support automatic processing and exchange of information related to order planning/forecasting and order generation. This requires that ERP systems are in place and can provide support in planning and control of warehouse and store operations and that POS systems are used to capture sales data.

Significant benefits are expected when automatic features are applied to deal with high frequency exchange and processing of high volumes of information. Partners are therefore recommended to introduce ICT to support automatic handling of information as information volumes and update frequencies increases.

Automatic features can also actively be used to further increase the speed of current practices, making planning intervals shorter and decisions more up to date. This means that partners should think of how current planning routines can be improved by automatic handling of information. Activities that may benefit from automatic information practices to increase the speed of planning and control are performance assessment activities, sales forecasting, and maybe even joint business planning.

Partner companies should invest in ICT to support critical information flows in their CPFR initiative. They are further recommended to build their CPFR initiative upon the use of ICT, to support automatic processing and exchanging of large amount of information at high frequency, typically related to order planning/forecasting and order generation activities. For example, wholesalers should identify information needs for generating orders and arrange for order transmission to warehouse operations by adopting an APS system in order forecasting and order generation and an EDI solution for transfer of orders. Retailers should ensure that the information needed for order generation is available (e.g. sales forecast, market plans, POS data, inventory information) and consider ICT, such as EDI, for automatic transfer of POS data and inventory information.

6.2.5 Use ICT to improve planning and control information

This study showed that major contributions of ICT are related to improvements in planning and control information and that ICT is mainly used for processing and communicating information to create forecasts and orders. Also, it revealed that ICT can ensure the quality of information exchange.

In the case, the accuracy of orders forecasts and orders was improved as these were generated in the new APS system. The case companies combined their intelligence of historical sales, market events, campaigns, and so on, and established joint plans and forecasts, which were implemented in the system and used for generating orders. This led to improved performance of replenishment and of pharmacy inventories.

By supporting automatic processing and exchange of information, ICT is likely to increase and speed up the availability of large volumes of information in a CPFR initiative. This means that ICT will make information available that might not be used for a specific purpose. Therefore partners are recommended to seek to adopt ICT for automatic processing of information and think of how this new information could be used. Moreover, information flows tend to be enriched when ICT is used to automatically process and exchange information in CPFR. This is why partners should use ICT to establish automatic processing of information at the same time as considering opportunities to automatically provide input information and distribute output information.

In particular, the detailed order information and historical sales information may constitute important input to improve joint planning and control in several ways. For example, it may be used to assess performance on a detailed level, from day to day, as well as on more aggregate level, in strategic planning, for instance. Thus, detailed execution information can be especially important as planning support when seeking to improve the planning accuracy.

Partners should carefully consider how to make use of the new information that is available to them in planning and control, in order to improve their joint performance. Partners may for instance use detailed execution information to improve promotional plans. Even though it may not be entirely clear what this information may be used for at the start of collaboration, new ways to improve joint planning should be considered continuously as the initiatives evolve. For example, wholesalers should ensure that ordering information is available in joint planning and control and retailers should ensure the availability of historical sales information.

6.2.6 Use ICT to implement a joint planning and control approach

The study revealed that standardization and collaboration is necessary in order to use ICT to process, communicate and generate information. ICT also facilitates process and organizational transformation for implementing a joint planning and control approach.

In the case, partners used the APS system to implement common routines and rules for replenishment that helped to harmonize the replenishment among pharmacies. Collaborative actions were necessary to agree upon these rules and standards. In this respect, ICT constituted a platform for collaboration. The joint replenishment team constituted an important interface between the wholesaler and retailer companies and they implemented agreed plans into the APS system. Moreover, the ordering logics were changed as order calculations were made based upon a combination of both warehouse and pharmacy costs. This adjustment reflected a transition from optimization of pharmacy operations to optimization of operations of both companies.

Partners need to adjust current processes and organizational structures in accordance with a joint approach in planning and control. ICT may be used to redesign processes, in particular those that are carried out at relatively high frequency such as order planning/forecasting and order generation. It is important that ICT solutions are considered simultaneously with new organizational structure and processes to ensure that the ICT can give support to the organization and that the ICT can be used to create value. Partners should therefore focus on establishing consistent organizational structures for joint planning and control with regard to activities that are carried out more frequently such as order planning/forecasting and order generation. For example, when a wholesaler takes over the responsibility for ordering from the retailer, ICT may facilitate the centralization of planning and control related to orders. ICT may hereby constitute a centralized information node or platform that can provide support in joint planning and control at various levels.

Another way of ensuring a joint approach for planning and control in CPFR is to adopt ICT to execute planning and control in accordance with common rules and standards agreed on. This means that ICT can be used to execute decisions in accordance with the joint approach that is defined in the set up and configuration of the system. Partners should thus seek to implement ICT to support planning and control and make sure that decisions supported by ICT actually follow agreements.

In order to ensure a joint planning and control approach, it becomes important to manage the ICT set up and configuration properly. Common agreements should be converted into planning and control rules in the system. Typically, an APS system can provide support to joint planning and control on ordering and thus its set up needs to be adjusted properly to reflect a joint approach. An APS system could of course also be used for processing information internally in a company, the scope of its calculations depends upon how it is set up and availability of information. This means that partners should carefully consider who should be responsible for setting up the joint planning and control rules in ICT systems and to what extent this should be a jointly performed task or a task for one of the partner companies. It is important that partners are aware of how the joint approach is to be translated into the ICT system and how the ICT will help to implement this joint approach.

ICT can help to implement a joint approach and standardize the way decisions are made in CPFR by ensuring that planning and control follows a standardized set of rules. In this way, ICT will both ensure that agreed rules are actually followed and enhance conformity in planning and control. The set up of rules for forecasting and ordering are usually reflected in the algorithms and parameters for replenishment. This is why partners are recommended to carefully define the foundation for forecasting and ordering calculations together.

In brief, partners should use ICT to support a joint approach especially related to order planning/forecasting and order generation. At the same time they should seek to adjust organizations and processes to a new joint planning and control structure. They should also use ICT to implement the jointly agreed rules and standards for forecasting and ordering decisions.

7. CONCLUSIONS

This chapter summarizes the results of the study and presents the concluding reflections. The contributions of this work are described. Limitations and suggestions for further research are also presented.

7.1 EXPLORING ICT SUPPORTED CPFR

The motivation for this study is based on the great potential of rapid ICT developments related to planning and control and supply chain collaboration. CPFR is often associated with ICT in literature but there are surprisingly few empirical studies addressing ICT related issues in CPFR. Moreover, even though several characteristics of ICT supported CPFR are revealed, these have been rarely systematically investigated in any large detail in research.

The purpose of this study has been to explore how ICT can support CPFR in order to develop a framework for ICT supported CPFR. Four major perspectives were chosen for the investigation including ICT capabilities, the impact of ICT on processes and information quality and conditions for ICT support. A case study was carried out of a CPFR initiative involving a wholesaler and a pharmacy retailer. The two companies had implemented an APS system to support their initiative.

The framework was developed based upon the results of the study. It aimed to enhance the level of detail and bring further structure to the topic by defining characteristics of ICT supported CPFR and organizing them into a single structure.

The framework highlights characteristics of ICT supported CPFR reflecting the appropriateness of adopting ICT and the degree of ICT exploitation. Characteristics related to the collaborative relationship, the ICT integration and standardization, as well as information volumes are expected to determine to what extent a CPFR initiative is especially suitable to be supported by ICT. Characteristics related to automatic information handling, exchange and processing of information, cost efficiency, information improvements and joint planning and control approach are expected to determine to what extent partners make productive use of ICT to support a CPFR initiative.

The framework can be used in future studies to characterize and analyze ICT supported CPFR. The framework was also used to develop recommendations for practitioners.

Concluding reflections upon how ICT can support CPFR are given next in view of the appropriateness of adopting ICT and of the exploitation of ICT in CPFR with focus on planning and control and collaborative activities.

7.1.1 Appropriateness of ICT support in CPFR

This study has shown that the appropriateness of adopting ICT depends upon conditions related to the collaborative relationship, the ICT integration and standardization, and information volumes. These conditions are likely to determine if a CPFR initiative is more or less suitable for ICT support.

A fundamental condition for ICT supported CPFR concerns the collaborative relationship between partners. A collaborative relationship can be characterized in several ways. The ownership relation was recognized to be of major importance in this study and a facilitator for establishing appropriate organizational structures and ensuring management support. Considerable collaborative efforts are necessary to ensure a collaborative environment of commitment, trust and willingness that is beneficial for ICT based collaboration. Even though an ownership relationship is not a prerequisite for ICT supported CPFR, it can serve as an important facilitator or enabler.

Another condition that may facilitate ICT supported CPFR is that partner companies should have a standardized ICT infrastructure that permits integration with other systems. The appropriateness of adopting ICT support in CPFR depends upon existing ICT systems that support internal communication and collaboration in partner companies. This means that the ICT systems that are used to support internal processes of companies are important for determining how suitable ICT is to support collaboration and communication with external partners.

Moreover, the use of ICT with automatic high frequency processing and exchange of large volumes of information has been emphasized in this study. ICT is more suitable in large scale compared to small scale CPFR in terms of information volumes. This does not necessarily imply that a large number of partners or interacting units must be in place as long as information volumes are large; an increased use of ICT in partner companies with increased information volumes in general may also speak for better conditions for ICT support in CPFR. ICT is thus more suitable in large scale initiatives with respect to information volumes where automatic features are necessary for dealing with these volumes.

Large information volumes can be beneficial but are not a prerequisite for adopting ICT in CPFR settings. Despite that major benefits of ICT are associated with large information volumes the possibility of establishing CPFR with ICT to handle smaller information volumes should not be neglected. Small scale initiatives, where simpler ICT tools such as e-mail and intranet solutions are used to communicate small amounts of information, will also co-exist in parallel with more advanced solutions for large volumes. However, it can be challenging to exploit any major benefits of ICT when used for dealing with minor volumes only.

7.1.2 Exploitation of ICT in planning and control activities

The study has shown that ICT is important for supporting planning and control activities of CPFR in several perspectives. ICT capabilities for processing and exchanging information are especially important. These two capabilities complement each other since information transferred from different partner sources is processed to establish joint plans, forecasts and orders. Automatic features of ICT can ensure high efficiency, especially by supporting high frequency transfers from several sources and processing of large amount of information. ICT can support efficient transfer and aggregation of information from multiple sources and can efficiently process information to improve plans and forecasts. By providing a better availability of large amounts of up to date information, ICT implies improved support to planning and control activities. ICT can also provide algorithms and methods, computational capacity and simulation models for what-if analyses, for instance. There are thus a wide range of reasons why ICT is important for planning and control activities; reasons of efficiency, frequency, accuracy, standardization and differentiation are a few examples that are briefly dealt with here.

ICT provides the foundation for implementing "real time" or high frequency planning and control. With high frequency transfer of information, plans and forecasts are regularly updated and refreshed at short intervals. For example, POS data can be transferred at different intervals to ensure that plans and forecasts are updated with minimum delay; for instance several times per day, once per hour, or every time a product is sold. The information update frequency should match the frequency of planning and control activities. With frequently updated plans and forecast, orders can be issued more frequently. Orders that are generated in "real time" can in turn trigger physical operations as goods can be delivered more frequently and at a more even pace.

Because ICT automatically handles large amounts of information, it can also efficiently ensure high accuracy in complex planning and control activities. The complexity of planning and control in CPFR also tends to increase with the number of partners and the number and variety of information sources. Planning and control efficiency can be improved by increasing the variety of how individual items are controlled. ICT is important for refining and adjusting plans and forecasts on a detailed item level to match the actual demand or sales pattern of single products. By improving the accuracy of plans, forecasts and orders on an item level, ICT facilitates a differentiated planning and control approach, with customized quantities and timing of deliveries that are adjusted to the demand patterns of individual products.

ICT provides opportunities for more advanced planning and control approaches in CPFR, which means that current planning and control methods may be transformed or that combinations of methods may be developed to support differentiated and customized approaches. The intelligence of planning and control systems may also be improved over time as large amounts of information can be used to enhance performance by automatic learning features.

At the same time as ICT provides support to more differentiated planning and control, automatic features also help to standardize collaborative procedures; items are planned and controlled in a homogeneous way according to agreed rules and ensures a harmonized planning and control approach. Automatic features also reduce the risk of that ordering and forecasts fall outside predefined standard rules. In a collaborative perspective, ICT can efficiently help to harmonize and standardize planning and control activities in CPFR as the complexity of collaborative networks grow.

Even though ICT does not necessarily help to reduce complexity, it can ensure high efficiency in highly complex activities. By serving as a platform for collaboration, merging and unifying joint rules and standards, and providing automatic features for information processing and communication, ICT is an efficient tool to support joint planning and control approaches. ICT can be used to deal with complexity challenges related to planning and control tasks that are shared between several partners. Moreover, with ICT support an increased number of partners do not necessarily have to mean reduced efficiency. With joint rules and routines already established, adding new partners or new units of existing partners might not automatically have to imply major efforts in terms of ICT adjustments.

7.1.3 Exploitation of ICT in collaborative activities

This study has further shown that ICT has major implications for how partners carry out CPFR activities. On one hand, ICT can imply increased collaborative actions that are necessary to establish joint rules and standards. On the other hand, ICT can be used to support automatic execution of planning and control independently of collaborative actions. By using ICT, partner companies can concentrate their resources on establishing and agreeing on joint plans, develop joint planning and control approaches and deal with exceptions while ICT can be used to run order forecasting and ordering more or less automatically.

An integrated joint foundation of agreed rules and standards is necessary for adopting ICT to automatically process and exchange information. Partners need to agree upon the rules, routines and methods for planning and control. The more information is involved, the more joint actions and decisions are needed to establish this joint foundation. ICT is an important trigger of collaborative actions as partners carry out joint meetings, continuous discussions and frequent communication to establish this joint planning and control foundation.

The foundation of agreed rules defines the planning and control setting in which ICT is implemented. Configuration and set up is necessary to ensure that it fits to these agreed business conditions. Even though major efforts may be required to establish joint rules and standards and for set up, the need for manual involvement in collaboration is more limited as soon as automatic features are running. Hence, ICT may imply that collaborative actions are concentrated to establishing agreed rules and configuration, translating business plans and joint agreements into parameter settings in ICT systems and execution is primarily managed automatically in line with the joint foundation.

7.2 CONTRIBUTIONS

This study has contributed to the development of new knowledge in several ways. The main contributions are shown in Figure 7-1.

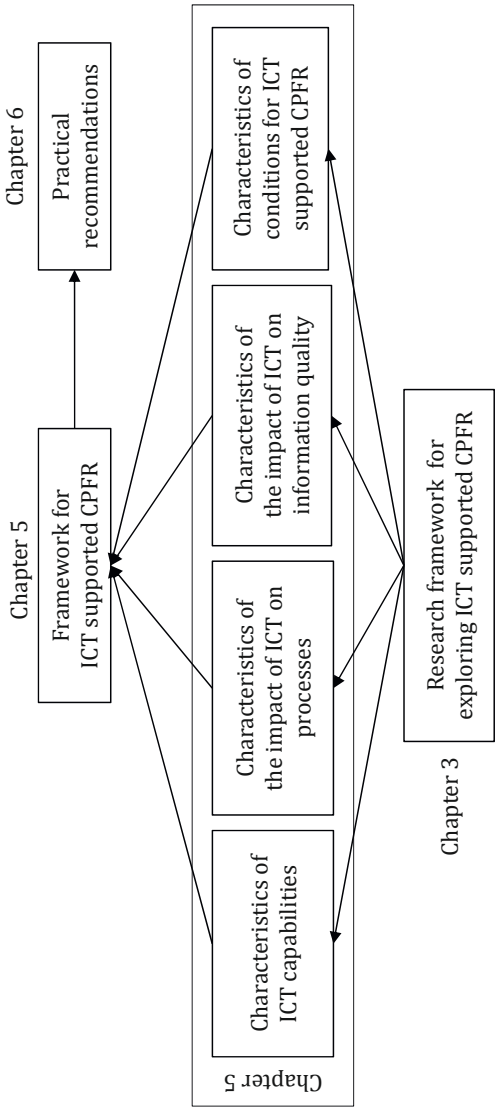

Figure 7-1 Contributions of the study

7.2.1 Framework for ICT supported CPFR

The main product of this thesis is a framework for ICT supported CPFR that defines and structures significant characteristics. A set of propositions are also defined. The framework was presented in chapter 5 (see Table 5-7). It has been developed based upon a combination of literature and empirical data from the case. The framework encompasses two major dimensions including ICT appropriateness, which reflects to what extent a CPFR initiative is especially suitable to be supported by ICT and degree of ICT exploitation, which reflects to what extent partners make productive use of ICT to support a CPFR initiative.

The framework provides a structure of characteristics that can be used in future studies for describing and analyzing ICT supported CPFR. The framework has also been used to develop recommendations for practitioners. Other researchers may use the framework and propositions in their further work for framing and structuring their investigations.

A collection of practical recommendations for ICT supported CPFR have been developed based upon the results of the study. These are presented in chapter 6. Their intention has been to provide practical conclusions of the study that may be useful for managers who consider adopting ICT to support CPFR initiatives. The recommendations may also be relevant to managers in retail or wholesale businesses, who consider implementing CPFR with partners in their supply chain and think of using ICT to support this implementation. Recommendations are likely to be useful for companies in the pharmacy industry as well as other FMCG industry segments.

7.2.2 New knowledge contributions

Regarding the contribution of new knowledge, the framework for ICT supported CPFR summarizes several characteristics that have been dealt with in previous research. However, it also provides insights to how ICT can support CPFR that have not earlier been dealt with in literature. The main contributions of this study to the development of new knowledge are specified here.

The application of ICT capabilities in CPFR for exchanging, processing and generating information has been widely recognized in earlier literature (e.g. Barratt & Oliveira, 2001, Barratt, 2004b, Chopra & Meindl, 2007). This study reveals another capability of ICT, the capability of facilitating collaborative actions. Collaborative actions are necessary to establish joint rules and procedures for how to exchange, process and generate information supported by ICT. Thus, ICT implies that partners need to jointly define how to use and handle information.

While literature points to the importance of scope and scale of collaboration in general for defining needs of ICT in CPFR (ECR Europe, 2001, Seifert, 2003, Ireland & Crum, 2005, Danese, 2006a), this study emphasizes the significance of information volumes for ICT support. This is a characteristic of collaboration scope and scale that is related to frequency of activities, intervals of information exchange, number of partners, number of replenishment points, number of information sources, plus the breadth of information and level of detail.

Literature confirms that ICT can increase efficiency and enhance information in CPFR (Ireland & Crum, 2005, Smith, 2006). This study gives further insights to the use of ICT to centralize the ordering activity and to ensure that information is up-to-date and information from various sources is combined. Besides that ICT can contribute to better information and more efficient information handling, ICT can assist in the implementation of a joint planning and control approach including common rules and standards and joint methods for forecasting and ordering.

The importance of large volumes of information for realizing benefits of ICT has been recognized in earlier works (Barratt, 2004a). This study emphasizes the significance of using automatic features of ICT to handle these information volumes.

Literature recognizes that ICT can improve information quality in CPFR (Stank et al., 1999, Petersen et al., 2005) and that there are variations in quality between different information types (Moberg et al, 2002). This study puts forward the significance of automatic features of ICT to improve information quality in information exchange, which has not been dealt with in previous literature.

Moreover, this study explains why the collaborative relationship is important for the impact of ICT on information quality (Jonsson & Gustavsson, 2008) by highlighting the importance of collaborative actions when information is exchanged automatically with ICT support in order to establish common rules and standards for the exchange.

The collaborative relationship is often recognized as a general condition for ICT supported CPFR in literature (e.g. Barratt & Oliveira, 2001, Danese, 2006b). The study provides further insights to this condition by highlighting that a joint ownership relation can facilitate ICT supported CPFR.

Literature acknowledges the importance of existing ICT to support integration of processes and information flows (Seifert, 2003, Barratt, 2004b), especially ERP systems (Chopra & Meindl, 2007) in addition to industry standards and standardization (Seifert, 2003). This study emphasizes that these conditions are especially significant when CPFR is supported by ICT to handle information automatically.

7.2.3 Target groups

The primary target group for this study are academics in the field of collaborative supply chain planning and control and with a particular interest in topics related to ICT supported CPFR. It is also intended for academics interested in the role of ICT in inventory management settings, especially fast-moving consumer goods (FMCG) industries.

The results are expected to have practical relevance for the discussion in companies on how to meet expectations regarding pay-offs of ICT investments that aim to support collaborative supply chain planning and control with partners. Therefore, managers who consider adopting ICT to support CPFR initiatives, especially in wholesale and retail companies in the pharmacy industry and in other FMCG industries, might also find this work interesting.

7.3 LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

The study has certain limitations that open for further opportunities of investigation. The proposed framework for ICT supported CPFR and related propositions is suggested to be used as a starting point for further developing knowledge on ICT supported CPFR into several directions.

7.3.1 Limitations of scope

The study provided insights to four perspectives of ICT supported CPFR. The scope was defined based upon empirical investigation and literature studies. The results are thus based upon these four perspectives. Further research could help to develop the framework for ICT supported CPFR to include additional perspectives such as the impact of ICT on planning and control methods.

Various types of ICT were investigated in the study with a particular focus on an APS system. Given the large variety of ICT solutions available to support CPFR, results could be verified through inquiries of CPFR settings that encompass ICT with characteristics that are different compared to the ones included in this study.

This study focused on how CPFR processes were affected by ICT with focus on information flows. Only few insights related to how ICT affected forecasting and order generation methods were thus provided. In order to get further detailed insights to how planning and control is affected by ICT, more research is needed that can provide more in-depth understanding of how methods and principles of planning and control are affected.

The empirical data of this study could not reveal that ICT had any major negative impact in the case. Due to the limited knowledge of the downsides of ICT supported CPFR this is suggested to be another area of further research. Cases where partners have failed to adopt ICT, have had bad experiences or have faced major difficulties during implementation could for instance be subject to studies. Such investigations would help to develop more balanced knowledge of both positive and negative implications of ICT.

7.3.2 Further investigations of characteristics

The study proposed that the collaborative relationship is a condition for ICT supported CPFR. Due to the wide array of different types of relations between supply chain partners, further research is needed to investigate the implications of different relational conditions for ICT supported CPFR with focus on different forms of interdependencies including for instance ownership relations and relative power positions between partners.

This study suggested that ICT is especially appropriate when dealing with large amounts of information. However, there may be differences in what characterizes large or small information volumes. Information volumes are generally measured in terms of bits and bytes. In CPFR, information volumes may reflect the number of entries in POS data and orders, the frequency of information transfer, the number of items in the collaborative assortment, the frequency of activities, the number of partners or replenishment points, the number of information sources, and so on. In order to further investigate the appropriateness of ICT more research is needed addressing characteristics of information in CPFR with a specific focus on information volumes.

The recommendations outlined in this work give a brief presentation of major insights gained through this study in a practical perspective. These could be used as a starting point for further development of guidelines or methodologies for how companies could increase chances of establishing CPFR initiatives with support from ICT. With an emphasis on practical considerations of ICT, such methodologies could complement existing general guidelines on CPFR implementation and drive stronger integration of ICT considerations with CPFR strategies.

Characteristics of ICT supported CPFR were defined in this study and several relations have been suggested. For example, automatic features of ICT were significant for information quality improvements and automatic procedures implied that partners could establish a joint approach to planning and control and common routines for information exchange. More research is however needed to provide further details on interdependencies between characteristics in the framework.

7.3.3 Other empirical settings

As mentioned earlier, results that are based upon a single case study may limit the transferability of results to other contexts compared to case studies of multiple cases (e.g. Yin, 2003b). However, since findings have been compared to current literature, results are valid in other contexts and not only restricted to the specific context investigated. Further research is suggested to strengthen the validity of results even further in several different contexts.

Results are expected to be valid for other industries with similar characteristics as the pharmacy industry, including short lead times, high efficiency, high service levels and high flexibility, and with frequent ordering and deliveries. Since these characteristics are similar to those of other consumer goods industries, results are likely to be representative also for other FMCG industries.

The study investigated ICT support of a CPFR initiative including a wholesaler and retailer. Results are expected to be valid for collaborative initiatives, with focus on inventory management of finished goods, between producers and retailers and not only limited to supply chains involving the wholesaler and retailer stages. Moreover, even though a CPFR initiative between two partners was investigated, results are also likely to be valid for initiatives with several (more than two) partners.

Compared to other types of ICT, such as e-mail, ERP systems and internet solutions advanced ICT such as the APS system of the case companies is associated with strong analyzing capabilities. Results are therefore expected to be valid also for settings where other types of advanced analytical ICT are adopted and not only limited to the type of APS system that was investigated in the case.

The ownership relation between the two partners in the case had to a great extent facilitated the decision to invest in joint ICT. Ownership relations between partners are assumed to be common in industries with strong integration between wholesalers and retailers such as in grocery distribution. Since this study highlights the importance of the collaborative relationship in more general terms, it is likely that results are also valid for CPFR initiatives between more autonomous partners with relationships characterized by high collaborative efforts and not only limited to the partners with ownership relations.

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APPENDICES

APPENDIX 1: OVERVIEW OF INTERVIEWS

Role or position	Scope of interview	Interview dates
Category manager and Team manager sales and purchasing, Alliance Boots (2 persons)	Planning and control activities Collaboration with Alliance Healthcare Impact of ICT on processes ICT systems Conditions for the APS system	24/10/2007
Director Wholesale, Alliance Boots	Collaboration wholesale-retail Conditions for the APS system Impact of ICT on processes Planning and control activities and information flows	4/10/2006 and 5/3/2009
IT director, Alliance Boots	Conditions for the APS system Impact of ICT on processes and information quality ICT structures and functionalities Planning and control activities and information flows	13/10/2006 and 24/10/2007
Pharmacy manager, Alliance Apotek, Valentinlyst	Impact of ICT on processes and information quality Pharmacy operations Planning and control activities and information flows	28/11/2006 and 11/8/2009
Pharmacy manager, Liseapotekene	Pharmacy operations Planning and control activities and information flows	7/5/2009
Pharmacy operations manager, Alliance Boots	Collaboration with Alliance Healthcare Impact of ICT on processes Planning and control activities and information flows	24/10/2007
Purchasing manager, Alliance Healthcare	Collaboration with Boots Impact of ICT on processes ICT systems and functionality of the APS system Planning and control activities and information flows	22/8/2006 and 22/10/2007
Purchasing wholesale, Alliance Healthcare	Planning and control ICT systems and information flows Collaboration with Boots	5/10/2006

Regional manager Alliance Apotek	Planning and control and information flows Collaboration with Alliance Healthcare ICT systems	1/12/2006
Replenishment manager, Alliance Healthcare	Collaboration wholesale-retail Functionality of the APS system Impact of ICT on processes and information quality Planning and control activities and information flows	5/10/2006, 22/10/2007 and 5/3/2009
Warehouse manager, Alliance Healthcare	Warehouse operations Planning and control activities and information flows Impact of ICT on processes	4/10/2006

APPENDIX 2: INTERVIEW GUIDE, EXAMPLES OF QUESTIONS

A. ICT in planning and control of pharmaceuticals distribution and pharmacy operations

- Describe the physical flow of goods and main activities in operations.
- Describe how the two companies have been integrated with the new CPFR initiative.
- What are the major ICT systems supporting operations?
  - Describe their roles.
  - Describe their main interfaces.
  - Describe the information flows supported by the systems.
- What are your main perceptions of and experiences with the new APS system?

B. CPFR with the APS system: process changes and conditions

- Describe your involvement in the collaborative activities with Boots/Alliance Healthcare.
- Describe how planning and control processes are carried out with regard to:
  - Activities, tasks and decision-making
  - Collaborative activities and external communication
  - Information flows and information sharing
  - ICT support
  - Organization and responsibilities
- How did these processes used to be performed before the APS system was implemented?
- What are the major changes and effects from the implementation of the new APS system?
- What are important conditions for implementing the collaborative initiative supported by the APS system?

C. Changes in information quality

- What are important information types from your perspective?
- Which information that you receive from external partner in the supply chain i.e. not from within your own organization is the most important for performing your tasks related to planning and control of the pharmacy inventory?
- Describe the information that you receive.
  - What is this information used for?
  - What requirements must be met in order for you to be able to perform your tasks?
  - What are the necessary properties or quality characteristics of this information?
  - What is the format of the information?
    - Is it in a digital format?
    - To what extent is manual involvement required?
- Does the information meet your quality requirements?
  - If not, why?
  - Improvement areas?
- How important are these properties and to what extent are requirements met?
- Has the APS system implied that requirements on information have changed?
  - If so, how?
  - How would you describe the information quality before and after the APS system was implemented?