

SUPPLY CHAIN PROCESS COLLABORATION AND INTERNET UTILIZATION: AN INTERNATIONAL PERSPECTIVE OF BUSINESS TO BUSINESS RELATIONSHIPS

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ABSTRACT: *This paper compiles the findings of an international study which primary objective was to investigate the relationships between Internet utilization in business-to-business relationships, collaborative efforts and their impact over supplier and customer-oriented processes performance. It highlights the Internet as an important enhancer of collaboration in supply chains and addresses the effects of such efforts on companies' overall performance. As a conclusive-descriptive and quantitative study, data from a survey of 788 companies from the USA, China, Canada, United Kingdom, and Brazil were analyzed with the use of descriptive statistics, reliability evaluation of the research model's internal scales, path analysis and structural equation modeling to evaluate supply chain processes collaboration, both up- and down-stream. Internet utilization in supplier and customer-oriented processes was found positively related to collaborative practices in business-to-business relationships. Collaborative practices in supplier and customer-oriented processes, in turn, showed potential effects on performance. Also, supplier-oriented processes performance was found positively associated with customer-oriented process performance. Both Internet use and collaborative practices are even more important in a high-context country like Brazil. The paper helps clarify the impact of Internet use on business-to-business collaborative relationships. In this sense, practitioners can take this impact to redraw the organizational landscape and business processes amongst supply chain participants.*

Key words: *supply chain management; business-to-business markets; Internet; collaborative efforts; process performance.*

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1. INTRODUCTION

Almost 11 years ago, in an article published at *Industrial Marketing Management* by Lancioni *et al.* (2000), a primary question was about the potential applications of Internet in business to business supply chain environments and how Internet utilization could help companies with many significant opportunities of cost reduction, improved communication among supply chain agents, increased levels of service and flexibility in terms of delivery and response time (Lancioni *et al.*, 2000). Hence, in the last few years the development of the Internet and its gradually stronger use by companies seems to have resulted in new governance structures and relationships in business-to-business markets. New information technologies, such as the Internet, are not simply tools to be applied, but processes to be developed (Castells, 1996). Information systems and information technology infrastructure have long been considered to be important vertical integration mechanisms within firms. It is also quite clear that information technology has played an enabling role in supply chain collaboration (Cheng *et al.*, 2010). In this sense, it would be relevant to consider Internet utilization as an enabler of more robust inter-firm coordination mechanisms with important effects on network structures (Holland and Lockett, 1998; Cheng *et al.*, 2010; Trkman *et al.*, 2007).

Such information-based coordination structures have evolved considerably since they first appeared in the 1990s. Current research has demonstrated many ways to integrate and synchronize materials and information flows, enhance supply chain efficiency, and reduce logistic management costs by collaborating with partners in up and downstream and/or outsourcing certain practices (Trappey *et al.*, 2010).

The aim of this study was to investigate the relationships between the Internet utilization in B2B markets, the development of collaborative practices, and performance of supplier and customer oriented value chain processes. This paper's main contribution comes from studying the interconnection of these constructs using a world-wide sample composed of 788 companies with headquarters in USA, China, United Kingdom, Canada and Brazil, and applying descriptive and multivariate statistics. The sample deliberately included companies from different industries in order to provide a cross industry perspective of global supply chain management best practices and performance.

Additionally, comparisons were made specifically between Brazilian companies and other sampled companies in this research. Although Brazilian companies are not the leading best practices in supply chain management processes, the country has significant economic influence in terms of internal markets and international trade. It is widely agreed that Brazil is one of the worlds' largest emerging economies, and an international player with massive growth potential. Therefore, one additional objective of this research was to investigate how Brazilian companies are positioned compared to other companies within the sample.

The structure of the paper is as follows. First, the theoretical background is presented. It suggests that information technology, and particularly the Internet utilization plays an

important role in enabling information exchanges between network participants and collaboration in supply chain processes. Then, the sample composition, techniques of data gathering, data treatment and validation tests are described. Next, the results are presented and discussed. Finally, some limitations are outlined along with suggested further research topics.

2. THEORETICAL FRAMEWORK

2.1. Supply chain collaborative relationships

Supply chain management emphasizes collaborative relationships between buyers and suppliers within a supply chain (Ryu *et al.*, 2009). Managing supply chains requires strong partnerships with customers and suppliers as they are perceived to impact internal operations and subsequently performance levels (Lancioni *et al.*, 2000; Law *et al.*, 2009). The key to effective supply chain management is the ability to establish long-term, strategic relationships with supply chain partners (Zelbst *et al.*, 2009). In terms of improving the performance of the supply chain as a whole, collaboration is clearly better than competition (Cheng *et al.*, 2010). These collaborative efforts focus on the development, combination, protection and shared use of resources (physical or not) to sustain collaborative practices between firms. Competitive business environments are becoming quite conducive to integration, cooperation, information sharing; with all of these being supported by information technology (Samaranayake, 2005). The redefinition of economies of scale and scope and the increasing reduction of transaction costs in the supply chain context are some of the effects of greater digital connectivity through extensive use of Internet infrastructure and networks (McIvor and Humphreys, 2004).

The development of new governance structures in automotive industries can be taken as an example of such efforts to enhance collaborative practices. First with the outsourcing of non-value adding service operations, then with production activities and, more recently, with innovative activities, the automotive industry has shown to be a fundamental forerunner of innovation in supply chains. New relationship structures have altered old governance forms between automakers and suppliers in segmentation regimes, putting pressure on first-tier suppliers to take on new responsibilities in manufacturing, logistics and product development (Liker and Choi, 2004; Dyer *et al.*, 1998).

In addition, in the last 30 years a huge process of deverticalization has been gradually maturing alongside the successful application of other philosophies and principles such as business process management, total quality management, lean production and Six Sigma. More recently, the persistence of deverticalization and outsourcing practices has been accelerating innovations in the areas of better integrated logistics and supply chain management practices. These innovations have favored improvements in time to market, costs, quality, flexibility and a timely response to demand (Gereffi, 2001; Arroyo and Bitran, 2009).

Moreover, supplier- and customer-oriented processes have also been significantly affected by information technology improvements. Often the more consistent use of Internet and information technology applications has had a central positive effect on information visibility amongst supply chain members, leading to an improvement in supply chain performance (Monczka *et al.*, 2005; Rupnik *et al.*, 2007). Potential benefits include the possibility of breaking organizational barriers by sharing critical information and interacting on a near real-time basis across the supply chains. Another benefit is the possibility to monitor processes in order to shorten the decision cycle process, allowing upstream suppliers and customers to respond more quickly and consistently (Monczka *et al.*, 2005; Samaranayake, 2005).

Especially in B2B relationships, the Internet can be seen as a resource to support the collection, analysis and treatment of data and information, ensuring wide accessibility and up-to-date information for real-time decision-making with suppliers and customers (Monczka *et al.*, 2005). The internal assimilation and external diffusion of Web technologies both significantly affect the benefits of supply chain management (Ranganathan *et al.*, 2004). One of the expected consequences – the monitoring of organizational and interorganizational performance – has been increasingly and strongly associated with the quality of information available, whereby more accessible and accurate information means better results in performance monitoring.

The performance with regard to attributes such as cost, consistency and flexibility depends on the quality and promptness of the information available. For both of these factors, the Internet utilization can enhance the potential of a highly “interactive firm”. As pointed out by Johansen and Riis (2005), the typical interactive firm participates in a range of different partnership constellations with other companies, enhancing “*collaborative relationships with a select set of partners, including suppliers, customers and competitors*”. The collaboration level is namely an effective value converter for direct technology value and process value (Chang and Shaw, 2009).

The roots of the concept of collaborative supply chain management lie in developments in the 1990s such as just-in-time practices along with the electronic data interchange (“EDI”) and quick response principles (Udin *et al.*, 2006). New theories, practices and concepts on this topic have steadily evolved. However, collaborative efforts are not only an enabler of smooth information sharing but also a necessary baseline for sharing knowledge, risks and profits (Udin *et al.*, 2006).

There are several ways to explain how the use of technologies such as the Internet, especially for information sharing between companies, can enhance relationships between suppliers and customers in B2B environments. It is now widely acknowledged that electronic communication can reduce both the costs of coordinating economic transactions and the costs of coordinating production planning efforts (Cagliano *et al.*, 2003).

Internet-based applications may be considered enablers of the greater efficiency of information transfers, the timeliness of information and the openness of relevant business

information exchanges. All of these performance measures are enhanced when collaboration is in place.

2.2 Inter-organizational collaboration: geographical and digital proximity

Organizations depend on their environment to gather the resources they need to carry out their activities. Companies do not exclusively control all their resources, making this exchange a fundamental phenomenon to assure their survival. Different dependence levels will characterize the possible links between companies intrinsic to their own economic activities (Dubois and Hakansson, 1997; Nohria, 1992). Such resource interdependency can be relevant to varying extents and the purpose of developing connections with other companies can be based on several distinct needs.

To avoid the logistics complexity of a geographically-dispersed supply chain, some firms (for example, those in the automotive sector) tend to ask their suppliers to locate their facilities nearby. Proximate supply in the automotive sector, achieved through the presence of supplier parks situated adjacent or close to vehicle assembly plants, has provided the means to move the customer-order decoupling point upstream and increase the percentage of vehicles that are built-to-order (Lyons *et al.*, 2006). Supply chain geographical proximity can therefore be defined as the physical closeness of the buying and supplying firm and the measures taken by firms for an improved, synergistic performance (Narasimhan and Nair, 2005). The concentration of production operations within a geographical region contributes to the formation of industrial clusters. These clusters are routes to organizational learning, knowledge sharing, innovation and economic development (Pinch *et al.*, 2003). Learning usually involves socialization and such interaction often requires physical proximity (Ensign and Hebert, 2009).

However, such proximity is not simply measured by the geographical distance between companies. A competitive supply chain also requires the management of relations with critical firms outside the region (Doner and Hershberg, 1999; Lechner and Dowling, 1999). Organizational proximity is thus defined as the extent to which relations are shared in an organizational arrangement, either within or between organizations (Boschma, 2005). It is based upon affiliation (actors belonging to the same relational area and similitude; actors resemble one another) (Davenport, 2005; Lemarie *et al.*, 2005).

Since early 2000 the intense use of digital technologies has motivated the emergence of a new organizational model (Romano *et al.*, 2001). This organizational model is based on the broad potential of the Internet, connecting intranets to extranets, and direct connectivity with other agents like governmental agencies, financial institutions and final customers. As Romano *et al.* (2001) mention when referring to cluster forms intensively based on digital technologies:

(...) virtual clusters are changing the shape of competition, the speed of adaptation to environmental changes, and the nature of leadership. Implementation of SCM

and customer relationship management (CRM) strategies constitutes the first step toward the formation of virtual clusters” (Romano et al., 2001, p.19).

There is compelling evidence that the efficacy of information technology has a positive effect on collaboration through the moderating effect of existing relationships (Cheng *et al.*, 2010). Efficient information and knowledge integration technologies are namely the key to handling complex networks (Lavbič *et al.*, 2010, Li and Chandra, 2007) and can thus reduce both the costs and lead times of the processes in the chain (Trkman and McCormack, 2010). Lockett and Brown (2000) add that interorganizational information systems have evolved as both a consequence of and to support interorganizational network forms. Interorganizational information systems are a response to the demands of new forms of collaboration between organizations and individuals, as well as a result of significant changes due to advances in information technology. A typical example of such an information technology-enabled supply chain is a case study of a supply chain in the textile industry that uses a system based on radio frequency identification to facilitate the coordination and integration of supply chain functions and activities, thus eventually enhancing the overall performance (Kwok and Wu, 2009).

The development of Internet-based solutions drives companies to consolidate their participation in e-market environments (Adebanjo *et al.*, 2006). This can potentially bring lower costs and a better performance. The expansion of such an approach to supply chain relationships is an important step to assure the development of mature forms of virtual clusters. Strategic use of the Internet and the collaborative practices in supply chains is a baseline for improving management practices.

2.3. Measuring performance on supplier and customer-oriented processes

Performance management is a way of measuring and improving performance, and may be seen as a process (Forslund and Jonsson, 2007; Forslund, 2010). Metrics are used to quantify the current efficiency and/or effectiveness (Neely *et al.* 1995). Quantifying the supply chain performance offers an opportunity for a company to solidify and align its performance measurements and process improvement actions with its competitive strategies (McCormack *et al.*, 2008).

Performance measures have been studied from different points of view. Measures can be grouped, for example, according to two distinct factors: (i) cost factors, including manufacturing costs and productivity elements linked to the company's final results, to net profit and profitability; and (ii) non-cost factors, involving attributes such as lead time, flexibility and quality, among other performance factors, and being measured by metrics which is not necessarily established in monetary values (De Toni and Tonchia, 2001; Neely *et al.*, 1995).

An alternative approach is taken by Beamon (1999) who emphasizes three separate types of performance measures: resource measures (R) – considering that efficient-

resource management is critical to profitability; output measures (O) – considering that, without an acceptable output, customers will turn to other supply chains; and flexibility measures (F) – based on the idea that supply chains must be able to respond to change.

Slack *et al.* (1995) propose that an operations system must meet broad competitive and strategic objectives that must be translated into performance measures of quality, speed, reliability, flexibility and cost. In this sense, it is relevant to understand how the trade-offs between those metrics are to be managed, and how such metrics are interrelated. Moreover, since the market and operational environments have changed over the years the question is whether traditional performance measures can be used and which of them should be given priority when measuring performance in a new enterprise environment (Gunasekaran and Kobu, 2007).

Cuthbertson and Piotrowicz (2008) suggest that it is problematic to define a common set of measures without a clear understanding of where an organization is located within the supply chain. Taking these issues into consideration, the SCOR (Supply Chain Operations Reference) model can be positioned as a powerful tool to address these challenges (SCC, 2008). The SCOR model emphasizes process orientation (a horizontal focus) and deemphasizes organizational or functional orientation (vertical focus), as mentioned by Bolstorff and Rosenbaum (2003). However, Shepherd and Gunter (2006) discuss that despite the power of the SCOR set of measures, it is still important to understand the factors that can influence its implementation, management, and control in organizations.

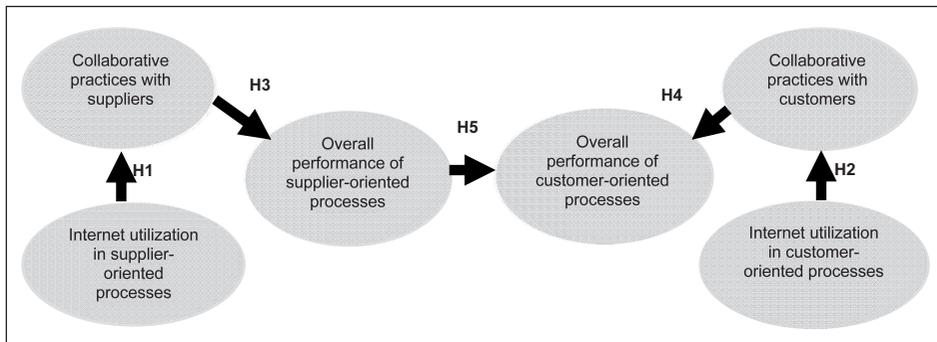
Since actual performance data are difficult to gather and compare between companies which have different strategic goals, we used a self-reported measure to assess supplier- and customer-oriented process performance. The use of such a self-reported approach has been validated in previous research and proven to be a reasonable mechanism to accurately measure comparative performance (Gupta *et al.*, 2000; Teo and Dale, 1997; Kumar *et al.*, 1993; Kumar and Stern, 1993).

2.4. The research model and hypothesis

The research model is composed of six major constructs: collaborative practices with suppliers; collaborative practices with customers; Internet utilization in customer-oriented processes; Internet utilization in supplier-oriented processes; overall performance of supplier-oriented processes and overall performance of customer-oriented processes. Aligned with the conception of supply chain value processes, the Internet utilization variables were divided into two distinct groups, supplier and customer-oriented processes. The former – supplier-oriented processes – relates to information exchange through the Internet with suppliers. The latter – customer-oriented processes – relates to variables that capture the intensity of Internet utilization to exchange information with customers.

The relationships between collaborative practices with suppliers and customers, Internet utilization, and the overall performance of supplier and customer-oriented processes were investigated. A graphic representation of these constructs is shown in Figure 1.

Figure 1: *The research model and hypotheses*



Source: Developed by the authors

Five null hypotheses were tested in this research:

- H1: On supplier-oriented processes, there is no significant evidence that Internet utilization impacts collaborative practices with suppliers
- H2: On customer-oriented processes, there is no significant evidence that Internet utilization impacts collaborative practices with customers
- H3: There is no significant evidence that collaborative practices with suppliers impacts overall performance of supplier-oriented processes.
- H4: There is no significant evidence that collaborative practices with customers impacts overall performance of customer-oriented processes.
- H5: There is no significant evidence that the overall performance of supplier-oriented processes affects the overall performance of customer-oriented processes.

3. METHODOLOGY

This research builds on earlier research that gathered global data on business process orientation and supply chain processes maturity (McCormack *et al.*, 2003; Lockamy and McCormack, 2004; McCormack, 2007). The survey included questions about the key supply chain management decision practices and their level of use in supply chain relationships. A literature review, along with discussions and interviews with experts and practitioners, were used as the basis for developing the survey questions. The discussions and interviews were structured around the SCOR model. The experts and practitioners were selected from the Supply Chain Council's member list. This list spanned multiple industries and contained individuals working in the supply chain management domain.

Specific measures representing Internet utilization and collaborative practices between companies and their suppliers and customers were identified and validated by building a candidate list of practices and circulating the list among supply chain management experts, asking them to accept or reject the measure. This specific part of the survey instrument was developed using a five-point Likert scale measuring the frequency of practices consisting of: 1 – never, or does not exist; 2 – sometimes; 3 – frequently; 4 – mostly; and 5 – always, or definitely exists. The performance construct can be characterized as a self-assessed performance rating for both supplier and customer-oriented processes. The construct is based on perceived performance as determined by the survey respondents. It is represented as a single item for supplier- and customer-oriented processes separately. The specific item statement on supply chain performance is: “Overall, this process area performs very well”. The participants were asked to either agree or disagree with the item statement using a five-point Likert scale (1=strongly disagree; 5=strongly agree).

The initial survey instrument was tested with a major electronic equipment manufacturer and several supply chain experts. Based on this test, improvements in wording and format were made to the instrument and several items were eliminated. The Supply Chain Council Board of Directors also reviewed the initial survey instrument at an early stage of its development.

With this present study, the survey instrument was slightly reorganized to better match the supplier and customer-oriented processes flows. A small sample of 30 respondents, from different companies, was used as a second pre-test in this study. Through a webpage and links that were sent for target companies, the data gathering process generated a final sample composed of respondents whose functions were directly related to supply chain management processes from 788 different companies, with headquarters in the USA, China, United Kingdom, Canada, and Brazil. The sample deliberately included companies from different industries in order to get a cross industry perspective. The study participants were selected from two major sources:

Set 1 - The membership list of the Supply Chain Council. The “user” or practitioner portion of the list was used as the final selection, representing members whose firms supplied a product rather than a service, and were thought to be generally representative of supply chain practitioners rather than consultants. An email solicitation recruiting participants for a global research project on supply chain maturity was sent out to companies located in USA, Canada, United Kingdom and China. The responses represent 39.3% of the sample composition with 310 cases.

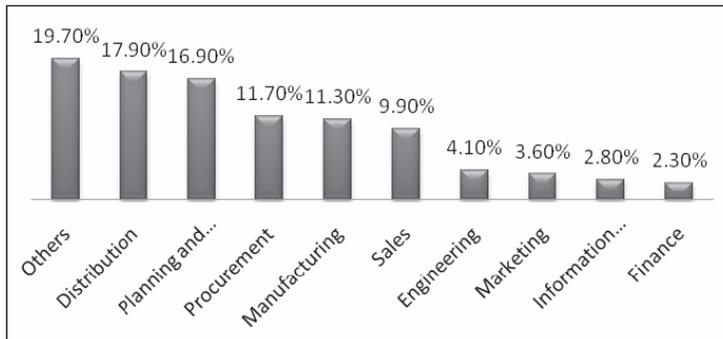
Set 2 - In Brazil, the companies were selected from a list of an important educational institution of logistics and supply chain management in the country. An electronic survey was done. From a total of 2,500 companies contacted, 534 surveys were received, thus yielding a response rate of 21.4 percent. After data preparation, 478 respondents were included in the sample, representing 60.7% of the total sample.

4. FINDINGS AND DATA ANALYSIS

The sample was made up of key respondents working in activities related to the supply chain management function in several industries including manufacturing, construction, retail, graphics, mining, communication, information technology, utilities (gas, water and electricity) and distribution. 49% of the companies came from the manufacturing industry, 18.9% from logistics and communication services, 7.2% from the food industry, 5.2% from the auto industry and from home utilities and 19.3% from other industries.

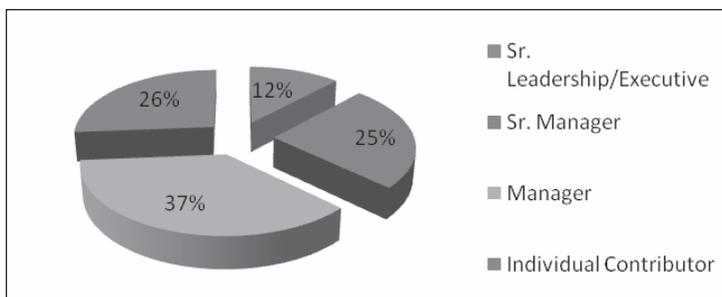
A sample profile of key respondents by their functional role in the organization is shown in Figure 2. The respondents came from nine positions (sales, information systems, planning and scheduling, marketing, manufacturing, engineering, finance, distribution, and purchasing). Approximately 20% of the respondents work in other positions, mainly in new supply chain oriented jobs such as “Global Supply Chain Manager” or “Supply Chain Team Member”.

Figure 2: Respondents by functional role



A profile of the respondents arranged by their position is provided in Figure 3. The share of senior leaders/executives, managers and consultants/ individual contributors is approximately the same.

Figure 3: Respondents by position



Initially, considered the hypothetical model proposed (Figure 1), the variables of the questionnaire were summed for each model's construct and the descriptive statistics were calculated as shown at Table 1 below:

Table 1: *Constructs' descriptive statistics*

	Minimum	Maximum	Mean	Std. Deviation
Overall performance of supplier-oriented processes	1.00	5.00	3.2246	.92353
Overall performance of customer-oriented processes	1.00	5.00	3.3350	1.03898
Internet utilization in customer-oriented processes	3.00	15.00	8.4643	3.12711
Internet utilization in supplier-oriented processes	3.00	15.00	8.2924	3.26947
Collaborative practices with suppliers	6.00	30.00	17.5216	4.94167
Collaboration practices with customers	4.00	20.00	11.6827	2.96414
Valid N (listwise)	788			

Correlation tests between the latent variables are presented in Table 2. A moderate and positive correlation exists between collaborative practices with suppliers and Internet utilization in supplier-oriented processes (0.44) and between collaborative practices with customers and Internet utilization in customer-oriented processes (0.39).

Such results indicate that using the Internet to gather information about suppliers and customers' processes can be beneficial in improving collaborative practices, possibly by improving digital proximity. In this sense, the Internet utilization can be considered an important instrument to develop collaborative practices and improve organizational proximity, even where geographical proximity does not exist (Boschma, 2005).

Table 2: *Direct correlations of latent variables*

	Correlations	R ²	
Collaborative practices with customers	↔	Overall performance of customer-oriented processes	0.6149
Collaborative practices with suppliers	↔	Overall performance of supplier-oriented processes	0.6275
Internet utilization in customer-oriented processes	↔	Collaborative practices with customers	0.3881
Internet utilization in supplier-oriented processes	↔	Collaborative practices with suppliers	0.4345
Overall performance of supplier-oriented processes	↔	Overall performance of customer-oriented processes	0.4352

* All correlations with a p-value < 0.01

The relationships between collaborative practices and overall performance of supplier- and customer-oriented processes are strongly positive (in both cases the correlations were around 0.62). One can assume that companies directing efforts to improve collaboration with their suppliers will improve their performance in supplier-oriented processes, and companies which invest in collaborative practices with their cus-

tomers will improve the performance of customer-oriented processes. Finally, it is worth mentioning that the positive correlation between the overall performance of customer-oriented processes and the overall performance of supplier-oriented processes (0.44) indicates that a wide and systemic approach to supply chain management is needed.

Structural equation modeling (Partial Least Squares; “PLS”) was used to test the hypothetical model and evaluate the influence of Internet utilization on collaboration and performance. Initially, the collaborative practices constructs in Supply and Distribution areas were considered as latent variables of the formative constructs related with performance. In addition, the impact of Internet utilization on collaboration was also considered.

The total direct effects/path coefficients and the total indirect effects were classified on three different impact levels: effect values ranging from zero to 0.2 were considered by the authors as weak; values positioned between 0.2 and 0.5 were classified as tenable; values over 0.5 were considered as strong effects. Adopting such a classification, an analysis of the direct effects or path coefficients is presented in Table 3.

Table 3: *Structural equation total effects – Direct effects/Path coefficients*

	Direction of the effect		Effect*
Internet utilization in supplier-oriented processes	→	Collaborative practices with suppliers	0.4345
Collaborative practices with suppliers	→	Overall performance of supplier-oriented processes	0.6275
Internet utilization in customer-oriented processes	→	Collaborative practices with customers	0.3881
Collaborative practices with customers	→	Overall performance of customer-oriented processes	0.4755
Overall performance of supplier-oriented processes	→	Overall performance of customer-oriented processes	0.1568

* All effects were significant with a p-value < 0.002 when submitted to the t-test with the bootstrapping technique

Use of the Internet in supplier-oriented processes has a moderate and positive impact (0.3881) on collaborative practices with suppliers. Such a finding, combined with a correlation coefficient of 0.44, as shown in Table 2, rejects the first hypothesis (H1) of a non-positive correlation between Internet utilization in supplier-oriented processes and the intensity of collaborative practices in supplier-oriented processes.

Use of the Internet for downstream relationships is moderately and positively correlated (0.3881) with collaborative practices. This finding, combined with a correlation coefficient of 0.39 rejects the second hypothesis (H2) of a non-existing positive correlation between Internet utilization in customer-oriented processes and the intensity of the collaborative practices in these processes.

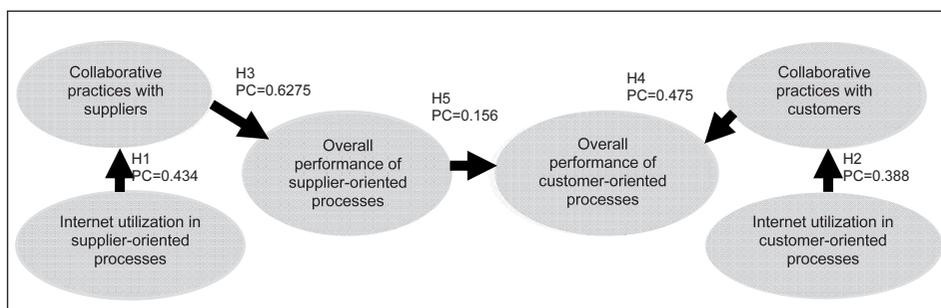
The path coefficient analysis revealed high and positive effects of collaborative practices on the performance of supply processes. This is also confirmed by the high correlation coefficient (0.62) between the two constructs. Based on that, the third hypothesis (H3) was rejected.

Similarly, the findings of this research help to reject the fourth hypothesis (H4) of the non-existence of a positive correlation between collaborative practices with customers and the overall performance of these processes, based on a path coefficient of 0.4755 – indicating a moderate effect – and a correlation of 0.6149.

The rejection of four null hypotheses clearly indicates that the use of Internet technologies in supplier and customer-oriented processes can result in more effective collaborative practices, improving organizational proximity amongst supply chain members and thus enabling a supply chain to achieve better performance results for final customers.

All direct effects between the latent variables that form the model's research are represented in Figure 4.

Figure 4: *Hypothetical research model: path coefficients (direct effects)*



Source: Research data

Moreover, the correlation between the performance in supplier and customer-oriented processes is 0.4352, whereas the path coefficient is 0.1568, indicating a weak but significant correlation. In this sense, problems faced by companies in supplier-oriented processes affect the results of customer-oriented processes, and vice versa. This confirms the importance of managing the whole supply chain in order to improve performance for the final customer.

Table 3 summarizes the test results for all five hypotheses. So as to subject the model's constructs to a systemic approach, an analysis of the indirect effects was also conducted and the results are presented in Table 4.

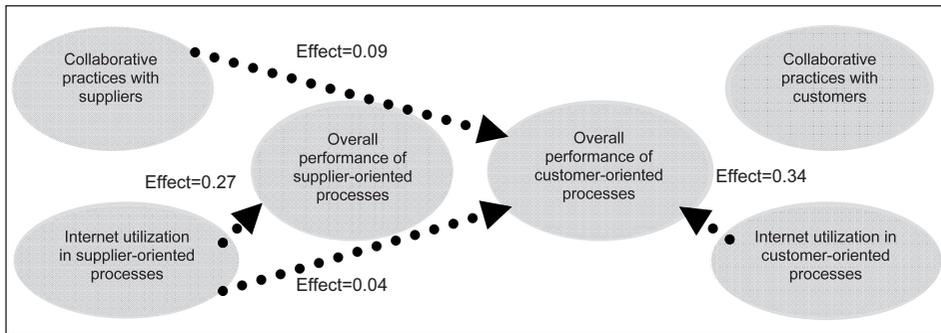
Table 4: *Structural equation total effects – Indirect effects*

	Direction of the effect		Effect*
Internet utilization in customer-oriented processes	➔	Overall performance of customer-oriented processes	0.3435
Internet utilization in supplier-oriented processes	➔	Overall performance of supplier-oriented processes	0.2726
Internet utilization in supplier-oriented processes	➔	Overall performance of customer-oriented processes	0.0427
Collaborative practices with suppliers	➔	Overall performance of customer-oriented processes	0.0984

* All effects are significant with a p-value < 0.008 based on the t-statistics test with the bootstrapping technique

The results show significant evidence of a moderate impact (0.2726) of Internet utilization in supplier-oriented processes on the performance of supply through collaborative practices with supply chain business partners upstream. The impact of Internet utilization in customer-oriented processes on the performance of customer-oriented processes through collaborative practices has a similar intensity (0.3435). The values concerning the effects of the Internet utilization and collaborative practices with suppliers on performance in customer-oriented processes (0.0427 and 0.0984, respectively) are weak, although the effect is statistically significant. In other words, supplier-oriented planning processes and customer-oriented planning processes must be aligned as synergic parts of a firm’s supply chain. All four of these indirect effects are presented in Figure 5.

Figure 5: *Hypothetical research model: indirect effects*



Source: Research data

Collaborative practices in supplier-oriented processes influenced by Internet utilization explain 39.4% of the overall performance. On the other hand, the collaborative practices in customer-oriented processes explain 42.2% of the performance. Table 5 presents some results from the model overview.

Table 5: *Quality indicators for the research model*

	R Square	Communality	Redundancy
Collaborative practices with customers	0.1506	0.4523	0.073
Collaborative practices with suppliers	0.1888	0.4743	0.0906
Internet utilization in customer-oriented processes	0	0.7082	0
Internet utilization in supplier-oriented processes	0	0.7924	0
Overall performance of customer-oriented processes	0.4219	1	0.3587
Overall performance of supplier-oriented processes	0.3937	1	0.3937

Source: Research data

Communality represents the sum of the correlations in the reflexive block with a formative latent variable. High indicators of communality indicate a variable that fits the solution well (Tenenhaus *et al.*, 2005). It measures the percentage of variance of one variable that can be explained by all remaining factors together. Given that most of the constructs of the model are reflexive, this can be considered a good indicator of the model's composition. The impact of the remaining factors should also be considered; a communality of 0.25 might appear quite low but can be significant if the item is important to improve the definition of the model. In the same way, the redundancy score measures the quality of the structural model for each endogenous block, considering the measurement model. Redundancy measures the percentage of variance in a factor that can be explained by exogenous factors of the model (Garson, 2009).

An adjustment global criterion of *goodness-of-fit* ("GoF") was also calculated. The *goodness-of-fit* is a geometrical average of the communalities and R^2 values present in the model. According to Tenenhaus *et al.* (2005), the GoF represents an index that can be used to validate models with PLS. The GoF obtained was 0.4186, indicating that the proposed model has reached 41.86% of the reachable fitness.

4.1. An exploratory analysis of Brazilian case

As indicated in the methodological section of this paper, the sample was composed by two major sources of respondents, namely one group of companies from Brazil (Set 2) and another composed by USA, Canada, United Kingdom and China (Set 1). Tests were conducted aiming to compare constructs' averages of those two distinctive groups. Table 6, present some descriptive results for each models' construct.

Table 6: *Constructs' averages statistics*

		N	Mean	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
Overall performance of supplier-oriented processes	Set 1	310	2.9484	2.8449	3.0519
	Set 2	478	3.4038	3.3249	3.4826
	Total	788	3.2246	3.1600	3.2892
Overall performance of customer-oriented processes	Set 1	310	2.9806	2.8770	3.0843
	Set 2	478	3.5649	3.4711	3.6586
	Total	788	3.3350	3.2624	3.4077
Internet utilization in customer-oriented processes	Set 1	310	7.1448	6.8960	7.3937
	Set 2	478	9.3201	9.0212	9.6189
	Total	788	8.4643	8.2457	8.6830
Internet utilization in supplier-oriented processes	Set 1	310	6.8949	6.6587	7.1311
	Set 2	478	9.1987	8.8791	9.5184
	Total	788	8.2924	8.0638	8.5211
Collaborative practices with suppliers	Set 1	310	15.2677	14.7525	15.7830
	Set 2	478	18.9833	18.5706	19.3959
	Total	788	17.5216	17.1760	17.8671
Collaborative practices with customers	Set 1	310	10.8000	10.4384	11.1616
	Set 2	478	12.2552	12.0195	12.4909
	Total	788	11.6827	11.4755	11.8900

Averages for all constructs were superior at the sample Set 2 of Brazilian companies. Independent samples t-test and analysis of variance test (ANOVA) were used in order to test this difference. In both tests averages were proven different when comparing two groups at a significance level of $p\text{-value} < 0.001$.

These findings may seem surprising at first glance; however several complementary explanations may exist. As pointed out by Ueltschy *et al.* (2007), Brazil boasts an impressive economic growth rate in the last two decades. In 2008 Brazil had a GDP over 1.5 trillion US\$ and was the fourth largest Internet market in the world, and the largest in Latin America, with online purchasing on the rise (The World Bank, 2010). In fact, the growth of Internet users in Brazil is impressive: 30 million in 2005; 53 million in 2005, 59 million in 2007 and 72 million in 2008. In a convergent finding, earlier research showed that Brazil has a higher proportion of electronic shoppers among all Internet users than United States or England (Brashear *et al.*, 2009).

Specifically regarding Brazilian B2B actual and potential markets, it is important to point out that Brazil is a large country with significant infrastructure and distance challenges; therefore buyers need to use the Internet as an additional mean of seeking new suppliers (and vice versa) (Samiee and Walters, 2006). Additionally, Brazil has a very dynamic manufacturing and services industry, is significant in terms of internal markets and international trade and many international world class supply chain service providers participate in different Brazilian economic sectors (McCormack *et al.*, 2008).

Not so surprisingly then, there are empirical evidences that even before 2003 large enterprises in Brazil had already used Internet technologies to develop networks in their business operations. From that time on, small to medium-sized enterprises have been also rapidly exploiting the ways in which the Internet can be used to give access to new domestic and overseas markets, as well as to global supply chains (Tigre, 2003). A similar finding is that already in 2005 Internet utilization for business relationships was faster in the developing markets than in the developed economies (Brashear *et al.*, 2009).

But additional and reasonable explanations for the findings presented on Table 6 can be due to other causes. Still the large difference cannot be explained solely by the ongoing and fast development of Brazil. Its GDP per capita is namely still less than one fourth of the USA. It may be due to the fact that Brazil has a high-context culture which values interaction and relationship building, unlike low-context cultures such as the United States, Canada or United Kingdom, where information exchange is viewed as the main purpose of communication (Rosenbloom and Larsen, 2003). Additionally, trust and long-term commitment are very important elements in high-context cultures, as pointed out by Ueltschy *et al.* (2007). Maybe the intensive Internet utilization by Brazilian companies is not only to support transactions and information exchange, but also to support other forms of collaborative efforts that demand relationship building and trust in a more comprehensive social communication framework. This is line with findings of Bianchi and Saleh (2009), which investigated the Chilean market and emphasized the importance of relational behavior for improving international performance. They suggested that trust and commitment, which can be built with extensive use of Internet, are essential to importer relational performance in that emerging market.

There may be a limitation in this analysis. In this study, the data were collected from respondents' self-assessment, which may lead to respondent perceptual bias (Zhu, 2007). In using questionnaires as the sole source of information, the perceptual bias is high, as the informants are the ones providing the data and giving their opinion (Gómez and Benito, 2008). Different respondent may interpret statements such as "strongly agree" or "above industry average" in different, inconsistent or incomparable manner. The potential problems of self-reporting are well documented (Ketokivi, 2004). Brazilian respondents, in that case, could have graded their performance, Internet usage and collaborative efforts scores higher due to lower benchmark contextualization of their competitive position or a lack of a global supply chain proper contextualization and perspective.

5. FINAL REMARKS

This paper studied the associations between collaborative practices, Internet utilization (as a proxy for digital/virtual interorganizational proximity) and the performance of supplier- and customer-oriented processes. Contrary to most of the existing research, the paper did not focus solely on a dyadic customer-supplier relationship but studied cooperation both up- and down-stream. Formal co-operative ties with other firms and a more consistent connection of processes within industries can be enhanced tremen-

dously by information technologies such as the Internet. Accordingly, access to supply networks is no longer limited by geographical boundaries but is enhanced by use of the Internet and Internet-based interorganizational systems.

The research statistically proved three important associations:

- the intensity of Internet utilization in supplier- and customer-oriented processes affects collaborative practices involving suppliers and customers;
- collaborative practices in supplier- and customer-oriented processes affect the performance in supplier- and customer-oriented process areas, respectively; and
- the companies' overall performance in supplier-oriented processes also affects their performance in customer-oriented processes.

Interestingly, Internet utilization/collaborative practices in an upstream relationship have a slightly larger effect on performance than in a downstream relationship. Since most of the companies are both suppliers and customers (of other companies) in a supply chain context, this indicates that while the collaboration is beneficial, on average customers acquire greater benefits.

The results also show that digital proximity through the intensive Internet utilization between companies can improve collaborative efforts and the operational performance of inter-organizational processes. The potential results of supply chain management and customer relationship management programs may therefore depend on the level of their digital proximity with suppliers and customers.

This research has practical implications. Even though all companies have already used the Internet in various ways for several years, the higher intensity of its use with both downstream and upstream partners still improves performance. This indicates that use of the Internet for improving collaboration between companies is still under-exploited. Further the extent and impact of the use of Internet may importantly depend on the origin of suppliers and/or customers; it may be even higher for countries in development and for high-context cultures like Brazil. Since most of the world supply chains have either large suppliers and/or customers in high-context cultures they should be invest appropriate time and resources to also exchange context, not just information, over the Internet. But the research has also several limitations. The concept of digital proximity was measured by Internet utilization in supply chain relationships which may not be a sufficient proxy for measuring the organizational and cultural changes needed to support collaboration. The performance of a supply chain was also measured with a single question. Further, the users' evaluations may not always accurately reflect the true performance and/or quality of their information systems (Goodhue, 1995).

The main topic for further investigation is how new organizational forms supported by Internet technologies have evolved over time, and what is the best way to measure their progress. A longitudinal study of a focal company, its suppliers and customers may be particularly interesting.

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APPENDIX A – QUESTIONNAIRE

Construct	Question
Internet utilization in supplier-oriented processes	Do your suppliers interact with you through the Internet? (email, online chat)?
	Do you gather information about your suppliers (and their products) through the Internet?
	Do you place orders for your suppliers' goods and services through the Internet?
Internet utilization in customer-oriented processes	Do your customers gather information about you (and your products) through the Internet?
	Do your customers place orders for your goods and services through the Internet?
	Does your company gather customer data (usage, forecast, ideas, complaints) through the Internet?
Collaborative practices with customers	Do you automatically replenish a customer's inventory?
	Do sales, manufacturing, distribution and planning organizations collaborate in the order-commitment process?
	Is your order-commitment process integrated with your other supply chain processes? Is the Distribution Management process integrated with the other supply chain processes (production planning and scheduling, demand management etc)?
Collaborative practices with suppliers	Are the supplier inter-relationships (variability, metrics) understood and documented?
	Do suppliers manage your inventory of supplies?
	Do you have electronic ordering capabilities with your suppliers?
	Do you share planning and scheduling information with suppliers?
	Do you collaborate with your suppliers to develop a plan? Do you measure and feedback supplier performance?
Overall performance of supplier-oriented processes	Overall, does this process area perform very well?
Overall performance of customer-oriented processes	Overall, does this process area perform very well?