DECISION SCIENCES INSTITUTE

Asymmetry, trust, innovation, and performance in supply chain management - a non-linear approach

Marek Michalski
San Francisco de Quito University
mmichalski@usfq.edu.ec

José Luis Montes Botella
Rey Juan Carlos University
joseluis.montes@urjc.es

Ram Narasimhan
Michigan State University
narasimh@broad.msu.edu

ABSTRACT
The purpose of this paper is to examine non-linear aspects of the asymmetry-performance relationship under varying conditions of trust and innovation. The paper offers a new approach that is useful for addressing strategic elements of supply chain management (SCM) relationships based on trust and innovation decisions.
The principal finding is that the influences of asymmetry on performance, in varying trust and innovation contexts, have unstable characteristics and have non-linear paths. Findings of the study provide rational insights to managers regarding when it is adequate to reduce (or not) asymmetric relationships with partners.

KEYWORDS: Supply chain management, Asymmetry, Trust, Innovation, Performance

INTRODUCTION

Supply chain (SC) is a network constructed to realize the goal of performance maximization through increasing the value and reducing the cost associated with the SC as a whole (Jüttner, Christopher and Baker, 2007).This network paradigm requires, especially today, the existence of trust and innovation in relationships among involved parties. Trust and Innovation are complex concepts, which play a key role in SC relationships. In order to develop better understanding of both concepts, we describe Trust as an expectancy of appropriate behaviors from partners and Innovation as an opportunity to create new products and/or services for customers utilizing SC relationships.

   SC relationships can reduce transaction costs (Madhok, 2006), reduce risk and uncertainty (Gao et al., 2005; Spekman and Davies, 2004), increase or maintain the firm's position in the market (Pavlou and Gefen, 2004), moderate organizational and managerial behaviors (Atkinson and Butcher, 2003), obtain required resources and technologies (Cao and Zhang, 2011; Davies and Prince, 2005), and render the network more efficient (Miles and Snow, 2007). With these perspectives and possibilities, it becomes difficult to get alignment of objectives between the SC partners (Sridharan and Simatupang, 2005) and reduce the threats of opportunism (Heide and John, 1990). Given this situation, the most inter-organizational relationships are often described as asymmetric.

The concept of asymmetric relationships generally refers to imbalance in different relationship dimensions such as size, power, resources, and competencies. Imbalance in relationship dimensions could be a barrier to SC collaboration processes because in such situations relationships are often dominated by formal agreements more than by trust. They don't motivate SC collaboration leading to innovation but simply ensure access to resources (Colurcio and Russo-Spena, 2013).

Such relationships are considered inherently unstable and likely to dissolve (Kumar et al., 1995) with differential impacts on SC structures and performance. Therefore, asymmetry, trust and innovation are not only the core, essential factors of relational management, but also the basics elements of network organization formation and operations (La Londe, 2002; Varma et al., 2006).

The SC itself is a kind of network system or network structure. As such, it is a complex non-linear system, which is co-influenced by various independent but related elements. Innovation, trust and asymmetry have been suggested in the literature as the key factors in a supply chain network that impact competitive advantage and successful performance (Hult, 2004; Laeequddin et al., 2011; Thomas and Esper, 2010; Colurcio and Russo-Spena, 2013). Despite the assertion of their importance, the relationships among them are still unclear.

Research on asymmetry in relationships is limited. The asymmetries become evident when the relationships involve actors with different positioning (Johnson and Ford, 2007). Asymmetries in SC network relationships have been analyzed from different perspectives. Most studies have focused on potentially negative *linear* effects of asymmetry on relationship stability, dissatisfaction, opportunistic behavior, network development or performance (Johnsen and Ford 2001; 2006; Thomas and Skinner, 2010). Although some research on the impact of asymmetry on innovation and trust exists (Michalski et al., 2013; Colurcio and Russo-Spena, 2013; Thomas and Skinner, 2010), a more thorough analysis is noticeably lacking and this omission creates a gap in the current literature. We suggest that focusing on a linear relationship is insufficient to ensure that managerial decisions would produce the desired effects.

In the present business environments SCM has a significant role in improving the performance of each participating organization in the SC. Information sharing, collaboration, cost reduction, flexibility, delivery, integration and resource utilization have been considered in literature as key drivers of supply chain performance (Singh and Pandey, 2013). However, there is growing need to improve the quality of knowledge in this area. Given evidence indicating that SC performance is also influenced by its environmental context, we suggest that is necessary to consider asymmetry in relationships as a new and important factor that influences SC performance and explore its effects. Exploring the influence of asymmetry on SC performance under different level of trust and innovation is also interesting from a strategic viewpoint. The strategic implications of asymmetry on performance may offer additional insights into why SC relationships succeed or fail.

Collaboration and interaction between firms are recognized as requirements for a firm to create value and to realize high-quality relationship performance (Johnson and Ford, 2006). High trust decreases uncertainty and opportunism and encourages higher commitment to the SC relationships (Wu, 2011). At the same time, high level of trust and commitment reinforce strongly inter-organizational ties that can be an obstacle for innovation. The main reason for this is that strong relationships lock firms into a narrow (tightly connected) network, making them dependent on a small number of sources of creativity and innovation (Capaldo, 2007). This situation reduce the likelihood that new ideas and opportunities will be explored more broadly. Investigating these issues would be very helpful to improve our knowledge and understanding about the role of trust and innovation as the mechanisms by which relationships are established and maintained between firms in SC.

The purpose of this study is to address the gaps identified above. Specifically, we aim to extend research by investigating following research questions:

1. *How does asymmetry influence the true nature of SC performance?*
2. To what extent do trust and innovation mechanisms exist across the supply chain?
3. What is effect of different levels of trust and innovation on performance in asymmetric SC relationships?

     This paper delivers new insights concerning these important questions. The rest of the paper is organized as follows: We first review the recent theoretical and empirical research literatures on trust, innovation and asymmetry, and propose a research model. Then we describe the methodology used to test the research model, followed by a discussion of the findings, and the implications for research and practice. Finally, we end with conclusions and areas for future research.

LITERATURE REVIEW

The performance of a SC depends on not only how efficiently the buyer and tier 1 partners cooperate with each other, but also on how well these partners cooperate with their own business partners (Halldorsson et al., 2007). Network Theory (NT) can be a basis for analyzing cooperative relationships for achieving greater performance than through individual efforts. The firm's continuous interaction with other members of a network is an important factor in the development of new resources (Haakansson and Ford, 2002). Thus, the possibility of advantageous interchange of resources helps firms to change the SC structure and motivate their members to pursue innovation.

     Network Theory contributes profoundly to an understanding of the dynamics of inter-organizational relations by emphasizing the importance of trust, innovation and integration processes between partners (Halldorsson et al., 2007).The parties in a supply network gradually develop mutual trust through the exchange processes. In these activities, innovation helps organizations achieve efficiency; especially, innovative applications of information technology. Innovation leads to value creation for customers and improves the quality of processes and products (Lin, 2008).From a network perspective, trust and innovation helps partners to build an "exchange platform," continually negotiating for exchanges of resources that are needed as resource requirements change. Consequently, a network does not seek an optimal equilibrium, but is in a constant state of dynamic change.

Role of Trust in SC Relationships

Despite the vast literature on trust, there is no clear understanding of concept of trust in the context of SC partner's relationship (Laeequddin, 2011). Researchers in different disciplines have interpreted trust in different ways and assigned it different values by focusing on specific aspects. The trust definitions spans the continuum from a predisposition to a set of beliefs about the (supplier) partner to an intention to engage in a set of behaviors. In each research context, trust has been viewed differently. Table 1 presents different definitions of trust.

Table 1. Concepts of Trust

Authors	Definitions
Barney and Hansen (1994)	Trust is the **mutual confidence**[1] that no party to an exchange will exploit another's vulnerabilities.
Mayer et al. (1995)	Trust is **willingness of a party** based on the expectations

---

1 We mark in bold the key concept of each definition

	that the other party will perform a particular action important to the trustor, irrespective of the ability to monitor or control the party
Lippert (2001)	Technology trust is **an individual's willingness to be vulnerable** to the technology based on expectations of predictability, reliability, and utility and influenced by an individual's predisposition to trust technology.
Riegelsberger et al. (2003)	Trust is a device to reduce complexity, a shortcut to **avoid complex decision processes** when facing decisions that carry risk.
Chen and Barnes (2007)	Trust is **perceived usefulness**, perceived security, perceived privacy, perceived good reputation, and willingness to customize are the important antecedents to online initial trust.
Kim et al. (2009)	Trust is a **complex and multifaceted construct.**
Laeequddin et al. (2009)	Trust is **a threshold level of a supply chain member's** (trustor's) risk-bearing capacity related to trustee.
Thomas and Skinner (2010)	Trust exists when one firm in a cooperative relationship has **confidence in the other firm's reliability and integrity**.
Wu (2011)	Confidence or **predictive ability of client** to group behavior expectation.

For our study, the concept of trust as a set of managerial beliefs is particularly relevant. We assume that beliefs motivate appropriate managerial behaviors, especially during collaboration processes in a SC. Based on the key concepts of the definitions presented above, we define trust in SC as: a complex and multifaceted construct centered on beliefs, in which predictive ability, reliability, mutual confidence and honesty in behaviors of an organization to its SC partners help avoid complex decision processes. These beliefs are reflected in the willingness to share information and knowledge, security and privacy in SC network relations. Thus, trust in SC is determined by the partner's propensity to trust in general and their ability, benevolence and the integrity of their beliefs (Mayer et al., 1995). Trust in inter-organizational relationships has been associated with positive outcomes, such as enterprise achievements, reduction of opportunism, long-term relationships and higher performance (Wu, 2011).

Several findings regarding trust also support the central role of trust as a key managerial concept. The importance of trust arises from the fact that it is regarded as an important contributor to the strength of different relationships (Grönroos, 2000). It is widely accepted that

trust is an important factor in dyadic business relations and an essential element for successful SC network interactions (Gounaris, 2005; Svensson, 2004). This suggests that in low-trust relationships managers would protect knowledge and commitment more by spending additional time and effort to improve the security of network relations. In contrast, if network relations are developed in high-trust environments the partners will be willing to share risk, resources and information much more freely. When the level of mutual trust is high, SC performance increases (Thomas and Skinner, 2010).

The concept of asymmetric relationships generally refers to imbalance in different relationship dimensions such as size, power, *trust*, resources, and competencies. Imbalance in relationship dimensions could be a barrier to SC collaboration processes because in such situations relationships are often dominated by formal agreements more than by trust. They don't motivate SC collaboration leading to innovation but simply ensure access to resources (Colurcio and Russo-Spena, 2013). In asymmetric trust environments the degree of interdependence between the partners in SC can be affected. La Londe (2002, p.10) argued that "issues of trust and risk can be significantly more important in supply chain relationships, because supply chain relationships often involve a higher degree of interdependency." According to this, it could be an advantage for each partner in SC to increase their dependency on exchange relationships. It does, however, raises the question: to what extent interdependency is mutually beneficial? It also makes it necessary to consider whether trust levels influence interdependency and consequently, performance in SC relationships.

Many scholars have suggested that relationships based on trust need to be reinforced by commitment to be successful (Gao and Bird, 2005; Gounaris, 2005; Morgan and Hunt, 1994). Both trust and commitment stimulate and facilitate the establishment of collaboration, especially in innovative activities. Thus, commitment is necessary to maintain a valuable relationship in SC collaboration agreements. Without trust and commitment, SC relationships become risky and vulnerable (Chu and Fang, 2006). Therefore, the success of supply chain management (SCM) requires a high degree of trust among SC partners (Hanfield, 2002). Based on these arguments, we hypothesize:

> H1. The intensity of trust moderates the influence of asymmetry on the
>   SC performance.

Role of Innovation in SC Relationships

The introduction of new products and services, or the entry into new markets, is likely to be more successful if accompanied by innovative SC designs, management practices, and technology (Arlbjørn et al., 2011). Innovation through SCM is becoming more prevalent and important as SC relationships become more strategic (Barret, 2000). Chen and Paulraj (2004) argue that SC network must be composed through a chain of interdependent strategic and collaborative relationships among the SC partners.

From this perspective, a SC relationship's principal objective needs to be the pursuit of mutual benefits through collaboration. Walters and Rainbird (2007), in their research, state that collaborative innovation combines elements of process innovation and product innovation within a network structure. Tether (2002) adds that collaborative efforts have been focusing on managing technological innovation and the complexity of engaging in collaborative arrangements for innovation. However, it is not understood whether collaborative innovation is possible in the presence of asymmetries in SC relationships.

Extant studies provide different definitions of SC innovation. We pointed out in Table 2, the substantial variation in the scope of innovation definitions in existing studies.

Table 2. Concepts of Innovation

Authors	Definitions
Porter (1990)	Innovation refers to **a complex process** which deals with uncertainty in the environment, so as to provide solutions for customer needs and find new ways to better organizational processes using new technologies
Garcia and Calantone (2002)	Innovation is an iterative process initiated by the perception of a new market and/or new service opportunity for a technology based invention, which **leads to development, production, and marketing tasks** striving for the commercial success of the invention.
Roy et al., (2004)	Innovation generation in a supply chain landscape involves **changes in product, process, or service** for the commercial success of the invention.
Walters and Rainbird (2007)	Innovation combines elements of process innovation management and product innovation management within a network structure that neither partner can create using its own resources to meet **customer or market-determined expectations** for product and/or service performance at an economic (viable) cost.
Arlbjørn et al., (2011)	Supply chain innovations are **not static elements** but will typically be triggered by the companies' dynamic interaction with their business environments.
Colurcio and Russo Spena (2013)	Collaborative innovation **creates challenges** to SME resulting from the inability to nurture and maintain the necessary resources and capabilities for growing to **build a competitive positioning and to create value** for the own company and for the network.

Using the key elements of each of these definitions (in Table 2), we define SC innovation as a complex and non-static process, which involves changes in product, process, or service and leads to development, production, and marketing within a network structure. SC innovation creates challenges for meeting customer or market-determined expectations, building competitive positioning and creating value for the firm and for its SC network.

In asymmetric environments, innovation is a dynamic and uncertain process, which involves deficiencies in reliable information about a partner's needs. Moreover, in asymmetric environments deficiencies of information in relationships between SC partners reduces their innovation capability, because lack of information sharing affects internal information processing (Berghman et al., 2012). Thus, one part of SC cannot use the information and knowledge related

to other partners to facilitate the creation of new ideas early in the innovation process (Noordhoff et al., 2011). This condition increases the uncertainty in the relationships between SC partners. This occurs most frequently in environments with low level of trust and collaboration.

High level of trust and collaboration can help transfer of knowledge and information among SC partners, encourage innovation and overcome the impact of uncertainty. However, trust and collaboration would be insufficient for innovation success, because innovation also requires complementary activities from different knowledge domains (Anand et al., 2010).

Exchanging knowledge and human resources have been identified as key activities in managing collaborative innovation (Johnsen and Ford, 2000). In order to develop new technologies, products or services more efficiently, firms generally require extensive use of resources and collaborative R&D relationships (Liu and Chen, 2004).

Superior performance is more typical in SC networks formed by technologically advanced organizations (Jonsson et al., 2007; Sebastiao and Golicic, 2008; Skjøtt-Larsen et al., 2007). Performance is better in SCs where the focal firm is relatively stronger in its technological capabilities (Herzlinger, 2006) compared to its network partners. In this case, asymmetrical relations positively influence SC performance. However, even technologically advanced firms typically focus more on acquiring peripheral technologies than cutting-edge technologies (Liu and Chen, 2004). Furthermore, these firms often limit their transfer of new technologies to less advanced SC partners. In this manner, they restrict leakage of their innovative technologies and capabilities through their network.

This has two implications. First, the potential risk that the firm's technology will fall into the hands of its competitors (Sanna- Randaccio and Veugelers, 2007) leads to lack of trust. Second, this behavior complicates co-designing new processes, exploring new technologies, developing new product and consequently innovation level decreases across the SC. In fact, some firms see their SC partners more as potential competitors than collaborators (Alcacer and Chung, 2007). Based on these arguments, the following hypothesis is proposed:

H2. The intensity of innovation moderates the influence of asymmetry on SC performance.

Asymmetry and SC Performance

Moberg, et al. (2003) define seven constraints that block SC collaboration, including lack of trust, different goals, and lack of transparency in information systems. Lambert (2008) presents similar viewpoints, affirming that development of the right types of relationships, without constraints and limitations, and the creation of value propositions for customers are critical for SC. Limitations and constraints increase complexities in SCM processes and motivate organizations to introduce new tools and forms of inter-organization relationships. Recent research suggests that one of the causes of such varying behaviors and constraints is the presence of asymmetry in SCM process (Chen and Chen, 2002; Johnsen and Ford, 2008; Thomas and Esper, 2010).

There is disagreement in the literature regarding the manner in which asymmetry impacts SC relationships (Johnsen and Ford, 2008; Sun and Collins, 2009; Thomas and Esper, 2010). Such conceptual disagreements call for further exploration of the multi-dimensional and complex nature of asymmetry (Thomas and Esper, 2010). Table 3 shows the substantial variations in the scope of asymmetry definition in existing studies.

Table 3. Concepts of Asymmetry

Authors	Definitions
Chen and Chen (2002, p.1013)	"…asymmetric strategic alliances as an

	investment by firms from developing countries to gain access to new network opportunities, or to **enhance their power in other network relationships**."
Johnsen and Ford (2008, p.472)	"…**imbalance in size and other single relationship dimension**… as power, commitment, dependence, knowledge or the initiation of change"
Sun and Colins (2009, p.2)	"…an "**uncertainty area**" between firms in information sharing, which makes it difficult for a firm to obtain full sets of reliable, accurate and timely information."
Thomas and Esper (2010, p.476)	"…relationship asymmetry refers to a **lack of perceived dyadic balance or proportionality of relationship** attributes and/or behaviors"
Nyaga et al. (2013, p.34)	"… **distribution of power among partners** because of differences in expertise, size, switching costs, dependence, contract structure, etc."

Using the key elements of each asymmetry definitions (Table 3), we define asymmetry as imbalance in size, power, dependence or other dimensions of dyadic or SC relationships in general. Following Thomas and Esper (2010), we suggest that relationships between SC partners become asymmetric when there is disequilibrium in the dimensions that influence these relationships over time. In particular, in such dimensions as conflict, cooperation, communication quality or relational leadership.

The concept of asymmetry is important to understanding SC relationships because it significantly affects performance (Michalski et al., 2013). We view performance as a multidimensional concept that includes four outcomes: growth and diversification of incomes, profit improvements, market participation and customer satisfaction. Empirical SC research uses various frameworks to explain the nature of SC performance. Some researchers suggest SC practices based on trust and innovation influence performance positively. Narasimhan and Nair (2005) suggest performance objectives of a firm can be positively affected (directly or indirectly) by the willingness to share confidential information, which supports trustworthiness between partners. Tan et al. (2002) found that information sharing and cooperation had a positive effect on performance. Fynes et al. (2005) confirm that SC relationship quality has a positive impact on SC performance and Hsu (2005) suggests trust, transparency, and visibility in SC relationships allow unexpected actions and negative outcomes. Firms' innovation processes and activities normally involve interaction and collaboration with other SC members. It has many potential benefits, such as idea generation, cost reduction, increasing flexibility, improving development, testing and diffusion, and shortening the time-to-market (Chen et al., 2013). Narasimhan and Narayanan (2013) argue that firms can effectively align internal innovation activities and

knowledge available in the supply network to gain superior performance. Sisodiya et al. (2013) found that the ability to build interfirm relationships in innovation is essential for gaining superior financial performance.

Other researchers have showed negatively influence of asymmetry: Kim et al. (2010) suggest uncertainty produces a negative effect on operation performance, product cost, and quality; Gulati et al. (2012) confirm that rising demand instabilities and high manufacturing specializations produce increased costs and affect SC performance negatively; Swink et al. (2007) report that manufacturers with supplier integration have poorer quality and potentially poorer new product flexibility. However, Swink and Song (2007) explained that cost coordination and increasing stakeholder integration in new product development efforts have both positive and negative effects on new product success.

Asymmetry in SC relationships exists not only in the aggregate form but also in a large majority of individual firms. From an individual firm perspective, suboptimal resource allocation, non-alignment of objectives and goals or asynchronous decision making process could reduce long-term performance and competitive advantage (Kearns and Lederer, 2003; Terjensen et al. 2012).

A review of the extant literature shows differing influence of trust and innovation intensity on the relationship between asymmetric relationships and SC performance. Thus, we propose:

> *H3. Asymmetry has a non-linear relationship with SC performance under different intensities of Trust and Innovation.*

In order to validate these views, this study examines how asymmetry influences SC performance under different levels of intensity of trust and innovation processes.

METHODOLOGY

To test these hypotheses, a survey was developed and administered. Data collection was carried out in Poland and Spain, regions that are important to global supply networks. Polish market has been least affected by the financial crisis in Europe in recent years and managerial behaviors have been stable affording a suitable environment to study trust and innovation.

During the last few years, Spanish companies' interests have grown to establish businesses in emerging markets such as Poland. Several Spanish companies have adapted practices, procedures, and management tools they used in Spanish markets to new business environments such as Poland. Spanish firms have had to adapt their SCM practices, especially with respect to trust and innovation. These implementations have been made within their SCs that have disparate structures in comparison to those found in their home country. As such, the authors had access to firms in these markets assuring a high level of interest in the study. Therefore, the sampling frame consisted of firms from Spain and Poland.

Sample and survey instrument.

To test the presented theoretical model and describe the relationships among asymmetry, performance, trust and innovation we gathered primary survey data using a questionnaire. The questionnaire was electronically sent to 545 SC organizations in Spain and Poland (279 Spanish firms and 266 Polish firms). Electronic surveys present certain advantages, such as faster data collection and higher response rates (Griffis et al., 2003). The firms were selected randomly and operate in various industries (e.g., electronics, metal, mining, auto, food, construction, logistics services, electric materials, pharmaceutics, cosmetics, energy, textiles, and others; see tables 4 and 5). We selected from those firms with annual sales ranging from $15 million to $100 million. The sampling frame represented a mixed structure of capital ownership and multiple sector.

As control variables, we collected data on characteristics of the supply chains that reflect market maturity. Emerging markets require large investments to cover customer needs, distribution infrastructures, brand adaptations, and development of specific knowledge (Porter, 1990). These requirements are difficult to meet with supply chains made up of few partners. In the Polish market, for example, a majority of supply chains include more than three partners, which confirms previous observations (Tab.4).

Table. 4 Supply Chain structure and research sectors in Poland

NUMBER OF PARTNERS IN SUPPLY CHAIN	N	%
more than 6	44	86.4%
3 to 6	29	11.1%
3 or fewer	6	2.5%
TOTAL	79	100%
SECTORS		
Logistics	10	
Construction	10	
Electronics & IT Hardware	8	
Metal	8	
Clothing, Footwear, & Fashion	7	
Food Industries	7	
Mining	5	
Cosmetics	5	
Automotive	5	
Electric material	5	
Pharmaceutic	3	
Energy	2	
Other	4	
TOTAL	79	

Table. 5 Supply Chain structure and research sectors in Spain

NUMBER OF PARTNERS IN SUPPLY CHAIN	N	%
more than 6	29	23.07%
3 to 6	19	19.23%
3 or fewer	42	57.69%
TOTAL	90	100%
SECTORS		
Logistics	12	
Electronics & IT Hardware	10	
Clothing, Footwear, & Fashion	10	
Construction	10	
Metal	10	
Food Industries	9	

Energy	8	
Mining	0	
Cosmetics	5	
Pharmaceutic	4	
Automotive	7	
Electric material	4	
Other	1	
TOTAL	90	

Maturity of market with well-established market mechanisms, systematically increases capabilities of a business process and an organization's ability to deliver higher performance over time (Rosemann and de Bruin, 2005). In a mature market, domestic and global suppliers compete intensely for market share and customer satisfaction (Johnson, 2000).

Before sending of questionnaires, we pre-tested their content in a pilot study to ensure the reliability and validity of our constructs. In the first step we relied primarily on items used in prior research and subjected them to a thorough pretest. We eliminated items that were unclear, ambiguous, or led to perceived over- laps in constructs. In the second step, the initial questionnaire was presented to selected managers of Spanish and Polish firms. Several of the questions were re-worded in order to improve their clarity in the pretest stage. The questionnaire was translated into Polish and Spanish to ensure that the respondents had a good understanding and comprehension of the issues addressed. In each case, the firm was invited to participate in the study through a letter addressed to the respondent (usually the manager) of the SCM or Procurement department.

Data were collected through a two-part survey in order to minimize the problems associated with common methods bias. The first part consisted of questions on the firm's general characteristics. The second part included a set of closed and open-ended questions dealing with specific issues of inter-organizational relationships in the SC process (Appendix A). We used the literature to identify valid measures for related constructs and adapted existing scales to measure trust (Svensson, 2001 and Ryu et al., 2008), innovation (Colurcio and Russo-Spena, 2013; Gilley and Rasheed, 2000 and Spekman, et al., 1998) and performance (Germain, Dröge and Spears, 1996; and Dröge and Germain, 2000). In the case of asymmetry, we developed our own measures based on our understanding of this construct. All items were scored on a seven-point, Likert-type scales. A Chow breakpoint test on the dependent variable (Armstrong and Overton, 1977) confirmed that there were no significant differences and there was no evidence of non-response bias in the sample.

The survey's single respondent nature may be susceptible to common method bias. Based on survey design guidelines for limiting common method bias recommended by Podsakoff et al. (2003), in first step, we follow suggestions related to questionnaire, we incorporated clear guidelines for the survey, used multiple questions for each construct for increases the precision of the estimate and introduced a cover letter with briefly introducing and promising that the answers would be kept confidential. In second step, we performed Harman's single-factor test, to check the existence of common method bias. The common variance results were 39.81% for Spain and 24.14% for Poland. Both below the commonly recommended 50% threshold, therefore suggesting common method bias is not a problem.

<u>Validity and reliability</u>

We used a confirmatory factor analysis (CFA) with maximum likelihood estimation to establish the construct validity of our measurements. The factor analysis supported the expected structure because the fit indices reflected an acceptable model fit. Internal consistency was measured by

Cronbach's alpha, composite reliability and the average variance extracted (AVE) (see Tables 7 and 8).

Table 7. Latent variables coefficients. Spain

	Sym	Trust	Perform	Innov	Trust*Sym	Innov*Sym
R-Squared		0.637	0.475	0.308		
Adj. R-Squared		0.630	0.463	0.294		
Composite Reliability	0.872	0.880	0.819	0.847	0.945	0.944
Cronbach's alpha	0.803	0.828	0.720	0.772	0.938	0.937
Avg. Var. Extracted	0.631	0.596	0.483	0.532	0.471	0.463
Full Collin. VIF	3.011	3.126	2.043	2.082	2.728	2.734
Q-Squared		0.639	0.496	0.303		

Table 8. Latent variables coefficients. Poland

	Sym	Perform	Trust	Innov	Trust*Sym	Innov*Sym
R-Squared		0.292	0.438	0.195		
Adj. R-Squared		0.266	0.430	0.194		
Composite Reliability	0.823	0.794	0.769	0.770	0.852	0.834
Cronbach's alpha	0.710	0.775	0.823	0.725	0.819	0.793
Avg. Var. Extracted	0.540	0.445	0.401	0.403	0.237	0.221
Full Collin. VIF	1.977	1.155	1.927	1.283	1.418	1.158
Q-Squared		0.337	0.436	0.178		

   In the two countries, Cronbach´s alpha measurements values exceed the recommended threshold of 0.700, for exploratory research. Our composite reliability values, ranged from 0.82 to 0.94 in the case of Spain and from 0.77 to 0.85 in the case of Poland. All of the CR values were greater than 0.60 thus, the values of these metrics were generally greater than the cut-off values suggested by Bagozzi and Yi (1988). As suggested by Fornell and Larcker (1981), to assess discriminant validity, we compared the average variance that was extracted and the variance that was shared between pairs of constructs. The results indicates that the square root of each average variance extracted was greater than the correlation coefficient in the

corresponding columns and rows. This confirmed adequate discriminant validity for our measurements (Tables 9 and 10, on diagonal).

Table 9. Spain. Discriminant Validity. Fornell-Larcker Criterion. Square roots of variance extracted (AVEs) on main diagonal

	Sym	Trust	Innov.	Performance	Trust*Sym	Innov*Sym
Symmetry	(0.794)	0.796	0.437	0.479	-0.389	-0.437
Trust	0.796	(0.772)	0.500	0.431	-0.341	-0.416
Innovation	0.437	0.500	(0.695)	0.639	-0.269	-0.081
Performance	0.479	0.431	0.639	(0.729)	-0.451	-0.249
Trust*Sym	-0.389	-0.341	-0.269	-0.451	(0.686)	0.739
Innov*Sym	-0.437	-0.416	-0.081	-0.249	0.739	(0.681)

Table 10. Poland. Discriminant Validity. Fornell-Larcker Criterion. Square roots of variance extracted (AVEs) on main diagonal

	Sym	Trust	Innov.	Performance	Trust*Sym	Innov*Sym
Symmetry	(0.735)	0.293	0.655	0.385	-0.377	-0.007
Trust	0.293	(0.667)	0.312	0.211	-0.181	-0.119
Innovation	0.655	0.312	(0.634)	0.365	-0.346	0.035
Performance	0.385	0.211	0.365	(0.635)	0.008	-0.014
Trust*Sym	-0.377	-0.181	-0.346	0.008	(0.487)	0.305
Innov*Sym	-0.007	-0.119	0.035	-0.014	0.305	(0.470)

Latent variable correlations for both countries show moderate to high values, indicating a good convergent validity of the measures used for each construct in the model.

Once the measurement model was validated, we assessed the validity of the structural model (Tables 7 and 8). In both cases, the models' coefficients of determination R^2 take values above the lower weak threshold limit of 0.190. Variance inflation factors (VIF values) were appreciably lower than the commonly admitted threshold value of 5. Therefore, we deemed multicollinearity was not a problem.

We received 169 completed surveys (90 from Spanish and 79 from Polish firms respectively), which represented a 32.24% of response rate in the case of Spain and 29.69% in the case of Poland. These response rates are sufficiently high and comparable to other studies in SCM literature (Chen and Paulraj, 2004; Lee, et al., 2011; Terjesen, et al., 2012)

Research Framework and Measures

The majority of the empirical research in SCM literature has used only linear models, which assume that there is a linear effect for asymmetry, trust, innovation and others factors on performance. Therefore, even if relationship between asymmetry and performance is curvilinear, linear models would simplify the relationship and mask the true relationships among the variables (Edwards 2002). However, Terjesen, et al. (2012) recently have showed an inverse U-shaped relationship between SC integration and performance. They found significant curvilinear relationships that indicated that integration contributed positively to performance up to a certain point, after which a negative relationship was observed. Therefore, complex congruence

hypotheses using curvilinear effects are required to test the full range of component measures (Venkatesh and Goyal, 2010).

The examination of complex relationships among constructs and an outcome variable requires two step hierarchical analysis to detect accurately their relationships (Edwards 1994, 2002). Following Venkatesh and Goyal (2010) and Terjesen et al. (2012), we used Polynomial modeling in our analysis that permits examination of curvilinear relationships between constructs. Polynomial regression is a stepwise model. First step of the analysis was testing the linear relationship of components (asymmetry, trust and innovation) with outcome variable (Performance). If the direct effects are significant, nonlinear effects are introduced in the next step (for a detailed discussion, see Edwards, 2002; Edwards and Harrison, 1993). In order to corroborate the hypothesized curvilinear relationship among asymmetry and performance, previously detected in the model (Chatelain et al., 2002; Temme et al., 2006), we estimated two polynomial regressions, one for Spain and one for Poland (see tables 11 and 12) relating asymmetry and performance. In the equation for Spain, p-values of the quadratic and cubic terms are above the common threshold $p <= 0.05$ reflecting the dominance of the linear component (see table 12). On the contrary, no linear effects have a strong significance ($p<= 0.05$) in the equation for Poland (see table 11).

Table 11. Poland. Polynomial Regression Results.

Dependient Variable: PERFORM				
Independient Variables	Coefficient	Std. Error	t-Statistic	Prob.
C	0.142118	0.142133	0.999888	0.3205
ASYM	0.625807	0.189602	3.300631	0.0015
(ASYM)^2	-0.239306	0.117303	-2.040073	0.0448
(ASYM)^3	-0.179643	0.073785	-2.434697	0.0172

Table 12. Spain. Polynomial Regression Results.

Dependient Variable: PERFORM				
Independient Variables	Coefficient	Std. Error	t-Statistic	Prob.
C	0.141497	0.183857	0.769605	0.4453
ASYM	0.573735	0.214565	2.673945	0.0102
(ASYM)^2	-0.191546	0.165664	-1.156227	0.2533
(ASYM)^3	-0.089739	0.081133	-1.106074	0.2742

During the second step of analysis, we used the Warp 3 algorithm (Chatelain et al., 2002; Temme et al., 2006) to test for the presence of non-linear relationships. We have used this type of modelling and algorithm as a means to explore simultaneously the complex causal, mediation and moderation relationships arising among Trust, Innovation, Asymmetry and Performance (Figure 1). This analysis allowed us to test, simultaneously, for performance variations, for various levels of Trust and Innovation in the presence of asymmetries. To corroborate the results, we tested the extent to which the non-linear relationship is valid in the context of the current data. In order to assess the postulated hypotheses, we propose a non-linear model (Figure 1) with statistical estimates derived from Partial Least Squares (PLS) regression analysis using WarpPLS 5.0 (Kock, 2015). Originally developed for econometrics, PLS has more recently been adopted in research in business, education, and social sciences. The decision to estimate the model using the Partial Least Squares (PLS) regression method was made according to the following criteria: the phenomenon investigated is relativity new and its modeling is in a developing stage; minimal recommendations exist concerning sample size, prediction accuracy;

and non-data multi-normality requirements. PLS is the preferred choice for research models which incorporate both reflective and formative constructs (Lehner and Haas, 2010; Wetzels et al., 2009). PLS regression aims to produce a model that transforms a set of correlated explanatory variables into a new set of uncorrelated variables (Tenenhaus, 1998). The parameter estimates in a PLS regression are derived from the direct correlations between the predictor variables and the criterion variable. This procedure uses two-stage estimation algorithms to obtain weights, loadings, and path estimates (Wold, 1985). The constructs of the model are unobservable (latent) variables indirectly described by a set of observable variables, which are denominated indicators. The use of multiple questions for each construct increases the precision of the estimate.

This paper applied, Warp 3 algorithm tries to identify nonlinear functions between pairs of latent variables in structural equations models and calculate their association coefficients accordingly (Kock, 2015). The Warp 3 algorithm (Kock, 2015) identifies a set of functions:

F1(LVp1), F2(LVp2) relating blocks of latent variable predictors (LVp1, LVp2 ...) to a criterion latent variable (LVc), as in

LVc = p1*F1(LVp1) + p2*F2(LVp2) + … + e

where p1, p2 ... are path coefficients, and e is the equation error term.

All variables are standardized. The more curvilinear the functions F1(LVp1), F2(LVp2) ...are curved the greater will be the difference between the path coefficients p1, p2 ... and those that would have been obtained via a linear analysis. This is done for a wide range of functions, with modification constants included. Simple graphical inspection (see figures 2, 3, 4, 5, 7, 8, 9 and 10), later formally tested, permitted assessment of whether the functions fitted by the algorithm are a good fit to the data.

Although 100 bootstrapping resamples is said to be sufficient (Efron et al. 2004) for the PLS analysis, 5000 resamples were performed (Hair et al., 2011). The decision to estimate the model using PLS was made according to the following criteria: The phenomenon investigated is relativity new and its modeling is in a developing stage, minimal recommendations exist concerning sample size, prediction accuracy and strict multinormality requirements (Henseler et al., 2009; Joreskög and Wold, 1982).

We interpret negative symmetry values as asymmetry indication. The model shows direct and indirect influence of asymmetries (Asym) and direct influence of trust (Trust) and innovation (Innov), on performance (Results). In addition, we tested for the presence of moderation (dashed lines), enhancing or constraining the direct effect of Asymmetry on Performance. Table 6 summarizes model fit and quality indices for both countries. The following indices were used to test hypotheses and model fit (Kock, 2013): average path coefficient (APC), average R-squared (ARS), average adjusted R-squared (AARS), average block variance inflation factor (AVIF), average full collinearity VIF (AFVIF), Tenenhaus goodness-of-fit index (GoF), Sympson's paradox ratio (SPR), R-squared contribution ratio (RSCR), statistical suppression ratio (SSR), and non-linear bivariate causality direction ratio (NLBCDR).

Table 6. Model Fit and Quality Indices Overview

Index	Value (Spain)	Value (Poland)	Value Interpretation
Average path coefficient (APC)	0.338, P=0.002	0.290, P=0.001	Significant if p<0.01
Average R-squared (ARS)	0.487, P<0.001	0.308, P<0.001	Significant if p<0.01
Average adjusted R-squared (AARS)	0.462, P<0.001	0.287, P<0.001	Significant if p<0.01
Average block VIF (AVIF)	2.269	1.524	Acceptable if <= 5, ideally <= 3.3
Average full	2.620	1.486	Acceptable if <= 5,

collinearity VIF (AFVIF)			ideally <= 3.3
Tenenhaus GoF (GoF)	0.508	0.340	Small >= 0.1, medium >= 0.25; large >= 0.36
Sympson's paradox ratio (SPR)	0.857	0.857	acceptable if >= 0.7, ideally = 1
R-squared contribution ratio (RSCR)	0.984	0.985	Acceptable if >= 0.9, ideally = 1
Statistical suppression ratio (SSR)	1.000	1.000	Acceptable if >= 0.7
Non-linear bivariate causality direction ratio (NLBCDR)	0.857	0.714	Acceptable if >= 0.7

The Tennenhaus GoF index (Tenenhaus et al., 2005) is a measure of a model's explanatory power, defined as the square root of the product between the average communality index and ARS. The communality index for a latent variable is defined as the sum of squared, un-rotated loadings with each loading associated with an indicator, divided by the number of indicators. The average communality index for a model is defined similarly, and considers all latent variables in the calculation. The SPR index is a measure of the extent to which a model is free from instances of Simpson's paradox. A Simpson's paradox indicates a causality problem, suggesting that a hypothesized path is either implausible or reversed (Pearl, 2009; Wagner, 1982). The RSCR index is a measure of the extent to which a model is free from negative R-squared contributions, which occur with Simpson's paradox instances (Pearl, 2009; Wagner, 1982). The SSR index is a measure of the extent to which a model is free from statistical suppression instances (MacKinnon et al., 2000). A statistical suppression instance indicates a causality problem, suggesting a hypothesized path is either implausible or reversed. The NLBCDR index is a measure of the extent to which bivariate, non-linear coefficients of association support the hypothesized directions of causal links in a model. All fit and quality indices discussed above met recommended thresholds (Table 6).

Regarding the hypothesis, hypothesis 3 proposed a non-linear relationship between Asymmetry and Performance, testing the assumption of a relationship between the two variables. As shown in our results H3 is supported (β =.12; β =.36 with p<0.01, fig. 1 and 6). Although not hypothesized, drawing on different intensity of Trust and Innovation could also have a non-linear relationship to Performance. The findings suggest that separately both Trust and Innovation have a relationship with Performance, which support H1 (β =.33; β =.09 with p<0.01, fig. 1 and 6) and H2 (β =.35; β =.35 with p<0.01, fig. 1 and 6). This is consistent with the literature that argues that Asymmetry has a limited effect on Performance when Trust and Innovation are present in the model (Michalski et al., 2013). For many managers in asymmetric business environments, a high level of trust or innovation seems to be excessive interdependence of SC partners. In the case of small and medium firms, the managers can avoid increasing the level of trust or innovation, because benefits do not evolve automatically from this decision. In this situation, they prefer maintenance of asymmetric relationships, although this could lead to reduction of performance.

Overall, structural model findings support all three hypotheses.

FINDINGS

We explore whether the changes in asymmetry levels have an impact on performance, under different intensities of trust and innovation in SC relationships. We also explore these relationships in different markets, in order to be sure that the results of these relationships do not depend on market development. It is interesting to examine how the intensity of trust and innovation in symmetric relationships differs from asymmetric relationships with respect to SC performance. Figure 1 shows model hypotheses, with corresponding p-values for the Spanish sample. Solid lines indicate causal relationships; dashed lines indicate moderation path and dotted lines show insignificant relationships. Beta coefficients were normalized, taking values between zero and one, and measuring the strength and direction of the relationships.

Figure 1. Research Model and Primary Results for Spain
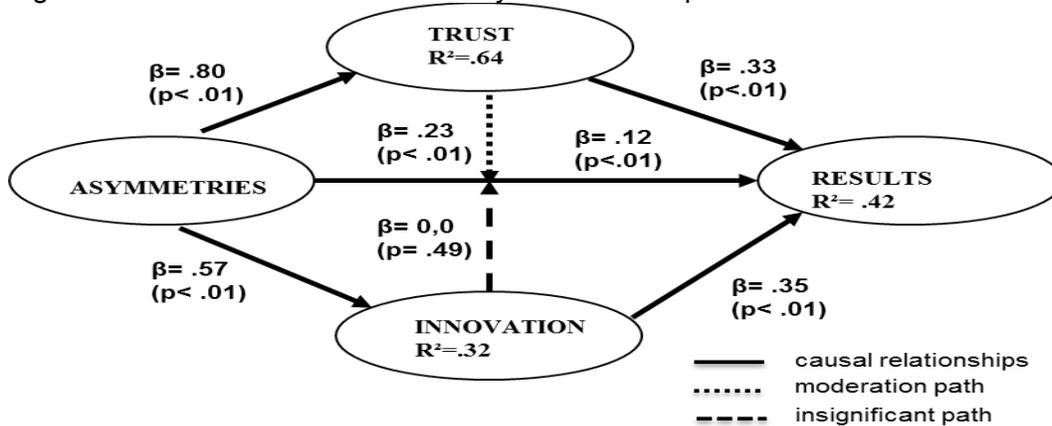
All relationships were significant ($p<0.01$), including the direct relationship between asymmetry and performance, with one exception. The indirect effects of innovation on performance were not significant. In the curve that reflects the relationship between asymmetry and results in the low-trust context in Spain, two inflection points are evident (Figure 2). These two turning points are at both ends of the curve, although for the most part, its path shows a steady growth tendency. In mature markets, reduction of high level of asymmetry is beneficial to SC performance, allowing its improvement. However, a small amount of asymmetry can help maintain this improvement.

At the other end of the curvilinear, relationship an increase of symmetry in relationships does not produce the same effect on performance, instead the performance begins to diminish. This situation allows us to suggest that in the case of low trust environments, SC partners must avoid highly asymmetric or highly symmetric relationships, if they want to improve their performance. The curvilinear relationship explains some of the conflicting findings in the literature. When there is asymmetry, under conditions of low trust, it can be conjectured that relational friction might lead to low collaboration and opportunism degrading performance. Similarly, when symmetry is high, network perspective would suggest that firms would have high level of connectedness with their network partners and such closure might not be conducive to knowledge exploitation and innovation (Narasimhan and Narayanan, 2013; Noordhoff et al., 2011). Our findings support Ramsay (2001) and Schoenher and Mabert (2006), who suggested that relationships among organizations of similar size, strength, and power are highly recommended.

In Spanish SCs characterized by high levels of trust, the relationship between asymmetry and performance is slightly different (see Figure. 2). Regarding the influence of asymmetry on performance in the high trust level context, the curvilinear relationship has a U shape. Decrease in the level of asymmetry (and even slight increase in symmetry) in relations between partners diminished the collaboration performance. We argue that the decrease of asymmetry may be associated with reduction of dependence on dominant partner due to attempts by dependent firms to modify the trading conditions, especially in terms of price, quality and delivery, without

fear of breaking the contract. The U shape relationship between asymmetry and performance also suggests that high level of trust can be costly for the firms. In this situation, managers try to balance the level of trust with anticipated superior performance. However, tendency to increase collaboration leads to performance decreases.

High trust levels removes the threat of opportunism allowing the partners to act somewhat independently. This effect is manifested until a threshold value of symmetry is reached. Beyond this value, symmetry in the presence of high levels of trust allows firms to commit resources to the relationship enhancing collaboration and innovation.

Figure 2. Asymmetry, Trust and Performance Relationships in Spain (Standardized Scales)
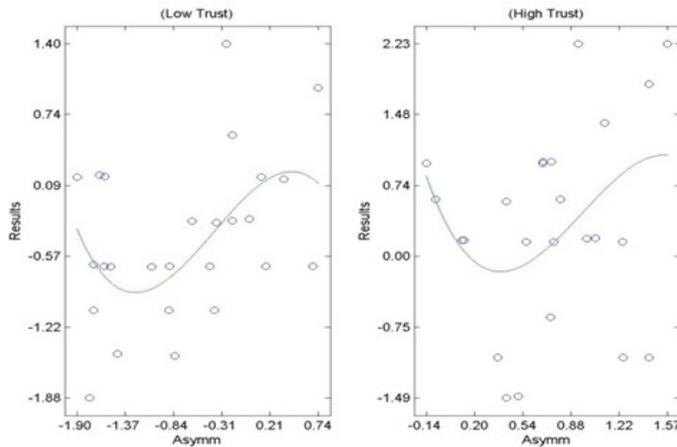
Performance was strong and positively influenced by growing of symmetry. The increasing portion of the U-shaped curve relates to this situation. In environments with high level of trust, the SC partners will be willing to communicate openly, accept sharing of information at all levels and bear risk jointly. Its influence is very positive for performance. According to this, we suggest that in the case of mature markets with high level of trust, the dependent companies should try to keep relative symmetry in their collaborative relationships as long as possible. This finding supports Feldman (1998), who argued that mutual interests are at play as long as a company can keep up their partner's perception that their relationship is still symmetric.

In Spanish SC characterized by low levels of innovation, the relationship between asymmetry and performance followed again a different curvilinear path (see Figure 3). For much of the asymmetry range, performance is negative. It seems that managers' belief that increased costs associated with innovationsare not   absorbed by the entire supply chain but by each participant in asymmetric environment. Innovations lead only to the trade-offs between operating costs and changes in unit costs in the supply chain, which are not necessarily evident at the same time. In this situation the reduction of asymmetry does not produce significant change in performance degradation.

Figure 3. Asymmetry, Innovation and Performance Relationships in Spain (Standardized Scales)
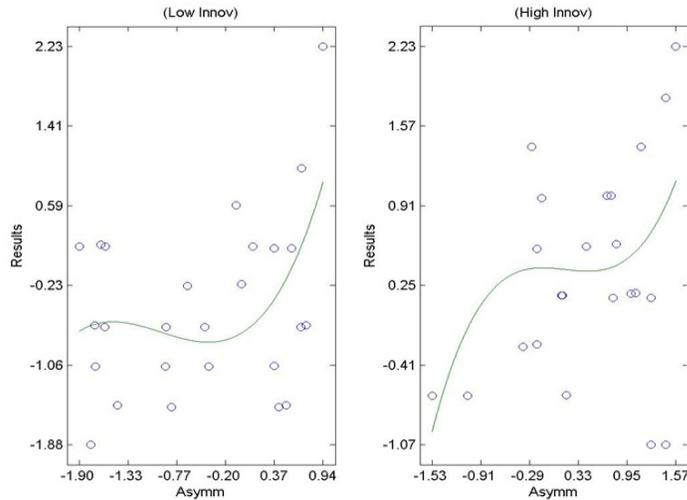
From other view point, asymmetry is not a problem for the development of collaborative innovation. Firms have a wide range of possibilities to search for larger partners to make investments in innovation. Differences in size, power, structure or resources between partners, so typical for asymmetric relations, will not affect and will not create barriers to this search.

The situation changes with the growth of symmetry in relations between partners in the SC; performance begins to grow quickly. This suggests that symmetry is necessary for driving differences in performance. Like Colurcio and Russo-Spena (2013), we reason that in mature environments with low innovation level, small firms need to work closely with other small firms, which are similar in their background of knowledge and routines whereas medium companies are searching to gain access to specific technological know-how.

In the case of high innovation, the path of performance again changes (see Figure.3). Decreased asymmetry, increasing degree of symmetry, produces rapid performance growth. In the middle part of the curve, where low levels of asymmetry or symmetry can be observed, the value of performance does not seem to be affected by these changes. The curvilinear relationship shows in an environment of high innovation intensity higher levels of asymmetry and symmetry are beneficial. This is characterized by situations where a focal firm might engage with a number of smaller but innovative firms to increase SC performance. In contrast, when innovation intensity is high, firms can also engage with supplier partners who themselves are large, have high resource endowments and similar in size, power and innovative ability in order to increase SC performance. Such situations can be observed in the behavior of firms in industries such as furniture and tiles in Spain. Companies in these sectors have begun working more closely with similar and highly innovative suppliers from other sectors such as construction, textile and lighting. The offer of innovative products produced collaboratively has increased performance and has created a new opportunity for growth.

The joint effects of asymmetry, trust and innovation on performance are shown in Figure 4 and 5 for Spain and 9 and 10 for Poland. The three-dimensional analysis facilitated by curvilinear modeling allows us to maintain distinction throughout the analysis and test complex congruence hypotheses, such as the difference in the absolute level of performance when the values of both trust and innovation are high compared to when both are low. This distinction is not possible to assess using direct measures (Venkatesh and Goyal, 2010). Positive effects on the performance from coordinated decreases in asymmetry (i.e. increasing level of symmetry) and increases in trust are evident. Even only one of these variables, if acted upon, increases Results. The same is evident when considering the joint effects of asymmetry and innovation on performance (Figure 5). A coordinated decrease of asymmetry and increase in innovation had

notably positive effects on results. An effect is evident, though more slowly, when acting predominantly or exclusively on only one of these variables.

Figure 4. Simultaneous Effects of Trust and Asymmetry on Firm Performance in Spain
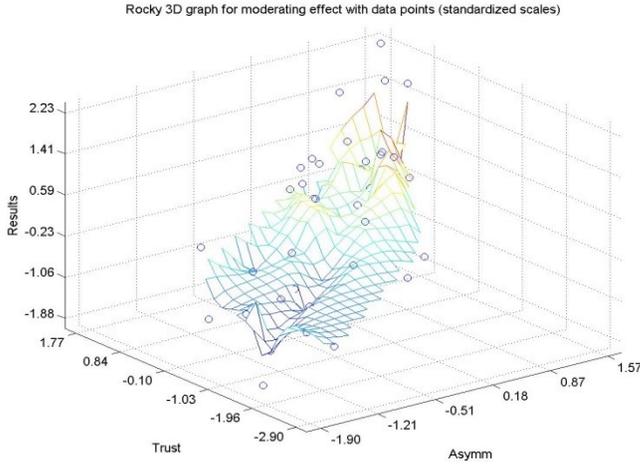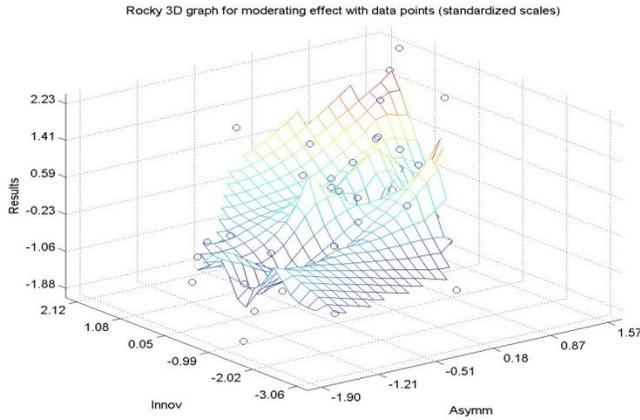

Figure 5. Simultaneous Effects of Innovation and Asymmetry on Firm Performance in Spain

Considering the Polish sample, Figure 6 presents the results, with corresponding p-values. Most relationships were significant (p<0.01), with two exceptions, the indirect effects of trust and innovation on Results were not statistically significant.

Figure 6. Research Model and Primary Results for Poland
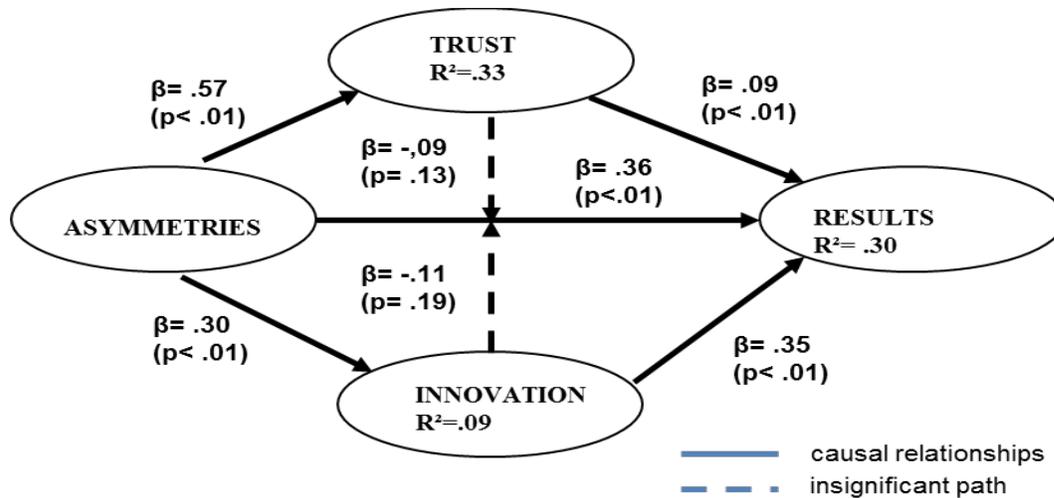
The curvilinear response functions for Poland show interesting relationships between asymmetry and performance in low and high trust context. They have a similar, although inverse path. Regarding the influence of asymmetry on performance in low trust environments, the curve had a classic-U shape. Although with a substantial spread, in high trust environments, we observed an inverted-U shape (Figure 7). A clearer picture emerges in figure 9, where it can be seen how increasing levels of symmetry and trust lead to higher performance.

In emerging markets with low levels of trust, in order to increase the performance, it is appropriate to establish highly asymmetrical or symmetrical relations between partners. In this type of relationships the safeguarding effect of collaboration is stronger, especially when risks of opportunism due to low level of trust are high (Corsten and Felde, 2004).

All intermediate solutions bring about the opposite effect (i.e. decrease performance). These findings are opposite to Johnsen and Ford's (2001) suggestions that to improve benefits from collaborative dyadic relationships it is necessary to change from asymmetrical to symmetrical relationships. We suggest that the cost and requirements of this change, especially in areas of organizational capacity and culture, in the short or medium term, do not justify it. If firms are seeking stability in relationships, the high level of asymmetry, which is reflected by the clear dominance of one party over another, could be acceptable and even beneficial.

Interestingly, the increase of trust reverses the nature of the relationship. In emerging environments, with high levels of trust, a slight asymmetry or symmetry creates the best conditions for growth of performance. High levels of symmetry and asymmetry drastically reduce performance. This suggests that it is not necessarily asymmetry or symmetry driving variations in performance, but rather the level of trust. This implies that in markets that are at a lower level of maturity in SCM, trust is much more important than symmetry in SC relationships. This finding deserves further investigation.

Figure 7. Asymmetry, Trust and Performance Relationships in Poland (Standardized Scales)
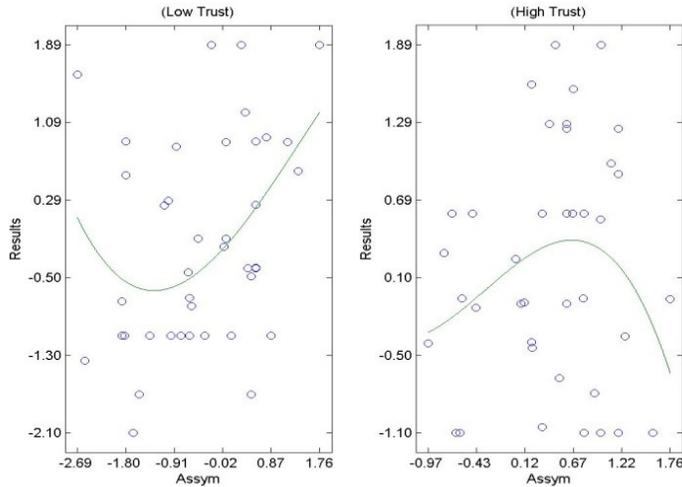
Regarding innovation, in the low-innovation context, the curvilinear relationship is very similar to that observed in the case of trust in the same environment (see Figure 8). Performance is severely affected in conditions of high degree of asymmetry and symmetry, although in the case of high symmetry environments growth of performance is limited. These findings support Noordhoff et al. (2011), who argue that one part of SC can use the innovation knowledge related to other partners to facilitate the creation of new ideas early in the innovation process. This behavior increases the uncertainty in the relationships between SC partners and could slow down performance.

If the level of innovation changes from low to high, the figure shows two breakpoints (see Figure 8). At these points, a change in the development trend occurs. In SCs with high innovation levels, in the first stages for high asymmetry, the effect on results was negative until the breakpoint, after which there was a change in benefits that turns positive until moderate symmetry is achieved. If values for symmetry continue to expand, the influence on performance becomes again negative.

As expected, the reduction of asymmetry in these environments produces improved performance (Wang, 2011), but the influence of symmetry on performance was a surprise. The results suggest that after getting by firms a high degree of symmetry, especially related to knowledge, information and power, can increase the risk of demotivation, lack of risk-taking in new projects and even lack of ambition in the relationships between the parties. This could lead directly to reduction of SC performance.

Considering the simultaneous effects of trust and asymmetry on performance (Figure 9), the results are clear in Poland, the emerging market. We detected a similar trend - increased trust and symmetry being associated with higher performance. It suggests that firms should not rely on asymmetry or trust to obtain substantial growth in performance, but the simultaneous application of both of them.

Figure 8. Asymmetry, Innovation and Performance Relationships in Poland (Standardized Scales)
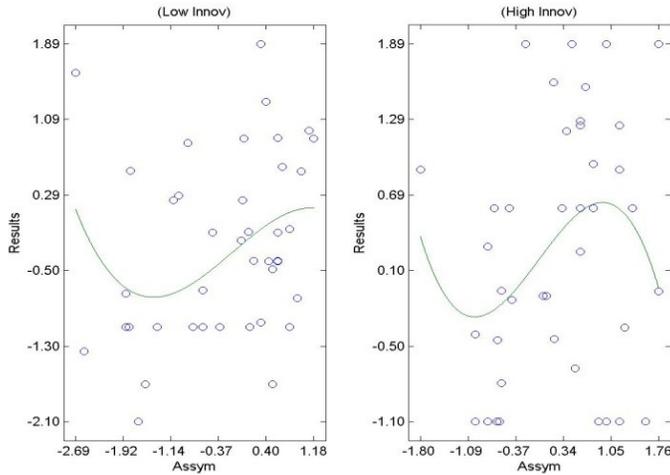
The simultaneous effects of innovation and asymmetry (Figure 10) in this market, results are similar. Although we detected a similar trend related to symmetry—increased innovation and symmetry accompanying higher results—the increase appears limited for the majority of firms in the case of high level of innovation.

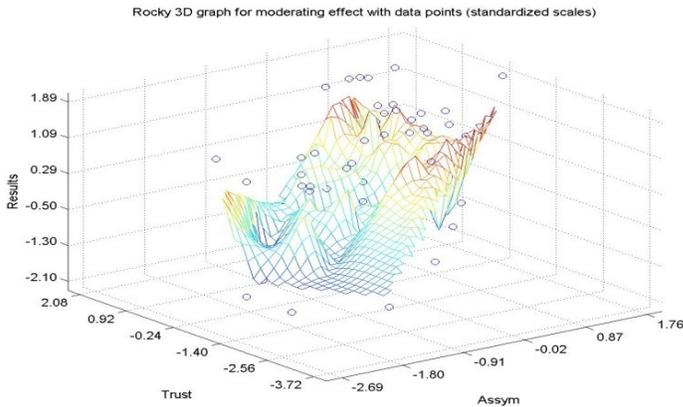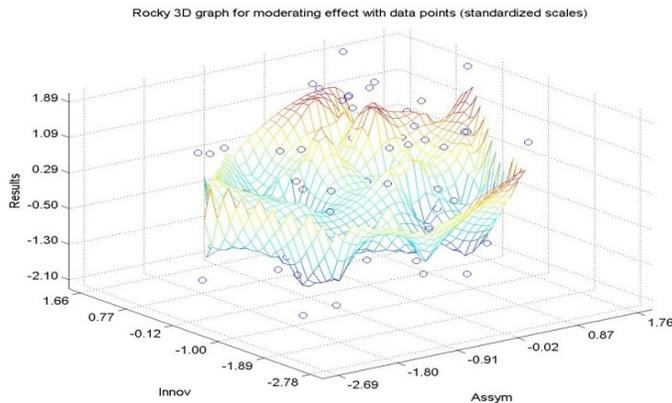Figure 9. Simultaneous Effects of Trust and Asymmetry on Firm Performance in Poland

Figure 10. Simultaneous Effects of Innovation and Asymmetries on Firm Performance in Poland

23

DISCUSSION

In extant literature that has investigated collaborative agreements, researchers agree that asymmetry is important and can significantly impact relationship performance. This exploratory research has uncovered some new and interesting findings relative to the nature of asymmetry's influence on performance in SC relationships. Our findings extend research that addresses asymmetry influences on performance under varying trust and innovation contexts in SCM. The findings also provide insights to practicing managers regarding how to more effectively approach their collaborative relationships.

SCM leads to greater interdependence between partners and has required monitoring and managing performance for mutual benefits. Critical issues for SCM systems are primarily concerned with trust and innovation. According to Laeequddin et al. (2012) trust is context-dependent phenomenon related to rationality, economic relationship, and dynamic capabilities of partners and adoption of technology. Mohd Noor and Pitt (2009) add that to ensure the success of collaboration, it must be founded with a high level of commitment among all parties in the SC. Maheshwari et al. (2006) observed that SC partners must focus on innovation, once they are stabilized and normal operations are achieved. Bouncken (2011) suggests that firms should invest resources in innovation, hoping that their partners will continue to offer future business once the innovation proves fruitful. We would add to these concepts the asymmetry and symmetry, context that affect and are affected by different intensity of trust and innovation. However, the effects of asymmetry or symmetry on performance are still not well understood. This research sought to shed some light upon this important issue.

From a theoretical perspective, it is apparent that relationships between asymmetry, performance, and SC trust and innovation are ambiguous depending on context. Current research, however, does not offer clear answers, but instead focuses on linear relationships among these variables. Perhaps the most significant findings are that the influences of asymmetry and symmetry on performance in varying trust and innovation contexts have varying effects (unstable character) and non-linear paths, a notion supported by Thomas and Esper (2010) who find that asymmetry is a complex and not a static issue, has a temporal character, although structural asymmetry may be constant.

The non-linearity regarding these relationships complicates the already complex and dynamic SCM processes. Temporal and unstable relationships in SC accord well with NT theoretical research (Lam, 2008; Miles and Snow, 2007; Skjoett-Larsen, 1999). Our findings confirm that managers do not seek an optimal equilibrium (i.e. stable relationship), but their management strategies rely on trust and innovation due to a constant state of dynamic movement.

Findings also indicate other suggestions for managers related to strategic decisions. Asymmetry, trust, innovation and performance relationship can take many forms. Managers operating in different environments, within varying contexts of trust and innovation, must recognize their specific contexts when making decisions since no two SCs are the same. In environments with low intensity of innovation in both contexts studied, the managers of small and medium firms are accepting asymmetric relationships over long periods of time more frequently, without suspecting that this may harm them greatly. Surprisingly, for small and medium firms, unbalanced relationships do not seem to be so critical. This is close to Colurcio and Russo-Spena (2013) line of thinking, who find that in asymmetric relationship, involvement in the innovation network of firms with different size is of mutual benefit for both partners. The larger partner offers marketing and technological input for improvement of products for small firms, which operate in a niche; thanks to this small firms can grow together with their small clients and suppliers; and Johnsen and Ford (2008) who suggest that small firms frequently accept asymmetric relationships as a method of attempting to secure their relations with important large companies and when participation in their network is more attractive than other opportunities. The smaller size of some firms gives them flexibility, agility and the advantage of

early involvement in new developments. . It promotes innovations and permits them freedom to make decisions related to selection of partners.

We argue that it is important for managers to recognize that in this case, too symmetric relationships might not return as much as asymmetric relations do. Managers can see trust as a mechanism for achieving coordination among SC partners. Despite some views of trust in literature, Kumar (1996) suggests that trust in SC relationships can be built between unequal entities, but only if there is fair play. This does not mean that such asymmetry relationships are not workable or enduring. Moreover, especially in low trust intensity environments, asymmetry may also have a positive effect, improving the performance level and bringing together firms with varied viewpoints, cultures and strategies. Thomas and Esper (2010) suggest that small firms accept the differences in the levels of commitment between themselves and a large retail chain if this allows them to maintain the present status quo. However, even in such a situation the involvement in the SC network must produce mutual benefit for all partners.

CONCLUSION, LIMITATIONS AND FUTURE RESEARCH

This exploration of asymmetry in inter-firm SC relationships makes several meaningful contributions to literature on buyer-supplier relationships. First, it provides greater understanding of a neglected area of SC relationship research, that of asymmetry in relationships. Empirical research, however, does not offer clear solutions, but instead focuses on linear relationships among variables chosen for investigation. Exploration utilizing non-linear relationships involving asymmetry has been lacking. This omission is especially noticeable given that some level of asymmetry is common in many interfirm relationships. This study adds a new point of view to SCM theory by suggesting that not all trust and innovation environments always and directly lead to performance improvements. Explication of non-linear paths and unstable nature of the influences of asymmetry and symmetry on performance in varying trust and innovation contexts is the principal contribution of this study.

The second contribution to the body of knowledge is that our findings offer suggestions for managers regarding strategic decisions. Some businesses do not enter high trust or innovation environment, because benefits do not evolve automatically by changing from asymmetric to symmetric partnerships. For many managers, a high level of symmetry together with high intensity of trust or innovation leads to excessive interdependence with SC partners, especially in the case of small and medium firms. It could limit La Londe's (2002) suggestion - that it is advantageous for each partner in a SC to increase the degree of interdependence - to large firms. Findings from this study provide guidance to managers regarding when it is appropriate to reduce asymmetric relationships with partners while considering varying trust and innovation contexts.

The third contribution of this research is that the development of symmetric relationship to improve SC performance under different trust and innovation contexts has limits. Managers must be careful when making the decision to replace an asymmetric relationship with a symmetric relationship even if it seems to be necessary to achieve rapid growth in performance, because expectations can be wrong.

Fourth, previous research suggests that trust and, recently, innovation are so important that any relationship is destined to fail without them. However, these suggestions are often unclear and too simple. Findings from this study provide guidelines for managers regarding when it is appropriate to invest in trust and innovation under asymmetrical/symmetrical relationships. This becomes even more critical in multi-partner supply chain relationships. We suggest when multiple firms are involved in an asymmetrical SC network, the need to identify the magnitude of trust and innovation capabilities across all parties is essential. Our results suggest that firms should engage in "supply network mapping" to better understand relationships in supply networks. Our findings offer some initial insights that should be investigated deeply.

Limitations and future directions

This paper has some theoretical and methodological limitations. Our study focuses only on one particular business environment in two countries. Dyer and Chu (2003) suggest that cultural differences between institutional environments may influence the development of interfirm relationships. In this context, it is possible that potential contextual variables such as national culture may have influenced the relationships observed. Another limitation of this study is the issue of generalizability since our sample was drawn from two European countries. Consequently, future research could explore validation of the results of this study in other countries

    We analyzed asymmetry's influence on performance from a conventional dyadic perspective of SC relationship. Multi-firms (network) analysis perspective would enhance the practical utility of this study for managerial application. Research may clearly identify the concept and roles of trust, innovation and other critical factors in asymmetrical inter-firm SC relationships.

    The conceptual and empirical approach used in this study considers the non-linear effects of the relationship between asymmetry and performance in the presence of varying trust and innovation levels, an approach that needs special attention. The approach provides a point of departure for future research that could address other moderating variables that affect the high power and low power firms in supply networks. It would be interesting to test whether the high power and low power firms experience different performance effects in asymmetrical relationships.

    Our research focused on relationship in industrial sectors. Future research could examine the asymmetry-performance relationship in other sectors; for example, the retail sector. Asymmetry in trust, innovation, power, collaboration or integration efforts within a retail network may have different influence on performance.

    This research highlights the importance of how firms should manage potential negative or positive consequences of asymmetry in multi-tier relationships; but much more research is needed to clarify the true role of asymmetry in SC relationships.

REFERENCES

Alcacer, J., & Chung, W. (2007). Location strategies and knowledge Spillovers. *Management Science,* 53(5), 760–76.

Armstrong, J.S. & Overton, T.S. (1977).Estimating nonresponse bias in mail surveys. *Journal of Marketing Research,* 16: 396-402.

Arlbjørn, J.S., de Haas, H., & Munksgaard, K.B. (2011). Exploring supply chain innovation. *Logistics Research,* 3(1):3-18.

Atkinson, S. & Butcher, D. (2003). Trust in managerial relationships. *Journal of Managerial Psychology,* 18(4): 282-304.

Bagozzi, R.P. & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science,* 16(1): 74-94.

Barney, J.B. & Hansen, M.H. (1994). Trustworthiness as a Source of Competitive Advantage. *Strategic Management Journal*, 15 (Special Issue): 175-190.

Barret, P. (2000). Achieving strategic facilities management through strong relationships. *Facilities,* 18 (10/11/12): 421-6.

Basnet, C., Corner, J., Wisner, J., & Tan, K. (2003). Benchmarking supply chain Management practice in New Zealand. *Supply Chain Management: An International Journal,* 8(1): 57-64.

Bouncken, R.B. (2011).Supply Chain Contingencies: The Effects of Up-Stream Directives on Supplier's Innovation Performance. *Engineering Management Journal,* 23(4): 36-46.

Cao, M. &Zhang, Q.Y. (2011). Supply Chain Collaboration: Impact on Collaborative

Advantage and Firm Performance. *Journal of Operations Management,* 29:163–80.

Capaldo, A. (2007). Network structure and innovation. The leveraging of a dual network as a distinctive relational capability. *Strategic Management Journal,* 28: 585-608.

Chatelin, Y.M., Vinzi, V.E., & Tenenhaus, M. (2002), State-of-art on PLS path modeling through the available software. Storrs, CT: Department of Economics, University of Connecticut.

Chen, Y-H. & Barnes, S. (2007). Initial trust and online buyer behavior. *Industrial Management & Data Systems*, 107 (1): 21 – 36.

Chen, I. & Paulraj, A. (2004). Understanding supply chain management: critical research and a theoretical framework. *International Journal of Production Research,* 42(1):131-63.

Chen, W., Brennan, L. & Zeng, D. (2013). Exploring Supply Chain Collaborative Innovation: Evidence from China*. Irish Journal of Management*, 32(2): 5-27.

Chu, S-Y. & Fang, W-Ch. (2006). Exploring the Relationships of Trust and Commitment in Supply Chain Management. *Journal of American Academy of Business,* 9(1):224-28.

Colurcio, M. & Russo-Spena, T. (2013). Collaborative Innovation — A Focus on Food SMES.In I. Muzzalupo (Ed.). *Food Industry*: 647-668.

Corsten, D. & Felde, J. (2004). "Exploring the performance effects of key-supplier collaboration*. International Journal of Physical Distribution and Logistics Management*, 35(6): 445-461.

Dyer, J. & Chu, W. (2003). The role of trustworthiness in reducing transaction costs and improving performance: empirical evidence from the United States, Japan, and Korea. *Organization Science,* 14(1): 57-68.

Edwards, J. R., & Harrison, R. V. (1993). Job Demands and Worker Health: Three-Dimensional Reexamination of the Relationship Between Person–Environment Fit and Strain. *Journal of Applied Psychology* 78(4): 628-648.

Edwards, J. R. (1994). The Study of Congruence in Organizational Behavior Research: Critique and a Proposed Alternative. *Organizational Behavior and Human Decision Processes*, 58(1): 51-101.

Edwards, J. R. (2002). Alternatives to Difference Scores: Polynomial Regression Analysis and Response Surface Methodology, in Measuring and Analyzing Behavior in Organizations: Advances in Measurement and Data Analysis, F. Drasgow and N. Schmidt (eds.), San Francisco: Jossey-Bass/Pfeiffer: 350-400.

Feldman, L.J. (1998). Industry viewpoint: relational interdependency and punctuated equilibrium. *The Journal of Business and Industrial Marketing,* 13(3): 288-93

Fynes, B., S. Búrca, & C. Voss. 2005. Supply Chain Relationship Quality, the Competitive Environment and Performance. *International Journal of Production Research* 43(16): 3303-3320.

Gao, T.S.M.J., & Bird, M.M. (2005). Reducing buyer decision-making uncertainty in organizational purchasing: can supplier trust, commitment and dependence help. *Journal of Business Research,* 58: 397-405.

Garcia, R. & Calantone, R. (2002). A Critical Look at Technological Innovation Typology and Innovativeness Terminology: A Literature Review. *Journal of Product Innovation Management*, 19(2): 110-132.

Gilley, K.M., & Rasheed, A. (2000). Making more by doing less: an analysis of outsourcing and its effects on firm performance. *Journal of Management* 26(4): 763-90.

Griffis, S.E., Goldsby, T.J., & Cooper, M. (2003). Web-based and mail surveys: comparison of response, data and cost. *Journal of Business Logistics,* 24(2): 237-58.

Gounaris, S.P. (2005). Trust and commitment influences on customer retention: insights from business-to-business services. *Journal of Business Research,* 58: 126-40.

Grönroos, C. (2000).Service Management and Marketing: A Customer Relationship

Management Approach. New York, NY: John Wiley & Sons.

Gulati, R., P. Puranam, & M. Tushman. (2012). Meta-organization Design: Rethinking Design in Interorganizational and Community Contexts. *Strategic Management Journal,* 33 (6): 571-586.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice* 19 (2): 139–151.

Håkansson, H. & Ford, D. (2002). How should companies interact in business networks? *Journal of Business Research*, 55(2):133-39.

Handfield, R.B. (2002). The new supply chain model. *APICS* January: 24.

Halldorsson, A., Kotzab, H., Mikkola, J.M. & Skjøtt-Larsen, T. (2007). Complementary theories to supply chain management. *Supply Chain Management: An International Journal*12 (4): 284–296.

Harman, H. H. (1967). Modern Factor Analysis. 2d ed. Chicago: University of Chicago Press.

Heide, J.B. & John, G. (1990). Alliances in industrial purchasing: the determinants of joint action in buyer-supplier relationships. *Journal of Marketing Research,* 27(1): 24-36.

Herzlinger, R. (2006). Innovating in Health Care-framework. Boston, MA: Harvard Business School Publishing.

Hingley, M.K. (2005), "Power to all our friends? Living with imbalance in supplier-retailer relationships", Industrial Marketing Management, Vol. 34, pp. 848-58.

Hsu, L-L. (2005). SCM System Effects on Performance for Interactions between Suppliers and Buyers. *Industrial Management & Data Systems,* 105(7): 857-875.

Johnson, J.K. 2000. *Global Marketing* (Second edition). Irwin McGraw-Hill. New York.

Johnsen, T.E. & Ford, D. (2000). Managing Collaborative Innovation in Complex Networks: Findings from Exploratory Interviews. Paper presented at the Sixteenth Annual Industrial Marketing and Purchasing Conference, 7–9 September, Bath.

Johnsen, R. & Ford, D. (2001). Asymmetrical and symmetrical customer-supplier relationships: contrasts, evolution and strategy. Paper presented at IMP Conference, Oslo, September, 9-11.

Johnsen, R. & Ford, D. (2008).Exploring the concept of asymmetry: A typology for analyzing customer-supplier relationships. *Industrial Marketing Management* 7(4):471-483.

Jones, S., Wilikens, M., Morris, P. & Masera, M. (2000). Trust requirements in e-business. *Communications of the ACM* 43 (2): 81-7.

Jonsson P, Kjellsdotter L, & Rudberg M. (2007). Applying advanced planning systems for supply chain planning: three case studies. *International Journal of Physical Distribution and Logistics Management,* 37(10):816–34.

Jüttner, U., Christopher, M. & Baker, S. (2007). Demand Chain Management-Integrating Marketing and Supply Chain Management. *Industrial Marketing Management,* 36 (3):377-92.

Kearns, G. S., & Lederer, A. L. (2003). A resource-based view of strategic IT alignment: How knowledge sharing creates competitive advantage. *Decision Sciences*, 34(1): 1–29.

Kim, D. J., Ferrin, D. L. and Rao, H. R. (2009). Trust and satisfaction, two stepping stones for successful e-Commerce relationships: A longitudinal exploration. *Information Systems Research,* 20(2): 237-257.

Kim, K. K., S-H Park, S. Y. Ryoo, and S. K. Park. (2010). Inter-organizational Cooperation in Buyer-supplier Relationships: Both Perspectives. *Journal of Business Research,* 63: 863-869.

Krishnan, R., Martin, X., & Noorderhaven, N.G. (2006). When does trust matter to alliance performance? *Academy of Management Journal*, 49: 894–917.

Kock, N. (2015). Warp PLS 5.0. Laredo, TX: ScriptWarp Systems.

Kumar, N., Scheer, L.K. & Steenkamp, J.B. (1995). The effects of perceived interdependence on dealer attitudes. *Journal of Marketing Research,* 32(3): 348-57.

Kumar, N. (1996). The power of trust in manufacturer–retailer relationships. *Harvard Business Review,* 74: 92–110.

Laeequddin, M., Sardana, G.D., Sahay, B.S., Waheed, K.A. & Sahay, V. (2009). Supply chain partners' trust building through risk evaluation: the perspectives of UAE packaged food industry. *Supply Chain Management: An International Journal,* 14(4), 280-90.

Laeequddin, M., Sahay, B.S., Sahay, V., & Waheed, K.A. (2010). Measuring trust in supply chain partners' relationships. *Measuring Business Excellence,* 14(3), 53-69.

Laeequddin, M., Sahay, B.S., Sahay, V., & Waheed, K.A. (2012).Trust building in supply chain Partners relationship: an integrated conceptual model. *Journal of Management Development,* 31(6), 550-64.

La Londe, B.J. (2002). Who Can You Trust These Days? *Supply Chain Management Review*, May-June: 9-10.

Lam, C.Y. (2008). Collaborative supply chain network using embedded genetic algorithms. *Industrial Management and Data Systems,* 108(8): 1101–10.

Lambert, D.M. (2008). Supply Chain Management: Processes, Partnerships, and Performance: Supply Chain Management Institute, 3rd edition, Sarasota, FL.

Lee, S.M, Lee, D.H., and Schniederjans, M.J. (2008). Supply chain innovation and organizational performance in the healthcare industry. *International Journal of Operations and Production Management,* 31(11): 1193-1214.

Lin, C. (2008). Determinants of the adoption of technological innovations by logistics service providers in China. *International Journal of Technology Management and Sustainable Development,* 7(1):19-38.

Liu, W.M. & Chen, J.X. (2004). A Study on Innovation Network, Complex Technology and it's Policy. *Forum on Science and Technology in China,* 5:56–9.

Madhok, A. (2006). How much does ownership really matter? Equity and trust relations in joint venture relationships. *Journal of International Business Studies,* 37(1):4-11.

Maheshwari, B., Kumar, V. & Kumar, U. (2006). Optimizing success in supply chain partnerships. *Journal of Enterprise Information Management,* 19(3): 277-91.

Mayer, R.C., Davis, J.H. and F. David Schoorman, F.D. (1995). An Integrative Model of Organizational Trust. *The Academy of Management Review,* 20(3): 709-734.

Michalski, M., Afifi, R., Montes, J.L., & Burns, R. 2013. "Asymmetries in Supply Chain Management: Differences between Poland and Spain." *The Journal of Management Policy and Practice*, 14 (6): 42-72.

Miles, R. & Snow, C. (2007). Organization Theory and Supply Chain Management: An Evolving Research Perspective. *Journal of Operations Management,* 25:459–63.

Moberg, C.R., Spey, T.W., & Freeze, T.L. 2003. SCM: Making the vision a reality. *Supply Chain Management Review* 7(5): 34-9.

Mohd Noor, M.N. & Pitt, M. (2009).The application of supply chain management and collaborative innovation in the delivery of facilities management services. *Journal of Facilities Management*, 7(4): 283-97.

Morgan, R.B, & Hunt, S.D. (1994). The Commitment-Trust Theory of Relationship Marketing. *Journal of Marketing,* 58(3):20-38.

Narasimhan R. & Nair A. (2005). The Antecedent role of quality, information sharing and supply chain proximity on strategic alliance formation and performance. *International Journal of Production Economics,* 96(3): 301-313.

Narasimhan, R. & Narayanan, S. (2013). Perspectives on Supply Network–Enabled Innovations. *Journal of Supply Chain Management,* 49(4): 27-42.

Noordhoff, C.S., Kyriakopoulos, K., Moorman, C., Pauwels, P. & Dellaertet, B.G.C. (2011).

The Bright Side and Dark Side of Embedded Ties in Business-to-Business Innovation. *Journal of Marketing,* 75(5): 34-52.

Pavlou, P., A. & Gefen, D. (2004). Building effective online marketplaces with institution based trust. *Information Systems Research,* 15(1):37-59.

Porter, M.E. 1990. *The Competitive Advantage of Nations*. The Free Press. New York.

Ramsay, J. (2001). The resource based perspective, rents, and purchasing contribution to sustainable competitive advantage. *The Journal of Supply Chain Management,* 37 (3): 38-47.

Riegelsberger, J. M., Sasse, A. & McCarthy, J.D. (2003). The researcher's dilemma: evaluating trust in computer-mediated communication. *International Journal of Human-Computer Studies,* 58 (6): 759-781,

Rosemann, M., & de Bruin, T. 2005. Application of a holistic model for determining BPM maturity. *BP Trends*, February: 1-21.

Ryu, S., Min, S. and Zushi, N. (2008). The moderating role of trust in manufacturer-supplier relationships. *Journal of Business & Industrial Marketing* 23 (1): 48-58.

Sanna-Randaccio, F. & Veugelers, R. (2007). Multinational knowledge spillovers with decentralized R&D: a game- theoretic approach. *Journal of International Business Studies,* 38(1):47–63.

Schoenherr, T., & Mabert, V.A. (2006). Bundling for B2B procurement auctions: Current state and best practices. *International Journal of Integrated Supply Management,* 2 (3):189-213.

Sebastiao, H.J., & Golicic. S. (2008). Supply chain strategy for nascent firms in emerging technology markets. *Journal of Business Logistics,* 29(1): 75–91.

Singh, S.Ch. & Pandey, S.K. (2013). Supply Chain Performance: A Review of Literature. *Journal of Supply Chain Management Systems*, 2(4): 1-12.

Sisodiya, S.R., Johnson, J.L & Grégoirec, Y. (2013). Inbound open innovation for enhanced performance: Enablers and opportunities. *Industrial Marketing Management,* 42(5): 836–849.

Skjøtt-Larsen, T. (1999). Supply Chain Management: A New Challenge for Researchers and Managers in Logistics. *International Journal of Logistics Management,* 10(2):41–54.

Skjøtt-Larsen, T., Schary, P.B., Mikkola, J.H., & Kotzab, H. (2007).Managing the global supply chain. Copenhagen, Denmark: Copenhagen Business School Press.

Spekman, R.E., Kamauff, Jr., J.W., & Myhr, N. (1998). An empirical investigation into supply chain management: A perspective on partnerships. *Supply Chain Management* 3(2): 53-67.

Spekman, R.E. & Davis, E.W. (2004). Risky business: expanding the discussions on risk and the extended enterprise. *International Journal of Physical Distribution & Logistics Management,* 34(5):414-33.

Sridharan, R. & Simatupang, T. (2005). Supply Chain Discontent. *Business Process Management Journal,* 11(4): 349-69.

Swink, M., R. Narasimhan, & C. Wang. (2007). Managing beyond the Factory Walls: effects of Four Types of Strategic Integration on Manufacturing Plant Performance. *Journal of Operations Management,* 25(1): 148-164.

Swink, M., & Song, M. (2007). Effects of marketing-manufacturing integration on new product development time and competitive advantage. *Journal of Operations Management*, 25(1), 203–217.

Svensson, G. (2001). Perceived trust towards suppliers and customers in supply chains of the Swedish automotive industry. *International Journal of Physical Distribution & Logistics Management*, 31 (9): 647-62.

Svensson, G. (2004). Vulnerability in business relationships: the gap between dependence

and trust. *Journal of Business & Industrial Marketing,* 19(7):469-83.

Tan, K. C., Lyman, S.B. & J. D. Wisner. (2002). Supply Chain Management: A Strategic Perspective. *International Journal of Operation & Production Management* 22: 614-631.

Tenenhaus, M. (1998). La regression PLS. Paris, France: Publi-Union.

Terjesen, S., Patel, P.C. & Sanders, N.R. (2012). Managing differentiation-integration duality in supply chain integration. *Decision Sciences* 43 (2): 303-339.

Tether, B. (2002). Who co-operates for innovation, and why? An empirical analysis. *Research Policy* 31:947-67.

Thomas, R. & Esper, T. (2010). Exploring relational asymmetry in supply chains: the retailer´s perspective. *International Journal of Physical Distribution & Logistics Management* 40(6): 475-94

Thomas, R. & Skinner, L. (2010). Total Trust and Trust Asymmetry: Does Trust Need to Be Equally Distributed in Interfirm Relationships? *Journal of Relationship Marketing* 9:43–53.

Temme, D., Kreis, H., & Hildebrandt, L. (2006). PLS path modeling – A software review. Berlin, Germany: Institute of Marketing, Humboldt University Berlin.

Venkatesh, V. & Goyal, S. (2010). Expectation disconfirmation and technology adoption: polynomial modeling and response surface analysis. *MIS Quarterly* 34(2): 281-303.

Walters, D., & Rainbird, M. (2007). Collaborative innovation: a value chain approach. *Journal of Enterprise Information Management* 20(5):595-607.

Wang, Ch-H. (2011). The moderating role of power asymmetry on the relationships between alliance and innovative performance in the high-tech industry. *Technological Forecasting & Social Change* 78: 1268–79.

Wold, H. (1985). Partial least squares. In S. Kotz & N.L. Johnson (Eds.), *Encyclopedia of Statistical Sciences Vol. 6*. New York, NY: Wiley: 581-91.

Wu, Z. (2011). A Model of Trust Governance on Partnership in Knowledge Supply Chain. *Contemporary Logistics* 4:61-5.

Appendix A

 VARIABLE   - ASYMMETRY – items
(Is the act considered as a sign of differences in behaviours of the supply chain
partners? Completely disagree = 1; Completely agree =7)

Lack of communication quality between supply chain partners
Lack of cooperation in partnership relations in supply chain
Easy acceptation of leadership position
Different level of commitment

VARIABLE - PERFORMANCE – items
(Could you evaluate your firm performance in the following areas? –
We are worst = 1; we are better than last period = 7)

Growth and diversification of incomes
Productivity improvement
Profits improvements
Market participation

VARIABLE - TRUST- items
(Is the act considered a sign of trust in supply chain relationships? Completely
agree =7; Completely disagree = 1)

Willingness to inform about cost and profit
We shared our knowledge with partners
Confidence partners reliability and integrity
We solve the problems through mutual agreements
The partners' suggestions are honest and true

VARIABLE - INNOVATION - items
(Could you indicate the extent of innovation in your supply chain relationships? Not at
all = 1; Large =7)

Information technology improve our market position
Our partners are interested in product innovation
Some of our partners are more interested in process innovation
We pursue continuous innovation in core processes
We improved trust due to innovation