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Supply Chain Cooperation Modeling: Trends and Gaps*

Anastasiia A. Ivakina[1] **and Ekaterina N. Zenkevich**[2]

[1] *St.Petersburg State University,*
7/9 Universitetskaya nab., St. Petersburg, 199034 Russia
E-mail: AnastasiyaIvakina@gmail.com
[2] *St.Petersburg State University,*
7/9 Universitetskaya nab., St. Petersburg, 199034 Russia
E-mail: Ekaterina.Zenkevich@gmail.com

Abstract The aim of this work is firstly to provide a comprehensive overview of the current trends in supply chain cooperation modeling and secondly to highlight the fruitful research avenues in this field based on a systematic literature review. As a result, it was found that in the previous years the research work on supply chain management has primarily focused on the study of materials and information flows and very little work has been done on the study of upstream and downstream flows of money. It is shown, that the evolution of the research in the field of supply chain cooperation modeling has evolved from centralized cooperative models through decentralized coordination models to collaborative models. Moreover, the unit of modeling has become significantly more complex from unconnected supply chains to multi-echelone systems. From the authors point of view, the further step ahead is development of models of collaborative supply chain networks, especially in the field of financial supply chain management.

Keywords: supply chain management, supply chain cooperation, supply chain modeling, thematic trend, methodological trend.

1. Introduction

1.1. Justification of the Research

The field of supply chain management (SCM) has developed as an academic discipline in the last 30 years, as can be observed by the growing number of academic journals and articles that focus on it. This research explores theoretical developments in this discipline by analyzing the existing stream of literature, what allows the authors to spot trends and gaps in the literature, and to identify fruitful areas for future research.

In order to inform future SCM development, it is helpful to reflect on where the gaps are in current theoretical perspectives. The following discussion is not meant to be an exhaustive list; rather, it is more a consideration of potential avenues of thought that may have saliency for SCM in general and supply chain collaboration (SCC) in particular.

SCM revolves around coordination and cooperation among several business partners that are linked through flows of material, money and information. These partners include suppliers of basic raw materials and component parts, manufacturers, wholesalers, distributors, transporters, retailers, banks and financial institutions. In general, the materials, component parts and finished goods flow downstream

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although the returned merchandise flows upstream. The money in contrast flows upstream in a supply chain whereas the information flows in both directions. For an effective supply chain system, the management of upstream flow of money is as important as the management of downstream flow of goods (Gupta and Dutta, 2011). Nevertheless, the research work on supply chain management has primarily focused on the study of materials flow and very little work has been done on the study of upstream flow of money.

The reminder of the paper is organized as follows: the next section describes the literature search procedures. The following section presents theoretical background in terms of SCC meaning, outlines the difficulties faced by SC members in adoption of SCC and possible causes of lack of coordination in SC. The next section deals with different mechanisms of SCC. In the next section SCC models are summarized. The last section concludes the paper and suggests an agenda for future research.

1.2. Research Questions and Objectives

The goal of the paper is to provide a comprehensive overview of the current trends in supply chain cooperation modeling and highlight the fruitful research avenues in this field based on a systematic literature review. To achieve the above formulated goal the following objectives are to be fulfilled:

1. To analyze the evolution of the key concepts in the field of supply chain management: supply chain, supply chain management, supply chain cooperation, supply chain coordination, supply chain collaboration, supply chain performance on the grounds of theoretical and methodological identification and systematization.
2. To analyze the metrics of supply chain cooperation performance, financial supply chain cooperation performance on the grounds of theoretical systematization.
3. To analyze the existing supply chain cooperation models, financial supply chain cooperation models and identify their strengths and limitations on the grounds of theoretical systematization.

1.3. Methodology of the Research

As the goal of the paper is to provide a snapshot of the diversity of the research being conducted in the field of supply chain management and especially financial supply chain management in order to outline further research paths on the basis of theoretical and methodological gap identification, only the journals ranked 4* or 4 (top journals in the field) in the Chartered Association of Business Schools Academic Journal Guide 2015 research were used for the initial search, namely: Journal of Operations Management, International Journal of Operations and Production Management, Production and Operations Management (in the field of Operations and Technology Management). It has been suggested that top-ranked journals should communicate, diffuse and archive scholarly knowledge more effectively than other journals.

The period of search was set from 2010 till 2015 year. An initial keyword search for articles containing any of the terms of the phrase financial supply chain management (limited to citations and abstracts of periodicals) was then subsequently limited to the exact phrase, financial supply chain management.

The papers in response to the above-mentioned objectives were gathered and systematically analyzed.

1.4. Limitations of the Research

The limitations of the following research are generally related to the method that we used to obtain the literature sample. Despite the fact that the aforementioned journals belong to the top-ranked specialist journals in the field, it however limits the external validity of our study and the possibility of extending the conclusions.

2. Trends and Gaps in Supply Chain Collaboration

2.1. Concept of Supply Chain Management

Globalization, technology boom, organizational consolidation as well as quickly altering government policy and regulation made it very important for companies to be familiar with the concept of supply chains (SC) that function inside and around the company. That is the reason why in recent years the area of supply chain management (SCM) has become very popular. This is evidenced by marked increase in practitioner and academic publications, conferences, professional development programs and university courses in the area. While interest in SCM is immense, it is clear that much of the knowledge about SCM resides in a narrow fields such as purchasing, logistics, IT and marketing. At least partly as a result of this, there appears to be little consensus on the conceptual and research methodological bases of SCM. This has contributed to the existence of a number of gaps in the knowledge base of the field. Thus, from a conceptualization perspective, the definition of the term is unclear.

According to Beamon (1998), a simple supply chain (SC) may be defined as an integrated process wherein a number of various business entities (i.e., suppliers, manufacturers, distributors, and retailers) work together in an effort to: 1. acquire raw materials, 2. convert these raw materials into specified final products, and 3. deliver these final products to retailers. This chain is traditionally characterized by a forward flow of materials and a backward flow of information (Beamon, 1998).

At its highest level, a SC can be decomposed to two basic, integrated processes: 1. the Production Planning and Inventory Control Process, and 2. the Distribution and Logistics Process. These processes, illustrated in Fig. 1 provide the basic framework for the conversion and movement of raw materials into final products.

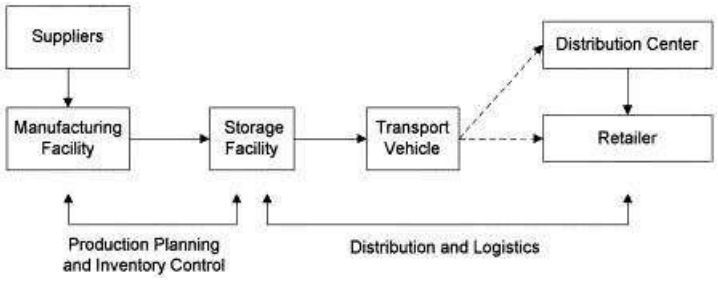


Fig. 1: Simple supply chain processes (adopted from Beamon, 1998)

The Production Planning and Inventory Control Process comprises of the manufacturing and storage sub-processes, and their interfaces. More specifically, production planning describes the design and management of the entire manufacturing process (including raw material scheduling and acquisition, manufacturing process

design and scheduling, and material handling design and control). Inventory control describes the design and management of the storage policies and procedures for raw materials, work-in-process inventories, and usually, final products (Beamon, 1998).

The Distribution and Logistics Process determines how products are retrieved and transported from the warehouse to retailers. These products may be transported to retailers directly, or may first be moved to distribution facilities, which, in turn, transport products to the retailers. This process includes the management of inventory retrieval, transportation, and final product delivery (Beamon, 1998).

These processes interact with one another to produce an integrated SC. The design and management of these processes determine the extent to which it works as a unit to meet the required performance objectives.

Definition of an integrated SC was affirmed by Akkermans (2003). He stated that SC is a network that consists of suppliers, manufacturers, distributors, retailers, and customers. This network is supported by three types of flows (material, information and financial) and requires more careful planning and closer coordination.

The evolution of the concept of SC took 30 years. Internal supply chain integration transitioned to external supply chain integration as there was a limited amount of performance improvement that could be achieved without involving suppliers and customers. External supply chain integration transitioned to goal directed network supply chains as firms understood that supply chains were non-linear networks and that there would be benefit for non-strategic (or non-integrated) suppliers to have visibility of demand. It is generally supposed, that by now we are facing the process of undergoing a transition to devolved, collaborative supply chain clusters. It is suggested that this transition is occurring due to the increased complexity, risk and costs that are being borne by focal firms who are attempting to manage large networks. By effectively outsourcing elements of this management to lead suppliers, there is devolvement of the collaboration into clusters.

The evolution of SC concept displayed in the previous paragraph can be used further and implemented to the concept of supply chain management, namely the evolution of SCM shown in Fig. 2.

Today one of the most wide-spread definitions of SCM is one produced the Council of by Supply Chain Management Professionals (CSCMP): SCM encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers.

Mentzer et al. (2001) define SCM as the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long term performance of the individual companies and the supply chain as a whole.

Given that the aim of this paper is not to review the numerous definitions of SCM in extant literature, it simply adopts one that of Mentzer et al. (2001) since it contains all the key elements (strategic coordination, collaboration across the whole supply chain and long-term performance), while dealing not only with material and information flows, but also with financial ones.

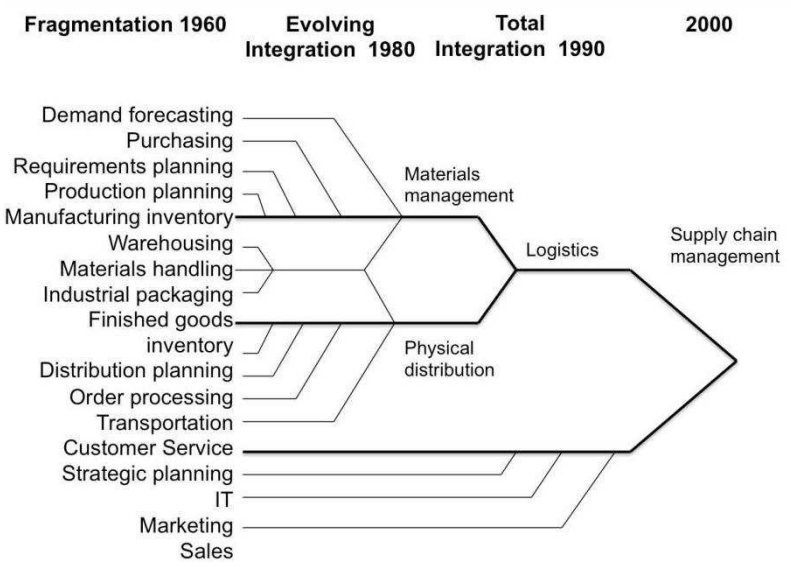


Fig. 2: Evolution of SCM concept (adopted from Coyle, et al., 2013)

2.2. Cooperation, Coordination and Collaboration in Supply Chains

A good indication of the maturity level of a field is the attitude of researchers to the definition of key concepts. In a mature field, most researchers would use existing standard definitions. In our case, there is no clear convergence among the authors on a single definition (although most were based on themes associated with operations research). Though, there are efforts in literature regarding collaboration of different functions of the SC, the study of coordinating functions in isolation may not help to coordinate the whole SC. It appears that the study of SC collaboration (SCC) is still in its infancy. Though, the need for collaboration is realized, a little effort has been reported in the literature to develop a holistic view of coordination.

Supply chains are generally complex and are characterized by numerous activities spread over multiple functions and organizations, which pose interesting challenges for effective SC collaboration. To meet these challenges, SC members must work towards a unified system and cooperate with each other. Collaboration is an amorphous meta-concept that has been interpreted in many different ways by both organizations and individuals. SC collaboration has proven difficult to implement although still has the potential to offer significantly improved performance. It is suggested that many of the problems related to SC collaboration are due to a lack of understanding of what collaboration actually implies. This poor understanding is further increased due to the association of collaboration with the hype surrounding e-business whereby technology has been promoted as the key to enabling wide scale inter-organizational collaboration.The evolution of the collaboration concept from simple generic integration concept can be tracked through the evolution of SCM strategies, tools, and techniques in time.

It is argued that SCM developed from a baseline of functional (independent) silos and the first level of integration was across functions (akin to process integration). This then moved to full internal integration involving a seamless flow through the internal supply chain, and finally to external integration embracing suppliers and

customers. The primary benefits were identified as improved customer service and reduced inventory and operating costs. What has changed since the introduction of the concept of SCM is the context within which supply chains operate, and the enablers of change and performance improvement. As a result the relevance of narrow, linear-based supply chain models has been challenged as firms have looked more and more toward networked and collaborative supply chain strategies to deliver superior performance.

SCM as a discipline has evolved rapidly. The early focus of SCM began when organizations began to improve their inventory management and production planning and control. The aim of these practices was to improve production efficiencies and ensure that the capacity of capital assets and machinery was utilized efficiently. This extended upstream to include the management of transport of raw materials at a time when firms were relatively vertically integrated.

The early definition of integration is provided by Frohlich and Westbrook: At the tactical level, there are two interrelated forms of integration that manufacturers regularly employ. The first type of integration involves coordinating and integrating the forward physical flow of deliveries between suppliers, manufacturers, and customers. The other prevalent type of integration involves the backward coordination of information technologies and the flow of data from customers to suppliers (Frohlich and Westbrook, 2001)

The next phase in the evolution of SCM was the systematization of materials, production, and transport management. This began with materials requirement planning (MRP) focusing on inventory control. MRP expanded to become MRPII by incorporating the planning and scheduling of resources involved in manufacturing. Both MRP and MRPII were conceived in the 1960s but did not gain prominence until the 1980s. MRP and MRPII evolved to become ERP, in an attempt to gain greater visibility over the entire enterprise (Stevens and Johnson, 2016).

The mid to late 1980s brought intense retrospection from western firms concerning the threat of Japanese firms that were perceived to be more competitive due to higher productivity. This period led to the implementation of Japanese practices such as total quality management (TQM) and lean by firms. These practices focused on reducing inventory through improving quality and flow and involving suppliers in product and process design. At this point, one can say, that cooperation is a substantial prerequisite for further coordination and collaboration.

The next phase in the evolution of SCM included the introduction of other process improvement practices (e.g. six sigma) that sought to provide a more concrete improvement method compared to TQM or lean. As process improvement, and the standardization of products and processes that facilitated it, took place, there was increasing awareness that end customers were requiring ever increasing levels of choice and differentiation. This led firms to consider that they had become too lean and rigid and should be focusing on creating agile supply chains to adapt to changing demand. The agile approach was blended with lean as demand could be decoupled into push and pull to create greater choice for the customer while still retaining some control (Stevens and Johnson, 2016).

The most commonly accepted definition of coordination in the literature is the act of managing dependencies between entities and the joint effort of entities working together towards mutually defined goals (Malone and Crowston, 1994).

The 1990s also saw a focus upon core competences within firms. This led to a rise in increased outsourcing of non-core activities to lower cost economies. Political factors such as unilateral liberalization measures and the removal of formal free trade barriers have contributed to the growth of developing countries exporting to high wage economies, encouraging firms to source from lower cost economies. This, in turn, fuels both demand for products from developed economies and the competition to supply. This changed the topology of the supply chain as well as the magnitude, profile and direction of material, and information flows. Significant changes have also taken place around the understanding of how a firm secures a competitive position. Traditionally, superior competitive advantage was seen to be a function of how a firm organized its resources to differentiate itself from the competition and its ability to operate at a lower cost. The prevailing tendency was to control as much of its upstream and downstream activities as possible, often leading to high levels of vertical integration (i.e. within a firm rather than with suppliers). Thus, firms focused more on managing, in-house, core competences, i.e. those competencies or capabilities that deliver value (as perceived by the customer) and outsourcing non-core activities to specialist often lower cost third parties. This resulted in the advent of 3PL providers and supply chain integrators.

Supply chains are inherently unstable in terms of inevitable challenges of forecasting and data integrity. Technology has been used to good effect to improve information flows. However, the increased remoteness of a global market and supply base, together with the need to manage an increasingly complex network has exacerbated the challenge. In addition to the issues caused by information distortion and a global supply base, the twenty-first century is a time when organizations are facing pressure from consumers and other stakeholders to have green and ethical supply chains. This requires organizations to become more transparent in terms of disclosing their sources of supply, which increases costs and may place pressure on moving away from the lowest cost economies where labor rights can be poor. At this period of time the concept of collaboration evolved.

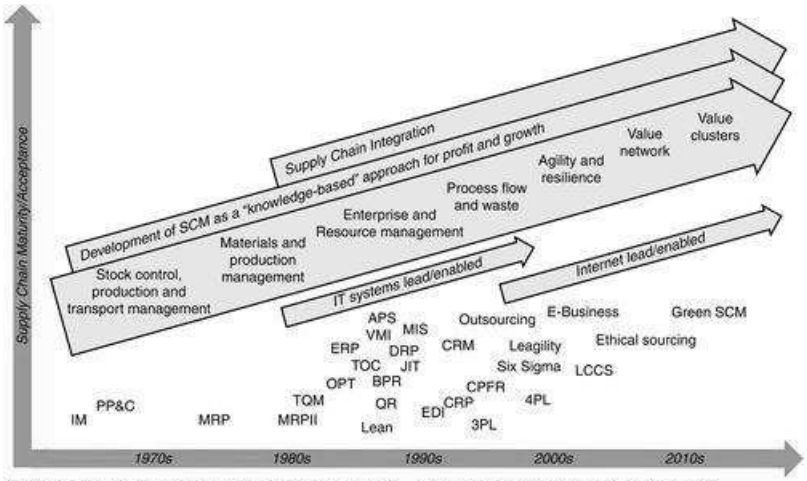
Collaboration is a very broad term and when it is put in the context of the supply chain it needs yet further clarification. When talking about collaboration many authors mention mutuality of benefit, rewards and risk sharing on the basis of the exchange of information. There seems to be no unique definition of SCC, although different perspectives have been presented in literature for coordinating SC:

- Collaborative working for joint planning, joint product development, mutual exchange information and integrated information systems, cross coordination on several levels in the companies on the network, long-term cooperation and fair sharing of risks and benefits.
- A collaborative SC simply means that two or more independent companies work jointly to plan to execute SC operations with greater success than when acting in isolation.
- A win/win arrangement that is likely to provide improved business success for both parties.
- A strategic response to the challenges that arise from the dependencies SC members.

M. Simatupang and R. Sridharan introduced one of the most cited definitions of SC collaboration in 2002. According to authors: A collaborative supply chain

simply means that two or more independent companies work jointly to plan and execute supply chain operations with greater success than when acting in isolation (Simatupang and Sridharan, 2002). But this definition is limited by the boundaries of the inter-organizational processes. To overcome this problem B. Flynn reflected more spread definition of Supply Chain Collaboration (SCC): as the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organization processes. The goal is to achieve effective and efficient flows of products and services, information, money and decisions, to provide maximum value to the customer at low cost and high speed (Flynn, Hou and Zhao, 2010). This definition more precisely outlined that collaboration in supply chain can happen not only between several companies but also at the level of one company.

Summing up, there seems to be no standard definition of SCC. Various perspectives on SCC as reported in the literature are testimony to this, but basically they fall into two groups of conceptualization: process focus and relationship focus. Some of these perspectives present the inherent capability or intangibles required to coordinate like responsibility, mutuality, cooperation and trust. The other perspectives can be visualized, based on the coordination effort required in achieving common goals in various activities of SC. Since the activities are different, the coordination requirements also vary with the complexity of the activity. The most challenging coordination perspective is to extend the concept of coordination from within an organization to coordination between organizations.



Notes: 3PL, third party logistics provider; 4PL, fourth party logistics provider; APS, advanced planning systems; BPR, business process re-engineering; CPFR, continuous planning, forecasting, and replenishment; CRM, customer relationship management; DRP, distribution resource planning; EDI, electronic data interchange; ERP, enterprise resource planning; IM, inventory management; LCCS, low-cost country sourcing; MIS, management information systems; MRP, material requirements planning; MRPII, manufacturing resource planning; OPT, optimized production technology; PP&C, production planning and control; QR, quick response; TOC, theory of constraints; TQM, total quality management; VMI, vendor managed inventory

Fig. 3: A timeline of SCM strategies, tools, and techniques (adopted from Stevens and Johnson, 2016)

This all points toward an explosion in SCM thinking over the last 25 years. Fig. 3 presents a timeline of SCM strategies, tools, and techniques. The dates in the figure are based upon when these practices were popularized, not introduced (Stevens and Johnson, 2016). Fig. 4 outlines the transition of collaboration.

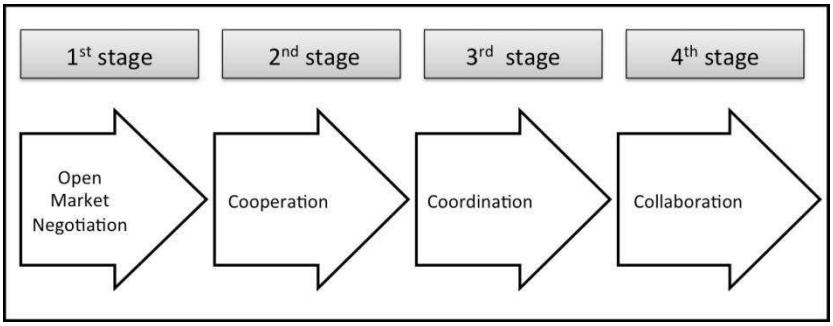


Fig. 4: Transition of collaboration (adopted from Mentzer at al., 2001)

If the collaboration is to be sustainable then there are a number of strategic elements, which must be present. Synthesizing the literature, supply chain collaboration consists of seven interconnecting components: 1. information sharing, 2. goal congruence, 3. decision synchronization, 4. incentive alignment, 5. resources sharing, 6. collaborative communication, and 7. joint knowledge creation. These dimensions are expected to be inter-correlated with each other, although there might be causal relationships among them (Barratt, 2004).

Information sharing refers to the extent to which a firm shares a variety of relevant, accurate, complete, and confidential information in a timely manner with its supply chain partners. Information sharing is described as the heart, lifeblood, nerve center, essential ingredient, key requirement, and foundation of supply chain collaboration. Information sharing can be defined as the willingness to make strategic and tactical data such as inventory levels, forecasts, sales promotion, strategies, and marketing strategies available to firms forming supply chain nodes.

Goal congruence between supply chain partners is the extent to which supply chain partners perceive their own objectives are satisfied by accomplishing the supply chain objectives. It is the degree of goal agreement among supply chain partners. In the case of true goal congruence, supply chain partners either feel that their objectives fully coincide with those of the supply chain, or, in case of disparity, believe that their goals can be achieved as a direct result of working toward the objectives of the supply chain.

Decision synchronization refers to the process by which supply chain partners orchestrate decisions in supply chain planning and operations that optimize the supply chain benefits (Simatupang and Sridharan, 2005). Planning decisions are required to determine the most efficient and effective way to use the firm's resources to achieve a specific set of objectives. There are seven key supply chain management planning decision categories: operations strategy planning, demand management, production planning and scheduling, procurement, promise delivery, balancing change, and distribution management (Barratt, 2004). Joint planning is used to align collaborative partner and to make operating decisions including inventory replenishment, order placement, and order delivery.

Incentive alignment refers to the process of sharing costs, risks, and benefits among supply chain partners (Simatupang and Sridharan, 2005). It includes determining costs, risks, and benefits as well as formulating incentive schemes. Successful supply chain partnerships require that each participant share gains and losses equitably and the outcomes of the collaboration are quantifiably beneficial to all. Incentive alignment requires a careful definition of mechanisms that share gains equitably, which means gains are commensurate with investment and risk (Barratt, 2004).

Resource sharing refers to the process of leveraging capabilities and assets and investing in capabilities and assets with supply chain partners. Resources include physical resources, such as manufacturing equipment, facility, and technology.

Collaborative communication is the contact and message transmission process among supply chain partners in terms of frequency, direction, mode, and influence strategy. Open, frequent, balanced, two-way, multilevel communication is generally an indication of close inter-organizational relationships (Barratt, 2004).

Joint knowledge creation refers to the extent to which supply chain partners develop a better understanding of and response to the market and competitive environment by working together. There are two kinds of knowledge creation activities: knowledge exploration (i.e., search and acquire new and relevant knowledge) and knowledge exploitation (i.e., assimilate and apply relevant knowledge).

There are multiple benefits accruing from effective SCC. Some of these include: elimination of excess inventory, reduction of lead times, increased sales, improved customer service, efficient product developments efforts, low manufacturing costs, increased flexibility to cope with high demand uncertainty, increased customer retention, and revenue enhancements.

These expected benefits of SCC motivated the researchers and practitioners to develop and test the concept of elements of collaboration, but further research is required to develop a deeper understanding of the relationships between these elements of collaboration.

Despite the popularity and potential benefits of SCC, many attempts fall short of the participants expectations. It was previously observed by Sabath and Fontanella (2002) that collaboration arguably has the most disappointing track record of the various supply chain management strategies introduced to date (Cao and Zhang, 2011). The difficulties faced in SCC activities may be visualized in the following way:

- There exist differences in the interest of SC members as the members work out of habit as an individual firm based on local perspective. Such an opportunistic behavior results in mismatch of supply and demand (Arshinder et al., 2008).
- The following types of conflicts may exist: conflicting goals and objectives (goal conflict), disagreements over domain of decisions and actions (domain conflict) and differences in perceptions of reality used in joint decision making (perceptual conflict) between SC members.
- The traditional performance measures based on the individual performance may be irrelevant to the maximization of SC profit in a collaborative manner.
- The traditional policies, particularly rules and procedures, may not be relevant to the new conditions of inter-organizational relationship. Moreover, there has been over-reliance on technology in trying to implement Information Technology (IT).

The consequences of lack of coordination may result in poor performance of SC as a whole, particularly in inaccurate forecasts, low capacity utilization, excessive inventory, inadequate customer service, inventory turns, inventory costs, time to market, order fulfillment response, quality, customer focus and customer satisfaction (Arshinder et al., 2008). These problems are solved by implementing some mechanisms in SC activities, which may result in the improvement of some performance measures. These mechanisms include: joint decision making, information sharing, resource sharing, implementing IT, joint promotional activities, etc. The other motivation seems to be the ability of SC members to share the risks and subsequently share the benefits. Further these mechanisms are discussed in detail.

SC Contracts. SC members coordinate by using contracts for better management of supplierbuyer relationship and risk management. The objectives of SC contracts are:

- to increase the total SC profit,
- to reduce overstock/understock costs, and
- to share the risks among the SC partners.

In buyback contract, the buyer is allowed to return the unsold inventory to some fixed amount at agreed upon prices. The manufacturers accept the returns from the retailers when the production costs are sufficiently low and demand uncertainty is not too great (Cachon and Lariviere, 2005).

In the revenue-sharing contracts, the supplier offers the buyer a low wholesale price when the retailer shares fraction of his revenue with supplier, which helps partners in selecting order quantities that are optimal for the whole SC (Cachon and Lariviere, 2005).

In the quantity flexibility contracts, the supplier and the buyer accepts some of the inventory and stock out cost burden. The supplier allows the buyer to change the quantity ordered after observing actual demand. The buyer commits to a minimum purchase and the supplier guarantees a maximum coverage (Tsay, 1999). The coordination achieved by the contracts provides incentives to all SC members and improves the service level.

There are a number of extensions to buyback contracts are presented in the literature like two period supply contract model for decentralized assembly system (Zou et al., 2008) and flexible returns policies in three-level SC (Ding and Chen, 2008) to fully coordinate SC members.

Information technology. IT is used to improve inter-organizational coordination and in turn, inter-organizational coordination has been shown to have a positive impact on select firm performance measures, such as customer service, lead time and production costs. IT helps to link the point of production seamlessly with the point of delivery or purchase. It allows planning, tracking and estimating the lead times based on the real-time data. Advances in IT (e.g. internet, EDI (electronic data interchange), ERP (enterprise resource planning), e-business and many more) enable firms to rapidly exchange products, information, and funds and utilize collaborative methods to optimize SC operations. The various coordination problems handled by information systems are:

- little value to the supplier because of competitive bidding,
- forced implementation of IT,
- incompatible information system at different levels of SC,

- greater lead times,
- inefficient purchase order, and
- misaligned e-business strategies and coordination mechanisms (Arshinder et al., 2008).

Information sharing. The SC members coordinate by sharing information regarding demand, orders, inventory, POS data, etc. Timely demand information or advanced commitments from downstream customers helps in reducing the inventory costs by offering price discounts and this information can be a substitute for lead time and inventory (Reddy and Rajendran, 2005). The value of information sharing increases as the service level at the supplier, supplier-holding costs, demand variability and offset time increase, and as the length of the order cycle decrease.

Joint decision making. Joint decision making consists of several key procedures:

- replenishment,
- inventory holding costs with dynamic demand,
- collaborative planning,
- costs of different processes,
- frequency of orders,
- batch size,
- product development to improve the performance of SC.

A coherent decision making helps in resolving conflicts among SC members and in exceptions handling in case of any future uncertainty.

There are many factors involved in achieving coordination like human, technology, strategies, relationship, rewards, sharing of knowledge, sharing benefits, aligning goals, scheduling of frequent meetings of stakeholders for conflict resolution, understanding of nature of intermediates and knowledge of SC concepts, status or power difference and resistance in following the instructions of other organizations.

Even though SCC improves the performance of the SC, it may not always be beneficial to coordinate all the SC members. The high adoption costs of joining inter-organizational information systems and information sharing under different operational conditions of organizations may hurt some SC members. Therefore, it is essential to investigate the conditions under which SCC is beneficial, so that it should not result in higher SC costs and imprecise information.

Cooperation Forms and Dimensions. Based on this definition, SCM can be broken into two parts: internal (which entails cross-functional coordination and collaboration within the company) and external. External SCM can further be broken into two parts: upstream, which has to do with coordination and collaboration with suppliers, and downstream, which has to do with coordination and collaboration with customers. In the SCM literature, these three parts can be referred to as internal integration, supplier integration and customer integration (Flynn et al., 2010; Wong et al., 2013; Yu et al., 2013) or supplier relationship management, internal SCM and customer relationship management (Dey and Cheffi, 2013).

Whilst many organizations have integrated various internal interfaces, e.g. marketing and logistics, purchasing and manufacturing, there are still few organizations that have achieved complete internal integration, i.e. purchasing-manufacturing-logistics-marketing (Fawcett and Magnan, 2002). Mentzer et al. (2001) classify these early forms of integration as predominantly based on interaction, in the sense that functional departments hold meetings and attempt to share more information. What

are missing from such initiatives are the joint goals, shared resources, and common vision that is espoused by the collaborative approach. A potential danger of internal collaboration is that organizations could achieve internal integration, and have simply created a larger albeit organizational silo (Barratt, 2004).

External collaboration presents a number of potential opportunities for vertical supply chain collaboration on the downstream side of the supply chain (customer relationship management (CRM); collaborative demand planning (which includes collaborative forecasting, CPFR, etc.); demand replenishment; and shared distribution) as well as on the upstream side of the supply chain (supplier relationship management (also referred to as supplier development, e.g. VMI, CRP); supplier planning and production scheduling; collaborative design (which could include new product introduction); and collaborative transportation).

Supply Chain Cooperation Performance. There is a growing recognition among company executives that today's business competition is no longer between individual firms, but between SCs. If a SC is properly managed, its whole value can be greater than the sum of its parts. Not surprisingly, there is an increasing demand for both scholars and business practitioners to make SCM more financially accountable. Optimizing financial performance along the SCs should be the ultimate goal of any SCM strategy. The existing literature has shown SCM's great potential to enhance a firm's key financial outcomes. To demonstrate the financial accountability of SCM activities a number of SCM drivers for firm-level financial performance are identified (Shi and Yu, 2013).

On the basis of collaborative management of relationships between the organizations that constitute the value chain and integrated coordination of processes from the ultimate supplier to the ultimate customer, SCM aims to create more value for customers, as well as for the supply chain partners, thus improving performance not only within each organization, but also across the whole chain (Shi and Yu, 2013). A SCM system entails the implementation of a set of practices that can be defined as activities deployed in an organization in order to enhance the effective management of its supply chain. Despite the constantly growing attention to SCM, contributions to the link between supply chain management practices (SCMPs) and performance are very diverse in scope and nature, and most often remain dispersed and incomplete.

The existing studies on the financial impacts of SCM have enabled the researchers to formulate some empirical patterns, with which we identify a number of performance drivers attributing to firm financial performance, in particular: sourcing strategy, information technology (IT), system integration, and external relationship.

Sourcing strategy. When a firm develops its sourcing strategy in the SCM context, it constantly weighs the total costs associated with the make-or-buy decisions. A well-developed SC sourcing strategy allows SC partners to focus on their key competitive advantages, thus resulting in a win-win situation for all involving parties. According to TCE, successful SC sourcing strategy should be able to reduce production costs and increase process flexibility since firms no longer need to commit to asset specificity (Williamson, 1981).

According to Shi and Yu (2013), the performance implications of SC sourcing strategy are widely debated in the literature. On one hand, several empirical studies have shown its positive contributions to firms' financial performance. It was

discussed, how purchasing and supply management affect financial performance such as business growth, profitability, cash flow, and asset utilization. On the other hand, not all the studies are able to establish positive relationship between sourcing strategy and financial performance. It was previously found, that firms performing more aggressive outsourcing practices do not experience significant and direct performance improvements. In addition, firm strategy and environmental dynamism are found to moderate the relationships between outsourcing intensity and financial performance. (Shi and Wei, 2013). Overall, SC sourcing strategy generate positive contributions to financial performance. However, an optimal level of outsourceability may exist to maximize the benefits.

Information technology. According to transaction cost economics (TCE), the main purpose of IT in SCM is to enhance SC collaboration and reduce coordination costs along SC by increasing SC visibility and transparency. Meanwhile, there is a debate on whether the IT capability can really serve as a catalyst in improving firms' performance. The skeptics' major argument is that particular SC technology can be easily duplicated by competitors, making it difficult for the investing firms to gain competitive advantages over their competitors. According to resource based view (RBV), therefore, the increasing investments in IT capability do not guarantee performance improvements. Blankley (2008) provides a comprehensive literature review relevant to the impacts of IT on the financial performance. He proposes a conceptual model to demonstrate how an effect chain is extended from SCM technology to a firm's financial performance. Therefore, the following empirical finding regarding the financial impacts of IT can be derived: Information technology in SCM makes positive contributions to financial performance, but IT alignments and implementations could affect financial outcomes.

System integration. An integrated SCM system enhances a firm's capability to coordinate all business processes within and beyond the firm's boundary. Enterprise resource planning (ERP) system, which integrates internal and external information flows and management functions within and across involving SC participants, is a typical example.

By collecting survey results from Korean and Japanese firms, Kim (2009) uses SEM approach to examine the causal relationship among SC activities, competitive strategy, SC integration, and firm performance. For both Korean and Japanese samples, there exists a significant relationship between SCM activities and competition capability. However, the mechanism of how SC integration impacts firm performance is different in Korean and Japanese samples due to firm sizes and levels of SC integration. In Korean firms, the interrelationship between SCM practices and competition capability enhances SC integration, which in turn has a direct effect on firm performance. On the other hand, some studies are not able to establish positive relationship between SCM integration and firms' performance. Hendricks et al. (2007) report mixed results concerning the impacts of ERP, SCM, and customer relationship management (CRM) on firms' long-term financial performance. Specifically, they find some improvements in firms' financial metrics (ROA and ROS) for the ERP and SCM adopters, but not for the CRM adopters. To partly explain this performance puzzle, some studies suggest that the SCM systems be integrated with other IT infrastructures to achieve the best performance. An integrated SCM system represents a firm's general capability to coordinate all business processes within and beyond the firm's boundary and improve overall financial performance.

Summing up, system integration in SCM achieves optimal financial performance when it is implemented together and aligned with IT infrastructures and overall business strategies.

External relationships. As a firm's unique resource and valuable asset, external relationships in SCM, including supplier and customer management, is expected to be highly associated with financial performance. As a matter of fact, it can be argued that the quality of external relationships with upstream and downstream partners is one of the most important drivers of financial performance. The association between external and internal contextual SCM factors and various performance measures in the information industry was earlier investigated in Taiwan. Several studies focus on the specific components of external relationships in SCM. For example, Flynn et al. (2010) especially investigate the impact of supplier-customer-internal (SCI) relationship on firms' performance in China. Empirical analysis shows that the SCI relationship is positively associated with both operational and financial performance.

SC collaboration and mutual trust are especially important to manage external relationships with suppliers and customers. Cao and Zhang (2011) investigate SC collaboration and its impact on firm performance. The empirical results indicate that SC collaboration considerably improve collaborative advantage, which in turn, has significant positive effect on firms' financial performance. In particular, the mediator role of collaborative advantage is stronger for small firms than medium and large firms. Therefore, we have following empirical finding: as a firm's unique resource and valuable assets, SC external relationships are highly associated with financial performance.

Over the past few decades, more and more executives have realized the strategic importance of SCM and recognized the distinctive competitive advantages that a well-managed SC can bring to the company. SCM has therefore attracted substantial investments across various industries recently and company executives not only need to know whether SCM is able to make positive contributions to firm-level financial performance, but also want to know how to direct their SC investments to enhance competitive advantages and optimize financial outcomes. SCM managers, therefore, are obliged to demonstrate SCM's positive financial contributions and justify relevant expenses.

As we constrain this study on the financial impacts of SCM practices, only accounting- and market-based financial measures are discussed in this section.

The accounting-based financial measures are direct indicators of a firm's financial conditions from different perspectives. For example, return on assets (ROA), return on equity (ROE), and return on investment (ROI) are usually used to examine a firm's asset and capital utilization, while profit margin, cost of goods sold (COGS), and economic value added (EVA) are common measures of a firm's capability to make profits. Some accrual measures, such as ROA, ROI, and profit margin, are particularly popular in the SCM literature. However, it is worth noting that the accrual measures are not always appropriate in performance measurement due to their own limitations. First, most accrual measures are not able to catch intangible or non-cash benefits associated with SCM practices, such as market share, market reputation, and company goodwill. Second, they are used to measure the past performance but are not forward-looking indicators. Third, they are relatively easy to be manipulated by accounting frauds and illegal practices. A few studies, therefore,

propose financial measures based on cash flow to directly evaluate a firm's profits and liquidity. To better catch the company-wide effects of SCM practices, several studies develop comprehensive financial measures by combining multiple corporate income and balance sheet values together.

As an essential complement to accounting-based financial measures, market-based measures focus on shareholder value. Shi and Yu (2013) state, that in one of the early studies investigating the impacts of SC strategy on shareholder value, Christoper and Ryals (1999) define the shareholder value as the financial value created for shareholders by the companies in which they invest. Since SCM activities are strongly associated with revenue growth, operating cost reduction, fixed and working capital efficiency, they are expected to impose significant effects on shareholder values. It is consistent with studies in other disciplinaries. Swink et al. (2010) employ Sharpe ratio to characterize how well the excess return of SCM excellence compensates the stockholder for the risk taken. As the most popular market-based measure, abnormal stock return documents the difference between the expected stock return and the actual stock return, which is often triggered by special SCM events (see event study in research method section for details). In a widely-cited study, Hendricks and Singhal (2003) propose a framework to link SC performance to shareholder value through operational metrics and intangible assets. In an efficient financial market, the improved SC performance eventually will be reflected on shareholder values. Johnson and Templar (2011) develop a unified performance proxy composing of different elements in profitability, liquidity, and productivity. Since a significant proportion of firm value today lies in intangible assets, market-based measures provide a more objective approach than the accounting-based measures. In the absence of deep understanding of SCM's contributions to shareholder value, SCM professionals have great impediments to assess the true value of SCM activities and justify the continuous SCM investments.

Fig. 5 summarises all the paths that link learning and growth perspective and internal process perspective (SCMPs and some operational non-financial performance measures) to the customer and financial perspectives (customer satisfaction, product quality and financial performance), which constitute a firms strategic objectives.

Theoretical Gaps in Supply Chain Cooperation. Despite research confirming the positive benefits of supply chain integration, and its importance to a firms success (Flynn et al., 2010), ambiguity remains as to what constitutes supply chain collaboration (Fabbe-Costes et al. 2014).

Currently there exists a gap in the SCM literature to link theoretical background and empirical evidences. A few authors have attempted to lay theoretical foundations for SCM by employing a variety of organizational theories, such as TCE, RBV, agency theory, institutional theory, network theory, game theory, and strategic choice theory (Chatha and Butt, 2015). With the exception of TCE and RBV, most theories, however, did not receive sufficient empirical supports in the literature. Thus, the following points can become starting points for further research:

1. *More diverse theoretical foundations.* Most of current empirical studies formulate their hypothesis in the framework defined by either TCE or RBV. Several other organizational theories, such as principle-agent theory and network theory, are discussed in the SCM context. Apparently, more diverse theoretical

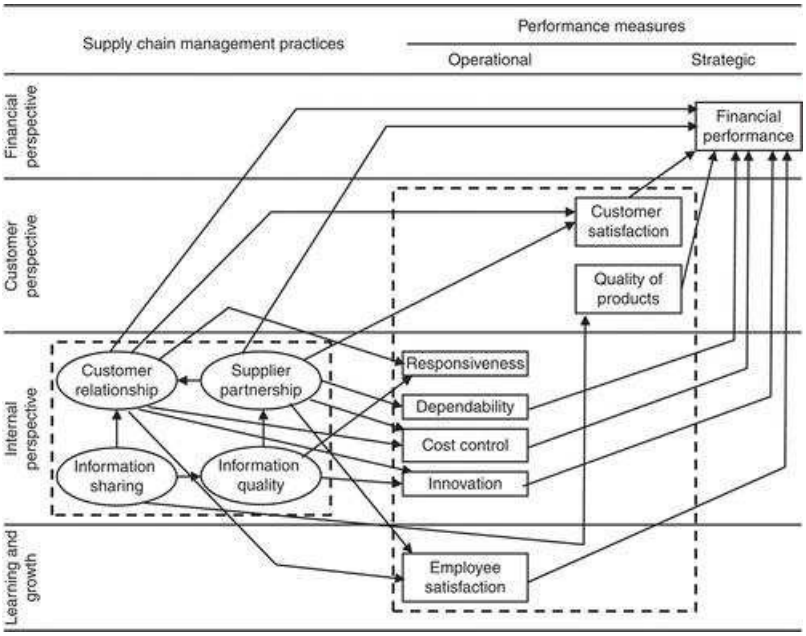


Fig. 5: Linkage of SCM practices on performance (adopted from Okongwu, Brulhart and Moncef, 2015)

foundations will enhance our understanding of SCM's financial impacts from different perspectives.

2. *Narrow focus.* Regarding the fundamental question of which SCM practices impact individually or collectively on which performance measures, most studies often focus on only one or few aspects (or parts) of the supply chain such as the upstream network (Eltantawy et al., 2015) or the internal relationships (Williams et al., 2013). In this field, two research streams can be distinguished: first, studies that aim to establish a link between two variables (a SCM practice and a performance measure) based on a unique construct of SCM and performance, Second, studies focusing on the impact of two or more SCM practices (considered separately or collectively) on one or several performance variables.
3. *Under-researched SC variables.* Besides the discussed variables, more SC variables should be empirically examined on its contribution to financial performance. For example, what quality characteristics are available to drive SCM improvement and what is their financial impact?
4. *Robustness of empirical results.* As stated in the previous section, this is an emerging research area and most studies reviewed in this paper are published recently. Therefore, the robustness of the empirical findings should be tested under different environmental settings. For example, what is the role of SCM under different macroeconomic climates? Are the financial contributions from effective SCM enhanced or weakened during economic recessions? What are the SC variables attributable to the performance change?
5. *Corporate bond market.* For empirical studies based on the secondary data, most of them employ the financial data from stock market. The influential corporate bond market is largely ignored in the literature. The inclusion of corporate bond

market is necessary to extend our understanding beyond the stock market. For example, how SCM activities affect a firm's cash flows and its ability to raise capitals from the corporate bond market?

2.3. Financial Supply Chain Cooperation

What emerges from the definitions and associated discussions on supply chain and supply chain cooperation is a broad concept that focuses on the flow of physical goods and services supported by business processes that run along the full extent of the supply chain from the end user to the raw materials suppliers and includes every organization involved in the design, manufacture, distribution and retail of the product or service. To contribute to the development of research into financial supply chains and to set out the broad scope of the case study, a formal definition of financial supply chains is proposed.

A financial supply chain (FSC) is the network of organizations and banks that coordinate the flow of money and financial transactions via financial processes and shared information systems in order to support and enable the flow of goods and services between trading partners in a product supply chain (Blackman, Holland, and Westcott, 2013).

Lately the importance of understanding the relationship between physical and financial supply chains has arised among supply chain finance practitioners such as finance providers, corporate, commercial and small and medium-sized (SME) clients, market investors, regulators or legal practitioners as well as it and infrastructure providers (Standard Definitions for Techniques of Supply Chain Finance, 2016). According to this document as one of the first attempts to establish this link, the Financial Supply Chain (FSC) is the chain of financial processes, events and activities that provide financial support to physical supply chain participants. Financial Supply Chain Management (FSCM) refers to the range of corporate management practices and transactions that facilitate the purchase of, sale and payment for goods and services, such as the conclusion of contractual frameworks, the sending of purchase orders and invoices, the matching of goods sent and received to these, the control and monitoring of activities including cash collections, the deployment of supporting technology, the management of liquidity and working capital, the use of risk mitigation such as insurance and guarantees, and the management of payments and cash-flow. FSC management involves the orchestration of a range of contributors to meeting FSC needs such as internal corporate functions, trading parties, and service providers in the area of supply chain automation and in the whole range of financial services.

In order to reduce vagueness in the term, it is needed to introduce master definition of a supply chain finance (SCF) provided in Standard Definitions for Techniques of Supply Chain Finance, (2016): the Supply Chain Finance is defined as the use of financing and risk mitigation practices and techniques to optimise the management of the working capital and liquidity invested in supply chain processes and transactions. The following aspects of this definition are highlighted by the authors:

– *Portfolio.* SCF is a portfolio of financing and risk mitigation techniques and practices that support the trade and financial flows along end-to-end business supply and distribution chains, domestically as well as internationally. This is emphatically a holistic concept that includes a broad range of established and evolving techniques for the provision of finance and the management of risk.

- *Parties.* Parties to SCF transactions consist of buyers and sellers, which are trading and collaborating with each other along the supply chain. As required, these parties work with finance providers to raise finance using various SCF techniques and other forms of finance. The parties, and especially anchor parties on account of their commercial and financial strength, often have objectives to improve supply chain stability, liquidity, financial performance, risk management, and balance sheet efficiency.
- *Event driven.* Finance providers offer their services in the context of the financial requirements triggered by purchase orders, invoices, receivables, other claims, and related pre-shipment and post-shipment processes along the supply chain. Consequently, SCF is largely event-driven. Each intervention (finance, risk mitigation or payment) in the financial supply chain is driven by an event or trigger in the physical supply chain. The development of advanced technologies and procedures to track and control events in the physical supply chain creates opportunities to automate the initiation of SCF interventions in the related financial supply chain.
- *Evolving and flexible.* SCF is not a static concept but is an evolving set of practices using or combining a variety of techniques; some of these are mature and others are new or leading edge techniques or variants of established techniques, and may also include the use of traditional trade finance. The techniques are often used in combination with each other and with other financial and physical supply chain services.

There is clearly a close and reciprocal relationship between physical and financial processes within a supply chain. The crucial importance of business processes in manufacturing supply chain management and that business processes run throughout the supply chain and connect separately owned companies was identified. The financial business process is defined as the set of activities involved in the coordination of financial transactions within and between separate companies that comprise a manufacturing supply chain and their banking partners. This could include, for example, invoices, domestic and international payments, foreign exchange transactions and remittance advice. In general, financial business processes operate in tandem with manufacturing and logistics processes because typically money flows mirror product flows in a supply chain.

Given that financial supply chains operate in parallel with product supply chains it is reasonable to adapt the framework proposed by Mentzer et al. (2001) and use it as the basis for our further research as these authors identified three interdependent supply chain dimensions: business processes, management components and network structure.

Financial Cooperation Forms and Dimensions. The goal of FSC structure is to increase the transparency and the level of automation of business processes along the financial value chain. The purpose is to save processing costs and reduce the working capital of the company. This definition does not consider where the financial supply chain actually begins and ends, because there are also analytical processes that are not directly related to a business process but which belong nonetheless to the financial supply chain.

According to Weiss (2011), the financial supply chain is different from the physical supply chain because it deals with the flow of cash instead of goods. Just as in the physical supply chain, though, every day that is lost in the cash-to-cash

cycle equals lost revenue. Besides a number of rather operational problems, there are several concrete key performance indicators and metrics that can be used to analyze financial supply chain. The financial supply chain stretches across different business processes, which are, in a broader sense, the two processes: order-to-cash and purchase-to-pay. The *order-to-cash* process includes, from the perspective of a supplier (or creditor), the following business process steps: 1. creditworthiness check, 2. invoice creation, 3. cash forecast, 4. financing of working capital, 5. processing of dispute cases, 6. cash collection, 7. settlement and payment, 8. account reconciliation.

From the perspective of a customer (or debtor), the *purchase-to-pay* process consists of the following business processes: 1. procurement, 2. cash forecast, 3. financing of working capital, 4. receipt of invoices, 5. resolution of discrepancies or exceptions, 6. invoice approval, 7. settlement and payment, 8. account reconciliation.

There are a number of operational factors within the order-to-cash and purchase-to-pay processes that can serve as indicators of a suboptimal financial supply chain:

- The number of paper-based business processes is very high and there are several changes in medium (for example, the creation of invoices).
- The straight-through processing rate is low, which means that there are multiple manual interventions and process steps.
- Companies struggle with a large number of dispute cases during the creation of invoices, and it takes them a lot of time to process these.
- There is a large amount of uncollectable receivables on the balance sheet, and many employees in receivables or collections management are involved in the resolution process.
- Enterprises have not implemented a consistent credit management policy, which results in a number of bad debt losses.
- Management has difficulties in predicting cash flows.
- There is no centralized cash management to control payment streams, and the company maintains too many bank connections.

The business process construct maps directly onto financial supply chains. Management components is concerned with the integration and coordination of business processes. In a financial supply chain, financial business processes are managed through information technology based systems and the sharing of information within and between organizations. To reflect the critical role of information technology combined with management systems, the term financial and banking information systems is used in place of management components. Network structure has been identified as a key feature in the supply chain literature and this concept applies equally to the network structure of organizations and banks involved in the financial supply chain.

If to look closer to the operations that are the essential parts of the companies that are using FSCM approach, they could be generally defined into several categories:

Receivables Purchase. Receivables discounting is a form of Receivables Purchase, flexibly applied, in which sellers of goods and services sell individual or multiple receivables (represented by outstanding invoices) to a finance provider at a discount.

Forfaiting is a form of Receivables Purchase, consisting of the without recourse purchase of future payment obligations represented by financial instruments or pay-

ment obligations (normally in negotiable or transferable form), at a discount or at face value in return for a financing charge.

Factoring is another form of Receivables Purchase, in which sellers of goods and services sell their receivables (represented by outstanding invoices) at a discount to a finance provider (commonly known as the factor). A key differentiator of factoring is that typically the finance provider becomes responsible for managing the debtor portfolio and collecting the payment of the underlying receivables.

Payables finance is provided through a buyer-led programme within which sellers in the buyers supply chain are able to access finance by means of Receivables Purchase. The technique provides a seller of goods or services with the option of receiving the discounted value of receivables (represented by outstanding invoices) prior to their actual due date and typically at a financing cost aligned with the credit risk of the buyer. The payable continues to be due by the buyer until its due date.

Loan, or Advance-based. Loan or Advance against Receivables is financing made available to a party involved in a supply chain on the expectation of repayment from funds generated from current or future trade receivables and is usually made against the security of such receivables, but may be unsecured.

Distributor finance is financing for a distributor of a large manufacturer to cover the holding of goods for re-sale and to bridge the liquidity gap until the receipt of funds from receivables following the sale of goods to a retailer or end-customer.

Loan, or Advance against Inventory is financing provided to a buyer or seller involved in a supply chain for the holding or warehousing of goods (either pre-sold, un-sold, or hedged) and over which the finance provider usually takes a security interest or assignment of rights and exercises a measure of control.

Pre-shipment finance is a loan provided by a finance provider to a seller of goods and/or services for the sourcing, manufacture or conversion of raw materials or semi-finished goods into finished goods and/or services, which are then delivered to a buyer. A purchase order from an acceptable buyer, or a documentary or standby letter of credit or a Bank Payment Obligation, issued on behalf of the buyer, in favour of the seller is often a key ingredient in motivating the finance, in addition to the ability of the seller to perform under the contract with the buyer.

Financial Supply Chain Cooperation Performance. There is a diversity of approaches and different frameworks to measure the performance of supply chains, taking into account financial and nonfinancial measurements, operational performance, strategic performance and highlevel measures of overall firm performance such as profitability.

One of the adapted frameworks to measure financial supply chain performance is the framework proposed by Gunasekaran et al. (2004) to measure the performance of physical supply chains. The advantages of using this rather broad framework are that it allows the researchers scope to examine the performance characteristics over three main performance areas (operational/tactical, quality and strategic) without being overly prescriptive at this relatively early stage of theory development concerning financial supply chains. In the context of financial supply chains, the operational/tactical performance includes measurements such as reduction in international payments from offsetting, efficiency of the foreign exchange process, the lead-time for the payment cycle within the banking system and the reduction of variability of customersupplier settlement dates. Six sigma quality measurement

concepts from manufacturing map directly onto financial processes, for example to measure the quality of payment and foreign exchange transactions. Examples of strategic outcomes from a financial supply chain are increased cohesion in the global financial supply chain and the development of a global payment factory.

The financial supply chain strategy is logically related to the manufacturing and logistics supply chain strategy and this is captured in the model by the interdependence between the financial supply chain strategy and the manufacturing and logistics supply chain strategy (Heuser and Brockwell, 2009). There is a two-way influence where the manufacturing activities place demands on the financial systems, and in turn the financial activities enable the functioning and operation of the manufacturing supply chain. This means that changes in the product supply chain such as new suppliers, increased globalization of operations and new commercial arrangements place demands on the financial supply chain. Similarly, new capabilities in the financial systems such as certainty of payment on a specific future date, guaranteed in a local currency and at a fixed exchange rate may enable better trading relationships.

The financial supply chain strategy is an adaptation of the supply chain model proposed by Lambert et al. (1998) and is defined by the set of inter-related theoretical constructs: financial business processes, financial and banking information systems, and financial network structure. The performance of the financial supply chain is defined in terms of the quality of operations measured by six sigma techniques, financial operational benefits such as reduced cash balances and better foreign exchange rates, and strategic outcomes such as the development of a global payments factory. The important aspect of performance is that it should be measured dynamically and related to the evolution of the financial supply chain strategy in order to develop a better understanding of how changes in the financial supply chain strategy are empirically related to performance. To understand how the model operates in practice it is applied in a global setting and the methodology and data collection are described in the next section.

In order to define the interdependency of the financial supply chain and the manufacturing supply chain research into Motorola has been made (Blackman, Holland and Westcott, 2013). The case data clearly shows that it is only possible to build a sophisticated global treasury management and payments system in tandem with a global production network, because the financial system uses core supply chain data to support its business processes. The interdependency between manufacturing and financial supply chains also makes strategic changes more complex. This partly explains the long time-scales involved in the implementation of standardized financial processes based on automated systems.

The empirical evidence that demonstrates the relationship between financial supply chain strategy and performance is mapping out of the evolutionary timeline of the financial supply chain strategy and relating key events and strategy changes to performance outcomes. Changes in the financial supply chain strategy can then be related to qualitative improvements in areas such as financial process innovations and better relationships with suppliers and banks, and also to quantitative, operational performance improvements, for example time-series payment volumes and six sigma levels.

Summing up, the overwhelming trend is towards a standard financial supply chain model to coordinate international banking and payments throughout the

physical supply chain. The movement of products and services encapsulated by the manufacturing supply chain is now supported by parallel financial and banking systems. As close collaboration is required between the trading partners within the supply chain to meet customer needs, the movement of funds has evolved to track the movement of goods in a concomitant manner rather than as a distinct and separate management function.

Theoretical Gaps in Financial Supply Chain Cooperation. Similar to other rapidly developing subject areas, there is no consensus or agreed definition of the concept. Global supply chain management systems rely on financial processes in addition to manufacturing, logistics and marketing activities to coordinate the flow of goods, services and money between separate stages in the supply chain. Financial supply chains are therefore an integral component of supply chains and yet there is very little research that specifically addresses the strategy, implementation and performance of global financial supply chains. Financial processes such as invoices, payments, foreign exchange and banking transactions have received very little attention in the supply chain literature because previous research has tended to focus almost exclusively on the movement of products and services in the supply chain and largely ignores the movement of money and related financial activities.

The literature in this area is only just emerging and is fragmented across academic and business publications. For example, in the academic literature Fairchild (2005) examined the integration of data from financial and physical supply chains to explore how companies can increase the efficiency of financial processes by integrating data from physical processes involved in the movement of goods and services with financial processes. Gupta and Dutta (2011) modelled the dynamics of financial supply chains in terms of the flow of money between customers and suppliers. Hofmann (2011) has analyzed two specific aspects of financial supply chains, risk and supplier financing in the automotive industry.

From a consultancy perspective, Hartley-Urquhart (2006) argued that companies should manage financial supply chains as closely as they manage physical supply chains in order to deal with the inherent complexity and risk of global production systems: as companies operate in a global environment where outsourcing and sourcing arrangements lead to more complex supply chain arrangements and risk management strategies (Chopra and Sohdi, 2004), the financial processes concerned with payments, visibility of the financial process, foreign exchange and risk management need to be much more sophisticated and integrated with the product supply chain. Heuser and Brockwell (2009) addressed similar issues, though from a banking perspective. Their focus was on the treasury management aspects of financial supply chains. In terms of early research originating from industry and management practice, there are parallels with the early development of the supply chain management concept, which was influenced by consultancy practice and industry specific research.

The logic of considering financial supply chains as an integral component of supply chains is that the flow of money and related financial and banking services is coordinated by shared financial processes that connect each stage of the supply chain in much the same way that manufacturing and logistics processes manage the flow of products from raw material suppliers through manufacturing, distribution and retail. Financial processes are therefore inextricably linked to the supply chain activities defined by Mentzer et al. (2001).

There is very little research that directly addresses the subject of financial supply chains that takes an overview of the topic and attempts to define a conceptual framework and illustrate it with significant empirical evidence over a period of time. There is also little consensus regarding the formal definition of the financial supply chain concept. An important element of the research is to understand the strategic evolution of financial supply chains in the context of the manufacturing supply chain over a significant time period, synthesize the performance metrics of a financial supply chain and set out a research agenda for financial supply chains. To start to address the lack of research into financial supply chains, it is necessary to define a framework that captures the core elements of the financial supply chain concept and relates it to the broader literature on manufacturing and logistics. In the next section a review of the literature is presented that forms the basis for the development of a research framework.

The literature that specifically addresses financial supply chains is scant and typically focuses on one specific aspect of the financial supply chain. Finance papers have tended to focus on the technical aspects of financial supply chains (Gupta and Dutta, 2011) and failed to address the strategic and operations management issues. Other research is also very specialized in nature. For example, researchers have examined the integration of manufacturing and financial data (Fairchild, 2005), currency hedging (Hofmann, 2011), financing arrangements (Hofmann, 2005) and technical risk from electronic payments (Johnson, 2008). However, none of these authors provide a conceptual framework or definition of financial supply chains. A broader view has been offered by practicing managers see for example Heuser and Brockwell (2009) who proposed a model of treasury management in the supply chain from a banking perspective but did not provide evidence for its use in practice.

Based on the following gaps defined there is number of research opportunities existing. Research into financial supply chains is in its infancy when compared to research into manufacturing supply chains. An agenda for future research opportunities is therefore proposed. The research frameworks used earlier were effective at capturing the principles of financial supply chains but the model could be extended in terms of additional variables, for example the nature of the strategic change process and project management techniques, and also into the nature of the relationships between the variables in the research framework.

Another important area is the detailed modeling of the flow of payments, akin to the modeling of product flows based on shared information between manufacturers and suppliers (Blackman, Holland and Westcott, 2013; Gupta and Dutta, 2011). What are the benefits to suppliers of receiving advance notification of payments with a certainty that they will receive funding in their own currency on a specific and guaranteed date? How should benefits such as reduced borrowing and foreign exchange requirements be quantified? How will the frequency of payments change in the future as it becomes possible to manage financial exchanges between trading partners at the level of individual items on a purchase order because of lower transactional costs from advances in information technology and banking systems?

In terms of formulating strategy for financial supply chains, moving away from a standard adversarial stance to a cooperative partnership approach with suppliers and banks requires a significant shift in the mind-set of senior finance managers who are typically accustomed to maximizing financial benefits within the organizational boundary of their own firm rather than looking to the competitive nature of the sup-

ply chain as a whole. However, the strategic benefits such as managing finances on a global scale and better relationships with suppliers, coupled with evidence from previous research that shows supply chain management capabilities are correlated with firm performance (Johnson and Templar, 2011) should encourage finance specialists to work closely with manufacturing and logistics managers to realize the benefits of closer integration across functional areas within the company and along the supply chain. In an economic environment where the availability and cost of bank funding are becoming significant problems, particularly for smaller companies, supply chain financing based on closer financial ties between large organizations and their supply networks becomes an attractive and strategically important opportunity. Empirical research in other global financial supply chains is needed to tackle these types of questions convincingly.

Another very important issue is the inability of key performance indicators (KPIs) of the FSCM defining. There are various key performance indicators that are relevant for measurement in financial supply chain management. One key metric is the cash flow cycle, which defines the period from delivery by suppliers until the cash collection of receivables from customers . It is the time period required for the company to receive the invested funds back in the form of cash. The cash flow cycle can be divided into the operating cycle which is the time period between delivery by suppliers and the actual cash collection of receivables, and the cash flow cycle which is the time period between the cash payment for inventory and the cash collection of receivables. The longer the cash flow cycle, the greater is the working capital requirement of a company, which means that a reduction of the cash flow cycle will immediately free up liquidity. However, the motivation as well as KPIs for an effective financial supply chain is very unobvious to define (Weiss, 2012).

In summary, it can be said that, empirical supply chain research has a limited focus on FSCM and is thus lagging behind. Similarly, scholars focusing on trade finance rather investigate the topic from a corporate risk perspective than a supply chain perspective (e.g. Chauffour and Malouche, 2011) and thus often omit the interplay of financial and operational flows in supply chains (Protopappa-Sieke and Seifert, 2010). Since FSCM by definition has a broad scope, the purpose of this paper can only be an initial attempt at investigating FSCM.

3. Trends and Gaps in Supply Chain Cooperation Modeling

3.1. Typology of Supply Chain Cooperation Models

As supply chain members are often separate and independent economic entities, a key issue in SCM is to develop mechanisms that can align their objectives and coordinate their activities so as to optimize system performance. In our research we are going to implement the typology of SCC models introduced by Li and Wang in 2007.

According to it, ideally, a decision in a supply chain can be made by a centralized decision maker with access to all available information to optimize system performance. This is possible when the entire supply chain is under the control of a single decision maker, or the coordination benefits can be fairly distributed among the individual members by a central planner. When such a solution can be implemented, the system is referred to as a centralized system. However, in general, neither a supplier nor a buyer can control the entire supply chain. Each supply chain member has its own state of information and decisions that can be made use to optimize its

own interest. When the supply chain members are separate and independent economic entities, they will act independently and opportunistically to optimize their individual benefits. In this case, an action plan has to be complemented with an incentive scheme that can allocate the benefits of coordination among the supply chain members so as to align their objectives of coordination. Such a system is regarded as a decentralized supply chain system.

In a supply chain, entities such as suppliers, manufacturers, distributors, and retailers, can belong to a single organization or independent organizations. However, the distinction between centralized and decentralized systems is more properly related to the incentive structures within the chain. At the most basic level, in a centralized supply chain, there is a central planner who makes decisions for the entire system, while each entity in a decentralized system functions as an autonomous unit. Decentralized control policies can be easily implemented and analyzed at the local level (function, department, firm, etc.), however coordinated planning of the individual entities in a way that optimizes the value of the overall supply chain (system) is a difficult undertaking. Research tools that are used for planning such systems include network flow models and Mixed Integer Programming (MIP) models.

1. Centralized supply chain systems. The objective is to develop a production/inventory policy to minimize system cost. It is typically assumed that demand occurs at a buyer/retailer continuously at a constant rate, and no backlogging, lost sales, or transshipment is permitted anywhere in the system. Early studies have focused on the existence and development of optimal policies. However, such policies are usually difficult to characterize and implement. Recent studies have focused on approximate policies that are nearly optimal and practically useful.

1.1. Deterministic systems. 1.1.1. No time coordination. The problem of optimizing a multi-echelon inventory system is a classical one. When the planning horizon is finite, an optimal lot-sizing policy exists. This optimal policy is typically non-stationary. Discrete-time lot-sizing problem was solved by developing various algorithms. The continuous-time version of the problem can be solved approximately by a discrete-time algorithm with a very small base planning period. When the planning period is infinite, however, an optimal policy is very difficult to characterize when there is more than one buyer.

1.1.2. Time coordination. The optimal replenishment policy of a multi-echelon inventory system, however, typically entails a very complex non-stationary structure and thus is difficult to obtain and of little practical use. As such, previous studies have considered heuristic policies by restricting the timing of orders for the supplier and buyers so as to meet the above necessary properties for an optimal solution. Specifically, early studies have focused on stationary-nested or single-cycle policies. A policy is called stationary if each facility orders at equally-spaced points in time and in equal amounts. A policy is nested if each facility orders every time any of its immediate suppliers does, and perhaps at other times as well (Li and Wang, 2007).

Stationary and nested policies are attractive because they are easy to implement. However, such policies may result in very bad results in some cases.

A special case of the above model is the classical joint replenishment problem (JRP). Consider an inventory system in which multiple items are ordered from a common source. A major ordering cost is incurred each time an order is placed to the common source, independently of the number of items that are included in

the order, and a minor ordering cost is incurred for each item that is included in the order. Obviously, ordering cost savings can be obtained when several items are replenished jointly. The key issue is then how to group these items. Many studies adopted group replenishment at constant intervals of time.

1.2. Stochastic systems. In reality, a stochastic model that specifies demand as a stochastic process is often more accurate than its deterministic counterpart the economic order quantity (EOQ) model (Li and Wang, 2007). However, a barrier to the application of a stochastic model is that the optimal policy does not have a simple structure, and is not easy to implement even if it does exist. This implies that appropriate coordination mechanisms are especially necessary.

Following the developments of multi-level production/ inventory systems, two classes of inventory control policies have been used for supply chain inventory management: an operationally simple, but not optimizing system performance installation policy (control of inventory is decentralized in the sense that each member makes its inventory decision separately based entirely on the local inventory position) and echelon stock policy that replenishes inventory based on the echelon inventory position (the sum of the local inventory position and the inventory positions at all its downstream members). Echelon base-stock policies are optimal in a periodic-review finite-horizon setting when there are no economies of scale in placing orders at all the stages except the most upstream stage in a serial inventory system. This result was later generalized to an infinite-horizon setting and assembly systems. Nevertheless, optimal echelon stock policies are extremely difficult to characterize when there are economies of scale in placing orders at all stages. Because of this difficulty, most previous studies have considered heuristic policies for serial inventory systems.

Obviously, as the echelon stock policy incorporates downstream agents inventory information for inventory control, it is superior to an installation policy.

Unfortunately, neither the installation stock nor the echelon stock completely characterizes the inventory state of a supply chain. To optimize system performance, inventory should be replenished at the supplier based on the exact inventory positions at the buyers. Nonetheless, this requires that demand and stock information at each stocking point be shared on a real time basis between the supplier and buyers in the supply chain. With the recent advances in information technology such as electronic data interchange (EDI) and other related developments, this is now possible. In fact, these developments have had a substantial impact upon SCM. As the time and cost to process orders are substantially lowered, impressive improvements in supply chain performance have been obtained. It is now a general belief that capturing and sharing real-time demand and stock information is the key to improving supply chain performance.

1.2.1. Independent and exogenously determined demand process. In a recent research by Sazvar (Sazvar et al., 2014) a stochastic mathematical model id developed in order to propose a new replenishment policy in a centralized supply chain for deteriorating items. In this model, they consider inventory and transportation costs, as well as the environmental impacts under uncertain demand. The paper (Rezapour and Farahani, 2010) develops an equilibrium model to design a centralized supply chain network operating in markets under deterministic price-depended demands and with a rival chain present. The two chains provide competitive products, either identical or highly substitutable, for some participating retailer markets. They

model the optimizing behavior of these two chains, derive the equilibrium conditions, and establish the finite-dimensional variational inequality formulation, and solve it using a modified projection method. Correlated demand process

2. Decentralized distribution system. Although more and more firms have realized that collaboration with their supply chain partners can significantly improve their profits, the centralization of inventory and production decisions for a decentralized supply chain is often unrealistic. The challenge, then, is to devise coordination mechanisms that are not only able to coordinate the activities but also able to align the objectives of independent supply chain members (Chen et al., 2000).

2.1. Deterministic systems. Previous research on the coordination of decentralized deterministic systems has focused on using quantity discounts to induce independent buyers to increase their order quantities.

Many studies have been done independently from the viewpoints of inventory and production management and marketing channel coordination. The studies in the two areas differ in their focuses and model assumptions. Specifically, previous studies in the inventory and production management literature have typically focused on improving channel efficiency in managing inventory and production activities under the assumption that annual demand is exogenously determined. In contrast, studies in the marketing literature have typically focused on sales profit maximization under the assumption that inventory and production costs are independent of the pricing decision. Various discount pricing policies have been developed.

In general, it is assumed that the external demand rate, which could be constant or price-sensitive, occurs at a retailer continuously over an infinite horizon, and the supplier has symmetrical information about the annual demand and relevant cost parameters of a buyer. The objective is to determine the inventory and quantity discount policies to minimize cost or maximize profit.

2.1.1. The case of a single retailer. Many existing studies have analyzed quantity discount policies in the setting of a supplier and a single buyer. Although a supplier normally faces many buyers in reality, this setting has been adopted for simplicity of analysis.

In addition to quantity discount policies, profit sharing mechanisms have also been proposed. Under this proposal, the system performance is first optimized and the resultant benefit is then shared between the supplier and the buyer. This solution can be considered as a cooperative solution. Its implementation, however, depends on the development of a profit sharing scheme that is acceptable to both parties.

The model proposed by Li, Wang and Cheng (2010) investigates the sourcing strategy of a retailer and the pricing strategies of two suppliers in a supply chain under an environment of supply disruption, characterizing the sourcing strategies of the retailer in a centralized and a decentralized system. As a result, they derive a sufficient condition for the existence of an equilibrium price in the decentralized system when the suppliers are competitive. Based on the assumption of a uniform demand distribution, the authors obtained an explicit form of the solutions when the suppliers are competitive.

2.1.2. The case of heterogeneous retailers. When there are many buyers, an important issue for the coordination of a decentralized supply chain is whether incentive schemes can be designed on an individual basis. However, such a coordination mechanism with a unified incentive scheme is difficult to develop. There are two reasons. First, as discussed previously, a suppliers optimal inventory replenishment

policy when facing a group of heterogeneous buyers typically entails non-stationary replenishment intervals and, thus, does not admit an explicit formulation. Second, a unified discount policy must be designed according to buyers cost and demand structures, as well as their economic behaviors, so as to fully exploit the benefits of coordination. When individual incentive schemes are permissible, a straightforward solution to the problem that is able to optimize system performance is for the supplier to negotiate a separate discount policy with each buyer, fixing the lot size and annual volume at the quantities that optimize system profit and selecting a price that is agreeable to both parties.

Suppliers in reality usually offer a common pricing policy that contains multiple break points to all buyers. Other than legal considerations, a common pricing policy is desirable not only for fairness of trade but also for ease of implementation. Multiple break points are offered to accommodate different cost and demand structures of heterogeneous buyers. However, a general discrete quantity discount is difficult to develop. As such, early studies adopted continuous approximations.

The models above, however, suffer from a common weakness that a heuristic inventory policy or simply an approximation of the inventory related cost function is assumed for the supplier. Obviously, neither a lot-for-lot policy nor a heuristic replenishment policy is desirable for the supplier.

2.2. Stochastic systems. In view of the difficulties in managing centralized stochastic multi-echelon inventory systems, it is an understatement that it is a challenge to coordinate a decentralized supply chain with stochastic demand. It is then not surprising that the literature in this category is scattered. As most real supply chain inventory systems fall into this category, this of course represents challenges and opportunities for future research.

Xu et al. (2014) investigate the impact of establishing a dual-channel supply chain coordinating contract when the supply chain agents are risk aversion under a mean-variance model. They present an analytical framework for marking price decisions in a centralized and a decentralized dual-channel supply chain with risk-averse, and analyze the impact of risk tolerance on the manufacturer and retailer's pricing decisions. The results show that the price set by a risk-averse dual-channel supply chain is lower than the one set by a risk-neutral dual-channel supply chain. Furthermore, compared with a centralized system, the vertical and horizontal competition in a decentralized system tends to result in channel inefficiency. To achieve channel coordination, the two-way revenue sharing contract is proposed that demonstrates the coordination of the dual-channel supply chain with risk-averse, and then it is analyzed how the risk attitude changes the parameters of the coordinating contract.

3.2. Typology of Financial Supply Chain Cooperation Models

In the field of supply chain management cooperation and collaboration are linked through flows of goods, information and finance business partners (basic raw materials and components suppliers, manufacturers, distributors, transporters, banks and financial institutions, etc.) and are core concepts. Thus, in terms of paradigm shift from competition to cooperation supply chains are often viewed as a networks of integrated companies (Mentzer et al., 2001). For an effective supply chain the management of upstream flow of money is as important as the management of downstream flow of goods (Gupta and Dutta, 2010). The problem of flow of goods in supply chains has been studied widely. But mainly the research on supply chain systems has focused on inventory cost, transportation cost and cost related to goods

procurement. However, there has been very little research work that focuses on the upstream and downstream flows of money (Kouvelis et al., 2006). Scholars only recently began to demonstrate in formal analytical models how planning, managing and controlling financial flows along supply chains positively affect supply chain profitability (Raghavan and Mishra, 2011). Even though the aforementioned studies provide an analytical framework to evaluate the financial impact of supply chain performance, they are based on implicit assumptions, such as joint decision-making, absenteeism of opportunism and perfect information sharing, which are rarely applicable. Considering the theoretical basis of the proposed research, there is a need of further step toward understanding the supply chain in terms of integration of financial, material and information flows (Mentzer et al., 2001, Wuttke et al., 2013).

According to Gupta and Dutta (2011) the research on flow of money in a supply chain has not yet attracted the attention of mainstream Operations Management scholars even though the problem is important and bears a great resemblance to flow of material. The money flow problem has primarily been studied as the problem of cash circulation, cash management and cash balance. Based on the available literature, the research work under the rubric of financial supply chains can be divided into the following three categories:

- Cash flow systems analogous to ERP systems.
- Models for cash management based on inventory concepts.
- Cross functions models integrating manufacturing and finance decisions.

Cash flow systems analogous to ERP systems. There is a plenty of literature on financial supply chains that has primarily focused on the use of technology in improving the cash flow process similar to that of ERP in a manufacturing environment. The main focus of these studies is on the improvement of actual business process interactions across multiple organizations in financial supply chain systems. Although, this approach of cash management may not be applicable in value-added-service operations where it is very difficult to pin point the exact return for each and every purchase and investment. In many cases such purchase and investment are made for strategic advantages, with no immediate clear-cut return. We believe that the flow of cash needs to be managed as an overall problem rather than trying to map which upstream flow results in which downstream flow and then make decisions. Such mapping approach may result in a non-optimal performance of the overall business in terms of cash situations of the company. The studies that deal with cash flow process or the C2C research do not develop a scheme for an optimal or near-optimal management of cash flow in financial supply chain system, as we have done in this paper. They do not optimize the payment schedule. These studies could be considered complimentary to the contribution of this paper because our paper specifies the optimal payment schedule whereas these studies focus on efficient processes.

Models for cash management based on inventory concepts. Another stream of research in cash management literature has borrowed concepts from inventory theory. In general, an organization maintains a portfolio of assets that include liquid cash, treasury bills, commercial papers, etc. The optimal cash policies for these organizations can be determined by minimizing costs of holding cash and various transaction costs to convert from one asset type to another. The mathematical models for cash balance primarily focus on balancing the cash in hand with the liquid asset like marketable securities based on firms needs for cash and predictability of such needs.

The cash balance problems addressed in this type of models are orthogonal to the problem of our research. The cash balance problems in these papers deal with internal cash management of an organization so that transaction cost is minimized or higher return can be found from these transactions. However, the problem we are studying focuses on management of external cash transactions such as cash received from downstream partners and cash payables to upstream partners.

Cross functions models integrating manufacturing and finance decisions. Some papers have emphasized that financial supply chain decisions should be integrated with advanced planning and scheduling decisions. These papers developed mixed integer linear programming based formulations for cash management in a chemical process industry. Cash management problem studied in these papers is based on maximizing the cash position by combining profit and the cost of making that profit. This approach may be applicable for manufacturing industries. However, in service industries such an approach may not be plausible. Our research bears some similarity to the approach presented in these papers. However, we address the problem of cash management to prioritize the payment schedule based on incoming revenue stream and pending invoices to be paid. The results of this study can be applied between any two levels of upstream and downstream partners, in both manufacturing and service industry in a supply chain.

The majority of the most recent research in financial supply chain management belongs to this stream of works. The outcome of the research by Blome, Paulraj and Schuetz (2014) is the analysis of the deviation from an optimal profile of supply chain collaboration and its detrimental effect on sustainability performance as well as market performance. The model obtained shows that the effects of alignment on performance measures are mediated by the firm's internal sustainable production. The research by Cao and Zhang (2011) inspects the nature of supply chain collaboration and explore its impact on firm performance based on a paradigm of collaborative advantage. As the result, valid model of these constructs was developed through empirical analysis which shows, that supply chain collaboration improves collaborative advantage and indeed has a bottom-line influence on firm performance, and collaborative advantage is an intermediate variable that enables supply chain partners to achieve synergies and create superior performance. A further analysis of the moderation effect of firm size reveals that collaborative advantage completely mediates the relationship between supply chain collaboration and firm performance for small firms while it partially mediates the relationship for medium and large firms. In their work Schoenherr and Swink (2012) cross-validate Frohlich and Westbrook's framework (Frohlich and Westbrook, 2001) utilizing multi-dimensional performance measures collected from supply chain managers. They also extend Frohlich and Westbrook's study by investigating the moderating role of internal integration on the relationships between arcs of integration and performance. In accordance with information processing theory, the results indicate that internal integration strengthens the positive impacts of external integration on both delivery and flexibility performance. The model obtained by Hadid and Afshin Mansouri (2014) lean constructs are identified and operationalized to establish their interrelation and impact on organizational performance. This paper synthesizes a comprehensive set of lean technical practices, lean supportive practices, inhibitors and expected outcome of lean service. Moreover, six influential contextual variables on the lean-performance relation are identified based on a review of the management accounting

literature, organizational strategy literature and diversification literature to overcome limitations of previous studies.

3.3. Gaps in Financial Supply Chain Cooperation Modeling

Different models of SCC have been proposed considering isolated activities or different functions of SC, nevertheless these models appear to be fragmented efforts.

A great deal has been written on centralized supply chain systems. When demand and lead time are deterministic, exact optimal coordination policies for many buyers are still difficult to characterize. However, power-of-two and integer-ratio policies provide a highly effective and practically useful framework to coordinate supply chain inventory activities. Nevertheless, similar coordination mechanisms have not been developed for a supply chain system when demand and lead time are stochastic. Although power-of-two and integer-ratio policies can also be applied, their applicability and effectiveness have not yet been fully established in this case. A future research area is then to develop optimal, or nearly-optimal but practically useful, inventory policies for supply chain systems with uncertain demand and/or lead time. For example, a suppliers (optimal) inventory policy when facing multiple heterogeneous buyers with uncertain demand and/or lead time is still an open issue.

With the recent advances in information technology, real time data exchange has become feasible and affordable. As a result, an equally important issue for SCC is to incorporate information into a coordination policy. The issue, however, is no longer whether information is useful, as this has been demonstrated by many previous studies. Rather, future research should focus on what information to be shared among supply chain members and how to use such information. Previous studies adopted different coordination policies and, as a result, obtained very different assessments for the benefits of information sharing. Apparently, this shows that optimal supply chain inventory policies depend on the information structure. When demand and stock information can be shared among all members in real time, neither the installation policy nor the echelon stock policy is optimal. Future research must then identify the desirable information structures and coordination policies under various supply chain structures.

In comparison to centralized supply chains, the literature on decentralized supply chain systems is less extensive. The coordination of decentralized supply chain systems is more difficult: facing the same challenge to optimize system performance and also requiring a scheme to reallocate the benefits of coordination so as to maintain the interest and participation of all independent supply chain members. When demand is deterministic, many incentive schemes have been studied. Among these incentive schemes, quantity discounts stand out to be the most widely employed mechanism to entice the cooperation of independent supply chain members. However, quantity discounts are usually not able to optimize system performance when there are heterogeneous buyers and/or multiple products. There is a need to develop more effective and practically useful incentive schemes. Furthermore, as an action plan to coordinate supply chain decisions and activities often lead to unbalanced cost burdens to different supply chain members, the incentive scheme and the coordination policy must be developed together as a single mechanism.

Finally, real research opportunities exist for the coordination of decentralized supply chain systems with stochastic demand and/or lead time. As compared to the above categories, the amount of literature in this area is severely unbalanced. Although a few previous studies have developed non-cooperative (Nash equilib-

rium) solutions, the coordination issue represents a real challenge. In view of the previous studies, a coordination mechanism for a decentralized supply chain system should include at least three components: 1. an operational plan to coordinate the decisions and activities of the supply chain members, 2. a structure to share information among the members, and 3. an incentive scheme to allocate the benefits of coordination so as to entice the cooperation of all members.

4. Conclusion

This literature review offers implications for both researchers and practitioners. For SCM research, this study makes contributions to existing knowledge by providing a state-of-the-art picture on the relationship between SCM and firm-level financial performance. On the one hand, effective SCM enhances both accounting- and market-based performance measures through the improvements in revenue growth, operating costs reduction, and working capital efficiency. On the other hand, disruptive SCM causes substantial financial losses in both short-term and long-term periods. The slow recovery from SC disruptions makes the firms even more vulnerable in this time-sensitive business environment.

Although, there is an emergent stream of literature which has highlighted the need to improve that kind of integration (Fairchild, 2005, Gupta and Dutta, 2011), these attempts are rather scant and fragmented. The review addresses a distinct gap in the operations and supply chain management literature by proposing that the improvement of supply chain performance and the optimisation of working capital along the supply chain requires a holistic understanding of the flow of physical and financial resources across supply networks.

This study pays particular attention to the problem, that over the past two decades the operations and supply chain management literature has focused primarily on the flows of physical goods and information, rather than financial supply chains (Fairchild, 2005; Gupta and Dutta, 2011). The financial supply chain, which runs parallel to the flow of goods and information, is common to all economic supply networks, and its integration with the physical supply chain is therefore a critical and ubiquitous aspect. It is shown, that the evolution of the research in the field of supply chain cooperation modeling has evolved from centralized cooperative models through decentralized coordination models to collaborative models. Moreover, the unit of modeling has become significantly more complex from unconnected supply chains to multi-echelone systems. From the authors point of view, the further step ahead, which is expected to be a fruitful avenue of thought, is development of models of collaborative supply chain networks, especially in the field of financial supply chain management.

References

Arshinder, Kanda, A., and Deshmukh, S. G. (2008). *Supply chain coordination: Perspectives, empirical studies and research directions.* International Journal of Production Economics, **115(2)**, 316–335. http://doi.org/10.1016/j.ijpe.2008.05.011

Barratt, M. (2004). *Understanding the meaning of collaboration in the supply chain.* Supply Chain Management: An International Journal, **9(1)**, 30–42. http://doi.org/10.1108/13598540410517566

Beamon, B. M. (1998). *Supply chain design and analysis: Models and methods.* International Journal of Production Economics, **55(3)**, 281–294. http://doi.org/10.1016/S0925-5273(98)00079-6

Blackman, I. D., Holland, C., and Westcott, T. (2013). *Motorolas global financial supply chain strategy.* Supply Chain Management: An International Journal, **18(2)**, 132–147. http://doi.org/10.1108/13598541311318782

Blome, C., Paulraj, A., and Schuetz, K. (2014). *Supply chain collaboration and sustainability: a profile deviation analysis.* International Journal of Operations and Production Management, **34(5)**, 639–663. http://doi.org/10.1108/IJOPM-11-2012-0515

Burgess, K., Singh, P., and Koroglu, R. (2006). *Supply chain management: a structured literature review and implications for future research.* International Journal of Operations and Production Management, **26(7)**, 703–729. http://doi.org/10.1108/01443570610672202

Cachon, G. P. G. P., and Lariviere, M. A. (2005). *Supply Chain Coordination with Revenue-Sharing Contracts: Strengths and Limitations.* Management Science, **51(1)**, 30–44. http://doi.org/10.1287/mnsc.1040.0215

Cao, M., and Zhang, Q. (2011). *Supply chain collaboration: Impact on collaborative advantage and firm performance.* Journal of Operations Management, **29(3)**, 163–180. http://doi.org/10.1016/j.jom.2010.12.008

Chatha, K. A., and Butt, I. (2015). *Themes of study in manufacturing strategy literature.* International Journal of Operations and Production Management, **35(4)**, 604–698. http://doi.org/10.1108/IJOPM-07-2013-0328

Coyle, J. J., Langley, J. C., Novack, R. A., and Gibson, B. J. (2013) *Supply Chain Management: A Logistics Perspective, Ninth Edition*, South-Western, Cengage Learning: Mason, USA

Eltantawy, R., Paulraj, A., Giunipero, L., Naslund, D., and Thute, A. A. (2015). *Towards supply chain coordination and productivity in a three echelon supply chain.* International Journal of Operations and Production Management, **35(6)**, 895–924. http://doi.org/10.1108/IJOPM-10-2013-0459 http://doi.org/10.1016/j.jom.2015.04.001

Fabbe-Costes, N., Roussat, C., Taylor, M., and Taylor, A. (2014). *Sustainable supply chains: a framework for environmental scanning practices.* International Journal of Operations and Production Management, **34(5)**, 664–694. http://doi.org/10.1108/IJOPM-10-2012-0446

Fairchild, A. (2005). *Intelligent matching: integrating efficiencies in the financial supply chain.* Supply Chain Management: An International Journal, **10(4)**, 244–248. http://doi.org/10.1108/13598540510612703

Fawcett, S. E., and Magnan, G. M. (2002). *The rhetoric and reality of supply chain integration.* International Journal of Physical Distribution and Logistics Management, **32(5)**, 339. http://doi.org/10.1108/09600030210436222

Flynn, B. B., Huo, B., and Zhao, X. (2010). *The impact of supply chain integration on performance: A contingency and configuration approach.* Journal of Operations Management, **28(1)**, 58–71. http://doi.org/10.1016/j.jom.2009.06.001

Frohlich, M. T., and Westbrook, R. (2001). *Arcs of integration: An international study of supply chain strategies.* Journal of Operations Management, **19(2)**, 185–200. http://doi.org/10.1016/S0272-6963(00)00055-3

Gunasekaran, A., Patel, C., and McGaughey, R. E. (2004). *A framework for supply chain performance measurement.* In International Journal of Production Economics, **87(3)**, 333–347. http://doi.org/10.1016/j.ijpe.2003.08.003

Gupta, S., and Dutta, K. (2011). *Modeling of financial supply chain.* European Journal of Operational Research, **211(1)**, 47–56. http://doi.org/10.1016/j.ejor.2010.11.005

Hadid, W., and Afshin Mansouri, S. (2014). *The lean-performance relationship in services: a theoretical model.* International Journal of Operations and Production Management, **34(6)**, 750–785. http://doi.org/10.1108/IJOPM-02-2013-0080

Hartley-Urquhart, R. (2006). *Managing the financial supply chain.* Supply CHAIN Management Review, **10(6)**. http://www.scmr.com/article/CA6376439.html

Hendricks, K. B., and Singhal, V. R. (2003). *The effect of supply chain glitches on shareholder wealth.* Journal of Operations Management, **21(5)**, 501–522. http://doi.org/10.1016/j.jom.2003.02.003

Hendricks, K. B., Singhal, V. R., and Stratman, J. K. (2007). *The impact of enterprise systems on corporate performance: A study of ERP, SCM, and CRM system implementations.* Journal of Operations Management, **25(1)**, 65–82. http://doi.org/10.1016/j.jom.2006.02.002

Hofmann, E. (2011). *Natural hedging as a risk prophylaxis and supplier financing instrument in automotive supply chains.* Supply Chain Management: An International Journal, **16(2)**, 128–141. http://doi.org/10.1108/13598541111115374

Johnson, M., and Templar, S. (2011). *The relationships between supply chain and firm performance: The development and testing of a unified proxy.* International Journal of Physical Distribution and Logistics Management, **41(2)**, 88–103. http://doi.org/10.1108/09600031111118512

Kim, S. W. (2009). *An investigation on the direct and indirect effect of supply chain integration on firm performance.* International Journal of Production Economics, **119(2)**, 328–346.

Kim, Y. H., and Henderson, D. (2015). *Financial benefits and risks of dependency in triadic supply chain relationships.* Journal of Operations Management, **36**, 115–129. http://doi.org/10.1016/j.jom.2015.04.001

Kouvelis, P., Chambers, C., and Wang, H. (2006). *Supply Chain Management Research and Production and Operations Management: Review, Trends, and Opportunities.* Production and Operations Management, **15(3)**, 449–469. http://doi.org/10.1111/j.1937-5956.2006.tb00257.x

Li, X., and Wang, Q. (2007). *Coordination mechanisms of supply chain systems.* European Journal of Operational Research, **179(1)**, 1–16. http://doi.org/10.1016/j.ejor.2006.06.023

Lambert, D. M., Cooper, M. C., and Pagh, J. D. (1998). *Supply Chain Management: Implementation Issues and Research Opportunities.* The International Journal of Logistics Management, **9(2)**, 1–20. http://doi.org/10.1108/09574099810805807

Li, X., Wu, Q., and Holsapple, C. W. (2015). *Best-value supply chains and firms competitive performance: empirical studies of their linkage.* International Journal of Operations and Production Management, **35(12)**, 1688–1709. http://doi.org/10.1108/IJOPM-01-2014-0014

Malone, T. W., and Crowston, K. (1994). *The Interdisciplinary Study of Coordination.* ACM Computing Surveys, **26(1)**, 87–119. http://doi.org/http://doi.acm.org/10.1145/174666.174668

Mentzer, J. J. T., Dewitt, W., Keebler, J. J. S., Min, S., Nix, N. W., Smith, C. D., and Zacharia, Z. G. (2001). *Defining supply chain management.* Journal of Business Logistics, **22(2)**, 1–25. http://doi.org/10.1002/j.2158-1592.2001.tb00001.x

Narayanan, S., Narasimhan, R., and Schoenherr, T. (2015). *Assessing the contingent effects of collaboration on agility performance in buyersupplier relationships.* Journal of Operations Management, **33-34**, 140–154. http://doi.org/10.1016/j.jom.2014.11.004

Okongwu, U., Brulhart, F., and Moncef, B. (2015). *Causal linkages between supply chain management practices and performance.* Journal of Manufacturing Technology Management, **26(5)**, 678–702. http://doi.org/10.1108/JMTM-01-2013-0002

Pezza, S. (2011). *Supply Chain Finance: gaining control in the face of uncertainty.* Aberdeen Group, (January), 1–23. http://doi.org/10.1080/13675560903555167

Prajogo, D., Oke, A., and Olhager, J. (2016). *Supply chain processes.* International Journal of Operations and Production Management, **36(2)**, 220–238. http://doi.org/10.1108/IJOPM-03-2014-0129

Rezapour, S., and Farahani, R. Z. (2010). *Strategic design of competing centralized supply chain networks for markets with deterministic demands.* Advances in Engineering Software, **41(5)**, 810–822. http://doi.org/10.1016/j.advengsoft.2010.01.001

Sabath, R. and Fontanella, J. (2002). *The unfulfilled promise of supply chain collaboration.* Supply Chain Management Review, **6)**, 24–29.

Sazvar, Z., Mirzapour Al-E-Hashem, S. M. J., Baboli, A., and Akbari Jokar, M. R. (2014). *A bi-objective stochastic programming model for a centralized green supply chain with deteriorating products.* International Journal of Production Economics, **150**, 140–154. http://doi.org/10.1016/j.ijpe.2013.12.023

Schoenherr, T., and Swink, M. (2012). *Revisiting the arcs of integration: Cross-validations and extensions.* Journal of Operations Management, **30(1-2)**, 99–115. http://doi.org/10.1016/j.jom.2011.09.001

Shi, M., and Yu, W. (2013). *Supply chain management and financial performance: literature review and future directions.* International Journal of Operations and Production Management, **33(10)**, 1283–1317. http://doi.org/10.1108/IJOPM-03-2012-0112

Silvestro, R., and Lustrato, P. (2014). *Integrating financial and physical supply chains: the role of banks in enabling supply chain integration.* International Journal of Operations and Production Management, **34(3)**, 298–324. http://doi.org/10.1108/IJOPM-04-2012-0131

Simatupang, T. M., and Sridharan, R. (2002). *The Collaborative Supply Chain.* The International Journal of Logistics Management, **13(1)**, 15–30. http://doi.org/10.1108/09574090210806333

Singhal, K., and Singhal, J. (2012). *Opportunities for developing the science of operations and supply-chain management.* Journal of Operations Management, **30(3)**, 245–252. http://doi.org/10.1016/j.jom.2011.11.002

Srinivasa Raghavan, N. R., and Mishra, V. K. (2011). *Short-term financing in a cash-constrained supply chain.* International Journal of Production Economics, **134(2)**, 407–412. http://doi.org/10.1016/j.ijpe.2009.11.014

Standard Definitions for Techniques of Supply Chain Finance (2016). *Global Supply Chain Financial Forum.*

Stevens, G., and Johnson, M. (2006). *Integrating the Supply Chain...25 Years On.* International Journal of Physical Distribution and Logistics Management, **46(1)**, 1–30. http://doi.org/http://dx.doi.org/10.1108/IJPDLM-07-2015-0175

Swink, M. L., Golecha, R., and Richardson, T. (2010). *Does Supply Chain Excellence Really Pay Off?* Supply Chain Management Review, **14**, 14.

Tsinopoulos, C., and Mena, C. (2015). *Supply chain integration configurations: process structure and product newness.* International Journal of Operations and Production Management, **35(10)**, 1437–1459. http://doi.org/10.1108/IJOPM-08-2013-0369

Vanpoucke, E., Vereecke, A., and Boyer, K. K. (2014). *Triggers and patterns of integration initiatives in successful buyer-supplier relationships.* Journal of Operations Management, **32(1-2)**, 15–33. http://doi.org/10.1016/j.jom.2013.11.002

Walker, H., Chicksand, D., Radnor, Z., and Watson, G. (2015). *Theoretical perspectives in operations management: an analysis of the literature.* International Journal of Operations and Production Management, **35(8)**, 1182–1206. http://doi.org/10.1108/IJOPM-02-2014-0089

Wang, Z., and Sarkis, J. (2013). *Investigating the relationship of sustainable supply chain management with corporate financial performance.* International Journal of Productivity and Performance Management, **62(8)**, 871–888. http://doi.org/10.1108/IJPPM-03-2013-0033

Weiss, J. B. (2011). *How to better manage your financial supply chain.* Cash Flow Management Best Practice, available at: www.qfinance.com/cash-flow-managementbest-practice/how-to-better-manage-your-financial-supply-chain.

Williamson, O. E. (1981). *The economics of organization: the transaction cost approach.* American Journal of Sociology, **87(3)**, 548–577, http://doi.org/10.1086/227496

Wong, C. W. Y., Wong, C. Y., and Boonitt, S. (2013). *The combined effects of internal and external supply chain integration on product innovation.* International Journal of Production Economics, **146(2)**, 566–574. http://doi.org/10.1016/j.ijpe.2013.08.004

Wuttke, D. A., Blome, C., and Henke, M. (2013). *Focusing the financial flow of supply chains: An empirical investigation of financial supply chain management.* International Journal of Production Economics, **145(2)**, 773–789. http://doi.org/10.1016/j.ijpe.2013.05.031

Xu, G., Dan, B., Zhang, X., and Liu, C. (2014). *Coordinating a dual-channel supply chain with risk-averse under a two-way revenue sharing contract.* International Journal of Production Economics, **147(PART A)**, 171–179. http://doi.org/10.1016/j.ijpe.2013.09.012