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Integrative Approach to Supply Chain Collaboration in Distribution Networks: Impact on Firm Performance*

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Abstract The study relies on previous research by Cao and Zhang (2011) and van Dijk (2016) and aims to provide theoretical insights and empirical findings on the impact of supply chain collaboration on the performance of firms and collaborative advantage as an intermediate variable in the context of the supply chain of a Russian distributor and its suppliers. The research is based on a case study of a large Russian distribution network, and it is considered to be explanatory and deductive, concerning the latent constructs in the conceptual supply chain framework. The obtained results indicate that supply chain collaboration improves collaborative advantage most significantly through decision synchronization, incentive alignment and information sharing, which in turn has a direct positive influence on operational and firm performance; moreover, a mediating effect of collaborative advantage on the relationship between supply chain collaboration and operational performance was established.

Keywords: supply chain collaboration, distribution networks, firm performance, collaborative advantage, dimensions of supply chain collaboration, structural equation model.

1. Introduction

The increasing number of organizations accessing new markets to seek higher efficiencies in sourcing and production have heightened the importance of supply chain management today. While there are many views held by scholars on how to define supply chain collaboration, some common features are evident. We advocate that collaboration involves multiple firms or autonomous business entities engaging in a relationship that aims to share improved outcomes and benefits. To achieve these improvements in performance, the business entities need to establish an appropriate level of trust; share critical information; make joint decisions; and, when necessary, integrate supply chain processes. Supply chain collaboration is often defined as two or more companies working together to create a competitive advantage and higher profits than can be achieved by acting alone (Simatupang and Sridharan, 2002). Olorunniwo and Li (2010) take a relational position arguing that collaboration can also be defined as a relationship between independent firms characterized by openness and trust where risks, rewards and costs are shared between parties.

Focusing more on the outcome of collaboration, Simatupang and Sridharan (2005) also use the term collaboration to describe "the close cooperation among autonomous business partners or units engaging in joint efforts to effectively meet

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end customer needs with lower costs". However, Singh and Power (2009) argue that cooperation is when firms exchange basic information and have some long-term relations with multiple suppliers or customers. Coordination occurs at a higher level where a continuous flow of critical and essential information takes place using information technology. Additionally, collaboration is higher than coordination, and, at this stage, a high level of commitment, trust and information sharing is required.

The widespread developments in supply chain technologies, tools and applications such as traceability systems, Quick Response, Efficient Consumer Response, Collaborative Planning, Forecasting and Replenishment and VMI have assumed firms will engage in a collaborative approach to the implementation and use of technologies (Lehoux et al., 2010; Deakins et al., 2008; Sari, 2008; Emberson and Storey, 2006; Derrouiche et al., 2008; Blackhurst et al., 2006). By taking this into consideration, Cao et al. (2010) argue that supply chain collaboration can be defined in different ways and could be either process focused or relationship focused. Notwithstanding, they derive a model for supply chain collaboration attributed to seven components (information sharing, goal congruence, decision synchronization, incentive alignment, resources sharing, collaborative communication and joint knowledge creation), which they term as mechanisms to reduce costs and risks (Soosay and Hyland, 2015). The study by Simatupang and Sridharan (2005) also proposes a model for the collaborative supply chain comprising five characteristics: collaborative performance system; information sharing; decision synchronization; incentive alignment; and integrated supply chain processes.

With the advent of new technology such as electronic commerce, the collaboration among multiple participants in the large-scale logistics distribution network has become much easier. Collaboration among multiple participants reduces logistics costs, increases profits for large-scale industrial companies, and can benefit the overall economy (Wang et al., 2017).

The research is constrained as following: the first part presents the theoretical framework. The second part provides the description of the research methodology, including the object of the study, data collection and sample descriptive statistics. It is followed then by results of correlation and regression analysis of depth and scope of collaboration, confirmatory factor analysis and the structural equation model of supply chain collaboration. The final part includes empirical findings and managerial implications of the obtained results.

2. Theoretical framework and hypotheses development

Supply chain collaboration is considered a major factor in maintaining a supply chain's competitive position and deemed an important research topic. It has received increased attention in the field of supply chain management with the number of articles published over the years. Supply chains, being inter-organizational and inter-functional, are known to be more effective with the coordinated and collaborative efforts among partners (Soosay and Hyland, 2015). This concept was first highlighted by Ellram and Cooper (1990) as a motivation for successful supply chain management.

Supply chain collaboration puts firms in a position of achieving better performance. To reach there, all participating members should make all necessary arrangements of collaborative practices, play according to rules, and follow all ethical principles to make things work well. Collaborative advantages, obtained through collaborative practices enable them to achieve the highest standards of excellence in customer services and processes and implement necessary improvements to match or exceed these standards (Simatupang and Sridharan, 2005). To achieve a high level of standard a company has to work hard and make all necessary improvements to get there. Collaboration has been referred to as the driving force behind effective SCM and may be the ultimate core capability (Min et al., 2005).

2.1. Supply Chain Collaboration Dimensions

Based on previous research by Cao and Zhang (2011) and Dijk (2016), this study used the following seven dimensions: information sharing, decision synchronization, incentive alignment, resource sharing, collaborative communication, joint knowledge creation and goal congruence. Our choice is based on the need to compare our results and the results of van Dijk (2016) obtained from the similar model. For better understanding, the role of each dimension for collaboration is discussed further.

Information sharing refers to the extent to which a firm shares relevant, accurate, complete, and confidential information duly with its supply chain partners (Cao and Zhang 2013). Previous research has identified that decision making and overall supply chain performance improve when information is shared between functions (Li et al., 2006; Simatupang and Sridharan, 2008). The information sharing is reported to improve supply chain agility and visibility. The ability to make better decisions and to take actions on the basis of greater visibility makes information sharing valuable to supply chain members. (Davenport et al., 2001). Core guidelines are that visibility should inform action, and that action becomes visible if supply chain members understand better the underlying principles that link integrated information and performance drivers. Information sharing generally facilitates decision synchronization through providing relevant, timely, accurate information required to take effective decisions about supply chain planning and execution. It enables participating supply chain members to make use of integrated information to help fulfill demand more quickly with shorter order cycle time (Fisher, 1997). According to Hall and Saygin (2012), the simple act of transferring data between functions will not improve supply chain performance unless the information is accompanied by more robust requirements for collaboration/cooperation.

Decision synchronization is the extent to which supply chain members are able to coordinate key decisions in planning and execution for optimizing supply chain profitability (Simatupang et al., 2002). The fact that supply chain partners have different decision rights and expertise about supply chain operations determines the importance of decision synchronization (Simatupang and Sridharan, 2005). The information availability needs to be fully synchronized with the decision making. Wadhwa and Rao (2003) indicated that improved decision knowledge can have a significant impact on supply chain performance. Decision synchronization provides feedback to supply chain performance on how performance metrics guide supply chain members to make effective decisions. It aids and enhances information sharing to identify what kind of information should be collected and transferred to the decision makers. Decision synchronization provides justification for incentive alignment to construct appropriate incentive schemes, because different supply chain members are responsible for different levels of decision making. Finally, decision synchronization helps supply chain members to carry out productive actions associated with integrated supply chain processes such as transportation, customer service and replenishment (Simatupang and Sridharan, 2005).

Incentive alignment can be defined as the process of sharing costs, risks, and benefits amongst the supply chain members (Simatupang and Sridharan, 2002). A successful supply chain partnership requires that all gains and losses should be distributed fairly across the supply chain and the collaboration outcome should be beneficial to all supply chain members (Manthou et al., 2004). Thus, incentive alignment motivates supply chain members to act consistently with their mutual strategic objectives, including making decisions that are optimal for the whole supply chain and providing truthful private information (Simatupang and Sridharan, 2008). Narayanan and Ananth Raman (2004) associate incentive alignment with the performance of the overall supply chain. If the supply chain members lack incentive alignment, their actions will not optimize the performance of the network, resulting in excess inventory, stock-outs, incorrect forecasts, inadequate sales efforts, and poor customer service. If supply chain members align their actions to the mutual purpose of collaboration, that will also enhance their individual profitability. It links performance scoreboards from supply chain performance to incentive. The more transparent the linkages between performance and incentives, the more effectively the given incentives are able to motivate the desired and required behavior. In conjunction with decision synchronization, incentive alignment provides incentives to motivate supply chain members to make effective decisions that reinforce the desired level of performance.

Resource sharing is the process of leveraging capabilities and assets and investing in them with supply chain members (Cao and Zhang 2013). Along with information sharing, resource sharing has been widely referred to as a key determinant of effective coordination (Arshinder et al., 2008; Huiskonen and Pirttil, 2002; Stank et al., 1999). Resource sharing among supply chain partners varies from tangible elements such as sharing of warehouses, machineries and logistical services to intangible elements such as information sharing and reputations (Ramanathan and Gunasekaran, 2014). Resource sharing is a critical part of many collaborative relationships (Ireland and Crum, 2005). Supply chain partners can develop critical resources that extend firm boundaries and that may be incorporated in interfirm activities and processes. These resources allow the collaborating firms to gain higher returns and sustainable competitive advantage (Dyer and Singh 1998).

Communication is a critical task for each function within a supply chain. The more intensely and frequently the communication takes place across the supply chain, the more comprehensible organizational goals and objectives become, which may increase the overall level of coordination across supply chain functions (Wagner and Buko, 2005). To optimize coordination within a supply chain, the objectives of the organization as a whole must be clear and accessible to all functions (Hugos, 2011). A lack of coordination may take place when necessary information is not available for decision-making and when functions operate without the guide of system-wide objectives (Sahin & Robinson, 2005). However, supply chain management is facilitated by clearly defined reporting structures and easily accessible information networks; hence, individual supply chain functions should be focused on high-level organizational interests to enable the alignment of the supply chain as a whole. Computing and communication technologies have played and will continue to play, an important role in improving design communication (Demirkan, 2005). New technologies have been applied in order to enhance distributed organizational interactions and achieve good coordination and communication between distributed project teams (Perry and Sanderson, 1998; Wikforss and Lofgren, 2007). Collaborative communication can increase the degree of the interaction and technical collaboration between different partners, making it easier to remove uncertainty and confusion in the early design stage, which cannot be replaced completely by partnering procurement. Collaborative communication has a positive impact on timeliness, understanding, and accuracy.

According to Malhotra et al. (2005), joint knowledge creation can be described as the degree to which supply chain partners develop a better understanding of and response to the market and competitive environment by working together. Essentially, joint knowledge creation is one of the most important objectives of collaboration (Hardy et al,. 2003; Gomes and Dahab, 2010; Cheung et al., 2011). Supply chain collaboration encourages collective learning for improving supply chain performance, which in turn provides benefits to all partners (Simatupang and Sridharan, 2004). Joint knowledge creation, as well as its distribution and shared interpretation allow firms in the supply chain to create new values such as developing new products, building brand image, responding to customers' needs, and establishing channel relationships (Johnson and Sohi, 2003; Luo et al., 2006; Kaufman et al., 2000). New product development in a high-tech environment requires the merging and integration of different technologies to network strategic communities inside and outside the company in order to share and transfer and thus create knowledge. Knowledge creation acquires expertise from outside the company. In order to create new knowledge, supply chain partners are engaging in interlinked processes that enable rich information sharing, and building information technology infrastructures that allow them to process information obtained from their partners (Malhotra et al., 2005).

Goal congruence is the extent to which supply chain partners perceive their own objectives to be satisfied by the accomplishment of the supply chain objectives. It is recognized as one of the key elements in the collaborative relationship between supply chain partners (Jap, 2001; Naude and Buttle, 2001). Alignment of goals leads to shared inter-organizational interests and thus assists the collaboration. One of the benefits it provides is the reduction of incentives for opportunism (Lejeune and Yakova, 2005). Congruent goals direct buyers and suppliers in the supply chain towards cooperative behaviours, such as constructive communication, mutual support and adaptation, and high commitment (Jap and Anderson, 2003). As a result, goal congruence facilitates synergy in the supply chain and efficient use of resources (Littler et al. 1995). Engaging in networks and supply chain alliances is a means for involved partners to achieve goals that they could not attain independently (Mohr and Spekman, 1994), the partners also bring their own organizational- and individual-level goals of improving their performance to the process (Schreiner et al., 2009). Goal congruence is a necessary requirement to clear understand and achieve supply chain members' goals and objectives as independent actors of alliance and as a part of the supply network as a whole.

In our research, we expected to ascertain a direct connection between supply chain collaboration dimensions and operational and firm performance. The aim of study is to estimate the level of impact of collaboration dimensions on operational and firm performance, which are the key indicators measuring supply chain performance.

2.2. Operational and Firm Performance

The existence of different perspectives blurs the decision regarding what it is (or not) significant to measure in a supply chain, thus a growing, yet important, number of performance measures has been suggested in the literature. At the end of the 1990s, most of the measures suggested in the area of supply chain management were focusing on the performance of the logistics and distribution networks. Undoubtedly, measures related to the inventory cost or lead time are important, but provide limited and inadequate view when the level of discussion refers to complex supply chain settings (Mehrjerdi, 2009). According to Van Hoek (1998), the scope of performance measurement in a supply chain needs to be holistic. A similar suggestion is also provided by other scholars, who agree that an integrated approach needs to be adopted when measuring performance in a supply chain (Bititci et al., 2000; Lambert and Pohlen, 2001). Beamon (1999) claimed that appropriate measures in supply chain management fall into three categories, namely resources, output and flexibility. Gunasekaran et al. (2001) argue that performance measures should be identified into different levels according to the decision-making process, thus the suggested measures are strategic, tactical and operational. De Toni and Tonchia (2001) suggested that financial and non-financial measures should be considered. In a synthetic and important study, Gunasekaran and Kobu (2007) reviewed the pertinent literature and a number of cases. They identified 46 different performance measures, addressing the performance of a supply chain. They remarked that almost 50 percent of the suggested performance measures are related to internal business processes (internal view) of a supply chain and the remaining 50 percent refer to the customer (external view) of the supply chain. Making the choice between the internal and the external view of a supply chain is also associated to finding the right balance between operational efficiency and customer responsiveness (Fisher, 1997). Other research efforts adopt a specific performance measurement framework (e.g. balanced scorecard) and suggest other sets of measures.

In this study, the term performance is considered as firm performance that includes such measures as sales growth, satisfaction with collaboration, market share growth, ROI, and consumer satisfaction, and operational performance. Operational performance refers to the ability of a company to reduce management costs, order-time, lead-time, improve the effectiveness of using raw materials and distribution capacity (Heizer et al., 2008). It has an important meaning to firms: it helps to improve effectiveness of production activities and to create high-quality products (Kaynak, 2003), leading to increased revenue and profit for companies (Truong et al., 2015). For the purpose of the study, operational performance addresses such parameters as on-time delivery to consumer, order fulfillment lead-time, total logistics costs, inventory turn and stock-outs.

2.3. Collaborative Advantages

Several studies in SCM have attempted to identify empirical evidence of the role of SCC on collaborative advantage (Cao and Zhang, 2011; Kanter, 1994) and performance (Nyaga et al., 2010; Ramanathan and Gunasekaran, 2014; Sheu, Yen, and Chae, 2006; Yu et al., 2013; Zacharia, Nix, and Lusch, 2011).

It has been well known that competitive advantage determines firms' profits and performance; however, since recently, the increasing competition has compelled companies to start changing their strategies in order to create joint competitive advantage with their partners (Lavie, 2006). Collaborative advantage is a relational view of inter-organisational competitive advantage (Dyer and Singh, 1998). In contrast to competitive advantage, which focuses only on the firm's own profit, collaborative advantage seeks to maximise a common profit for joint rent-seeking activities (Lavie, 2006). Collaborative advantage cannot be achieved by any firm alone, rather it can be acquired when different firms pursue collaborative action for synergistic outcomes (Vangen and Huxham, 2003).

One of the primary business strategies to improve supply chain performance is well-integrated supply chain. Real-time information exchange with suppliers in the upstream and with customers in the downstream will create an opportunity where optimization can take place. Linkage, which helps reduce lead-times, will undoubtedly reduce the adverse effect (i.e. bullwhip effects) and contribute to enhancing performance. Theoretically, it has been well-known that supply chain integration creates strategic advantages.

In previous research, it has been asserted that collaborative advantage is a way of improving performance (Sheu, Yen, and Chae, 2006; Yu et al., 2013). Jap (2001) discovered that joint competitive advantage has a positive influence on economic outcomes.

Collaboration is intended to generate customer value by producing mutual advantages among suppliers, manufacturers, and distributors with respect to the supply of low-cost, high-quality products and services. Many of the problems that manufacturing firms face, such as parts shortages, delivery issues, quality problems, and cost increases, are rooted in the lack of effective supply chain integration (Kim, 2009). Supply chain collaboration makes use of shared resources and knowledge (both internal and external to an organization) optimal to achieve operating synergy and efficiencies, reduce costs, and enhance profits (Stock et al., 2010). It also allows firms to take advantage of different specialized capabilities through intensive coordination, which allows for the accumulation of economies of scale in production, purchasing, logistics, and problem solving. Supply chain collaboration systematically synchronizes the resources and capabilities of every supply chain participant to enhance service performance, lower total costs, develop innovation etc. All of this allows to predict a direct connection between dimensions of collaboration and collaborative advantages. Moreover, the links between CA and firm performance and operational performance are also expected to be significant. Hence, collaborative advantage has a mediating role and enhances the effect of supply chain collaboration dimensions on firm performance and operational performance. The level of impact of dimensions on collaborative advantages and firm performance and operational performance will be estimated further.

2.4. Distribution Supply Network Structure

Supply chain collaboration helps small and medium-sized companies to reduce costs, while increasing operational efficiency. Despite these benefits, supply chain collaboration encounters many challenges including partner search and selection. A key driver of the overall profitability of a firm is distribution because it directly impacts both the supply chain costs and the customer experience. Distribution refers to the steps taken to move and store products from the supplier stage to a customer stage in the supply chain. Good distribution can be used to achieve a variety of supply chain objectives ranging from low cost to high responsiveness. As a result, companies in the same industry often select different distribution networks with similar and comparable structure.

Most distribution networks have a network supply chain structure. The network structure is a complex supply chain with a combination of divergent and convergent structures. It is one of the possible supply chain structures like serial, dyadic, divergent, convergent, and network. The serial structure is the typical structure studied in the literature in which supplier, manufacturer, distributor and retailer are considered. This structure is in fact obtained by cascading several dyadic structures. The dyadic structure consists of two business entities. A divergent structure is used to represent a more realistic supply chain in which one entity (e.g. supplier) distributes stock to several downstream entities. In a convergent structure, several entities (e.g. several suppliers) deliver components to a single manufacturer or to a distribution center (Montoya-Torres and Ortiz-Vargas, 2014). An example of the network supply chain structure is depicted on Figure 1.

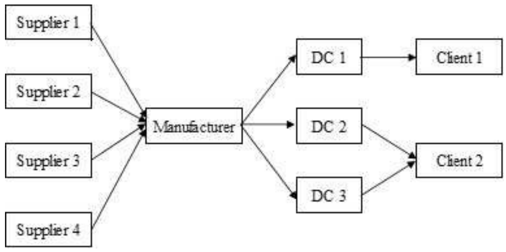


Fig. 1. Example of network supply chain structure. Source: Montoya-Torres and Ortiz-Vargas (2014)

Many papers on distribution networks focus mainly on classifying the mathematical models. For example, Vidal and Goetschalckx (1997) reviewed the mixed-integer programming models for strategic production-distribution network design and identified the main features of those models (e.g. assumptions, objective functions, and affecting factors). Beamon (1998) provided a focused review of mathematical modeling approaches, and four types of models were identified based on the nature of the inputs and the objectives. In addition, the number of articles considered in these previous reviews was limited. As an example, Bilgen and Ozkarahan (2004) reviewed optimization models for production distribution network design based on 35 published articles only. Meixell and Gargeya (2005) identified the decisions, objectives, level of integration from production sites to end customers, and globalization variables by reviewing no more than 18 research articles (Mangiaracina et al., 2014). This review considered the literature related to the distribution network design: first, in the downstream supply chain (i.e. from manufacturing plants to customers, as shown in Figure 2) and second, affected by the flow from up to downstream (and not by reverse flows). Reverse logistics, in fact, often requires specific facilities, such as collection centers (where customers bring the products) and/or recovery/manufacturing facilities (where returned products are refurbished/remanufactured) (Melo et al., 2009). Figure 2 presents an example of a distribution network, which is the most relevant for this research.

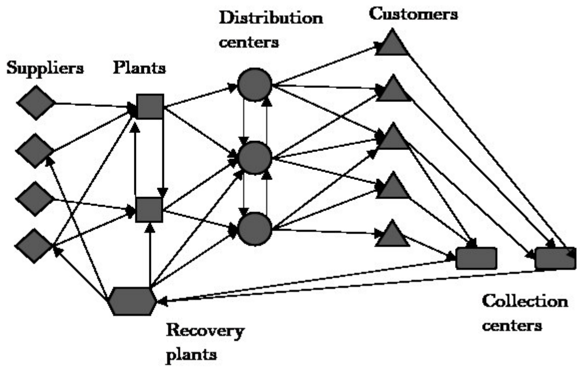


Fig. 2. Example of distribution network structure. Source: Mangiaracina, Song and Perego (2015)

In our case the part of the network structure that consists of relationships between suppliers and a distributor, is considered. An important feature of this structure is the existence of decision-making firm related to the distributor organization, which, in fact, has a role of a 3PL operator in terms of supply chain management.

In this paper, we focus on the SCN design of a two-echelon supply chain, that involves more than 600 suppliers and 8 distribution centers located in different regions of Russia, and a distribution decision-making center (headquarter of distribution firm – focal firm). The reason for the limitation of our research by the two-echelon supply chain is the focus on the upstream relationships between suppliers (manufacturers mostly) and distributor.

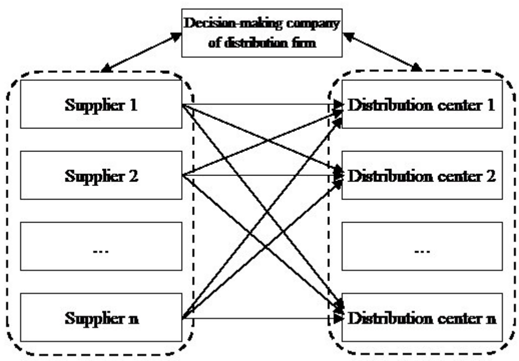


Fig. 3. Considered part of supply chain distribution network. Source: partially adapted from Montoya-Torres and Ortiz-Vargas (2014)

Figure 3 depicts a part of distribution network structure with decision-making center. The material flow is directed from suppliers to distribution centers as depicted in Figure 1. The information flow is directed from DCs to DMC and from DMC to suppliers and then back. Thus, each link starting from a manufacturer, passing through a distribution center, and ending at a retailer can be regarded as a potential transportation route. The majority of decisions related to the development strategy, contract system, location of distribution centers, building and equipment of warehouses, information integrated processes and other belong to the managing company, while operational management is related to the regional departments (distribution centers).

2.5. Hypotheses Development

From the theoretical background, we have derived principal constructs of the supply chain collaboration that were used in our theoretical, measurement and structural models. They include supply chain collaboration dimensions (SCCD), collaborative advantage (CA), operational performance (OP), and firm performance (FP). To address the research issues, seven basic and important elements of collaboration and its underlying structure were identified with the help of the existing related literature (Cao and Zhang, 2011; van Dijk, 2016). Thus, the construct SCCD included 7 variables, namely: information sharing, decision synchronization, incentive alignment, resource sharing, collaborative communication, joint knowledge creation and goal congruence. The latent construct CA consisted of 4 items: offering flexibility, process efficiency, innovation and business synergy. To recap, the measurements for the latent construct OP were developed in the theoretical review and included 5 items: on-time delivery to consumer, order fulfillment lead-time, total logistics costs, inventory turn and stock-outs. Finally, for the latent construct FP 5 measures were adopted from theoretical background, namely: sales growth, satisfaction with collaboration, market share growth, ROI, and consumer satisfaction.

Relation-based view provides us theoretical support to our model because we focused on:

- how dimensions of supply chain collaboration impact collaborative advantage and firm and operational performance;

– how collaborative advantage impact firm and operational performance.

The developed conceptual supply chain collaboration framework suggests that supply chain members need to embrace supply chain collaboration dimensions and to conduct and perform the dimensions of supply chain properly. If a firm accomplishes to do so, the properly executed supply chain collaboration dimensions will lead to efficient and effective collaborative advantages, which in turn will have positive direct impact on operational performance and firm performance.

According to Cao and Zhang (2011), by collaborating, supply chain partners can work as if they were a part of a single enterprise. They can access and leverage each other's resources and enjoy their associated benefits. Such collaboration can increase collaborative advantage and enhance firm performance and operational performance. Thus, we can formulate the following hypotheses.

Supply chain collaboration dimensions:

H1a: Supply chain collaboration dimensions have a significant positive direct effect on operational performance;

H1b: Supply chain collaboration dimensions have a significant positive direct effect on firm performance;

H1c: Supply chain collaboration dimensions positively impact collaborative advantage at a significant level.

Collaborative advantage:

H2a: Collaborative advantage has a direct significant impact on operational performance;

H2b: Collaborative advantage has a direct positive significant influence on firm performance;

H2c: Collaborative advantage positively mediates the positive relationship between supply chain collaboration dimensions and operational performance;

H2d: Collaborative advantage positively mediates the positive relationship between supply chain collaboration dimensions and firm performance.

Operational performance:

H3: Operational performance has a direct positive significant impact on firm performance.

Compared to van Dijk (2016), we excluded cross-border business barriers and collaboration barriers from our research. In fact, all considered companies operate on Russian markets and cross-border barriers do not exist. Moreover, contemporary political environment encourages Russian companies to cooperate, thus collaborative barriers between them have been decreasing for the past three years. Most manufacturers were forced to increase their sales volumes in domestic markets, establishing closer relationships with distributors operating in domestic markets. Figure 4 depicts the conceptual supply chain collaboration hypotheses framework used in this research.

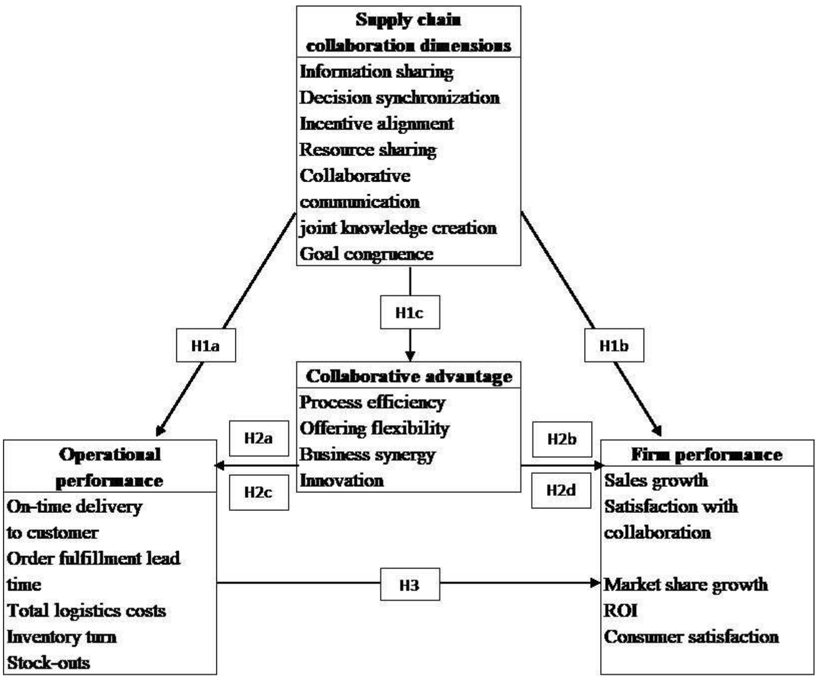


Fig. 4. Conceptual supply chain collaboration hypotheses framework. Source: partially adapted from Cao and Zhang (2011) and van Dijk (2016)

3. Research design

In order to test the conceptual supply chain collaboration framework, the two-step approach was used for assessing the Structural Equation Modelling (SEM) (Anderson and Gerbig, 1988). Analyzing research data and interpreting results can be complex and confusing. Traditional statistical approaches to data analysis specify default models, assume measurement occurs without error, and are somewhat inflexible. However, structural equation modeling requires specification of a model based on theory and research, it is a multivariate technique incorporating measured variables and latent constructs, and explicitly specifies measurement error. A model (diagram) allows for specification of relationships between variables. Moreover, a two-step approach has a number of comparative strengths that allow meaningful inferences to be made. First, it allows tests of the significance for all pattern coefficients. Then, the two-step approach allows an assessment of whether any structural model would give an acceptable fit. Third, one can make an asymptotically independent test of the substantive or theoretical model of interest. Hence, the suitability of the formulated conceptual model in this research paper was tested before the eventual structural path relationships in the conceptual supply chain framework were examined to test the hypotheses.

3.1. Object of the Study.

The subject of this study is supply chain collaboration in a distribution network, where the focal firm is one of the largest participants in the market. Therefore, the object of the study is the relationship between the focal firm (distributor) and its suppliers, manufacturers. The focal firm is represented by a large-sized distribution company operating in Russia for more than 25 years. The market share of the distributor was estimated at 17-20% at the end of 2015. The company is presented in more than 150 cities in different regions of Russia from the North-West to the Far East. As a major player in the market, the company has its own intra-organizational supply chain network including 8 distribution centers with full category A warehouses. All warehouses are equipped by warehouse management systems (WMS). There are more than 60 sales departments with full category B warehouses. The number of employees is more nearly six thousand. The number of suppliers having a valid contract is 632 by the end of 2016. Among suppliers, there are more than 400 manufacturers. The main suppliers of the company are manufacturers representing electrical industry divided into six parts, namely: Cable production; Industrial electrical equipment; Lighting products; Installation electrical equipment; Safety systems and Fasteners and Plumbing, the latter being a new direction of development of the focal company. Among the suppliers, there are such global giants as Philips, ABB, Schneider Electric, Siemens and others. Most cable production manufacturers are represented by Russian companies, which is also associated with the fact that the level of foreign trade activity has been decreasing for the last several years.

3.2. Data collection

To validate our research model with the data, we adopted a survey questionnaire with measurement items derived from the previous research (van Dijk, 2016; Cao and Zhang, 2011). The setting of this study views SCC as internally and externally focused functional areas. So, the study categorizes both planning and sharing as market and operations-oriented activities. To execute this perspective, relevant literature was reviewed and then relevant items for relevant constructs were obtained. The items were then discussed by experts (operations, marketing, collaborative communications and information sharing) and practitioners. Such procedures intended to ensure face validity and content validity. We followed van Dijk (2016) in the survey development, using a five-point Likert scale where 1 and 5 were "strongly disagree" and "strongly agree", respectively. The survey incorporated multiple items for each of the constructs. Most of these items were developed or adopted from available SCC or SCM literature.

The instrument included 19 questions that evaluated the impact of supply chain collaboration constructs and their indicators on performance of suppliers involved in the distribution network. The first four questions were demographic in nature and evaluated the organization profile. Questions 5 to 10 deal with the data on the collaborative relationships that suppliers have with their distributor. The third section of the questionnaire (questions 11 to 17) examined the SCC development and its impact on organizational performance, including three open questions asking respondents to share their views on the potential areas of improvement in collaboration. Questions 18-19 in the final section aimed at investigating the SCC barriers and impediments that foreign suppliers face, however, due to aforementioned reasons, these indicators were excluded from the research. The questionnaire was prepared in Russian and English versions. The Russian version was sent out to the respondents and the English version was used in the research for the purpose of language uniformity.

The survey aimed to measure the level of practice of various construct items and targeted a single industry to ensure deep understanding. The questionnaire was initially subjected to review by researchers and practitioners in the area of supply chain management. After the instrument was approved, the primary data were collected using the service Google Forms. The survey link was mailed via email to 632 small, medium and large sized suppliers of the distribution network described above. Respondents were asked to fill in the questionnaire, if they had SCC experience. This limitation is allowed when the subject under study is not a usual practice, and the purpose is to get as many responses as possible.

Contacts were obtained from the distributor, and emailing was organized through the decision-making distributor company. It provides direct connection with distributor's business partners. Survey descriptions/extra information, motivations for respondents and the request to forward the email to another person who has more experience in SCC were highlighted. With a response time of five weeks, a total of 65 online responses were received of which 4 had excessive missing values, yielding 61 (9.7 per cent) usable responses. As the subject under study is not a usual practice, the response rate is considered acceptable and is also consistent with similar other studies (Cao and Zhang, 2011; van Dijk, 2016). The summary of the respondents who participated in the survey is shown in Table 1. Among large companies that participated in the survey there are firms related to six different industries, most of them are manufacturers.

Table 1. Distribution of the respondents in different industries

Industry	**Number of companies**	**50-100**	**101-250**	**251-500**	**501-1000**	**More than 1000**
Cable production	6	-	3	1	1	1
Industrial electrical equipment	17	10	2	2	1	2
Lighting products	1	-	1	-	-	-
Installation electrical equipment	17	7	1	6	1	2
Fasteners and plumbing	5	-	2	2	1	-
Safety systems	15	10	2	1	-	2

3.3. Sample descriptive statistics

The descriptive statistics of the sample is provided to assess the overall profile of the respondent group and get better understanding of the supply chain considered in this research. For the purpose of the study, IBM SPSS Statistics 24 software was used to calculate descriptive statistics.

Almost all firms in the sample operate in the Russian Federation (98.4%), only one firm operates in Italy. The reason for such situation is increasing prices for imported products, reduction of foreign trade activity and, thus, the offset of supplier selection priorities in the Russian market.

The majority of respondents are concentrated in three industries: Industrial electrical equipment (27.87%), Installation electrical equipment (27.87%), and Safety systems (24.59%). The results of the distribution of respondents by industry composition in both frequencies and percentages are presented in table 2.

Table 2. Descriptive statistics by industry composition

Industry description	**N**	**(%)**
Cable production	6	9.84%
Fasteners and plumbing	5	8.20%
Industrial electrical equipment	17	27.87%
Installation electrical equipment	17	27.87%
Lighting products	1	1.64%
Safety systems	15	24.59%

Of all respondents, 27 (44.3%) reported that their firm has between 50-100 full-time employees (FTEs), 11 (18%) respondents declared to have 101-250 FTEs. Slightly more, 12 (19.7%) respondents stated that they have 251-500 FTEs. A smaller number of respondents reported to have 501-1000 and more than 1000 FTEs, 4 (6.6%) and 7 (11.5%), correspondently. Thus, we can conclude that the majority of respondents represent small and medium enterprises.

The majority of respondents, 36 (59.0%) have long-term relationships with their distributor, that is, for more than 5 years, 21 (34.4%) respondents have reported to have a relationship with their distributor for 1-5 years, and only 4 respondents indicated that the relationship with their distributor has been lasting for less than one year, this group of respondents related to Fasteners and Plumbing industry, which represent a new direction of development of the focal company.

As for the type of relationship strategy in the supply chain, most of the respondents (86.9%) stated to maintain cooperative relationship with their distributor. The distribution of respondent firms according to the relationship strategy with their distributor is presented in table 3.

Table 3. Type of supply chain relationship strategy

Type of supply chain relationship strategy	N	(%)
Cooperative	53	86.9%
Competitive	6	9.8%
Command	2	3.3%

The long-term relationship between partners facilitate a high level of cooperation and, therefore, lead to the cooperative type of supply chain strategy. Another reason why most respondents reported the cooperative type of supply chain strategy is that all of them are partners of the single distributor and, hence, perceive the relationship within the network as a priori cooperative, rather than competitive or command. To support this, the cross-table of type of supply chain relationship strategy and relationship length is provided below.

Table 4. Cross-table of type of supply chain relationship strategy and relationship length

Strategy/length	<1 year	1-5 years	More than 5 years
Cooperative	3 (4.9%)	18 (29.5%)	32 (52.5%)
Competitive	1 (1.6%)	2 (3.3%)	3 (4.9%)
Command	0 (0.0%)	1 (1.6%)	1 (1.6%)

4. Analysis of Modeling Results

4.1. Correlation and Regression Analysis of Depth and Scope of Collaboration

Following van Dijk (2016), the depth and scope of collaboration were assessed by means of the construct collaboration areas. While the scope of collaboration is measured by the number of business processes and activities in collaboration, the depth of collaboration represents the level and degree of integration of processes in collaboration, and it increases with the volume and frequency of material and information exchanges and the employed coordination mechanisms (Skjoett-Larsen et al., 2003). For the purpose of the study, IBM SPSS Statistics 24 and IBM SPSS Amos 24 were used to conduct data analysis.

In our research, we asked the respondents to evaluate the extent of collaboration in several areas, the results are presented in table 5.

Table 5. Collaboration areas

Collaboration area	**Min**	**Max**	**Mean**	**SD**
Production	1	5	1.85 (Little involvement)	1.263
Inventory management	1	5	2.95 (Some involvement)	1.371
Distribution	1	5	2.90 (Some involvement)	1.411
R&D	1	5	1.48 (No involvement)	0.942
Supply chain design	1	5	2.69 (Some involvement)	1.444
Product development	1	5	1.69 (Little involvement)	1.148
Promotion	1	5	4.02 (Great involvement)	1.008

The means of involvement in most collaboration areas were lower than the scales mid-point (3). Thus, we can conclude that the respondents perceived a low level and degree of collaboration in most collaboration areas. The only collaboration area which had a larger mean (4.02) than the mid-point (3) was promotion. Hence, the respondents perceive to have the highest level of collaboration with their distributor in the area of promotion. The lowest level of collaboration was assigned by the respondents to the area of R&D with the mean value of 1.48. It is followed then by product development and production areas with means of 1.69 and 1.85 respectively. A higher degree of collaboration is perceived to be in the areas of supply chain design, distribution and inventory management, which all have means close to the mid-point (3).

The correlations between collaboration areas and operational and firm performance indicators were calculated to examine the relationship between these independent and dependent variables. The results of the Pearson correlation are presented in table 6.

Table 6. Correlation between collaboration areas and firm performance and operational performance indicators

Dependent/ Independent	**Production**	**Inventory Management**	**Distribution**	**R&D**	**Supply Chain Design**	**Product Development**	**Promotion**
Sales growth	.138	.215	.279*	.104	.128	.182	.210
Satisfaction with collaboration	.181	.324**	.334**	.268*	.095	.302*	.228
Market share growth	.038	.270*	.213	.002	.016	.116	.144
ROI	.025	.245	.200	.179	.126	.120	.140
Consumer satisfaction	.200	.319**	.370**	.232	.178	.334**	.272*
On-time delivery to consumer	.377**	.200	.354**	.199	.246	.353**	.295*
Order fulfillment lead time	.427**	.292*	.446**	.326*	.287*	.436**	.235
Total logistics costs	.009	.154	.197	.035	.165	-.010	.033
Inventory turn	.303*	.417**	.410**	.143	.261*	.240	.065
Stock-outs	.190	.247	.205	.133	.247	.050	.156

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Statistically significant correlations were observed in all collaboration areas and were found to be positive. Collaboration in production resulted in moderate significant correlation with on-time delivery to consumer (.377**), order fulfillment lead time (.427**) and inventory turn (.303*). Collaboration in inventory management led to moderate significant correlation with satisfaction with collaboration (.324**), consumer satisfaction (.319**), and inventory turn (.417**), and showed weak correlation with market share growth (.270*) and order fulfillment lead time (.292*). Next, collaboration in distribution had moderate significant correlation with satisfaction with collaboration (.334**), consumer satisfaction (.370**), on-time delivery to consumer (.354**), order fulfillment lead time (.446**) and inventory turn (.410**), weak significant correlation with sales growth (.279*). Besides that, collaboration in R&D led to weak significant correlation with satisfaction with collaboration (.268*) and order fulfillment lead time (.326*). Collaboration in supply chain design showed weak significant correlation with order fulfillment lead time (.287*) and inventory turn (.261*). Also, collaboration in product development resulted in moderate significant correlation with consumer satisfaction (.334**), on-time delivery to consumer (.353**) and order fulfillment lead time (.436**) and weak significant correlation with satisfaction with collaboration (.302*). Finally, collaboration in promotion demonstrated weak significant correlation with consumer satisfaction (.272*) and on-time delivery to consumer (.295*). No significant correlations were found in the dependent firm performance variable ROI and operational performance variables total logistics costs and stock-outs.

By computing composite variables through summing up collaboration areas and firm performance together with operational performance, we analyzed the correlation between these two composite variables. The composite variable collaboration areas had a moderate significant correlation with the composite variable of operational and firm performance (.426**).

In order to gain a more detailed insight into the effects of collaboration areas on operational and firm performance indicators, we performed multiple regressions. Following van Dijk (2016) and Bagchi et al. (2005), the cut-off value for adjusted R square was set on .10. To avoid the multicollinearity issue, we assessed the variation inflation factor (VIF) of the collaboration areas, operational performance and firm performance variables. VIF between 5 and 10 may be a reason for concern, whereas VIF above 10 indicates high correlation that leads to the multicollinearity problem. Most VIFs were in the range between 1.228 and 4.234, only the area of product development had the VIF value 5.457. Nevertheless, all VIF values were well below the maximum acceptable cut-off value of 10, which indicates the absence of multicollinearity. The results of multiple regression of collaboration areas as independent and firm performance as dependent variables are presented in the table 7.

The results of the multiple regression analysis show that the firm performance variable satisfaction with collaboration was significantly correlated with the collaboration areas inventory management, supply chain design and promotion. It is interesting to note that in the case of the relationship between supply chain design and satisfaction with collaboration, the regression parameter was negative. As we have information that in most cases all supplies are organized by distributor on the terms of Ex Works and the transfer of ownership of the goods is carried out in the supplier's warehouse, design of supply chain does not exist in fact. Thus, we can assume that most respondents do not have any joint practices with their distributor in supply chain design.

Table 7. Multiple regressions of collaboration areas and firm performance

Firm performance variables	**Collaboration area variables**	**Regressions parameter estimate (Beta)**	**Adjusted R square**
Satisfaction with collaboration	Inventory management*	.350	.176
Satisfaction with collaboration	Supply chain design*	-.371	.176
Satisfaction with collaboration	Promotion*	.362	.176
Market share growth	Inventory management*	.429	.121
Market share growth	Promotion*	.340	.121
Consumer satisfaction	Promotion*	.348	.192

*. $P < 0.05$

We can suggest that collaboration in inventory management and promotion between suppliers and their distributor is particularly valuable and effective, thus it leads to suppliers' satisfaction with collaboration itself. The multiple regression analysis also showed that market share growth was significantly correlated with the collaboration areas inventory management and promotion. Finally, collaboration in the area of promotion had a significant correlation with consumer satisfaction. The logic of this correlation is quite clear: distributor has a great experience in the area of promotion and the opportunity to use best practices in the market, which results in consumer satisfaction.

However, by computing the composite variables through summing the collaboration area variables and firm performance variables, a linear regression analysis was conducted between these two composite variables. The composite variable collaboration area had a non-significant positive parameter estimate with the composite variable firm performance (.307). Moreover, the adjusted R square was lower than the cut-off value of .10, namely: .079.

Multiple regression analysis showed no significant regressions between collaboration areas as independent variables and operational performance indicators as dependent variables were observed. Nevertheless, by computing the composite variables through summing the collaboration area variables and operational performance variables, a simple linear regression analysis was conducted between these two composite variables. The same as with the Pearson correlation analysis, the sum of collaboration area variables had a significant parameter estimate with the sum of operational performance variables (.445**). Furthermore, the adjusted R square was higher than the cut-off value of .10, namely .185. Thus, it can be stated that there is indeed a positive relationship of the scope and depth of collaboration with operational performance.

The results of multiple regression of operational performance as independent and firm performance indicators as dependent variables are presented in the table below.

Table 8. Multiple regressions of operational performance and firm performance

Firm performance variables	**Operational performance variables***	**Regressions parameter estimate (Beta)**	**Adjusted R square**
Sales growth	Inventory turn*	.408	.165
Satisfaction with collaboration	Inventory turn*	.337	.175
Market share growth	Inventory turn***	.603	.240
ROI	Total logistics costs**	.381	.278
Consumer satisfaction	Inventory turn*	.315	.206

***. $P < 0.001$, **. $P < 0.01$, *. $P < 0.05$

Analysis of multiple regression of operational performance variables on firm performance indicators showed significant regression between operational performance indicator inventory turn and firm performance indicators sales growth, satisfaction with collaboration, market share growth and consumer satisfaction. Besides that, significant regression was observed between operational performance indicator total logistics costs and firm performance variable ROI. Moreover, by computing the composite variables through summing the operational performance variables and firm performance variables, a simple linear regression analysis was conducted between these two composite variables. The composite variable operational performance had a significant positive parameter estimate with the composite variable firm performance (.550***). In addition, the adjusted R square was higher than the cut-off value of .10, namely .290. Thus, it can be stated that there is indeed a positive effect of the operational performance on firm performance.

To provide an integrative and comprehensive analysis of collaboration areas, a path diagram of the multiple regressions was constructed. The independent variables of all collaboration areas were combined to one latent construct "collaboration areas", whereas the latent constructs operational performance and firm performance were determined as dependent variables. The results of the multiple regression analysis are visualized in the path diagram included in Appendix 1. Table 9 on the next page shows standardized regression coefficients and their significance.

The table above and the path diagram show that there is a positive significant relationship between the latent construct collaboration areas and the latent construct operational performance (.521*). Moreover, there is a significant positive effect between the latent construct operational performance and the latent construct firm performance (.416*). However, there is no significant effect between the latent construct collaboration areas and firm performance.

To sum up, the scope and depth of collaboration between the suppliers and their distributor in this study can be evaluated as moderate. The results of multiple regression analysis showed that collaboration in the areas of inventory management, supply chain design and promotion had the most positive significant effect on several firm performance indicators, namely: satisfaction with collaboration, consumer satisfaction and market share growth. However, in other collaboration areas, that is, production, distribution, R&D, and product development no significant results from collaboration were observed.

Table 9. Standardized regression coefficients and their significance

Relationship			Regression parameter estimate (Beta)	P-value
Collaboration areas	→	Operational performance	.521*	.011
Operational performance	→	Firm performance	.416*	.011
Collaboration areas	→	Firm performance	.081	.611
Collaboration areas	→	Product development	.825**	.002
Collaboration areas	→	Supply chain design	.652***	***
Collaboration areas	→	R&D	.710**	.003
Collaboration areas	→	Distribution	.670**	.004
Collaboration areas	→	Inventory management	.627*	.010
Collaboration areas	→	Production	.883**	.002
Collaboration areas	→	Promotion	.413	
Firm performance	→	Sales	.715	
Firm performance	→	Satisfaction with collaboration	.933***	***
Firm performance	→	Market share	.747***	***
Firm performance	→	ROI	.628***	***
Firm performance	→	Consumer satisfaction	.779***	***
Operational performance	→	On-time delivery	.856	
Operational performance	→	Order fulfillment lead time	.966***	***
Operational performance	→	Total logistics costs	.386**	.002
Operational performance	→	Inventory turn	.546***	***
Operational performance	→	Stock-outs	.121	.366

***. $P < 0.001$, **. $P < 0.01$, *. $P < 0.05$

In addition, the relationships between the composite variables of collaboration areas, operational performance and firm performance were analyzed. As a result of the regression analysis, a positive significant effect (.445**) of collaboration areas on operational performance was observed. Moreover, operational performance had a significant positive relationship with firm performance (.550***). To explain such results, we should understand that the term collaboration implies involving active engagement in the solution of operational issues. Coordination of strategic issues only without operational cooperation is not enough for satisfied results. In this case, operational performance influences firm performance.

The abovementioned significant positive effects and relationships were also supported by the path diagram of collaboration areas that is attached in Appendix 1. The structural model measured the relationship between the unobserved latent constructs collaboration areas and operational performance (.521*), collaboration areas and firm performance (.081), and operational performance and firm performance (.416*). Thus, it can be inferred that if the latent construct collaboration increases by one standard deviation, the latent construct operational performance increases by a standard deviation of .521 at the 5 percent level of significance. Thus, a higher level of collaboration has a significant positive impact on operational performance. Moreover, if the latent construct operational performance increases by one standard deviation, the latent construct firm performance increases by a standard deviation of .416 at the 5 percent level of significance.

4.2. Descriptive statistics of the Latent Constructs of the Structural Equation Model

Before presenting the results of Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM), we provide descriptive and inferential statistics of the latent construct Supply Chain Collaboration Dimensions (SCCD) in table 10 and the latent construct Collaborative Advantage (CA) in table 11.

Table 10. Descriptive statistics of dimensions of supply chain collaboration

Dimension	Min	Max	Mean	SD
Information sharing	1	5	4.10	0.926
Decision synchronization	1	5	3.57	1.258
Incentive alignment	1	5	3.16	1.344
Resource sharing	1	5	2.92	1.441
Collaborative Communication	2	5	4.36	0.817
Joint knowledge creation	1	5	2.90	1.350
Goal congruence	1	5	3.56	1.245

As it is shown in table 10, among the most used dimensions of collaboration, collaborative communication (4.36) and information sharing (4.10) had the highest means, also decision synchronization (3.57) and goal congruence (3.56) were used to some extent, whereas resource sharing (2.92) and joint knowledge (2.90) were perceived as the least used collaboration dimensions in the supply chain.

Table 11. Descriptive statistics of collaborative advantages

Collaborative advantage	Min	Max	Mean	SD
Process efficiency	1	5	3.48	0.868
Offering flexibility	1	5	3.85	0.910
Business synergy	1	5	3.48	0.906
Innovation	1	5	2.97	1.064

The descriptive statistics in table 11 shows that flexibility (3.85) was evaluated by respondents as the most important advantage derived from collaboration in the supply chain. Such collaborative advantages as business synergy (3.48) and process efficiency (3.48) were evaluated equally by respondents, while innovation (2.97) was ranked as the least important advantage.

For better understanding of the supply chain collaboration effect, respondents were asked to rate performance improvements due to collaboration in ten specific areas using a five-point Likert scale. The results are presented in table 12.

As for the operational performance and firm performance, the means are generally around the point 4 (Agree). Hence, we can conclude that most respondents perceived a positive change in operational and firm performance resulting from collaboration. Two operational performance indicators, total logistics costs and stock-outs have lower means, which are closer to the mid-point 3 (Neutral). Thus, the respondents perceive almost no effect of collaboration on their total logistics costs and stock-outs. Four indicators have the highest means among all performance indicators, namely: sales growth (4.34), satisfaction with collaboration (4.3), consumer satisfaction (4.11), market share growth (4.07) and on-time delivery to consumer (4.02). These indicators were perceived by respondents to have achieved the highest improvement through collaboration.

Table 12. Descriptive statistics of firm performance and operational performance

Firm and operational performance	**Min**	**Max**	**Mean**	**SD**
Firm performance				
Sales growth	2	5	4.34 (Agree)	0.680
Satisfaction with collaboration	3	5	4.30 (Agree)	0.558
Market share growth	2	5	4.07 (Agree)	0.910
ROI	2	5	3.49 (Neutral)	0.766
Consumer satisfaction	3	5	4.11 (Agree)	0.661
Operational performance				
On-time delivery to consumer	2	5	4.02 (Agree)	0.671
Order fulfillment lead time	2	5	3.92 (Agree)	0.781
Total logistics costs	2	5	3.39 (Neutral)	0.802
Inventory turn	1	5	3.77 (Agree)	0.824
Stock-outs	1	5	3.07 (Neutral)	0.946

4.3. Confirmatory Factor Analysis

This research follows a two-step SEM approach. The first step in this approach requires to develop and assess the measurement model, whereas the second step requires to specify and assess the structural model (Hair, 2010). Confirmatory factor analysis (CFA) is a multivariate statistical procedure, which corresponds to the measurement model. It is a theory-driven statistical method, employed to test predefined hypotheses. All latent constructs and indicators were determined in advance and presented in the conceptual framework, therefore, confirmatory factor analysis (CFA) was used to evaluate the measurement model fit and validity. After the measurement model was proved to adequately represent theory with the data obtained for the study, structural equation modeling was used to analyze the hypothesized relationships between constructs. All statistical analyses were completed in IBM SPSS 24 and IBM SPSS Amos 24. The level of significance for all tests was set at 0.05 level.

Following Van Dijk (2016), we decided to conduct a preliminary test of construct reliability analyzing each of the constructs apart from the other ones. From the point of view of statistics, reliability is explained as the proportion of inconsistent observations due to individual differences in respondents. This means that even a reliable survey will have varying responses due to the fact that respondents have different opinions on questions, not because of the fact that the questionnaire questions were unclear or ambiguous. Consequently, a test for reliability was conducted for all four latent constructs.

The preliminary reliability analysis was run using Cronbach's alpha coefficient. It indicates that all latent constructs taken separately, disregarding possible correlations between them and potential cross-loadings are able to capture the concept described. As a rule, Cronbach's alpha cut-off value is 0.7, however small negative deviations are acceptable (Cooper and Schindler, 2006; Malhotra and Birks, 2006). The results of Cronbach's alphas test are presented in table 13.

Table 13. Cronbach's alpha (a preliminary test of construct reliability)

Latent construct	**Number of indicators**	**Cronbach's alpha**
Supply Chain Collaboration Dimensions	7	0.881
Collaborative Advantage	4	0.755
Firm Performance	5	0.850
Operational Performance	5	0.732
All items	34	0.897

The results in table 13 indicate that most latent constructs have Cronbach's alpha coefficients higher than the cut-off value 0.7. Moreover, the composite Cronbach's alpha of the whole dataset is well above the threshold of 0.7. Thus, based on the preliminary test of Cronbach's alpha, all the latent constructs and its indicators were included in the CFA.

Following the preliminary test of reliability by means of Cronbach's alpha, CFA was conducted to ensure composite, convergent and discriminant validity along with construct reliability (Gerbing and Anderson, 1988) as well as the overall model fit. Each indicator loading was treated as an a priori indicator for the latent construct it measures, and all the latent constructs were allowed to be correlated as there was no ground for an assumption that latent constructs are not correlated. The output for the measurement model after the initial CFA is included in Appendix 2.

Measurement model fit assessment shows how well the observed data fits the theoretical framework developed at earlier stages. The overall fit of the measurement model was assessed by means of several indices to have a better understanding of the goodness-of-fit. The rule of thumb suggests relying on, at least, one absolute fit index and one incremental fit index besides traditional χ^2 results (Hair et al., 2010). The table below compares the expected measurement model fit indices for the good fit with the obtained ones.

Table 14. Initial CFA. Model fit assessment

Expected		**Obtained**
χ^2 normed	<2.0 – good fit 2.0-5.0 – acceptable fit	1.680 (good)
CFI	> 0.95 great > 0.90 moderate > 0.80 sometimes acceptable	.804 (sometimes acceptable)
RMSEA	< .05 good 0.05 - 0.10 moderate > 0.10 bad	.106 (bad)

Source: (Hair et al., 2010; Van Dijk, 2016)

To find the areas of the measurement model improvement, construct validity is assessed along with modification indices. We start the analysis of construct validity with the analysis of convergent validity (factor loadings should be greater than 0.5, preferably higher than 0.7). The latent constructs CA and OP had some indicators with low loadings (<0.5) to their respective construct, which could cause problems for the model fit of the structural model, taken into account the relatively low sample size of the data set. Table 15 below contains data on factor loadings produced after the initial CFA.

Table 15. Initial CFA. Factor loadings

Construct		**Indicator**	**Regressions parameter estimate (Beta)**
SCCD	→	Goal congruence	.637
SCCD	→	Knowledge creation	.698
SCCD	→	Collaborative communication	.646
SCCD	→	Resource sharing	.689
SCCD	→	Incentive alignment	.867
SCCD	→	Decision synchronization	.866
SCCD	→	Information sharing	.695
CA	→	Innovation	.657
CA	→	Offering flexibility	.794
CA	→	Process efficiency	.699
CA	→	Business synergy	.487
FP	→	Sales growth	.736
FP	→	Satisfaction with collaboration	.899
FP	→	Market share	.761
FP	→	ROI	.540
FP	→	Consumer satisfaction	.790
OP	→	On-time delivery	.866
OP	→	Order fulfillment lead time	.948
OP	→	Inventory turn	.563
OP	→	Total logistics costs	.402
OP	→	Stock-outs	.153

As the results in the table 16 show, several indicators had low factor loadings. In particular, the indicator of OP stock-outs had an extremely low loading (.153), which could be problematic in further analysis and, hence this indicator was regarded as a potential candidate for removal. Although some other indicators had loadings lower than the cut-off value of 0.5, in particular, business synergy (.487) and total logistics costs (.402). Rather than automatically eliminating such indicators, researchers should carefully examine the effects of item removal on the composite reliability, as well as on the construct's content validity.

The results of the CFA functioned as an input to conduct composite reliability, as well as convergent and discriminant validity tests. In particular, such tests as composite reliability (CR), average variance extracted (AVE), maximum shared variance (MSV), and average shared variance (ASV) tests were conducted. The threshold values for the mentioned tests are provided in table 16.

Table 16. Reliability and validity threshold values

Reliability and validity tests	Cut-off value
Composite reliability	>0.70
Convergent validity	CR > AVE
	AVE > 0.50
Discriminant validity	MSV < AVE
	ASV < AVE

Source: (Hair et al., 2010; Van Dijk, 2016)

In order to calculate the reliability and validity tests, the correlation table and standard regression weight table of the initial CFA, including all the latent constructs, were used as an input. The results were calculated by means of an Excel macro (Gaskin, 2014). Table 17 summarizes the outcomes of reliability and validity tests.

Table 17. Reliability and validity test results after initial CFA

	CR	AVE	MSV	FP	SCCD	CA	OP
FP	0.866	0.569	0.287	0.754			
SCCD	0.889	0.539	0.116	0.115	0.734		
CA	0.759	0.447	0.308	0.536	0.340	0.669	
OP	0.751	0.430	0.308	0.475	0.180	0.555	0.656

As the result of testing reliability and validity, the latent constructs OP and CA showed convergent validity issues (AVE<0.5), which means that the indicators of the latent construct do not correlate well among each other. The problem could lie in the low factor loadings of the indicators previously mentioned: stock-outs (.153), business synergy (.487) and total logistics costs (.402). After removing the indicator with the lowest loading related to the construct OP, that is stock-outs, a new reliability and validity analysis was run to determine if it met the threshold values. The results of new reliability and validity tests are presented in table 18.

Table 18. Reliability and validity test results after revised CFA

	CR	AVE	MSV	FP	SCCD	CA	OP
FP	0.866	0.569	0.287	0.754			
SCCD	0.889	0.539	0.116	0.115	0.734		
CA	0.758	0.446	0.304	0.536	0.340	0.668	
OP	0.803	0.530	0.304	0.468	0.178	0.551	0.728

According to the reliability and validity test results, the convergent validity of the construct OP improved and achieved the threshold value of 0.5, however that was not still true for the construct CA. However, following van Dijk (2016), in the spirit of the study and due to the low effect on model fit of the only one low reliability indicator, all items of the latent construct CA were included in the model, despite low loadings of some of them. The revised confirmatory analysis can be found in Appendix 3. The table below provides model fit indices after the revised confirmatory factor analysis. The model fit indicators were found to be acceptable for further analysis.

Table 19. Model fit indicators after revised CFA

Expected*		**Obtained**
χ^2 normed	<2.0 – good fit 2.0-5.0 – acceptable fit	1.355 (good)
CFI	> 0.95 great > 0.90 moderate > 0.80 sometimes acceptable	.907 (moderate)
RMSEA	< .05 good 0.05 - 0.10 moderate > 0.10 bad	.077 (moderate)

4.4. Test of Common Method Bias

The revised CFA was further used to test the common method bias by means of a common latent factor (CLF), which captures the common variance among all observed variables in the measurement model. Afterwards, the standardized regression weights from the model with the CLF were compared with the standardized regression weights of the measurement model without the CLF. The measurement model with CLF is illustrated in Appendix 4. The CLF should be retained and moved to the structural model if there are differences greater than 0.2 between the standardized regression weights of the two models. The results of the comparison of the standardized regression weights are presented in the table 20.

As the table above demonstrates, the difference between the standardized regression weights of the model with CLF and the measurement model without CLF was not greater than the cut-off value 0.2; hence, the measurement model without CLF was hereinafter moved to the structural model.

4.5. Structural Equation Model of Supply Chain Collaboration

After conducting CFA and approving of the measurement model, the structural model can be put forward for the analysis by means of SEM. SEM represents a combination of linear equations that are used to test causal relationships between latent constructs (Hair et al., 2010). As a final result, SEM is used to identify to which extent the theoretically developed model fits observed data in the sample. The main difference between CFA and SEM is that in SEM the focus is shifted to relationships between latent constructs rather than the relationships between indicators and latent constructs. We used the measurement model without CLF to build the structural equation model that is illustrated in Appendix 5. The table below provides model fit indices for the structural model.

The results of the structural equation model showed that the latent construct SCCD had a significant positive effect on the latent construct CA (.408*). The latent construct CA had a significant positive influence on the latent construct OP (.520**) and the latent construct FP (.389*). Besides that, it is interesting to note that the control variable firm size had a significant negative effect on the latent construct CA (-.419*). No significant direct effects were observed for the relationship between SCCD and OP (.083) and between SCCD and FP (-.038). In addition, the relationship between OP and FP was also insignificant (.253). Table 22 presents the results of the standardized regression weights of the structural model.

Table 20. Comparison of standardized regression weights of the model with CLF and the model without CLF

Relationship			Estimate (without CLF)	Estimate (with CLF)	Difference
SCCD	→	Goal congruence	0.996	1	0.004
SCCD	→	Knowledge creation	0.528	0.499	-0.029
SCCD	→	Collaborative communication	0.34	0.291	-0.049
SCCD	→	Resource sharing	0.444	0.398	-0.046
SCCD	→	Incentive alignment	0.683	0.642	-0.041
SCCD	→	Decision synchronization	0.619	0.559	-0.06
SCCD	→	Information sharing	0.353	0.299	-0.054
CA	→	Innovation	0.496	0.564	0.068
CA	→	Offering flexibility	0.84	0.864	0.024
CA	→	Process efficiency	0.721	0.724	0.003
CA	→	Business synergy	0.265	0.363	0.098
FP	→	Sales growth	0.703	0.703	0
FP	→	Satisfaction with collaboration	0.936	0.939	0.003
FP	→	Market share	0.743	0.739	-0.004
FP	→	ROI	0.624	0.649	0.025
FP	→	Consumer satisfaction	0.775	0.772	-0.003
OP	→	On-time delivery	0.851	0.861	0.01
OP	→	Order fulfillment lead time	0.939	0.958	0.019
OP	→	Inventory turn	0.558	0.551	-0.007
OP	→	Total logistics costs	0.417	0.398	-0.019

Table 21. Structural model fit assessment

Expected*		**Obtained**
χ^2 normed	<2.0 – good fit 2.0-5.0 – acceptable fit	1.355 (good)
CFI	> 0.95 great > 0.90 moderate > 0.80 sometimes acceptable	.907 (moderate)
RMSEA	< .05 good 0.05 - 0.10 moderate > 0.10 bad	.077 (moderate)

Table 22. Standardized regression weights of the structural model

Relationship			Regressions parameter estimate (Beta)	P
SCCD	→	CA	.408*	.037
Firm Size	→	CA	-.419*	.010
CA	→	OP	.520**	.009
SCCD	→	OP	.083	.534
CA	→	FP	.389*	.028
SCCD	→	FP	-.038	.762
OP	→	FP	.253	.123
SCCD	→	Goal congruence	.615	
SCCD	→	Knowledge creation	.594***	***
SCCD	→	Collaborative communication	.637***	***
SCCD	→	Resource sharing	.670***	***
SCCD	→	Incentive alignment	.817***	***
SCCD	→	Decision synchronization	.923***	***
SCCD	→	Information sharing	.692***	***
CA	→	Innovation	.560	
CA	→	Offering flexibility	.911***	***
CA	→	Process efficiency	.674***	***
CA	→	Business synergy	.355**	.003
FP	→	Sales growth	.703***	***
FP	→	Satisfaction with collaboration	.944***	***
FP	→	Market share	.737***	***
FP	→	ROI	.642***	***
FP	→	Consumer satisfaction	.771	
OP	→	On-time delivery	.859***	***
OP	→	Order fulfillment lead time	.961***	***
OP	→	Inventory turn	.548	
OP	→	Total logistics costs	.397**	.007

4.6. Mediation effect of Collaborative Advantage

According to the previously developed conceptual hypotheses framework, the latent construct CA is expected to positively mediate the relationship between the latent constructs SCCD and OP and between SCCD and FP. Hence, the mediation analysis was conducted in SPSS Amos 24. There are several methods to test the mediation relationships, such as Sobel's test (1982) and the Baron and Kenny approach (1986), which are regarded as more traditional ones. Both of the mentioned methods have low power compared to more modern approaches and are typically no longer recommended (e.g., MacKinnon et al., 2002; Biesanz, Falk, & Savalei, 2010). One of the most preferred methods currently is bootstrapping, which is a resampling method that is used to build a confidence interval for the indirect effect (Preacher & Hayes, 2004). One of the main advantages of the bootstrapping method is that it does not violate assumptions of normality and is therefore can be used for small sample sizes (Preacher & Hayes, 2004), which is the case in this research. Our mediation analysis was performed with 2000 bootstrap replications. To infer the observed significance level of the effects, nonparametric bootstrap bias-corrected confidence intervals were used. The results of the mediation analysis are presented in table 23.

Table 23. Indirect effect of SCCD through CA on OP and FP

Path	Estimate	P-value	Lower	Upper
SCCD → CA → OP	.212	.002	.031	.452
SCCD → CA → FP	.159	.067	-.006	.581

The indirect effect of SCCD through the mediation variable CA on OP was positive and significant (.212**). The last two columns in table 23 show the upper and lower limits for the 95% confidence intervals. These values correspond to the 2.5th and 97.5th percentiles from lowest to highest rank-ordered estimates of the indirect effect derived from the 2.000 samples. Since zero does not fall between the confidence interval ranging from 0.31 to .452, we can conclude that there is a significant mediation effect. Thus, it can be stated that collaborative advantage positively mediates the relationship between supply chain collaboration dimensions and operational performance of the firm.

The indirect effect of SCCD through mediation variable CA on FP was positive, but not significant (.159), moreover the confidence interval range in this case does include zero, which means that CA does not mediate the relationship between SCCD and FP. In this case, we can propose that collaborative advantage form a sustainable advantage or superiority in operating activities.

To sum up the analysis of mediation effect, through the influence of supply chain collaboration dimensions on operational performance of firms involved in the distribution network, the performance of the entire supply chain improves, and as the result the performance of the individual firm.

5. Empirical Findings and Managerial Implications

This study set out to empirically test the relationship between supply chain collaboration dimensions, collaborative advantage and operational and firm performance by means of structural equation modeling. The measurement model developed in this research was based on the conceptual SCC hypotheses framework, adapted from previous research (Cao et al, 2011; van Dijk, 2016). The final measurement model was transformed into the final structural equation model. This final structural equation model was used for mediation analysis of the mediation construct CA to test the formulated hypotheses in the conceptual SCC framework. As a result, the structural model, presented in Figure 5, showed that the latent construct SCCD had a significant positive effect on the latent construct CA (.408*).The latent construct CA had a significant positive influence on the latent construct OP (.520**) and the latent construct FP (.389*). The similar results were obtained by Cao and Zhang (2011) in their research: supply chain collaboration had a significant positive direct impact on collaborative advantage (.640**). At the same time, Cao and Zhang (2011) considered only firm performance as the latent construct, without including operational performance as a separate latent construct. Their result was also significant (.500**), which indicated that collaborative advantage had a significant positive direct effect on firm performance.

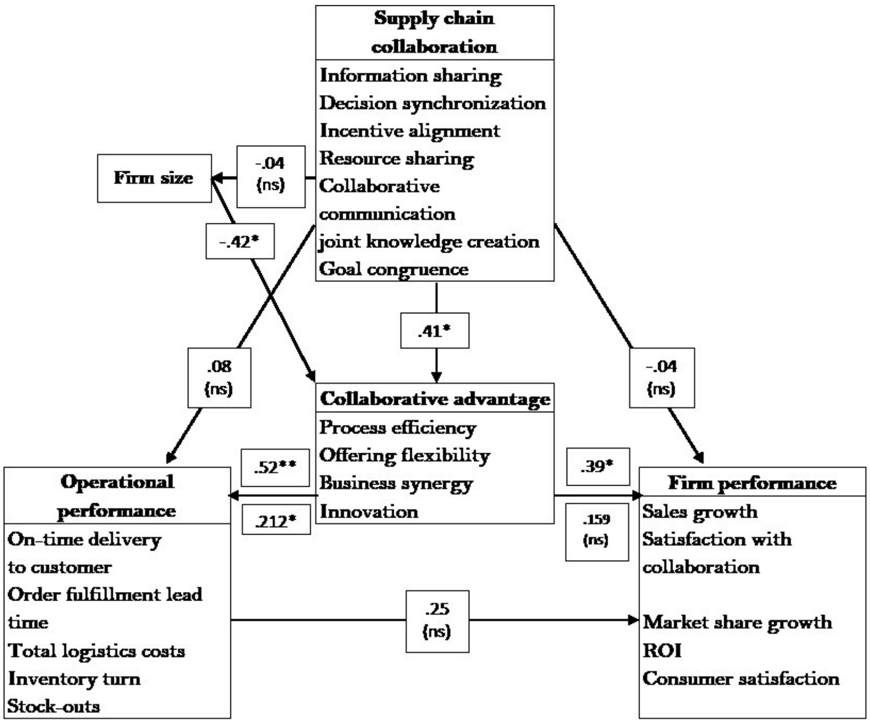


Fig. 5. SEM full model results of conceptual SCC hypotheses framework. Source: Author's own

The results obtained by van Dijk (20160 are similar to those achieved in the research by Cao and Zhang (2011) and in this study. There were significant positive effects of dimensions of collaboration on operational performance (.472**), dimensions of collaboration on collaborative advantage (.651***), collaborative advantage on firm performance (.429***) and operational performance on firm performance (.579***).

As for other results obtained in this research, no significant direct effects were observed for the relationship between SCCD and OP (.083) and between SCCD and FP (-.038). In addition, the relationship between OP and FP was also insignificant (.253). It is noteworthy that van Dijk (2016) achieved comparable results for the relationship between SCCD and FP, which was negative (-.180*), as well as in this research (-.038). This negative effect can be explained by increased costs due to the waste of resources required for collaboration without first achieving collaborative advantages.

Besides that, it is interesting to note that in this research the control variable firm size had a significant negative effect on the latent construct CA (-.419*). It means that there is an inverse relationship between firm size and collaborative advantage. The reason for this relationship is that smaller firms get more advantages relative to their firm size than larger firms. In the context of the examined distribution network, In our case we have examined a variety of firms, ranging from small companies (50-100 FTEs) to the larger ones (more than 1000 FTEs). For small firms, the cooperation with a large distributor provides opportunities to increase the market share by leveraging the distributor's resources and advantages. In contrast, the larger firms are more competitive and have their own advantages that are no worse than the distributor's ones, hence, they do not aim to cooperate and access the distributor's resources.

It can be concluded that the different dimensions of supply chain collaboration had a significant positive effect on realizing and achieving collaborative advantages. Moreover, as a result of the mediation analysis, the positive and significant indirect effect (.212**) of SCCD through the mediation variable CA on OP was established. Therefore, improvement in operational performance can be achieved by first obtaining collaborative advantages, in particular, offering flexibility, process efficiency, innovation and business synergy, which, in turn, are achieved by practicing SCC dimensions. The relationship implies that, in order for a supply chain as a whole to perform well, firms should try to create a win–win situation that all participants collaborate to achieve business synergy and compete with other chains. According to Cao and Zhang (2011), generally, competitive intentions make individual firms promote their own interests at the expenses of others, which is very insidious for collaboration and can worsen or destroy the relationships. Long-term relationships such as supply chain collaboration have to be motivated by the mutuality of intent, goal congruence, and benefit sharing (Wong, 1999; Tuten and Urban, 2001). Thus, managers need to align goals and benefits with supply chain partners for creating collaborative advantage. Such collaborative advantage indeed directly increases the performance for each partner in the chain. In addition, no significant mediation effect between SCCD and FP through CA was established. However, the direct relationship between SCCD and CA (.408*), as well as between CA and FP (389*) were significant.

Our study found that effective supply chain collaboration leads to better operational performance through collaborative advantage. However, the results empirically confirm that supply chain collaborative advantage directly improves operational performance and firm performance. Whereas much of the previous research was focused on direct relationship between collaboration and performance (Duffy and Fearne, 2004, Stank et al., 2001 and Tan et al., 1998), our study, following Cao and Zhang (2011) and van Dijk (2016), considers an intermediate variable collaborative advantage. Thus, we imply that the improvement of the firm performance should be realized through the achievement of collaborative advantages first. As the empirical results of this study show, the main instrument of obtaining collaborative advantages is the dimensions of supply chain collaboration. Under the conditions of the growing uncertainty of business environment and increasing competition, decision synchronization (.923***), incentive alignment (.817***) and information sharing (.692***) come at the forefront. Practicing these collaborative dimensions allow firms to improve process visibility and reduce the uncertainty level in decision-making.

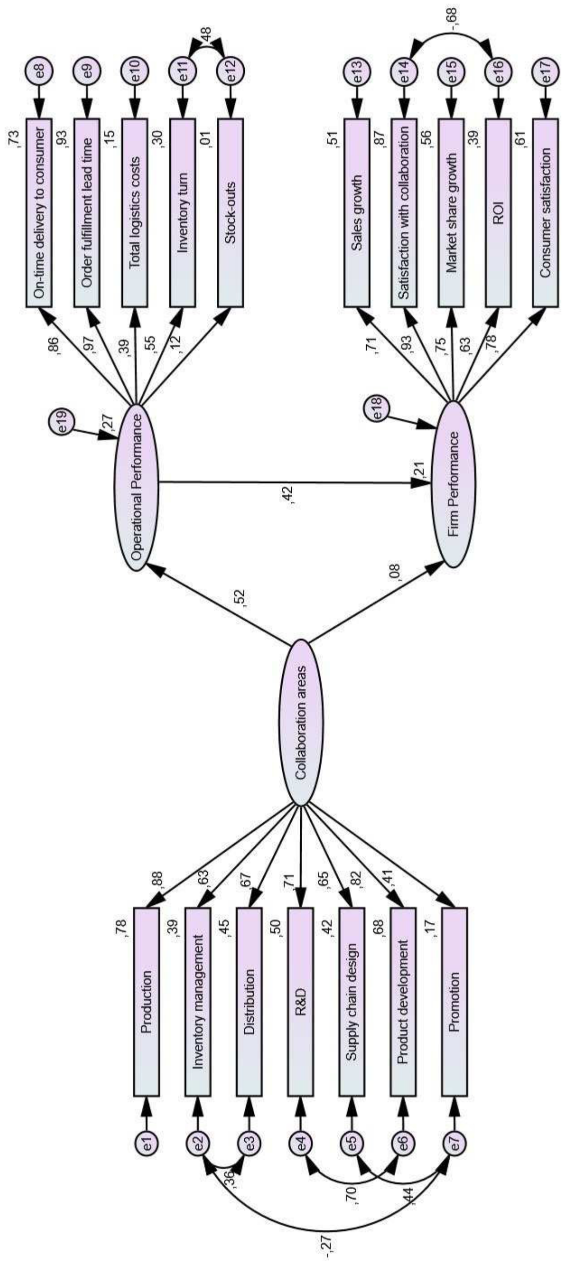
There are different definitions and measures of collaborative advantages, which can help managers to improve shared supply chain processes and achieve benefits for all members. However, this study, consistently with the research by Cao and Zhang (2011) and van Dijk (2016), confirms that the use of such collaborative advantages as offering flexibility, process efficiency, innovation and business synergy is the most efficient.

The empirical findings showed that collaboration in the areas of inventory management, supply chain design and promotion had the most positive significant effect on several firm performance indicators, namely: satisfaction with collaboration, consumer satisfaction and market share growth. Since the term collaboration cannot be considered apart from operational activity, most collaboration areas are related to operational functions, not only to strategic management. Consequently, the effect of collaboration areas on operational performance is much higher than on firm performance. Nevertheless, the operational performance has a significant effect on firm performance.

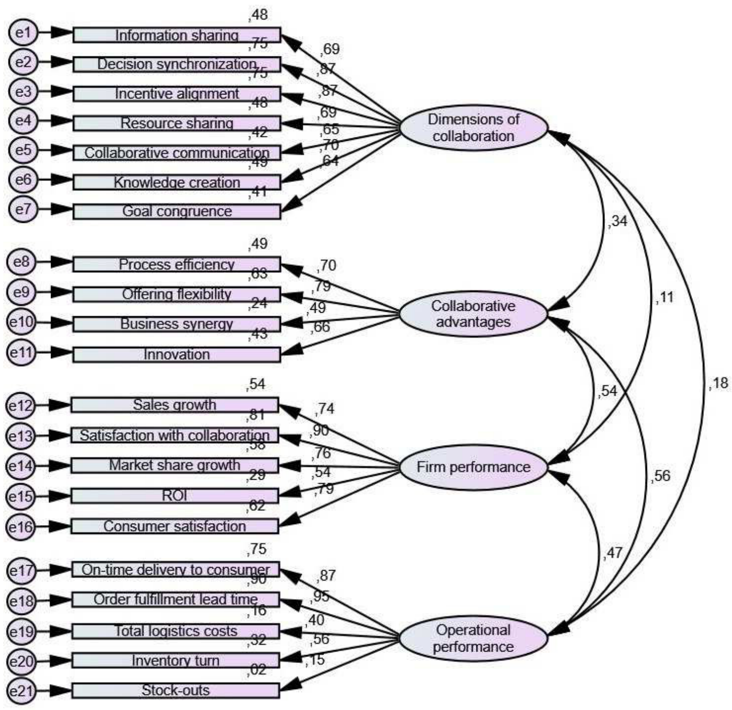
In conclusion, after summarizing all the empirical and statistical analyses and formulating the conclusions and implications, the main contribution of this research is that in line with the research by Cao and Zhang (2011) and van Dijk (2016), our study found that the performance of firms practicing collaboration in the supply chain can be improved by obtaining collaboration advantages first. Moreover, unlike other studies, our research explains why small firms tend to collaborate more than the larger ones in the context of the distribution network encompassing mainly Russian firms operating in one industry. Taking into account that each industry has its specific features, future research should be aimed at studying networks of firms operating in one industry to deeper understand the links and principles of collaboration.

6. Appendices

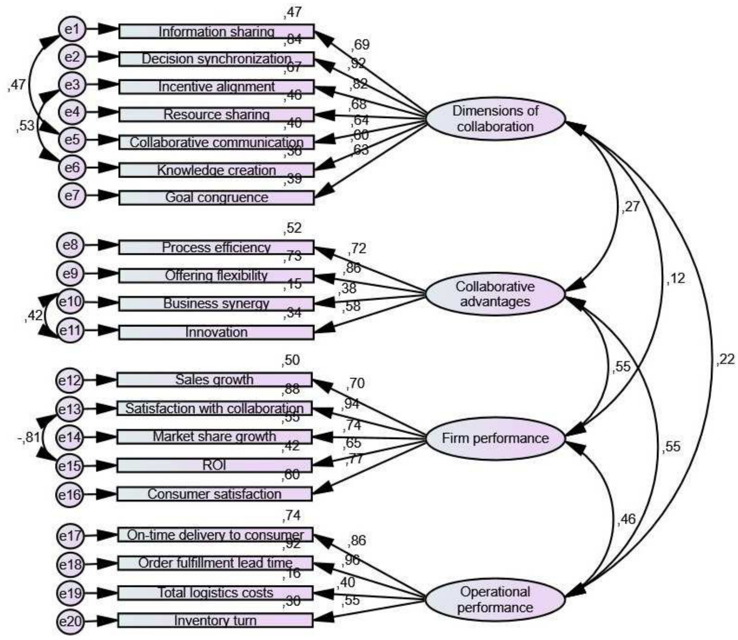
Appendix 1. Path Diagram of Collaboration Areas



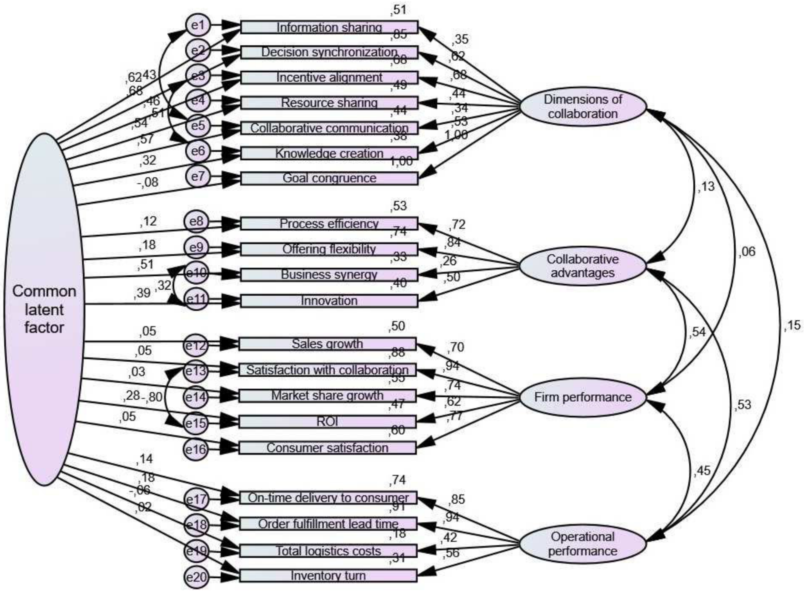
Appendix 2. Results of Initial Confirmatory Factor Analysis



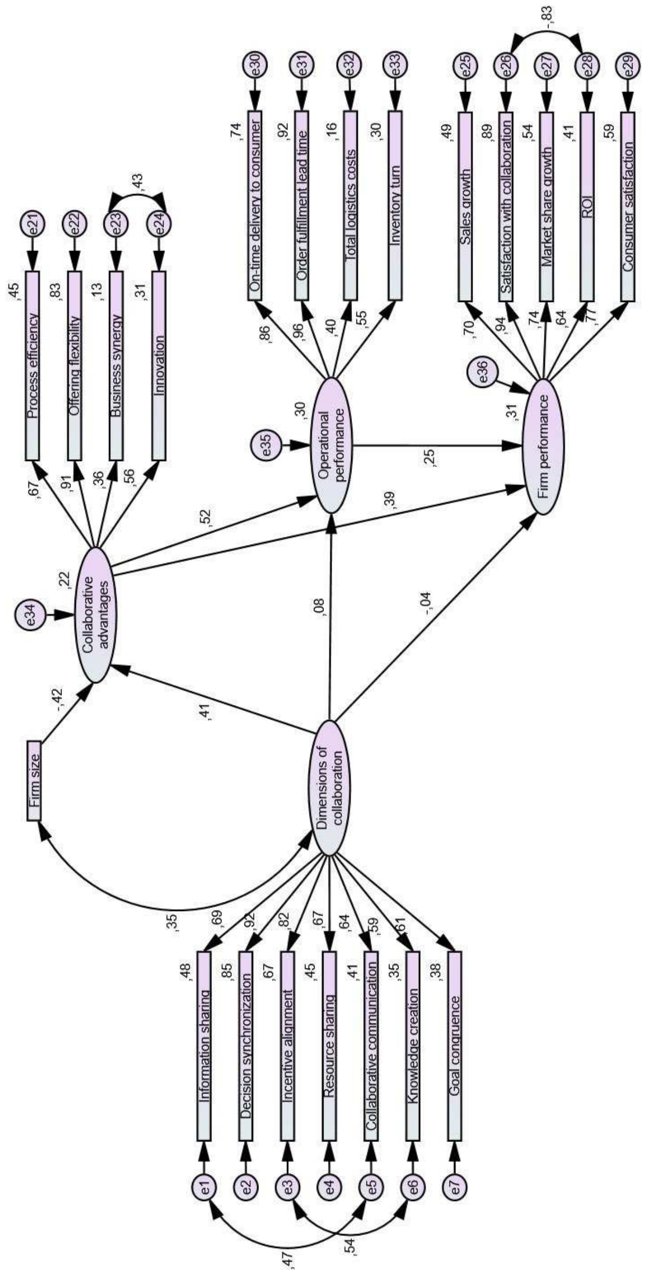
Appendix 3. Results of Revised Confirmatory Factor Analysis



Appendix 4. Results of Confirmatory factor analysis with a Common Latent Factor



Appendix 5. Results of the Structural Equation Model of Supply Chain Collaboration



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