Collaborative Markets in B2B Relationships

Since about 2000, relationships among firms within the supply chain have been changing in order to face new threats and opportunities that have arisen from web-based technologies. In the literature, two trends are emerging: market mechanisms are emphasized through electronic catalogs, auctions, and exchanges; at the same time, web technologies support collaboration among partners within the supply chain. This divergence opens up space for the emergence of a particular typology of relationship, which can be defined as a collaborative market. In such a relationship, the flexibility of new technologies reduces costs and resources needed to communicate and coordinate with suppliers, thus allowing companies to collaborate over a short-term horizon.

The aim of this research is to analyze and understand the main implications of Internet adoption in the relationships across the supply chain and to test its influence on the customer-supplier interaction. Evidence is based on a survey administered to 162 U.S. companies that investigates customer-supplier relationships before and after Internet adoption.

Keywords : Supplier Relationship Management; Purchasing Process; Internet; Business-to-Business, Survey Methods, Factor Analysis.

Introduction

The introduction of web-based technologies led to an e-commerce paradigm: companies started to adopt the new technologies in order to enter new markets, to enhance revenues in existing ones, and to supply better customer services to the final consumer. Soon e-commerce became e-business, interacting with many processes within the company and affecting transparency, visibility, efficiency, and costs reduction. In particular, processes going beyond the boundaries of the firm are influenced by this trend and relationships among companies within the supply chain are changing in order to face new threats and opportunities related to the Internet. Nowadays, when the success of any company depends on its network of relationships with customers and suppliers, it becomes extremely important for academics and practitioners to study how technology is influencing these relationships.

The Internet seems to be supporting two trends in industrial relationships. The first of these trends is characterized by standardization and market mechanisms through electronic catalogs, auctions, and virtual exchanges. The second of these trends is the opportunity to enhance the value added with higher customization and to improve supply chain performances with close relationships through new technologies, which make possible the integration of different companies’ information systems. In the literature it was hypothesized that the first trend should support indirect or MRO (maintenance, repairs, and operations) categories purchases, and the second trend should support direct or strategic procurement (Caniato et al., 2009). In reality, the consequences of the introduction of new technologies are rather complex and their influence on supply chain management and companies’ relationships is not easy to analyze. Within such context, the aim of this
article is to study and understand how the Internet adoption in the supply management processes might influence the relationship between the customer and its supplier in terms of required efforts and level of coordination and collaboration obtained.

In order to answer this research question, this study was based on a literature review and rationalization about supply chain management, customer-supplier relationships, technology use, and Internet tools adoption. Propositions based on such literature were then validated through a survey administered to 162 US companies.

The work is divided into four sections. Initially, main literature contributions relating to the subject are analyzed. Based on the literature review, in the second section the research question is stated, research propositions are explained, and the methodology to validate such propositions is described. The third section analyzes construct validity and reliability, discusses data analyses, and draws the main results of the research. The last section synthesizes the main conclusions.

The Internet Adoption In Customer-Supplier Relationships

In the customer-supplier relationships literature, a traditional distinction has always been made among markets, hierarchies, and partnerships or vertical alliances (Rice & Ronchi, 2002; Williamson, 1979).

Markets are the traditional arm's length transaction. Of course, the goals and objectives of the two actors involved in the transaction might not match; for this reason, the relationship is not exclusive: the buyer could find other suppliers and the seller could find other customers. As a consequence the time horizon of the relationship is often short (Ellram, 1991). Hierarchies provide full control over all the activities performed so customers’ and suppliers’ objectives become the same. The costs of acquiring or merging with another company could be very high and the efforts in making the two cultures compatible could be high as well. The time horizon of this relationship is very long and the switching costs related to the integration are relevant (Williamson, 1975).

Vertical alliances are typically a multi-dimensional and goal-oriented relationship between two firms in which risks and rewards are shared. Companies with similar objectives decide to collaborate, for example, either on inventory management or on new product development or marketing activities (Ellram, 1995; Lamming, 1993). This relationship presents typically a medium-long-term commitment and a high level of information sharing (Lambert et al., 1996; Walker & Harland, 2008). Such commitment and collaboration often lead to strategic benefits for both partners (Narasimhan & Das, 2001). With regard to this kind of relationship, one of the main and most critical themes debated in the literature is trust between companies (Lee & Gao, 2005).

What are the main implications of Internet adoption in the relationships across the supply chain?

The evolution of web-based tools in supply chain management has followed three major streams that are coherent with most common interactions between customers and suppliers within the previously mentioned coordination mechanisms (Angeles & Nath, 2007; Bartezzaghi & Ronchi, 2004; Batenburg, 2007; Kalakota, 2000; Kim & Shunk, 2004). The Internet could streamline inefficient procurement processes by removing the manual, paper-based, administrative and bureaucratic elements inherent in traditional purchasing systems.

This approach has been used mostly for low volumes and high-frequency MRO items procurement. Moreover, rather high levels of standardization and low description complexity characterize these items. These items include things such as office supplies,
spear parts, airline tickets, and various other services. For these goods, the procurement process cost often overcomes the purchase cost itself; for this reason companies adopt e-procurement in order to streamline and make more efficient such processes. On the contrary, high-volume direct materials, as shown in the following, need tools allowing either higher price savings or higher collaboration.

The Internet supporting market efficiency: e-sourcing

Internal efficiency in the procurement process is only one opportunity provided by web-based technologies. Malone, Yates, and Benjamin, describing the effect of information and communication technology (ICT), assert an overall shift of business relationships from hierarchies towards markets (Malone et al., 1987, 1989). In particular, they envision a further reduction of transaction costs in addition to the effects of e-procurement: products are easier to describe, asset specificity has been reduced, and information transfer on the markets is far more efficient. These conditions lead to the so-called frictionless commerce paradigm (Brynjolfsson & Smith, 2000). The overall effect is the increase of market situations to the detriment of hierarchies.

Such trends have been fostered by the emergence of web-based tools aimed at increasing market efficiency. Some examples of such market tools are public electronic catalogs, electronic exchanges, and electronic auctions. The adoption of these tools in order to increase supply market efficiency is also called e-sourcing (Carr, 2000; Hartley et al., 2004; Jap, 2000; Schoenherr, 2008; Smart & Harrison, 2003).

The Internet supporting collaboration: e-collaboration

The previous two sections highlighted how web-based technologies might support procurement process efficiency and market efficiency. As a matter of fact, in Malone et al. (1987), the authors also envisioned the existence of many cases of high-asset specificity and complex product descriptions for which new technologies would be adopted to increase collaboration among companies. In such situations, companies work closely together leading to either dyadic collaboration or to network collaboration (Morgan & Monczka, 1996), thus building a sort of virtual or extended enterprise (Borders et al., 2001; Childre, 1998; Romano et al., 2009).

The roots of e-integration are in the traditional EDI (electronic data interchange) point-to-point specific connections. These are dedicated systems that allow synchronous batch communication from one company’s computer system to a trading partner’s computer system (Harland et al., 2007; Ogden et al., 2008; Simchi-Levi et al., 2000). The following evolution of technology and XML standards can further facilitate collaboration among organizations by using two possible architectures (Clarke & Flaherty, 2003): extranets and Internet hubs. Highlight the concept of e-collaboration by defining three core integration activities:

- **Information sharing**: This is a first level of integration among trading partners. It consists of transferring and sharing any kind of documents and information (e.g., orders, invoices, inventory levels, technical drawings).
- **Collaborative planning**: This level involves collaboration on planning, forecasting, and inventory management activities. Also DSS (decision support systems) might be used in order to optimize planning decisions across the whole chain.
- **New product development**: In this case, trading partners collaborate on product development and engineering activities by exchanging and working, for example, on CAD files.

**Research Aims, Propositions, and Methodology**

The previous section highlighted possible roles of the Internet in supply management and more specifically in customer-supplier relationships. Within such a context, the specific objective of this work is to test the effects of Internet adoption on markets and on vertical alliances or partnerships.

**Research Propositions**

There are a number of contributions stressing the aspect related to market efficiency, thus hypothesizing an overall shift towards arm’s length relationships. Some others focus their attention on integration and collaboration aspects.

This research study starts from the assumption that a correlation exists between the efforts invested into the relationship and the level of coordination obtained: the higher the efforts the higher the level of coordination (Figure 1). The level of coordination can be measured through a number of variables found in the literature. In particular, variables explaining the level of coordination are divided into operational ones and technological ones. From the operational perspectives, higher coordination is provided by sharing activities or information such as inventory levels, final customer’s demand signals, production plans, or even collaborative inventory management, production planning, and demand forecasting. From the technological perspective, higher coordination is provided by technical drawings visibility, prototype tests visibility, or even collaborative product and process design, and technology co-development.

The efforts required to manage the relationship are not widely studied in the literature (Monczka et al., 1998; Moore, 1998, Caniato et al., 2005); however, from literature and empirical evidence based on case studies, some variables emerged (Bartezzaghi & Ronchi, 2005): time and resources spent to sustain the relationship, costs in ICT, costs sustained for joint team working, and investments in specific tangible assets (e.g., dedicated plants). All these dimensions contribute to increase switching costs once a vertical alliance is established.

The horizontal segments in the figure represent the effort gap.
between a market relationship and a vertical alliance. When companies start to establish a partnership, they face initial investments that are needed to effectively increase coordination from the market level to the alliance level.

The basic assumption of this article is that the Internet has shifted the coordination level - coordination efforts correlation allowing either higher levels of coordination with the same level of efforts (see the "A" arrow in Figure 1) or lower efforts with the same level of coordination (see the "B" arrow in Figure 1). Moreover, the maximum level of collaboration can be even higher than before due to the new technological platforms, which allow higher information richness and coordination (e.g., CPFR [collaborative planning forecasting and replenishment] applications, mobile team work infrastructures).

As a consequence, if companies decide to build a long-term alliance to reach a desired level of efficiency and effectiveness, and because of the high transaction costs on the market, today it is possible to improve coordination with other firms due to standard communication protocols and lower transaction costs (arrow “B”).

However, another effect of the Internet can be hypothesized. In some cases companies adopted market mechanisms for purchasing categories because the investment gap (the horizontal segment in the figure) between market and vertical alliance did not make further coordination worthwhile. Today those companies can build possible alliances for those categories without higher efforts into the relationship (arrow “A”).

The consequences of the previous considerations are clearly shown in the figure. The distinction between markets and vertical alliances has been exasperated by the twofold role of the Internet (arrows “A” and “B”). The effect of this divergence is the possible adoption of a short-term collaborative relationship, addressed to as “Collaborative Market” in this study. Collaborative Markets would provide higher coordination levels than traditional market relationships (above line 1 in the figure) with the same coordination efforts adopted in traditional market relationships (on the left side of arrow “A”). As a consequence companies would have the opportunity to increase coordination levels also in short-term relationships.

Summarizing these considerations, three main propositions can be drawn:

P1. A correlation exists between the efforts invested into supporting the customer-supplier relationship and the level of coordination reached within the relationship itself.

P2. The coordination level - coordination efforts correlation can be shifted through the Internet adoption into the relationship. That means it is possible either to achieve higher coordination with the same level of efforts or to reduce the efforts maintaining the same level of coordination.

P3. The shift of the curve leads to the divergence between markets and vertical alliances, opening potential opportunities to Collaborative Markets.

Research Methodology

These three propositions have been tested by operationalizing a model including the two main mentioned concepts: coordination efforts and coordination level. Such dimensions have been measured before and after Internet adoption in the customer-supplier interaction. Data were gathered through a questionnaire based on the literature (Ballou et al., 2000; Croom, 2000; Morgan & Monczka, 1996; Narasimhan & Das., 2001;
Olsen & Ellram, 1997), carefully designed and tested through a panel of experts in the field and through eight pilot cases before mailing. This preliminary process was aimed at testing and modifying measured variables in order to provide content validity to the study and to be sure that required information was perceived in the same way by different people in the field (Bohrnstedt, 1983).

There are two main typologies of survey design: cross-sectional surveys collect and analyze information from one precise moment; longitudinal surveys collect and analyze information coming from the same subjects, but at separate moments. Although this is not a proper longitudinal study because data are not physically gathered in different points of time, the collection provides longitudinal evidence because questions in the questionnaire refer to before and after the Internet adoption. This kind of survey design is named impure panel design or time-ordered cross-sectional design (Menard, 1991).

This sampling and questionnaire procedure was preferred to one that analyzed and compared companies adopting the Internet with companies not adopting it for a specific reason: it could eliminate the possible introduction of bias in the sample because of the reasonable risk of comparing companies adopting the Internet, which probably are the most innovative and best performers on the market generally leading in terms of best practices, with companies not adopting the Internet, which probably are not the best in the market in any sense. The research was aimed at studying the motivations and effects of the Internet adoption ceteris paribus in order not to bias the results of the analyses; the best way to obtain ceteris paribus conditions is to compare the same set of companies and the same set of purchases before and after the Internet adoption.

Considering the general and cross-industry objective of the research, the sample selection has considered companies across different manufacturing industries. A broad database containing over 15,000 companies operating in the United States was built starting from data provided by three major associations: ISM (Institute for Supply Management), CSCMP (Council of Supply Chain Management Professionals), and PMAB (Purchasing Management Association of Boston). The distribution of companies across industries was approximately the same in all three initial databases; therefore, the overall sample could be considered as representative of the industrial population in the United States. Fifteen hundred companies were selected from the broad database; the number of companies for each industry was selected through a stratification process on industrial sectors. Within each industry, a random selection was performed. Because some contacts had wrong addresses, a second group of cases was selected. Some of them were contacted twice in order to complete missing answers. It was necessary to deal with missing values only in very few cases and only for continual variables (e.g., revenues, employees). In such situations missing answers were replaced with the average of the total sample, according to a standard procedure used to replace missing values (Norusis, 1993). This is a slight approximation but it allows performing the analysis on a larger set of data, thus increasing the significance of results. As far as non-respondents were concerned, in the majority of cases, they replied to the letter of participation stating their interest in the research, but saying that company policies forbade them to divulge any kind of information (privacy concerns). A total of 1,498 companies were contacted, with a response rate of 12.3% (185 responses). Finally, after the data quality-filtering process, 162 good

### Table 1

<table>
<thead>
<tr>
<th>Industry</th>
<th>N</th>
<th>Company sales (US$ millions) N</th>
<th>Number of employees N</th>
<th>Supply chain position (products sold to) N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automotive</td>
<td>7</td>
<td>0 - 50</td>
<td>0 - 250</td>
<td>Materials manufacturers</td>
</tr>
<tr>
<td>Mechanical</td>
<td>24</td>
<td>51 - 150</td>
<td>251 - 500</td>
<td>Product assemblers</td>
</tr>
<tr>
<td>Electronic</td>
<td>23</td>
<td>151 - 500</td>
<td>501 - 1500</td>
<td>Distributors</td>
</tr>
<tr>
<td>Telecommunication</td>
<td>11</td>
<td>501 - 2000</td>
<td>1501 - 6000</td>
<td>End consumers</td>
</tr>
<tr>
<td>Textile &amp; Apparel</td>
<td>8</td>
<td>&gt; 2000</td>
<td>&gt; 5000</td>
<td>others</td>
</tr>
<tr>
<td>CPG</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food &amp; Beverage</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health care</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>162</td>
<td><strong>Total</strong> 162</td>
<td><strong>Total</strong> 162</td>
<td><strong>Total</strong> 162</td>
</tr>
</tbody>
</table>

responses were received and analyzed (Table 1). On average, companies in the sample had been using the Internet in the customer-supplier interaction for about 18 months.

Once data have been collected, it was necessary to test construct validity and reliability. In the first step of the analysis we reduced the number of variables considered in order to simplify the description and the understanding of phenomena by creating valid and reliable measures. This task was performed through a series of factor analyses followed by related reliability analyses (O’Leary-Kelly & Vokurka, 1998). Because the goal of factor analysis is to obtain valid factors that help explain the correlations among variables, these must be related to each other for the factor model to be appropriate. Bartlett’s test of sphericity was used to test the hypothesis that the correlation matrix in each case was an identity matrix. This hypothesis was always rejected. Another indicator that needed to be tested before proceeding with the proper factor analysis was the Kaiser-Meyer-Olkin (KMO) measure. If variables share common factors, the partial correlation coefficients between pairs of variables should be small when the linear effects of the others are eliminated. If the KMO measure is approximately equal to 1 then the partial correlations are approximately equal to 0. In all the cases, values were higher than 0.6 and accepted (Norusis, 1993).

The main factors were then extracted through the principal component method using a Varimax rotation in order to distinguish and understand the dimensions more clearly. The number of factors was determined according to the cumulative percentage of variance explained, the change of the slope in the scree plots (mainly considering factors with eigenvalues higher than 1; Norusis, 1993), the correlation among variables, and the interpretability of the resulting factors themselves. Variables presenting either factor loadings lower than 0.4 or similar factor loading values in more factors were excluded from the analysis (Fullerton & McWatters, 2001). The resulting components were then analyzed in terms of scale and construct reliability, measuring the Cronbach’s alpha coefficient among the grouped variables. The factors presenting low values of alpha were further split until a good coefficient was obtained. The alpha’s threshold value was 0.6 (Fullerton & McWatters, 2001); all alphas were higher than 0.7; only one factor (efforts before the Internet adoption) presented a lower value (0.67).

Data Analysis and Discussion of Results

The relationship was described in terms of characteristics and coordination efforts required to manage the interaction between the two companies.

Characteristics of the relationship

In the questionnaire the characteristics of the selected relationship, mostly in terms of coordination modes before and after the Internet adoption, were described by the following variables: length of the relationship, length of the contracts, volume of the purchases, arm’s length transaction, marketing activities, order tracking/tracing, production information, inventory information, product information, JIT coordination, collaborative planning and forecasting, VMI, consignment stock, collaborative product design, collaborative process, and technology development. The variables and the adopted questions were the outcome of the preliminary process described previously used to fine-tune the survey tool (based on the literature, a panel of experts, and eight pilot cases).

Due to the structure and the purpose of the questionnaire, for each variable two values were available: before the Internet adoption and after the Internet adoption. For this reason, two factor analyses were conducted and then a summary table was worked out (Table 2). In this table the eigenvalues, the variance explained, and the Cronbach’s alphas are shown for both analyses, and the resulting factor loadings are calculated as the average of the factor loadings before and after the Internet adoption.

The arm’s length transaction was excluded from the analysis because its factor loadings were low in every component. This variable was therefore used only to cross-check the presence of possible incompatibilities in the answers (e.g., an arm’s length relationship with collaboration activities in place). Length of contracts and volume of purchases presented low factor loadings and appeared within different factors in the two analyses; for these reasons they were excluded from the table as well. As far as order tracking and tracing is concerned, it presented significant values for operational collaboration and information sharing. That is quite reasonable because in both cases order tracking is a basic aspect. For this reason, it was excluded from the analysis, obtaining factors as orthogonal as possible in order to make themselves more explainable and to avoid multicollinearity problems in subsequent analyses. From the analysis three main factors describing the relationship emerged (according the process described in “Research Methodology”): operational collaboration, technological collaboration, and information sharing.

Operational collaboration: This component describes the relationship in terms of operational processes and activities jointly performed by the two companies. They consist of just-in-time coordination in production and materials management, collaborative planning and forecasting, and practices of vendor-managed inventory and consignment stock. All these variables recall the same concept of operational collaboration mentioned in the literature. Furthermore, from the analysis, another dimension also seems to contribute to building a collaborative operational relationship: collaboration in marketing activities. Although the corresponding factor loading is the lowest, jointly performed promotions, advertisement, and co-branding practices contribute to
determining the level of operational collaboration.

Technological collaboration: This second main factor describes the relationship in terms of development processes jointly performed by the two companies. Collaborative design in product development and collaboration in new processes and technologies development are typical practices determining the level of technological collaboration. As for the previous factor, all these dimensions are supported by evidence from the literature. Collaborative development implies a high level of knowledge sharing and therefore a high level of trust between the two parties; this takes time and requires long-term relationships. As a matter of fact, the adoption of the Internet cannot influence the length of the relationship because it is related only to time. For this reason, this dimension was excluded from the analysis because it would not have explained the variance of the sample before and after the Internet adoption.

Information sharing: This last factor describes the amount of information shared between the two companies. This dimension does not imply collaboration in terms of joint decision making, but consists of just providing visibility to the other party. Such visibility could be in terms of sharing information about inventory levels, about technical specifications of the product, and about production planning schedules.

Efforts required to manage the relationship

In the questionnaire the efforts required to manage the selected relationship before and after the Internet adoption were described by the following variables: time and resources, ICT costs, joint team working costs, and investments on assets.

As in the previous case, for each variable two values were available: before the Internet adoption and after the Internet adoption. For this reason, two-factor analyses were conducted and then a summary table was worked out with the same procedure used for Table 2 (see Table 3). From the analysis only one main factor describing the efforts required to manage the relationship emerged.

Coordination Efforts: This unique component describes the efforts in terms of costs in ICT, costs sustained for the organization of joint team work sessions, investments in tangible assets within the relationship from the company and the supplier, and, finally, time and resources spent to sustain and coordinate the relationship.

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1. This variable would not explain the variance of the sample before and after the Internet adoption because the length of the relationship does not change when adopting the Internet. For this reason it was excluded from the analysis.
The coordination level—coordination efforts correlation

The second step of this analysis was aimed at proving the existence of the correlation between the level of coordination and efforts required by the relationship and the hypothesized shift of such correlation through the adoption of the Internet technologies. In order to pursue that goal, a multivariate regression model was tested; the main results of which are reported in Table 4.

The model considers operational collaboration, technological collaboration, information sharing, and total coordination (simple average of the previous three factors) as dependent variables. A multivariate model was chosen because of the interrelations existing among these variables. The stem-and-leaf diagrams of dependent variables showed a normal distribution (Norusis, 1993). The model was built as follows for each of the coordination variables:

\[ y_i = \beta_0 + \beta_4 d_i + \beta_3 \ln(\text{efforts}) + \beta_1 d_i \ln(\text{efforts}) + \beta_2 \text{relevance} + \epsilon_i \]

which can be written also as follows:

\[ y_i = (\beta_0 + \beta_4 d_i) + (\beta_3 + \beta_1 d_i) \ln(\text{efforts}) + \beta_2 \text{relevance} + \epsilon_i \]

where:

- \( y_i \): is the value of one of the four dependent variables (i.e. type of coordination) considered for the case \( i \);
- \( d_i \): is the dummy variable indicating "0" if the data refers to the situation before the Internet and "1" if the data refers to the situation after the Internet;
- \( \text{efforts}_i \): indicates the level of coordination efforts measured for the case \( i \);
- \( \text{relevance}_i \): is the relevance of the acquired material in the case \( i \);
- \( \text{criticality}_i \): is the criticality of the acquired material in the case \( i \);
- \( \text{sm_complexity}_i \): is the supply market complexity for the acquired material in the case \( i \);
- \( \mu_i \): is the residual term, which is assumed as normally distributed, mean zero and constant variance.

Relevance, criticality, and supply market complexity have been introduced as control variables in the model because they were supposed to explain part of the coordination and collaboration pursued by the customer and the supplier.

The dummy variable has been introduced for two reasons: first, it allows testing the significance of the difference of the intercept before and after the Internet adoption; second, it allows testing the difference in the slope of the relationship between efforts and coordination level before and after the Internet adoption.

Finally, a logarithmic relation between efforts and level of coordination has been introduced for two reasons. First, modeling the hypothesized function (see Figure 1) would have needed too many parameters to be estimated considering the sample size; therefore, a simple decreasing derivative of the coordination level has been hypothesized. Second, a function of the dependent variable with a saturation limit could cause heteroschedasticity problems because the variance of the dependent variable could not be constant in proximity of the limit. Statistical analyses have shown that a logarithmic relationship fits the variables better than a simple linear one.2

As far as the multivariate model is concerned, results show that all the independent variables considered are significantly correlated to the dependent ones, excluding the dummy (before and after the Internet) and the supply market complexity. In order to interpret deeply such results, the univariate parameter estimates are useful.

The operational collaboration model explains 63.9% of its variance. Intercept, efforts, \( d \times \ln(\text{efforts}) \), and material criticality are all correlated with the level of operational collaboration. The intercept value is 1.025, which means that there is low coordination when the independent variables are at the lowest level in the scale. The model tests the correlation existing between operational collaboration and efforts invested into the relationship through a logarithmic expression (\( P1 \) not rejected), which also means that a saturation effect exists. The most interesting evidence is that \( d \times \ln(\text{efforts}) \) has also a significant and relevant coefficient (0.949); this result shows how the slope of the relation

\[ \text{Table 3} \]

<table>
<thead>
<tr>
<th>Efforts required to manage the relationship</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
</tr>
<tr>
<td>ICT Costs</td>
<td>.544</td>
</tr>
<tr>
<td>Joint team working costs</td>
<td>.831</td>
</tr>
<tr>
<td>Assets</td>
<td>.757</td>
</tr>
<tr>
<td>Time and Resources</td>
<td>.596</td>
</tr>
<tr>
<td>Eigenvalue before the Internet</td>
<td>2.382</td>
</tr>
<tr>
<td>Eigenvalue after the Internet</td>
<td>2.623</td>
</tr>
<tr>
<td>Variance explained before the Internet</td>
<td>58.05%</td>
</tr>
<tr>
<td>Variance explained after the Internet</td>
<td>65.58%</td>
</tr>
<tr>
<td>Cronbach’s Alpha before the Internet</td>
<td>.67</td>
</tr>
<tr>
<td>Cronbach’s Alpha after the Internet</td>
<td>.82</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.
Total variance explained before the Internet: 58.05%.
Total variance explained after the Internet: 65.58%.
between efforts and operational collaboration increases after the Internet adoption (see equation \( E2 \)). That suggests the shift of such correlation (\( P2 \) not rejected). Finally, criticality of the material is also significant in explaining the level of coordination: the more the material is specific, customized, new, and complex, the more companies pursue operational collaboration. The simple dummy variable does not present a significant parameter (two-tailed significance 0.621). This result suggests that the simple introduction of the Internet does not provide a higher level of coordination per se if it is not supported by greater efforts. In a similar way, material relevance and supply market complexity seem not to explain the level of coordination either.

The technological collaboration model is the least explained (54.6%). In that model, analogous considerations to the operational collaboration model can be drawn for the intercept, the dummy, the efforts, and the product characteristics. Exception is made in the \( d \cdot \ln(\text{efforts}) \) parameter. Such a parameter is not significant (two-tailed significance 0.752); it means that the Internet introduction in the relationship has not shifted, on average, the correlation between technological collaboration and efforts (\( P1 \) not rejected and \( P2 \) rejected). This result implies two possible conclusions: either at this stage the Internet could not

**Table 4**
Multivariate regression model between Coordination Level and Coordination Efforts.

<table>
<thead>
<tr>
<th>Model</th>
<th>Parameter</th>
<th>B</th>
<th>Std. Error</th>
<th>T</th>
<th>Sig. (^4)</th>
<th>F</th>
<th>Sig. (^6)</th>
<th>R(^2)</th>
<th>Durbin-Watson (^5)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intercept</strong></td>
<td></td>
<td>1.052</td>
<td>.250</td>
<td>4.208</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Operational</strong></td>
<td>d</td>
<td>-1.23</td>
<td>.247</td>
<td>-4.96</td>
<td>.021</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( \ln(\text{efforts}) )</td>
<td>.401</td>
<td>.182</td>
<td>2.215</td>
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\(^{3}\) Significant parameters are shown by italic numbers.
\(^{4}\) Two-tailed significance.
\(^{5}\) The Durbin-Watson measure (DW) tests the residuals auto-correlation. In this case, the upper bound to be exceeded in order to reject the auto-correlation is 1.80. If the DW measure is higher than 2, the test has been done on 4-DW (Dillon and Goldstein, 1984; Maddala, 1992).
support appropriately the co-development process or companies could have not used the technology with the objective to increase collaboration in such activities. The first conclusion is coherent with research on media-richness theory (Daft & Lengel, 1984, 1986; Dennis & Kinney, 1998). Based on this groundwork, the Internet is currently rich enough to leverage lower-level efforts (operational collaboration and information sharing), but insufficiently rich to leverage high-level efforts (technological collaboration).

The information-sharing model is explained by the independent variables obtaining 60.5%. The effect of the first four parameters is similar to operational collaboration: the correlation between information sharing and efforts exists, and such correlation has been shifted through the use of the Internet (P1 and P2 not rejected); the dummy contribution is not significant in shifting the interception. The intercept is higher than in the other cases, illustrating that reaching information sharing is less demanding than other kinds of coordination (operational and technological). In terms of characteristics only relevance seems to explain the higher level of information sharing.

Finally, not surprisingly, the interpretation of the total coordination model is similar to the multivariate model. The variance explained is 70.2%. All the variables significantly explain the level of coordination, excluding the usual dummy and supply market complexity. This result means that the overall level of coordination is correlated to the efforts required by the relationship and such correlation has been changed in slope through the Internet (P1 and P2 not rejected), although it has not moved up (the dummy presents a two-tailed significance of 0.653). Material relevance and criticality all contribute to the explanation of higher levels of coordination, and supply market complexity is not a driver in increasing coordination and collaboration.

Figure 2 clearly shows the underlying concept of the model; only the total coordination model is provided but analogous considerations could be drawn for the others, excluding technological collaboration that does not appear to be influenced by the Internet adoption (as seen before). The interpretation of the graph is significant in the middle range of dependent variable values because it is supposed to be normally distributed and 1 and 5 are accumulation points cutting off the distribution itself. However, general conclusions can be drawn.

The Internet introduction into the relationship has doubled the slope of the curve describing the coordination efforts correlation in the analyzed sample while keeping unaltered the minimum level of coordination (intercept 0.947): though, because this is in the proximity of the accumulation point, the variance could vary. In general terms, it means that the adoption of the Internet per se is not useful if not supported by efforts in terms of time and resources, joint team working, and appropriate investments in ICT and assets. The two curves show that web-based technologies make possible either higher levels of coordination and collaboration with equal efforts than before or lower efforts with equal levels of coordination and collaboration. This evidence clearly supports proposition P3, which is based on the shift of the coordination efforts correlation as explained previously. A brief summary of the results is shown in Table 5.

Conclusions

The effects of the Internet introduction in customer-supplier interaction along the supply chain have been analyzed in this study.

![Figure 2](image)

**Figure 2**
Total coordination level - coordination efforts correlation before and after the Internet adoption (a best fit line is provided in order to show the patterns)
The research highlighted the twofold role of the Internet. Web-based tools such as electronic auctions, liquid exchanges, and public electronic catalogs emphasize market efficiency, thus making more convenient arm’s length transactions among companies. However, the Internet, with its capability of standardizing communication protocols and supporting richer information sharing than before, provides the possibility of creating deeper relationships based on higher coordination and collaboration than before. This context creates a divergence between pure market relationships and vertical alliances or partnerships.

Such divergence can be explained by the shift of the coordination level-coordination efforts correlation. Companies might build collaborative relationships on the market without investing as much effort as they should have done in the past. At the same time, companies might reach higher coordination with the same efforts as in the past. In reality, the work has analyzed three dimensions of coordination: operational collaboration, technological collaboration, and information sharing. The shift in the correlation has been tested for information sharing and operational collaboration, whereas technological collaboration does not seem to be affected by the adoption of Internet tools.

In such a condition, a potential form of short-term collaboration might emerge: the collaborative market. A collaborative market relationship occurs when companies choose trading partners through a market-oriented approach, but new technologies allow them to reach a high level of coordination and collaboration without big investments. These are short-term relationships with low initial costs and therefore low switching costs: if the relation is not worthwhile any more, trading companies can give it up and find someone else in the market. The existence of such relationships should allow companies to better compete by leveraging their dynamic collaborating networks.

The emergence of collaborative markets might boost even further the outsourcing phenomenon companies are going through. One barrier to outsourcing has always been the loss of control; by supporting higher coordination with relatively low efforts, the Internet supports outsourcing through information re-integration. In other words, companies are more and more fragmenting their supply chains and at the same time they are gaining higher control through the integration of pieces of information and collaboration processes.

Particularly interesting applications might be experienced in industries characterized by large orders and projects. General contractors in the construction industry, for example, could leverage this kind of relationship with their subcontractors during the construction project life cycle.

However, some barriers still exist in the pursuit of collaborative markets. In particular, trust issues, lack of process and communication standards (Albrecht et al., 2005), current internal data and processes, learning effect issues, privacy and competitive concerns, and data security are all obstacles to be overcome in order to enable such a typology of relationship.

In conclusion, it is useful to address some possible limitations and future developments of this research study. A possible limitation is related to the data collection (time-ordered, cross-sectional design); future research might focus on a proper longitudinal study by collecting data from two different moments. Finally, this article focuses on the dyadic relationship between customers and suppliers; future studies might address the supply network overall by analyzing the set of dynamic relationships upstream and downstream in the network.

References


About the Author

Stefano Ronchi is Associate Professor of Business Organization & Management and Purchasing & Supply Management at Politecnico di Milano; he is also Unitech Vice President of Academic Partners, and he is Deputy Dean for MBA Programs at MIP Politecnico di Milano - School of Management. In January 2002 Stefano got his PhD in Management Engineering discussing the results of a research project on the adoption of the Internet technologies in Supply Chains carried out at the Massachusetts Institute of Technology - within the Integrated Supply Chain Management Program (ISCM).

His current main research stream is Purchasing and Supply Chain Management. On this topic he has been participating in many research and consulting projects both in Italy and abroad and he is also author of over 40 international journal and conference papers.

He is member of the Italian Management Engineering Association (AIK), the European Operations Management Association (EurOMA) and the International Purchasing and Supply Education and Research Association (IPSERA). He is also reviewer of the Journal of Purchasing and Supply Management (JPSM).