The Effects of the Internet Adoption In Customer-Supplier Relationships

The Markets - Vertical Alliances Divergence and the Emergence of Collaborative Markets

Stefano Ronchi
THE EFFECTS OF THE INTERNET ADOPTION IN CUSTOMER-SUPPLIER RELATIONSHIPS

THE MARKETS - VERTICAL ALLIANCES DIVERGENCE AND THE EMERGENCE OF COLLABORATIVE MARKETS
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- To facilitate research integration and mobility on a global level.
- To enhance research quality and, in particular, to promote synergy and collaboration on empirical research.
- To promote a better quality of PhD training and supervision.
- To promoting joint research programmes involving companies and academia offering the prospect of rigorous training and exposure of PhD students.

The CINet is unique for its focus on innovation management as well as for the specific vision that is shared by partner institutions concerning the role and potential contribution to innovation and improvement of human resources at all levels.

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THE MARKETS - VERTICAL ALLIANCES DIVERGENCE AND THE EMERGENCE OF COLLABORATIVE MARKETS

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# Table of contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table of contents</td>
<td>vii</td>
</tr>
<tr>
<td>1. Introduction</td>
<td>9</td>
</tr>
<tr>
<td>2. The role of the Internet in Supply Chain Management</td>
<td>11</td>
</tr>
<tr>
<td>2.1 The Internet supporting the procurement process: e-procurement</td>
<td>12</td>
</tr>
<tr>
<td>2.2 The Internet supporting market efficiency: e-sourcing</td>
<td>12</td>
</tr>
<tr>
<td>2.3 The Internet supporting collaboration: e-collaboration</td>
<td>13</td>
</tr>
<tr>
<td>3. Research aims and methodology</td>
<td>15</td>
</tr>
<tr>
<td>3.1 Basic assumptions of the research</td>
<td>15</td>
</tr>
<tr>
<td>3.2 Aims of the research</td>
<td>16</td>
</tr>
<tr>
<td>3.3 Research methodology</td>
<td>17</td>
</tr>
<tr>
<td>4. Case studies</td>
<td>25</td>
</tr>
<tr>
<td>4.1 Grapes</td>
<td>25</td>
</tr>
<tr>
<td>4.2 Noragri</td>
<td>26</td>
</tr>
<tr>
<td>4.3 Smart Technologies</td>
<td>28</td>
</tr>
<tr>
<td>4.4 Motorauto – Fiumelli</td>
<td>30</td>
</tr>
<tr>
<td>5. Research hypotheses</td>
<td>33</td>
</tr>
<tr>
<td>5.1 Motivations to the Internet adoption in customer-supplier relations</td>
<td>33</td>
</tr>
<tr>
<td>5.2 Internet tools choice</td>
<td>34</td>
</tr>
<tr>
<td>5.3 The Market - Vertical Alliance divergence</td>
<td>35</td>
</tr>
<tr>
<td>6. Survey Design</td>
<td>39</td>
</tr>
<tr>
<td>7. Survey Analysis</td>
<td>43</td>
</tr>
<tr>
<td>7.1 Motivations to the Internet adoption</td>
<td>43</td>
</tr>
<tr>
<td>7.2 Internet tools choice</td>
<td>44</td>
</tr>
<tr>
<td>7.3 The Market - Vertical Alliance divergence</td>
<td>48</td>
</tr>
<tr>
<td>8. Conclusions and future developments</td>
<td>55</td>
</tr>
<tr>
<td>9. References</td>
<td>57</td>
</tr>
</tbody>
</table>
The effects of the internet adoption in customer-supplier relationships
1. Introduction

In the last years a great attention has been paid to the potentialities related to the Internet adoption within business processes. Firstly, the introduction of web-based technologies led to the 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 the e-commerce became e-business due to the interaction of the new technologies with all processes within the company. As a matter of fact, also processes going beyond the boundaries of the firm are influenced by this trend and in particular the relationships among companies within the supply chain are changing in order to face new threats and opportunities.

As far as the relationships across the supply chain are concerned, the Internet seems supporting two apparently contrasting trends. On the one hand, standardization and market mechanisms are emphasized through electronic catalogs, auctions and liquid exchanges. On the other hand, there 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 integrable different companies’ information systems. At a first glance, it could be hypothesized that the first trend should support indirect or MRO (Maintenance, Repairs and Operations) materials purchases; while the second trend should support direct or customized materials procurement.

In reality, the consequences of the introduction of the new technologies are rather complex and, although they do not change dramatically traditional business concepts, their influence on supply chain management and companies’ relationships is not easy to analyze. The Internet changes the nature of traditional relationships and leads to new possible configurations. Those changes are allowed by the technology, but its introduction will not be worthwhile if it is not supported by an integrated analysis within the company and beyond it, upstream and downstream in the supply chain. This implies the reengineering of processes, organizations and managerial configurations. Performances of processes across the supply chain are strongly influenced by these interactions between new managerial and organizational configurations and new technologies. There is not a deterministic one-way impact of one of these two areas on the other, but their development is mutually fostered and supported by each other.
Within such context, the aim of this research study is to analyze and to understand clearly what are main implications related to new technologies on vertical relationships between companies along the supply chain. In particular, three main objectives are addressed in the work.

The first main objective of the research is to clarify what are the motivations that should stimulate companies to adopt web-based technologies within their relationships with suppliers.

The second objective is to identify what are the appropriate Internet tools companies should adopt according to their specific goals.

Finally, the most relevant objective is to explain what are the implications on customer-supplier relationships related to the Internet adoption.

In order to answer these research questions, all the study has been based on a wide literature review and systematization, which mainly concern three research streams: supply chain management, customer-supplier relationships, and Internet tools adoption within inter-enterprise relationships. Literature analysis supported the clear definition of the research questions and the formulation of preliminary research assumptions. The overall empirical methodology has then followed three subsequent stages. The first stage is exploratory in nature and consists of case analyses and qualitative interviews. The second stage is explanatory in nature and consists of survey analysis. Finally, the third stage is descriptive in nature and consists of web sites analysis. Along the entire research process, the unit of analysis has been the customer-supplier relationship.

The exploratory stage aims at identifying main variables explaining and influencing the Internet adoption in procurement relationships. Evidence has been collected from four case studies of companies adopting the Internet in some of their relationships with suppliers. In addition, a wider inquiry has been carried out over the Internet and with academics, consultants, and experts in the field in order to gather further information about general trends in such context.

The outcome of this first stage is the formulation of preliminary answers to previously mentioned research questions, thus stating clear hypotheses underlying such answers. Subsequently, the explanatory stage aims at testing formulated answers and related underlying hypotheses through a survey analysis. Such survey is based on a questionnaire sent out in the period July-August 2001 to a sample of 1,500 North American companies, randomly selected from a 15,000 firms database, which resulted from data provided by the NAPM (National Association of Purchasing Management), the CLM (Council of Logistics Management), and the PMAB (Purchasing Management Association of Boston). Valid responses are 162 out of 185 respondents (response rate of 12.3%). Collected data were analyzed through different statistics methods; as far as the testing purpose of the analysis is concerned, factor analysis, logit and multiple regression models, and analysis of variance techniques have been adopted.

Finally, as research hypotheses were proved, an Internet research has been performed in order to collect and analyze further data about emergent supply chain services offered on web, thus providing a detailed description of web-portals supporting coordination and collaboration between customers and suppliers.
2. The role of the Internet in Supply Chain Management

Within this section, only a brief literature review on the Internet in Supply Chain Management is provided.

In customer-supplier relationships literature, a traditional distinction has always been made among markets, hierarchies and partnerships or vertical alliances (Williamson, 1975; Williamson, 1979; Ellram, 1991; Ellram, 1995; De Maio et al., 1992; Lamming, 1993; Macbeth et al., 1994; Dyer et al., 1998; Dyer et al., 2000; Simchi-Levi et al., 2000; Rice et al., 2002).

Markets are the traditional arm’s length transaction. One company needs a specific product or service, and it simply purchases that on the market from the best bidder. Of course, the goals and the 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 its time horizon is often short.

Hierarchies provide full control over all the activities performed and the objectives become all the same. The costs of acquiring or merging another company could be very high and the efforts in making the two cultures compatible could be such high as well. Due to the characteristics of this relationship, the time-horizon is very long because the switching costs related to the integration are relevant.

Vertical Alliances are typically a multi-dimensional and goal-oriented relationship between two firms in which both risks and rewards are shared. Companies with similar objectives decide to collaborate either on inventory management or on new product development or on marketing activities; and these are only few examples. Due to the goals commonality and the kind of information shared, this relationship presents typically a medium-long term commitment. Such a commitment and collaboration often lead to strategic benefits for both partners. With regard to this kind of relationship, one of the main and most critical themes debated in literature is surely trust between the companies.

Within this classification, a simple and comprehensive way of identifying potential opportunities offered by the Internet in customer-supplier relationships is thinking at the nature of the relationship itself. The first basic activity underlying each interaction is transaction management; a second basic activity is matching demand and supply; and
finally, the third and most demanding one is coordinating and collaborating between parties (Chopra et al., 2001). The evolution of web-based tools in supply chain management has followed the same path (Kalakota, 2000).

In 1987, Malone, Yates and Benjamin already envisaged three basic information technology effects that would have deeply influenced customer-supplier relationships in the three mentioned activities (Malone et al., 1987; Malone et al., 1989). The first effect is termed electronic communication effect, which means that information technology can decrease dramatically the costs of communication, therefore facilitating transaction management. The second is named electronic brokerage effect, which means that standards and protocols of an electronic market can enhance transparency within a market. This leads to the increase of the number of alternatives that can be considered, the increase of quality of the selected alternative, and the decrease of the entire selection process cost, therefore facilitating demand-supply matching. Finally, the third effect is called electronic integration effect, which means the possibility to integrate customer and supplier's information systems, therefore facilitating coordination and collaboration. These three effects of the Internet make it a support respectively to the procurement process, to the market efficiency, and to collaboration.

2.1 The Internet supporting the procurement process: e-procurement

The first generation B2B phenomenon started with buy-side electronic catalogs implemented by software companies like Ariba, SAP, Microsoft Market, Intelsys, and CommerceOne. Many authors refers to this generation with the term e-procurement (Bowles, 1999; Kalakota, 2000; Croom, 2000; Chopra et al., 2001). The Internet could streamline inefficient procurement processes by removing the manual, paper-based, administrative and bureaucratic elements inherent in traditional purchasing systems. This kind of solution essentially aggregates a pre-selected group of suppliers and builds an integrated catalog containing different items. Any employee can browse the customized catalog, choose the goods or services, and then send an electronic purchase order over the Internet. Where management approval is needed, an appropriate workflow routes automatically the order through the proper channels.

As far as the characteristics of such electronic catalogs are concerned, they have been mostly used for low volumes and high frequency MRO (Maintenance, Repair and Operating materials) items procurement. Moreover, rather high levels of standardization and low description complexity characterize these items. Such items include things like office supplies, spare parts, airline tickets and various services. For these items, 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 process. On the other hand, high volumes direct materials, as shown below, need tools allowing either higher price savings or higher collaboration.

2.2 The Internet supporting market efficiency: e-sourcing

Internal efficiency in the procurement process is only the first and most simple opportunity realized through web-based technologies. Malone, Yates, and Benjamin,
describing the effect of information and communication technology on two dimensions characterizing the transaction, assert an overall shift of business relationships from hierarchies towards markets (Malone et al., 1987; Malone et al., 1989). Analogous considerations can be drawn for the Internet itself. Web based technologies can handle and communicate complex, multidimensional product descriptions much more easily than traditional mode of communication. Therefore some items considered complex before, now are easier to describe. In addition, flexible manufacturing technology allows rapid setup of production lines and multi-item production, thus reducing the assets specificity of some components. Therefore some items considered highly asset-specific before, now are less specific. The shifts of these two dimensions through the Internet adoption determine the overall reduction of transaction costs (Williamson, 1975 and 1979): products are easier to describe, specificity of assets has been reduced, and information transfer on the markets is far more efficient. These conditions lead to the so called frictionless commerce paradigm (Brynjolfsson and Smith, 2000). The overall effect is the increase of market situations to the detriment of hierarchies. Such trend has been supported by the emergence of web based tools aiming at increasing markets efficiency. Some examples of such market tools are: 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; Jap, 2000).

2.3 The Internet supporting collaboration: e-collaboration

In the previous two paragraphs, it has been highlighted how web-based technologies might support procurement process efficiency and market efficiency. As a matter of fact, in the already mentioned Malone's contribution (Malone et al., 1987), the authors also envisage the existence of many cases of high asset specificity and complex product descriptions for which new technologies will be adopted to increase collaboration among companies. In such situations, companies work closely together leading to either dyadic collaboration or to network collaboration, thus building a sort of virtual or extended enterprise (Ross, 1999; Borders et al., 2001).

The roots of e-integration are in the traditional EDI (Electronic Data Interchange) point-to-point specific connections; these are dedicated systems that allow a synchronous batch communication from one company's computer system to a trading partner’s computer system. The following evolution of technology and XML standards can surely further facilitate collaboration among organizations by using two possible architectures (Porter, 1998): Extranets and Internet Hubs. Extranets are software extensions of a company’s enterprise system that can be delivered through the Internet to another company; the main limitations to this approach are the training complexity and the low scalability. Internet hubs establish a central hub (or portal) where all the interconnection and interfaces information are maintained; users can access using a standard web browser and view information coming from different enterprise systems. In addition, also systems integration with the Internet Hub is possible. Lee and Whang (Lee and Whang, 2001) call such Internet Hub the Information Hub. An Information Hub is the corporate portal that supports collaboration activities and information sharing among partners of the supply
chain. The authors 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.
In this section, basic assumptions underlying the research, research questions and research methodology are deeply discussed.

3.1 Basic assumptions of the research

Based on literature reviewed, the overall research has been based on the following definition of Supply Chain Management:

*Supply Chain Management is a process-oriented approach to managing product, information and funds flows across the overall supply network, from the initial suppliers to the final end consumers.*

The *Supply Network* is a network of firms linked by customer-supplier relationships aimed at interchanging products or services from the original supplier to the end consumer. The term "network" is preferred to "chain" because it emphasizes the web structure of companies' relationships as opposed to a simple linear one. The overall network consists of two parts: the *upstream network*, made by suppliers, and the *downstream network*, made by customers and distributors (adapted from Handfield, 2001).

Supply Chain Management suggests a *process-oriented approach* in managing the multiple relationships within the overall supply chain: the objective is to create the greatest value not simply for the company, but for the whole supply network across all the processes involving the supply chain firms.

Finally, such approach has to deal with *product, information and funds flows*, as broadly discussed in literature.

Referring to this definition of supply chain it is clear that each node of the network is related to at least another one by a customer-supplier relationship. As a consequence, the analysis of customer-supplier interactions is the first step a company should set out in order to correctly manage its supply network; the customer-supplier relationship is the kernel of supply chain management. The current competitive paradigm is not exactly supply chain versus supply chain, as stated by some authors, but supply network versus
supply network (Rice and Hoppe, 2001), and the key competitive factor is the ability to manage an effective portfolio of customer-supplier relationships, from markets to vertical alliances. The choice of such unit of analysis has been driven by the need to focus the attention on a specific problem with defined borders in order to be clearly understood. However, some drawbacks exist as far as relationships portfolio management and the multiple interactions among companies within a network are not considered. The main variables determining the convenience of one type of relationship or another have been widely discussed in literature (the presence of transaction specific investments, the frequency of the purchase, the risk and uncertainty related to the environment, the strategic relevance of the purchase, the supply market complexity, the complexity of product description). Such variables are basically referable to two main factors: the characteristics of the object of the transaction and the supply market characteristics.

As far as the differences between markets and vertical alliances are concerned, two dimensions have been adopted in order to identify the level of integration, coordination and collaboration in the relationship: depth of the alliance and scope of the alliance. An assumption of this work is that such factors and dimensions (object of the transaction, supply market characteristics, depth of collaboration, and scope of collaboration) are still valid in explaining the kind of relationship to be created between customer and supplier. Furthermore, these variables help in explaining also the motivations and the effects of the Internet adoption within the relation and the choice of the appropriate tools according to the defined goals.

Finally, another assumption that builds the bases of the research is related to the twofold role of the Internet in such vertical relationships. As previously discussed, on the one hand the Internet supports market efficiency, and, on the other hand, it provides opportunities for deeper collaboration. This aspect might lead to a divergence between short-term market relationships and long-term vertical alliances. Such divergence might open new opportunities for collaborative environments, even though based on short-term relationships. This last main assumption is the thread running through the whole work.

### 3.2 Aims of the research

Basing on main assumptions and definitions formulated in the previous paragraph, the overall objective of the research is to analyze the consequences of the Internet adoption in vertical relationships between companies along the supply chain. In particular, the specific objectives of the research are described as follows. 

The first main objective of the research is to clarify what are the motivations that should stimulate companies to adopt web-based technologies within their relationships with suppliers.

As seen before, lot of contributions has been written on benefits deriving from the adoption of the Internet. Some examples are: electronic auctions used to lower purchase prices, electronic catalogs used to streamline administrative procurement processes, electronic exchanges used to increase markets liquidity, and collaborative software used to reduce inventories and increase service levels. This research aims at collecting previous contributions and field evidence in order to provide a schematic and synthetic framework of what are the real motivations that would lead to adopt the Internet into customer-supplier relationships, and therefore what are the benefits a company could get.
The second objective is to identify what are the appropriate Internet tools companies should adopt according to their specific goals.

Once understood what are the main motivations pushing towards the Internet adoption in customer-supplier relationships, it is important to understand other two factors. Firstly, motivations will be related to the object of the transaction between supplier and customer: companies are supposed to have different motivations according to the nature of the considered material (e.g. direct vs. indirect material). Secondly, different web-based tools would be appropriate according to both the kind of material and the motivations. This research aims at answering these two points, both creating a link between motivations and kind of materials which are object of the transactions, and identifying the appropriate tools according to specific materials and goals.

Finally, the most relevant objective is to explain what are the implications on customer-supplier relationships related to the Internet adoption.

In literature, different typologies of vertical relationships between customers and suppliers have been described; from markets to vertical alliances, from equity partnerships to hierarchies. In particular, the scope of the research and the literature analysis have focused on the "market / vertical alliance dilemma". In literature it is possible to find different contributions, some of them stressing market efficiency aspects, and others focusing on opportunities of closer collaboration between companies (section 2). This research question is aimed at exploring and explaining what are main consequences of the opportunities offered by web-based technologies into both arm's length relationships and vertical alliances.

3.3 Research methodology

Given the specific objectives of the research and the basic assumptions illustrated before, the unit of analysis of the whole study is the customer-supplier relationship. Such relationship might be either market alike or vertical alliance alike. In studying such topic, the overall research methodology has been divided into three main stages: an explorative stage, an explanatory stage, and a descriptive one (figure 1). The aim of the first stage was to develop knowledge about new technologies, about motivations and tools of the Internet adoption in the procurement process and into customer-supplier relationship, and to refine the research hypotheses to be tested and validated in the second explanatory stage. Finally, a descriptive stage has been performed in order to describe the main features of collaboration services exploitable through the Internet.

Stage 1: Exploratory analysis

The objective of this stage is to understand what are the variables characterizing the role of the internet in customer-supplier relationships: what are the drivers leading to the use of new technologies in the different typologies of relationships, what are the main technologies and tools, and what are the emergent effects of web-based technologies adoption.

Two methods have been used to perform, triangulate, and cross-fertilize (Patton, 1987) the investigation: four case studies and an exploratory inquiry.
Case studies

A general definition of case study can be drawn by Yin: "A case study is an empirical investigation that analyze a particular phenomenon within a real context, especially when borders between phenomenon and context are not well defined".

It is clear that a case study deeply considers contextual factors, which are difficult to be exhaustively included in other methodologies (e.g. survey or simulation). The more complex the phenomenon to be analyzed, the more variables are relevant, and the more difficult is to design a rigorous research methodology. For this reason case studies have been deeply used, also in conjunction with other techniques, in order to provide a better understanding of the numerous factors and variables existing within the problem.

Case studies can be classified along three dimensions (Ronchi, 1999): approach, timing, and number. As far as the objectives of the research are concerned, the supporting methodology is based on explorative case studies (approach). This allows exploring and identifying the different aspects of the problem by analyzing the real use of the new
technologies and the difficulties faced in implementing them (Platt, 1992, Yin, 1994). Cases are mainly retrospective (timing), although there is an attempt to study relationships before and after the Internet adoption. Finally, multiple cases design (number) aims at providing a quite wide perception of different possible situations in order to draw research hypotheses.

The multiple cases have been chosen through a *theoretical replication process*, as opposed to a *literal replication process* (Eisenhardt, 1989; Yin, 1994). Whereas literal replication selects cases with similar expected results, theoretical replication perform the selection with the aim of studying different foreseen results. As the aim of this first stage was to explore different kinds of effects related to the Internet adoption into the relationship, 2 cases in which arm's length relationship was emphasized and 2 cases in which coordination was emphasized were selected. In particular, the first two cases analyze the adoption of electronic auctions, the third one analyzes the creation of a supplier portal enhancing coordination with suppliers, and the fourth one analyzes the adoption of an electronic catalog built to increase internal processes efficiency, but resulting also in a deeper coordination with the supplier.

Moreover, as the objectives of the research are not specific to a particular industrial sector, 4 different industries have been considered: food & beverage, chemical, telecommunication, and automotive. Companies were selected from multiple sources (trade and business journals, web pages, and experts’ advice). The choice of industries and companies, however, was also influenced by the difficulty of finding firms with established Internet adoption and willing to share their experiences. For this reason, quite big companies present almost worldwide were contacted in order to obtain a high probability of finding interesting practices on the Internet.

<table>
<thead>
<tr>
<th>CASE STUDIES</th>
<th>Grapes</th>
<th>Noragri</th>
<th>Smart Technologies</th>
<th>Motorauto - Fiumelli</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industry</strong></td>
<td>Food &amp; Beverage</td>
<td>Chemical</td>
<td>Telecommunication</td>
<td>Automotive</td>
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<td>Native country</td>
<td>U.S.A.</td>
<td>Norway</td>
<td>U.S.A.</td>
<td>Italy</td>
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<tr>
<td><strong>Revenues</strong></td>
<td>$680 M</td>
<td>$5 B</td>
<td>$33 B</td>
<td>€4.5 B</td>
</tr>
<tr>
<td><strong>Employees</strong></td>
<td>1,300</td>
<td>11,000</td>
<td>150,000</td>
<td>26,000</td>
</tr>
<tr>
<td><strong>Final products</strong></td>
<td>Fruit based products</td>
<td>Fertilizers</td>
<td>Network systems</td>
<td>Spare parts</td>
</tr>
<tr>
<td><strong>Object of transaction</strong></td>
<td>Grape juice concentrate</td>
<td>Film spools</td>
<td>Components</td>
<td>Polyethylene envelopes</td>
</tr>
<tr>
<td><strong>Internet tool</strong></td>
<td>Electronic auction</td>
<td>Electronic auction</td>
<td>Private portal</td>
<td>Electronic catalog</td>
</tr>
<tr>
<td><strong>Effects on relationship</strong></td>
<td>Arm's length emphasis</td>
<td>Arm's length emphasis</td>
<td>Much higher coordination</td>
<td>Higher coordination and process efficiency</td>
</tr>
</tbody>
</table>

Table 1: Case studies sample.

As far as the object of the transaction is concerned, the sampling process tried to select companies in order to study both direct and indirect materials. As a result, in the Grapes and Lucent cases the acquired objects are direct to the final products, and in the
Motorauto case it is an indirect material. As far as the Noragri case is concerned, the object of the transaction is an indirect material (flexible packaging), but its characteristics make it similar to a direct one (see the case for further details).

The initial contacts with companies took place through a phone call or an e-mail to one of expected interviewees or to a human resources representative who took care of arranging and scheduling interviews. It was difficult to find the right persons within each organization, and especially, to find some people from the suppliers of the selected companies. Suppliers' opinions are important to avoid the risk of analyzing a biased case. Target informants were sent a brief description of the research that made clear the objective of the study, its expected outcome, and the contribution participants were expected to give or receive. In addition, a brief outline of the interview was included. Confidentiality of sensitive data was ensured.

The outline of the interview was based on the developed interview protocol. Such protocol aimed at analyzing four specific areas of interest. The first one concerned general information about the company, those pieces of information not found through other sources. The second area investigated the scope within which Internet was adopted; in particular the object of the transaction, its characteristics, and selected suppliers. The third area aimed at discovering what motivations drove the company towards web-based tools adoption. Finally, the last section of the interview aimed at analyzing major results and main effects on the relationship with suppliers.

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<thead>
<tr>
<th>CASE STUDIES</th>
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<th>Noragri</th>
<th>Smart Technologies</th>
<th>Motorauto - Fiumelli</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchasing manager</td>
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<td>X</td>
<td>X</td>
<td>X</td>
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<td>Materials planning manager</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IT manager</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Supplier account manager</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Other</td>
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</table>

Table 2: Informants profile.

Different sources of information were selected. Of course, multiple interviews were the major sources of relevant data and information; the possibility of interviewing more people allowed to triangulate their ideas, therefore building rather objective cases (Patton, 1987). Furthermore, the research has been based on field notes, company reports or other public documentation found from the public relations offices or from companies' web sites.

**Exploratory inquiry**

Cases analysis has been integrated by an explorative inquiry (Kerlinger, 1986, Lee, 1991) in order to have a more superficial, but wider perception of what is happening in the different industries. Such inquiry has consisted in specialized journals analysis, Internet browsing, and over 10 open interviews with experts in the field: academics, consultants, and practitioners. Interviews have been focused on description of new web-based tools, trends in their adoption, and variations in vertical relationships.
The aim of the integration between these two methods was to create a process of cross-fertilization of ideas and propositions from one side to the other. The inquiry provided a wide perspective of the state of the art and the variables relevant to the problem within companies and industries, while case studies allowed generating cause-and-effect hypotheses through a deeper analysis.

In this first stage the study has been mainly qualitative in cross-case analysis (Trochim, 1989, Cook and Campbell, 1979, Wholey, 1979). The output has consisted of the formulation of first hypotheses answering the research questions. In particular, issues concerning the relations among motivations, the use of the Internet, and objects of the transaction emerged. Moreover, hypotheses about effects related to the use of the Internet into customer-supplier relationships have been formulated.

**Stage 2: Explanatory analysis**

Once research propositions have been stated in the first stage, empirical evidence coming from survey methodology may provide the basis for hypotheses testing. It has been stated in literature that survey research is suitable for both explorative and explanatory research (Kerlinger, 1986, Lee, 1991). In fact, the observation of the real world allows building statements about the rules and norms that govern the system under study. Empirical evidence coming from survey research might also provide the basis for hypotheses testing, thus leading to build new theories or to generate new ideas or assumptions to further investigate. This second typology of survey research is the most diffused in the Operations Management discipline.

As far as the explanatory intent of this second stage is concerned, an explanatory survey has been performed. Basing on propositions resulting from the explorative stage, a specific survey analysis was designed. The details of survey design are explained in section 6, after presenting hypotheses to be validated (see section 5). Therefore, within this section only general considerations on the selected survey methodology are given.

There are two main typology of survey design: on the one hand, *cross-section* survey aims at collecting and analyzing information in one precise instant of time; on the other hand, *longitudinal* survey aims at collecting and analyzing information coming from the same subjects, but in different instants of time. Although this is not a proper longitudinal study, as data are not physically gathered in different points of time, the collection provides longitudinal evidence, as questions in the questionnaire refer to both before and after the Internet adoption (see section 6). This kind of survey design is named *impure panel design* (Bailey, 1995) or *time-ordered cross-sectional design* (Menard, 1991).

In designing a rigorous survey, five main steps need to be followed: questionnaire definition, sample extraction, data gathering, data analysis, and reliability & validation.

**Questionnaire definition**

The first step in the survey tool definition is the choice of which variables to measure and how to measure them. Such choice depends on what are the hypotheses to be tested. In this work, variables have been derived form hypotheses formulated. In particular, relevant variables are: the acquired material and the supply market characteristics, the description of the relationship with suppliers before and after the Internet adoption, the motivations...
driving to the adoption of the Internet, the adopted Internet tool, and, finally, the obtained performances.

Variables might be measured through either a structured or semi-structured questionnaire, and data might be collected through either nominal scales, or ordinal scales, or interval scales, or relative scales, or continuous scales (Flynn et al., 1990). Within this research a structured questionnaire has been designed, and both continuous scales (e.g. revenues), and interval scales have been adopted. In this latter case, 5-point Likert scales have been used.

The second step is to test the tool. The test might be performed by discussing with other researchers or experts in the field, and by building a pilot test with some respondents. In this research, both of these testing methods have been adopted.

Sample extraction
It is necessary to define the population, and then to extract the sample from such population according to the scope of the research. The selected sample must present some characteristics: firstly, it must be sufficiently large to allow statistical analyses, secondly it must provide equal selection probability among all cases included within the population without introducing biases, thirdly, it must be efficient, that is the researcher does not select not desired subjects.

In order to select a balanced sample, random selection is the most adopted mode. However, when the population presents some non-homogeneous subgroups (e.g. different industries) the stratification procedure allows the sample to be as most representative as possible of the whole population. The detailed selection and stratification process of this research is described in section 6.

Data gathering
Once defined the survey tool, and extracted the sample, the data gathering process starts. There are different methods: direct interviews, telephone interviews, mail (including electronic mail and fax), existing databases or historical data. Of course, each method presents advantages and disadvantages. Within this research, the questionnaire was sent by snail mail, electronic mail, and also uploaded on a web site.

Data analysis
Within survey research many statistical methods might be adopted. Such methods can be either more explorative and descriptive in nature (e.g. cluster analysis, association analysis), or more explanatory (e.g. ANOVA, linear regressions).

As far as the explanatory intent of this survey, different explanatory techniques have been used to study collected data. Hypothesis testing techniques such as analysis of variance, chi-square test, logit and linear regression models have been adopted to prove correlation among variables. A summary of data analysis is reported in section 7 together with main results. Moreover, factor analysis reduced the number of dimensions for subsequent analyses, helped interpreting the characteristics of the sample, and provided constructs validity analysis (see below).

Reliability & validation
Constructs reliability is frequently defined as the degree of consistency of a measure. The internal consistency of a set of measurement items, therefore, refers to the degree to
which items in the set are homogeneous. As a consequence, reliability also measures the ability to replicate the study (Flynn et al., 1990). Reliability can be tested through a test-retest procedure, parallel forms, or the proper internal consistency. All these procedures essentially are correlation-based methods. The first procedure implies the repetition of the experiment, the second one implies the construction of two measures for the same variable, while the third one, which is also the most adopted, implies an intercorrelation analysis among items that comprises the measured variable.

The most widely accepted measure of a measure's internal consistency is Cronbach's Alpha (Cronbach and Meehl, 1955). Alpha is the average of the correlation coefficient of each item with each other item. Measures presenting Alphas higher than 0.6 or 0.7 are considered reliable (Nunnally, 1978). Within this work, constructs reliability has been tested through the internal consistency procedure by calculating the Alpha.

Reliability is a prerequisite to establishing validity, but it is not sufficient (Schwab, 1980). As far as validity is concerned, three main typologies are widely recognized: content validity, construct validity, and criterion validity (Hair et al., 1992).

A variable is considered to have content validity if there is general agreement from the literature or from experts that the considered items cover all the aspects of the variable itself.

A measure has construct validity if it measures the theoretical variable that it was designed to measure. The most adopted method to test construct validity is the Principal Components Factor Analysis (Hair et al., 1992).

Finally, criterion or predictive or external validity investigates the empirical relationship between the scores on a test instrument (predictor) and an objective outcome (the criterion). Usually, it is tested through a multiple correlation coefficient between the instrument score and performance.

Within the study, content validity is provided by literature review and discussions with academics and experts in the field. Moreover, constructs validity, has been tested through Principal Components Factor Analyses.

**Stage 3: Descriptive analysis**

The second stage of the research has proved some of the research propositions formulated in section 5. In particular, the last hypothesis (H4) refers to a collaborative market model, which is mentioned at the end of the quoted research assumptions (section 3.1).

This last stage of the research aims at investigating the existence of web initiatives that could be used to generate the main characteristics of the mentioned emergent relationship model. In particular, the services offered by those web sites have been analyzed. Such analysis supports the description of main collaboration services exploitable through the Internet.

Although the web-site analysis has focused on a specific typology of portals (mainly consortia vertical portals), it provides a quite comprehensive view of available collaboration services. The choice of such portals is mainly due to the fact that private exchanges are difficult to analyze, as companies are not often willing to share their distinctive competencies.

This last stage, however, will not be described within this paper.
The effects of the internet adoption in customer-supplier relationships
4. Case studies

In this section, main information are briefly provided for the four analyzed cases.

4.1 Grapes

Grapes is one of the biggest producers in the world of fruit based products such as jelly, jam, preserves, spreads, fruit juice drinks and cocktails and it is the first producer of Concord and Niagara grapes juices. It sells products mainly to trade customers and retailers all over the world through a brokers network. The main products sold in the juice industry are orange juice, apple juice, grape juice and prune juice. This sector is characterized by a fierce competition; only few examples are Minute Maid (The Coca-Cola Company), Tropicana (Pepsi), Citrus World (another cooperative), Gatorade which is in a similar market cannibalizing fruit juices and of course the private labels.

Grapes is headquartered in Concord, Massachusetts, and its total revenues have increased from $600 million to $680 million in the last three years with a net income variable between -$7 million and +$3 million. The company employs over 1,300 people at its facilities in Massachusetts, New York, Michigan, Pennsylvania and Washington States.

The unit of analysis of the case is the procurement process and the established relationships for the white grape juice concentrate procurement from California. This product is the second base material for liquid concentrates, frozen juice concentrates, fruit juice drinks and cocktails; it represents the 15% of the total cost of the product on average and a total annual purchase volume of around $30 million on average (between 4% and 5% of the total revenues). Its purchase is based on yearly contracts, which determine the overall quantities and related prices, and it is shipped on regular basis through all over the year from suppliers to customers. This is a standard and non-complex material, but with a strong impact on final products features. For this reason it must match very tight quality specifications.

In the late seventies and the early eighties, due to the strict requirements for the white grape juice concentrate and its relevance to the final products, Grapes decided to set
closer relations with three suppliers from California on the base of their production capacity and capabilities (Rallo, Medel and Futigua).

Three companies were chosen because of the characteristics of the food industry, and in particular the grape fruit industry. The choice of suppliers is mainly based on two factors:
- quality specifications;
- price.

Once you find the supplier matching those factors, the problem is very much related to the stability of its production capacity all over the year; with a parallel sourcing strategy Grapes could overcome the problem by relying on more than just one producer. Those three companies used to produce, and they still do, concentrate for wine fermentation, which requires different and less tight specifications than for juices. Grapes required them better quality both in the process and in the product in exchange for support in their improvement and a long term and exclusive relationship. As a matter of fact, the three companies had to develop a new product for Grapes. This alliance was not based on a formal contract, but on mutual trust. The contracts were stipulated year by year concerning the annual supply.

Starting from 1998 Grapes decided to adopt internet reverse auctions in the procurement process of some products that the company used to buy through long term and consolidated kind of relationships. Some examples of those products are labels, caps, plastic and glass bottles, and also grape juice concentrated. The decision was driven by the increasing pressure of the industry to reduce the price of the final products. The main objective in using electronic auctions was to drive the purchase prices down; in the case of labels, Grapes managed to lower the price by 30% compared to the previous one.

In the case of grape juice, as a matter of fact, the former supplier Rallo won the auction and the price reduction was not as significant as Grapes expected, while in other cases it was. As a consequence of the selection process, Rallo did win the contract, but the relationship resulted much colder than before and the spirit of collaboration was not as motivated as before. People felt exploited by the process, and when the event was over, they were less trusting of the buyer. As one seller said: “They talk about the relationship being a partnership and this [the auction] really takes it away. There is not a partnership there at all. What they do is throw away your existing business that you have worked very hard to achieve and maintain. You work with them to give them cost reductions over the years and they send it out across the board for a competitive bid. I just do not think that is fair”.

At the end of that summer, the demand for grape juice concentrate based products increased and Rallo did not have enough capacity to face the additional volumes. As a consequence, Grapes contacted the other bidders who lost the auction, Medel and Futigua among the others. They managed to cover the increased demand with their capacities and the company’s sales increased in the fall, but the price Grapes had to pay for each gallon was much higher than the one suppliers used to set in normal contracts.

4.2 Noragri

Noragri is a Norwegian company which business is natural resources transformation. Its major businesses are oil and energy, light metals, and chemicals and fertilizers. It is the greatest company in Norway and it keeps growing with numerous divisions and business
units worldwide. Total revenues equal to $10 billions in 1999 and $14 billions in 2000. Net profit increased from $350 millions in 1999 to $1,2 billions in 2000.

The materials studied in this case are polyethylene film spools (polyethylene is a chemical derivative from oil) purchased by Noragri and used as flexible packaging. These spools might be made of either single sheets or double sheets forming a tubular film. The flexible plastic material is obtained through a concurrent co-extrusion process of five layers. The film is 160 micron thick and must be printed on both sides (front and back).

Due to the process itself, there is a high dependence between the film and the plant used to package the final product: the film supplied by the supplier enters directly into customer's production plants. As a consequence, the packaging material must have strict characteristics:

- mechanical resistance to traction;
- heat resistance to be effectively sealed by the customer's plant;
- right dimensions to be introduced into the automatic packaging plant.

In order to test the material, the supplier produces several samplings. These samplings are then directly tested on customer's plants.

In 1985, Noragri bought a new plant, more complex than the previous ones. Such complexity involved also the automatic packaging process, thus making necessary the search for a better supplier than current ones in order to develop an appropriate packaging film. The firm contacted more potential suppliers making them developing sampling lots of film spools to be tested on the new plant. The fastest company providing the required sample, which was also very good in quality, was Lamp, an Italian SME (Small Medium Enterprise) with about €10 million of revenues. It performs internally both the co-extrusion and the printing processes. Such supplier sells its packaging products to different industrial sectors: chemical and pharmaceutical, food and beverage, construction, publishing, and automotive.

Since then, a long lasting relationship has been established between the two companies. At the beginning, Lamp spent lots of efforts in designing and developing new polyethylene films that matched specific Hydro's needs. It also modified part of its production process to reach the desired quality. The Italian SME proved also to be a valid collaborator in co-design activities as Norwegian and Italian designers often worked together to develop the packaging material, thus reducing time to market.

After the first phase of technological integration, also some operational coordination activities was put in place. Noragri provided to Lamp full visibility in its own inventories, and also demand signals directly coming from final customers were provided to the supplier. In addition, monthly forecasts were constantly shared and discussed. The high level of coordination between the two companies led to inventories and stock-out reduction, by speeding up and streamlining the overall procurement process.

At the end of year 2000, Noragri central purchasing department management decided to change the traditional procurement process. It decided to perform electronic reverse auctions on some purchased items categories in order to reduce procurement costs, thus facing increased price competition at worldwide level. FreeMarkets platform was chosen to manage the bidding process. Each category would have been auctioned through the so-called CBE (Competitive Bidding Event). Plastic and paper bags for fertilizers and chemicals was one of these categories.

As a consequence, from January 2001 Lamp has had to interact with Hydro through two different channels. On the one hand, there was the traditional interaction with local
facilities in order to supply the spools till the end of the former contract; on the other
hand, there was the interaction with FreeMarkets for the stipulation of the new contract.
By the end of July, Hydro published the final classification of suppliers for plastic and
paper bags, and asked the first one to start with sampling procedures (Lamp was classified
in the sixth position). The first supplier was a Norwegian company with about €50
millions of revenues; it was a new comer and it had not any contact with Hydro before.
There were many problems during the sampling process; finally, after over three weeks,
the supplier recognized not to be appropriate for those specific polyethylene spools, due
to the difficulties in matching the right customer's plant requirements.
The second classified supplier was a French multinational company that had some
transactions with Noragri in the past. Unfortunately, sampling spools tested on Hydro's
plants did not pass the traction test.
Finally, the third classified supplier managed to sample the right spools matching all the
requirements. It was a new comer Italian SME with €5 millions of revenues. Noragri
decided to sign the contract with this company. The contract price was set equal the
reserve price.
The whole final selection process took much more time then expected, therefore the new
contract started only in November. During the month of October, Hydro had to buy
spools by extending the old contracts with Lamp and traditional suppliers. This led to
further negotiation with such suppliers, which were not very benevolent in responding
such need.

4.3 Smart Technologies

Since the beginning of the twentieth century, Lucent has become a major player in
optical, data, and wireless networking; web-based enterprise solutions that link public and
private networks; communications software; professional network design and consulting
services; and communications semiconductors and optoelectronics. It employs over
150.000 employees allover the world with total revenues equal to $30 billion in 1999 and
$33 billion in 2000. Lucent's net profit was $3.5 billion in 1999 and $3 billion in 2000. Its
research and development arm (R&D Lab) is one of the most prolific invention factories
in the world; R&D yearly spending is about $4 billion, 12% of total revenues.
Since the second half of year 2000, Lucent has been suffering a downturn, partially due to
the disillusion related to e-business. However, during this period the company, led by its
Chairman and CEO Henry Schacht's conviction that Internet will be the future, focused
its core business on the broadband and mobile Internet, also by spinning off some
activities (e.g. Avaya and Agere Systems). One of the results of this new vision was also
the redefinition of Lucent's supply chain.
Within this context, the case provides the analysis of a supply chain initiative based on the
Internet adoption rather than describing one specific relationship. Such choice is justified
by the interesting topics arising from a more complete perspective (e.g. strategic and 2nd
tier suppliers relationship), which, however, includes customer-supplier relationships by
default.
In the past, sourcing strategy was not a high competitive priority and a modest part of
production was run into Lucent’s own facilities. Moreover, suppliers were simply
considered as production capacity providers, without any other value added capability. In
the late 1990s Lucent started a process of deep redefinition of its supply chain. Top management recognized supply management as central to success in this business and invested a huge commitment in creating a world class supply chain management organization. Such recognition led to the conviction that suppliers should have played a greater role in the business and that Lucent's dictating behavior should have transformed into a more collaborating one by building relationships respecting mutual interests.

Among other initiatives, a supply chain portal was developed with the aim of improving coordination between Lucent and the supply base.

The project started in the middle of 2000, all the activities were performed by internal IT staff, and the first version was delivered in January 2001.

The mission accomplished by that portal has been stated by one of Lucent's IT people: "Enable the most flexible and efficient supply chain by leveraging strategy, processes and technology that integrate Lucent organizations, trading partners, and eMarketplaces to create real-time, global visibility and decision making control over the virtual supply chain". According to Lucent, the portal performs as a gateway into information, applications, and global data, and defines common processes across its virtual community; as a result, the all chain would benefit from: increased speed to market of new products, lower design and operational costs, higher customer fulfillment rates.

Up to date, integration with eMarketplaces has not been done yet, but a collaboration initiative started during the summer 2001 with e2open.com, a vertical marketplace in the high-tech industry.

The supply chain portal supports a number of coordination and collaboration services between Lucent and its suppliers. All these services are exploitable through the web simply using a web browser. Main services are:

**Communication content:** this main tab exists as a single area for supply chain partners to visit and be provided with general supply chain information.

**Escalation management:** the escalation application is designed to provide suppliers the ability to effectively communicate the risk of components shortages and order cancellation issues; as the business changes and the needs arise, the tool can evolve to handle new urgent requirements by coordinating different suppliers.

**Price management:** the price management tab provides Lucent's users and supply chain partners with the ability to collaborate on pricing new businesses, repricing existing ones and in the tracking of price and supplier performance history to ensure that the best sourcing decision are made based on price and quality.

**Engineering/Technical management:** the engineering/technical data management section of the portal was developed to provide suppliers and external manufacturers with a gateway into the most recent revisions of manufacturing, design, and other engineering specifications needed to complete their jobs.

**Performance dashboard:** the dashboard metrics section of the portal is designed to share information on financial performance, quality, service level, and partner development with suppliers.

**Demand management:** the demand management application allow Lucent’s and its suppliers to share information about demand forecasts, expected stock covers, and to collaborate on the demand forecasting process.

**Inventory management:** the inventory management service provides all users with full stocks visibility along the whole supply chain, and it is very useful in effectively reallocating excess inventory and identifying obsolete inventory.
In addition to these main services, also other applications are available (e.g. documents management, administrative reports, invoices and purchase orders visibility).
The described services are all viable through the web, and users upload most of information real-time. The system is integrated with Lucent's ERP and MRP systems, but it is not integrated with suppliers' though, as the investment would have been huge while the IT strategy of Lucent consists of proceeding step by step. Currently, first and second tier suppliers data concerning demand and inventory positions are sent daily through a flat file which standard format has been defined. This file automatically updates portal information.

Using the supply chain portal brought a number of benefits. The relationship with suppliers has been improved; as one of the suppliers said: "The full view that was given through the portal helps us with our forecasting and planning… we can see a major change". Portal adoption lead to 100 M$ stockout less than previous year in the same period and an inventory reduction from 6,5 B$ to 3.2 B$ across the whole supply chain. Estimates state that time and resources spent into coordination have been reduced by 50% for both Lucent and its suppliers.

4.4 Motorauto - Fiumelli

Fiumelli is a company belonging to the Motorauto Group, a major multinational holding company based in Italy with total revenues of €57 billions. Fiumelli is leader worldwide in the automotive lighting sector, and it is second and third in Europe respectively in dashboards and fuel ignition systems. Its production facilities are located in Europe, North and South America, and Asia. Its global sales amount is about €4.5 billions, 4.8% of which are invested in R&D. It employs 26,000 employees globally, with 59 production facilities and 22 research centers.
The analyzed objects of transaction are plastic envelopes made of polyethylene film (a molecule deriving from oil) and purchased by Fiumelli in order to wrap its components. Fiumelli uses them as flexible packaging for two typologies of materials: automotive spare parts produced within manufacturing plants and then sent to single repair shops through distribution centers; small mechanical parts like nuts, screws, and bolts sent together the spare part by default. Such a package is an indirect material with low strategic relevance and low purchase volume for Fiumelli. Precisely, employees manually insert components into the envelopes, which, therefore, do not enter the production process either.

However, the considered material is highly customized to Fiumelli both in terms of measures (height, length, and thickness) and graphics. As far as the graphics are concerned, each envelope is printed with one or more colors in order to represent different brand logos such as Motorauto, Alfa Romeo, and Lancia. Due to the rigidity of printing and welding plants in this specific industrial sector (packaging industries), the customized definition of measures and graphics increases the asset specificity, thus leading to a sort of dependence between customer and supplier. The supplier providing the described envelopes to Fiumelli is Lamp, an Italian SME (Small-Medium Enterprise) with about €10 million of revenues. Fiumelli has purchased envelopes from Lamp for decades, building an historical and reliable relationship.
Different companies belonging to Motorauto Group have always managed purchasing activities separately through local purchasing departments, Fiumelli’s was one of these. Such configuration was extremely inefficient, especially for indirect and MRO (Maintenance, Repair, and Operations) materials; fragmentation does not allow to reach most efficient economies of scale and, moreover, it replicates activities and resources department by department. On average, purchasing costs constitute the 60% of total Motorauto costs; with these huge volumes there is the opportunity to aggregate demands and save high inefficiencies.

For these reasons, at the beginning of year 2000, Motorauto decided to launch its own e-procurement platform: Fast Buyer. The objective of this initiative was threefold. Firstly, Motorauto decided to aggregate all purchasing activities performed within the group in one unique purchasing department; this would have led to the desired economies of scale and to a more efficient demand and requirements management. At the same time, through a web-based catalog, all procurement activities in the different production facilities would have been streamlined and automated, from items search on the catalog to the final shipment to the facilities. Thirdly, the ambitious project had also the aim of becoming an European marketplace addressed to external customers and suppliers, and not only captive ones. For this last reason, Fast Buyer platform has recently started providing also auction services. As far as the scope of the study is concerned, the attention will be focused on the first two objectives of the initiative and the relationship between Motorauto and Lamp.

Motorauto new central purchasing department started a process of comparison and selection amongst its over 20,000 indirect material suppliers; such comparison was based on past performances in terms of quality and reliability. At the beginning of December 2000, 260 suppliers were contacted to participate the initiative; Lamp was amongst these.

Of course, there were some costs to be faced by Lamp in joining the platform. The smallest ones were those finalized at the creation of the catalog itself: $3,5 for each item uploaded on the platform times a total of 57 items equals a very low cost of about $200. The biggest effort was spent in terms of time and human resources spent into the physical realization of the catalog and into participating the numerous meetings organized by Motorauto and Requisite, the technological partner.

The terms of long-term frame contract between Motorauto and Lamp were defined. In particular, they defined, besides the technical specifications, the size of minimum lots, the minimum invoice amount, the return conditions, the delivery lead times, the payment conditions, the packaging size, and, of course, the current prices. Those prices are monthly updated, and Lamp can continuously maintain and improve the catalog offer. In October 2001 the pilot system has been activated, and Lamp can see real-time all the orders coming from all Motorauto Group’s companies.

The adoption of this e-procurement platform has led to higher efficiency in the overall procurement process, by reducing costs and lead times. Motorauto has managed to increase its procurement efficiency mostly aggregating demands coming from all captive enterprises and eliminating replicated and fragmented activities. Moreover, the automation of internal processes has surely reduced procurement times and costs within every organization.

As far as Lamp is concerned, it might seem that such initiative has not provided many improvements, also considering the initial efforts in designing the catalog and the increased contractual power of the customer. In reality, some improvements can be noted.
also on the supply side. Firstly, the fulfillment process has been speeded up, as communication with customers is managed through the web without time consuming multiple faxes and telephone calls aiming at monitoring the orders status. Secondly, Lamp has accessed to other customers within the Motorauto Group, thus increasing its market share. This increment might further increase once Fast Buyer access the European market.
5. Research hypotheses

Through the four case studies analyzed in the previous section, it was possible to state main hypotheses answering the research questions.

5.1 Motivations to the Internet adoption in customer-supplier relationships

The first research question of this study addresses the motivations companies have in using web-based tools in customer supplier relationships. Analyzing the case studies, a preliminary answer can be given.

Various contributions seem to lead to a quite consolidated view in defining benefits and motivations. As seen in section 2, there are three main motivations driving companies in the use of the Internet. The first driver is the pursuit of lean and more efficient internal procurement processes. The second driver resides in the will to shift relationships towards markets by increasing market efficiency. Finally, the third one is the improvement of collaboration activities between the two parties.

All these issues were surely found in the field, however a deeper interpretation arises. Some of such motivations are considered primary objectives, but some others are more instrumental goals than real pursued objectives. Speaking with people and analyzing interviews, the real motivations could be summarized as follows.

First of all, the prime need that emerged was surely the requirement for higher efficiency in internal procurement processes; this essentially means reducing order cycle time, reducing inventory, streamlining activities, and reducing pure transaction management costs.

Secondly, another need regards the reduction of the overall procurement costs; this essentially means the reduction of suppliers searching and selection costs, negotiation and evaluation costs, and the proper purchasing cost of acquired materials. It can be noted that the first two mentioned components are exactly the first two components of transaction costs (Williamson, 1979; Watson, 2000), while the third transaction cost (transaction management) has been included in the previous motivation.
Finally, the third main motivation can be defined as the improvement of supply process effectiveness; this includes quality issues, time to market reduction, innovation requirements, and service level to final customer. Motivations found in literature and those found in the field are not inconsistent, but they are slightly different.

![Diagram of Motivations in the Internet adoption]

The first motivation is exactly the same in the two perspectives, and the reduction of procurement costs, as stated in literature, essentially coincides with the will to increase market efficiency. The main difference resides in the collaboration objective. From the field analysis, it has not been considered as a primary goal per se, but it is an instrumental objective pursued by companies in order to increase both process efficiency and effectiveness (figure 2).

From these considerations the first proposition of the work emerges:

**H1**: The search for customer-supplier collaboration exploiting web-based technologies is explained by the need to increase process efficiency and effectiveness.

In order to prove this hypothesis a regression model among the mentioned variables has been tested (see below). On the basis of what found in literature and in case studies analysis the operationalization and validity and reliability analyses of the described concepts have been done during the survey design phase.

### 5.2 Internet tools choice

The second research question addresses the relation among motivations, acquired materials, and typology of Internet tools adopted.
The three main motivations have just been described: supply process efficiency, procurement costs reduction, and supply process effectiveness.

The dimensions characterizing materials are widely described in literature (Williamson, 1979; Kraljic, 1983; Olsen and Ellram, 1997; Malone et al., 1987; De Maio and Maggiore, 1992). In particular, in the study, considered dimensions essentially refer to the presence of transaction specific investments, the frequency of the purchase, the strategic relevance of the purchase, the supply market complexity, and the complexity of material description.

As far as web-based tools are concerned, they can be classified through different characteristics. Firstly, there are transaction tools, which are essentially electronic catalogs, electronic exchanges, and electronic auctions. Secondly, portals offering such services can be either vertical or horizontal. Thirdly, the actor managing such portals can be either the supplier, or a consortium, or an independent entity, or the company itself. Finally, especially in private portals, companies might use web-EDI services or specific team working tools enabling distant collaboration.

![Diagram](image)

**Figure 3: Relations among motivations, acquired material, adopted tools, and results.**

As far as multiple relationships among all these variables could exist, they all have been introduced in the questionnaire in order to set interdependencies and correlation among motivations, acquired materials, and web-based tools. In order to analyze such interdependencies the general model represented in figure 3 will be tested. In particular, the influence of the motivations and the characteristics of the acquired material on the Internet tools choice will be analyzed. Moreover, results obtained through the adoption of each tool will be also tested.

### 5.3 The Market - Vertical Alliance divergence

The third research question addresses the key topic concerning the implications on customer-supplier relationships related to the Internet adoption. As described in section 2, 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.

Considerations illustrated by these previous studies, case studies evidence, and inquiries among experts delineate, in reality, a progressive divergence between markets and vertical
alliances: the two typologies of relationship and the behavior of people involved are becoming more and more different. On the one hand, it is possible to find cases where arm's length transactions are exasperated through the use of electronic auctions, or, even more, consolidated alliances have been destroyed to pursue purchasing cost reduction (e.g. Grapes). On the other hand collaborative partnerships are emphasized thanks to visibility and collaboration tools offered by the technology (e.g. Smart Technologies). As a matter of fact, such divergence is evident and can be explained by the opportunity offered by web-based technologies to shift the trade-off efforts-integration into customer-supplier relationship as illustrated in figure 4.

A trade-off exists between the efforts invested into the relationship and the level of integration obtained: the higher the efforts the higher the level of integration. The level of integration or coordination can be measured through a number of variables found in literature, essentially referring to a scheme that differentiates between scope of collaboration and depth of collaboration (Ronchi, 2001). In particular, variables explaining the level of integration or coordination are divided into operational ones and technological ones. On the operational perspectives, higher coordination is provided by inventory levels visibility, final customer's demand signals visibility, production plans sharing, or even collaborative inventory management practices, production planning and demand forecasting. On 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.

![Figure 4: Efforts-Integration trade-off shift.](image)

The efforts required to manage the relationship are not widely studied in literature (Monczka et al., 1998; Moore, 1998); however, from literature and empirical evidence some variables emerged: time and resources spent into sustaining the relationship, costs in
Information and Communication Technology, costs sustained for joint team working, and investments in specific tangible assets (e.g. dedicated plants). This last dimension contributes to increase switching costs once established a vertical alliance.

The horizontal segments in the figure represent such switching costs. When companies start to establish a vertical alliance, they face initial investments that are specific to the relationship. These investments are necessary to start an effective and efficient relationship and are considered as switching costs when the customer and the supplier want to terminate the alliance.

Literature contributions in customer-supplier relationships can be read as an attempt to find ways of managing such trade-off; most of them consider the object of the transaction or the supply market characteristics as the main driving factors in choosing the position a company should assume on the trade-off curve (see for example Kraljic's contribution in 1983). If the object of the transaction and the supply market complexity do not make necessary a high level of integration, it is not worthwhile to spend a lot of efforts trying to build a vertical alliance (figure 5).

The Internet has shifted such trade-off allowing either higher levels of integration with the same level of efforts or lower efforts with the same level of integration. Moreover, the maximum level of collaboration can be even higher than before thank to the new technological platforms, which allow higher information richness and integration (e.g. CPFR applications, mobile team work infrastructures).

In this situation the border between market and vertical alliance has (see the "A" arrows in figures 4 and 5). As a matter of fact, where companies decided to build a long-term alliance to reach the desired level of efficiency and effectiveness and because of the high transaction costs on the market, today it is possible to improve the procurement process with any other firm thank to standard communication protocols and the lower transaction
costs. This trend has already been foreseen by Malone (Malone et al., 1987, 1989) and would support an overall shift of customer-supplier relationships towards markets. However, another surprising effect of the Internet can be hypothesized (see the "B" arrows in figures 4 and 5). Where companies adopted market mechanisms with components or sub-assemblies for which they would have liked to have a more efficient and effective integrated procurement process, but the investment-gap between market and vertical alliance did not make worthwhile further integration, today those companies can build possible alliances without higher efforts into the relationship.

The consequences of the previous considerations are clearly shown in the figures. 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 creation of a new kind of relationship. This typology of relationship is called in this work "Collaborative Market".

Summarizing these considerations, three main propositions can be drawn:

H2: A trade-off exists between the efforts invested into supporting the customer-supplier relationship and the level of integration reached within the relationship itself.

H3: This efforts-integration trade-off can be shifted through the Internet adoption in the relationship.

H4: The shift of the curve leads to the divergence between markets and vertical alliances, opening opportunities to a new typology of relationship: the Collaborative Markets.

These three hypotheses will be tested by operationalizing a model including the two main mentioned concepts: efforts and integration. Such dimensions will be measured before and after the Internet adoption. Data were gathered through a questionnaire carefully designed and tested both through experts in the field and through 8 pilot cases before the mailing process.
6. Survey Design

There are two main typologies of survey design: on the one hand, cross-section survey aims at collecting and analyzing information in one precise instant of time; on the other hand, longitudinal survey aims at collecting and analyzing information coming from the same subjects, but in different instants of time. Although this is not a proper longitudinal study, as data are not physically gathered in different points of time, the collection provides longitudinal evidence, as questions in the questionnaire refer to both 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 the one consisting in analyzing and comparing companies adopting the Internet with companies not adopting it for a precise reason. This latter choice might have introduced bias in the sample, with 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 wanted to study 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 before and after the Internet adoption.

Considering the general and cross-industry objective of the research, the sample selection has considered companies across different industries. This choice has been driven also by the fact that relatively few companies really already adopt web-based tools in the procurement process; therefore pursuing a study focused on a specific industry could have led to very few available cases, thus making difficult a statistical analysis. However, any pure services industry was excluded from the sample, as materials procurement is not a primary concern. A broad database containing over 15,000 companies operating in the U.S. was built starting from data provided by three major North American associations: NAPM (National Associations of Purchasing Management), CLM (Council of Logistics Management), and PMAB (Purchasing Management Association of Boston). The distribution of companies across industries was approximately the same in all the three initial databases, therefore the overall sample could be considered as representative of the
industrial population in the United States. 1,500 companies were selected from the broad database; the number of companies for each industry has been selected through a stratification process on industrial sectors. Within each industry, a random selection was performed. As part of contacts had wrong addresses, a second number of cases were selected. Some of them were contacted twice in order to complete missing answers. In very few cases and only for continuous variables (e.g. revenues, employees) it was necessary to deal with missing values. 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 allows performing the analysis on a larger set of data, thus increasing the significance of results. As far as non-respondents are concerned, in the big 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 responses have been received and analyzed (table 3). Data collection refers to the period July and August 2001.

<table>
<thead>
<tr>
<th>Industry</th>
<th>N</th>
<th>Company sales (US$ millions)</th>
<th>N</th>
<th>Number of employees</th>
<th>N</th>
<th>Supply chain position (products sold to)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automotive</td>
<td>7</td>
<td>0 - 50</td>
<td>32</td>
<td>0 - 250</td>
<td>44</td>
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<td>31</td>
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<tr>
<td>Mechanical</td>
<td>24</td>
<td>51 - 150</td>
<td>38</td>
<td>251 - 500</td>
<td>25</td>
<td>Product assemblers</td>
<td>25</td>
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<tr>
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<td>151 - 500</td>
<td>24</td>
<td>501 - 1500</td>
<td>20</td>
<td>Distributors</td>
<td>50</td>
</tr>
<tr>
<td>Telecommunication</td>
<td>11</td>
<td>501 - 2000</td>
<td>37</td>
<td>1501 - 5000</td>
<td>37</td>
<td>End consumers</td>
<td>24</td>
</tr>
<tr>
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<td>&gt; 2000</td>
<td>31</td>
<td>&gt; 5000</td>
<td>36</td>
<td>others</td>
<td>32</td>
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<td></td>
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<tr>
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<tr>
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<tr>
<td>Construction</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>33</td>
<td></td>
<td></td>
<td></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>
<td><strong>Total</strong> 162</td>
<td><strong>Total</strong> 162</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Sample description.

Once data have been collected, it was necessary to test constructs validity and reliability. The first step of the analysis consisted in the reduction of 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 and Vokurka, 1998). Since 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. Bertlett'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 needs to be tested before proceeding with the proper factor analysis is 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 and 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 and McWatters, 2001).
The effects of the internet adoption in customer-supplier relationships
7. Survey analysis

Within this section, construct validity and reliability analyses are not described as the attention is focused on proving formulated hypotheses.

7.1 Motivations to the Internet adoption

In figure 6, parameter estimates and 2-tailed significance levels of a simple linear regression model between collaboration and primary motivations are provided\(^1\). Collaboration between parties has been measured as the increment of the level of total integration after the Internet adoption. The change might be either positive or negative. One simplified assumption within the model is a direct relation between the aim of increasing or decreasing the collaboration and the actual occurred change in terms of collaboration itself. This result shows that the higher integration reached with the supplier is reasonably explained by the will to improve process efficiency and effectiveness, thus confirming the first hypothesis \((H1)\). On the contrary, procurement costs reduction objective is not significantly correlated to the increase of collaboration between customer and supplier.

\(^1\) To test the assumption of linearity among the exogenous and endogenous variables, scatter plots were reviewed. To ensure that residuals were not correlated, the Durbin-Watson statistic was calculated (Dillon and Goldstein, 1984; Maddala, 1992).
Supply process efficiency

Market efficiency

Procurement costs reduction

Collaboration between parties

Supply process effectiveness

\[ \beta_1 = 0.344 \quad (0.023) \]

\[ \beta_2 = -0.243 \quad (0.439) \]

\[ \beta_3 = 0.456 \quad (0.005) \]

Figure 6: Motivations in the Internet adoption. \( R^2 = 0.54 \), \( F\text{-sig.} = 0.007 \).

7.2 Internet tools choice

The second research question aims at identifying which typologies of Internet tools have been adopted by companies in which situations and what are the impact on performances.

![Web-based tools adoption within the sample.](image)

Figure 7: Web-based tools adoption within the sample.
The analysis considered the main web-based tools commonly used. Three main classes have been studied: the proper tool, the nature of the portal supporting the tool, and the property of the portal itself. In figure 7 the percentage of adoption for each of these classifications within the sample is shown.

Evidence shows that companies use mainly transaction supportive tools, such as sell-side catalogs, liquid exchanges, and reverse auctions. However, analyses shown below suggest that many respondents stated to use liquid exchanges without knowing exactly what they are, but simply considering them as synonym of marketplaces. In fact, none of analyzed variables seem to explain their adoption, which should be driven, instead, by the will of increasing market efficiency, thus reducing procurement costs.

It is important to note that sell-side catalogs are designed by suppliers, but they might be uploaded either on the supplier, or a private, or whatever kind of portal. Direct auctions and team working tools are the least diffused web tools so far.

Previous tools are mainly used through vertical portals (27.8% of cases), although also horizontal marketplaces are quite diffused, especially in the case of electronic auctions (e.g. Freemarkets).

Finally, an interesting result is related to the property of the portal running the selected tools. Most of the companies rely on private portals, either suppliers’ (36.1%) or their own (37.5%). Few uses independent portals, or even initiatives run by industry consortia.

After considering web-based tools diffusion within the sample, a logit multiple regression model was tested in order to explore the influence of material characteristics and motivations on the tools choice. Equation E1 was tested:

\[
\ln \frac{P(\text{tool}_k)}{P(\text{no tool}_k)} = \beta_0 + \beta_1 \text{relevance}_i + \beta_2 \text{criticality}_i + \beta_3 \text{sm\_complexity}_i + \\
+ \beta_4 \text{pro\_cost}_i + \beta_5 \text{efficiency}_i + \beta_6 \text{effectiveness}_i + \epsilon_i
\]

where:

- \(P(\text{tool}_k)_i\) is the probability the company \(i\) adopts the tool \(k\);
- \(P(\text{no tool}_k)_i\) is the probability the company \(i\) does not adopt the tool \(k\);
- \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 \(i\);
- \text{pro\_cost}_i\) is the priority assigned to the goal of reducing procurement costs by company \(i\);
- \text{efficiency}_i\) is the priority assigned to the goal of increasing the supply process efficiency by company \(i\);
- \text{effectiveness}_i\) is assigned to the goal of increasing the supply process effectiveness by company \(i\);
- \(\epsilon_i\) is the residual term, which is assumed as normally distributed, mean zero and constant variance.

The results of the logit analyses are not reported in this methodological paper and results are only summarised.

As far as liquid exchanges are concerned, buy-side catalogs, vertical marketplaces, and consortia portals, Chi-square statistics have significance levels higher than 0.05; therefore, in these cases the sample does not allow to reject the hypothesis that all the parameters equal zero. However, some considerations can be drawn for the other web tools.
Sell-side catalogs are mainly used for non-critical materials procurement in order to increase supply process efficiency. This is the typical case of MRO materials. In such cases, the criticality and the relevance of materials do not make necessary a high involvement of the customer in the catalog definition; the catalog is then uploaded and integrated with internal systems in order to streamline procurement processes.

Reverse auctions are preferred for the procurement of highly relevant materials in order to reduce the overall procurement costs (suppliers' search, selection, negotiation, and the price itself). Such materials are generally direct to the final product, relevant to its features and constitute a high percentage of the cost.

Web EDI is adopted for any kind of material, but their supply market complexity is usually low. This can be related to the fact that the supplier must also invest into the adoption of the EDI, and the higher is the number of other potential suppliers and the competition among them, the more likely such supplier would be willing to make itself more attractive, and the more likely the customer would have the power to impose web EDI transactions. By using web-EDI, the company does not pursue the reduction of procurement costs, but it is interested into increasing the effectiveness of the supply process, especially in terms of time to market and stock-outs.

Direct auctions present for the buyers the same motivations of reverse auctions. Generally speaking, the electronic auction is seen as a tool allowing the purchase of a relevant material at the lowest cost as possible.

Team working tools are adopted mainly in situations where supply market complexity is high. In such a condition, the company is willing to create long-lasting relationship with good suppliers (see also Kraljic, 1983), eventually supported by web team working tools in order to facilitate the interaction. Not surprisingly, the primary goal is not the reduction of the procurement cost, but the increase of the process effectiveness in terms of time, quality and innovation.

The adoption of horizontal portals is less clearly explainable than previous tools. Companies seem recurring to horizontal marketplaces when supply market complexity is high in order to reduce the overall procurement cost. Supply process efficiency does not seem to be a priority.

As far as the property of the hub supporting the selected tools is concerned, companies prefer leveraging their own portals when acquiring highly critical and customized materials within relatively low complexity supply markets. This is explainable through the privacy and competitive concerns related to critical components and the need for contractual power over suppliers, which must be willing to adopt the customer's initiative. In such a situation, buyers do not seem caring about reducing the overall procurement cost.

Companies in the sample adopt suppliers' portals mainly for standard and low criticality materials procurement. In such situations, buyers consider the supplier's initiative as a way of increasing supply process efficiency and effectiveness, thus reducing lead times, operative costs and increasing quality and service level.

Finally, independent or public marketplaces are used in order to smooth the supply market complexity and the contractual power of suppliers. As a matter of fact, in such situations the buyer pursues the reduction of supplier search, selection, and negotiation costs and the material price as well. This goal is pursued also to the detriment of process efficiency.
The adoption of vertical rather than horizontal portals and of private rather than supplier, independent, or consortium, is surely related to the typology of transaction tools they offer. In the analyzed sample, horizontal portals offer mainly liquid exchanges and reverse auctions, which are typically tools adopted to increase market efficiency. On the contrary, vertical portals appeared to offer a wider range of tools, including catalogs and team working tools. Private initiatives within the sample, either customer's or supplier's, offer a wider range of tools than independent or even consortium initiatives. These last portals are mainly focused on increasing market efficiency; therefore it is logical that companies adopt them in order to reduce their procurement costs.

In order to understand the effectiveness of such web-based tools, analyses of variances were performed. Performance indicators were compared between companies adopting a particular tool and those not adopting it. Also in this case, only a summary of results is provided.

In a similar way to what found before, nothing interesting can be said about the performances through the adoption of liquid exchanges, buy-side catalogs, vertical marketplaces, and consortia portals. Also analyses on direct auctions do not provide interesting evidence.

Analyzing the other results, it is possible to note that sell-side catalogs, contrarily to what expected by companies, have not led to higher efficiency in the procurement process; neither they have led to increased effectiveness or to reduced procurement costs.

On the contrary, reverse auctions seem satisfying the expectation of companies. Within the sample, the reverse auction adopters managed to significantly reduce the overall procurement costs more than non adopters (significance=0.001).

The use of web EDI has procured to companies high efficiency and effectiveness within the supply process. Since EDI is an integrating tool, this result further supports the hypothesis that the integration with the supplier is an instrumental objective for the primary goal to improve the supply process (H1). However, those advantages occur to the detriment of procurement costs. Probably, imposing web EDI to the supplier, negotiation costs and the material fixed costs increase.

Not surprisingly, team working tools increase the effectiveness of the supply process, both in terms of quality, innovation and service level to the final customer.

Results actually confirm the fact that horizontal portals help reducing the overall procurement costs, but this happens to the detriment of process efficiency. Probably this is due to the still high coordination costs occurring between the company and the portal itself. However, as seen before, in such cases process efficiency is not a primary concern.

The analyses support the fact that private portals are adopted mainly in dealing with critical and customized materials, thus stressing the privacy concerns issue. Results show that companies adopting private portals see their procurement costs increasing. Probably this is related to the request for adaptation from suppliers.

On the contrary, suppliers' portals seem fully satisfying companies needs. The overall procurement costs decrease, probably due to discount and incentives policies by the supplier; at the same time both the supply process efficiency and effectiveness increase.

---

2 In those cases, the sample did not allow properly testing the differences in means and variances.
Finally, as expected by companies, independent portals help aggregating demand and reducing the overall procurement cost.

7.3 The Market - Vertical Alliance divergence

In section 2 the effect of the Internet adoption on both markets and vertical alliances has been analyzed; the aim of this section is to test the hypotheses formulated in section 5 underlying the emergence of a collaborative market model. In particular, the use of Internet based tools is supposed to shift the trade-off between the degree of collaboration characterizing the relationship and the efforts required to manage the relationship itself (see figure 4). Such shift would emphasize the dichotomy between market and vertical alliance.

Such hypothesis was tested through two subsequent steps. Firstly, a one-way ANOVA was performed in order to test differences in means and variances of integration levels and efforts before and after the Internet adoption, secondly, a multivariate regression model was tested to verify the correlation among integration levels, efforts, and the Internet adoption. As the two analyses provided similar results, in this paper only the most interesting one is presented: the multivariate regression model.

Multivariate regression model

This analysis was aimed at proving the existence of the trade-off between level of integration and efforts required by the relationship and the hypothesized shift of such trade-off 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 integration, technological integration, information sharing, and total integration as dependent variables. A Multivariate model was chosen because of the interrelations existing among these variables. To test the normal distribution of the dependent variables, their stem&leaf diagrams have been analyzed (Norusis, 1993b).

The model was built as follows for each of the integration variables:

\[ y_i = \beta_0 + \beta_1 d_i + \beta_2 \ln(\text{efforts}_i) + \beta_3 d_i \ln(\text{efforts}_i) + \beta_4 \text{relevance}_i + \beta_5 \text{criticality}_i + \beta_6 \text{sm_comple...} \]

which can be read also as follows:

\[ y_i = (\beta_0 + \beta_1 d_i) + (\beta_2 + \beta_3 d_i) \ln(\text{efforts}_i) + \beta_4 \text{relevance}_i + \beta_5 \text{criticality}_i + \beta_6 \text{sm_comple...} \]

where:

- \( y_i \) is the value of one of the four dependent variables (i.e. type of integration) 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 efforts measured for the case \( i \);
**relevance**, **criticality**, **sm complexity**, **ε**

are the relevance of the acquired material in the case \( i \);

are the criticality of the acquired material in the case \( i \);

is the supply market complexity for the acquired material in the case \( i \);

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, as they are supposed to explain part of the coordination and collaboration pursued by the customer and the supplier.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Value</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
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<td>7.466</td>
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</tr>
<tr>
<td>( D )</td>
<td>0.031</td>
<td>1.060</td>
<td>.379</td>
</tr>
<tr>
<td>ln(efforts)</td>
<td>1.118</td>
<td>4.499</td>
<td>.002</td>
</tr>
<tr>
<td>( d \ast \ln(efforts) )</td>
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</tr>
<tr>
<td>Relevance</td>
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</tr>
<tr>
<td>Criticality</td>
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<td>.000</td>
</tr>
<tr>
<td>Sm_complexity</td>
<td>0.018</td>
<td>0.602</td>
<td>.662</td>
</tr>
</tbody>
</table>

Table 4a: Multivariate regression model between Integration and Efforts\(^3\).

The dummy variable has been introduced for two reasons: firstly, it allows testing the significance of the difference of the intercept before and after the Internet adoption; secondly, it allows testing the difference in the slope of the relation between efforts and integration before and after the Internet adoption.

Finally, a logarithmic relation between efforts and level of integration has been introduced for two reasons. On the one hand, modeling the hypothesized function (see section 5) would have needed too many parameters to be estimated considering the sample size, therefore a simple decreasing derivative of the integration level has been hypothesized. On the second hand, a function of the dependent variable with a saturation limit could cause heteroscedasticity problems, as the variance of the dependent variable could not be constant in proximity of the limit. Statistical analyses have proved that a logarithmic relationship fits the variables better than a simple linear one\(^4\).

As far as the multivariate model is concerned, results show that all the independent variables considered are significantly correlated to the dependent ones, excluded 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 integration model explains 63.9% of its variance. Intercept, efforts, the product dummy by efforts, and material criticality are all correlated with the level of operational integration. The intercept value is 1,025, which means that there is low integration when the independent variables are at the lowest level in the scale. The model proves the trade-off existing between operational integration and efforts invested into the relationship through a logarithmic expression, which also means that a saturation effect

\(^{3}\) Significant parameters are shown by italic numbers.

\(^{4}\) The \( R^2 \) values of \( .639 \), \( .546 \), \( .605 \), and \( .702 \) measured through the logarithmic relationship decrease to \( .598 \), \( .492 \), \( .591 \), and \( .644 \) if measured through a linear relationship.
exists. The most interesting evidence is that also \( d* \ln(\text{efforts}) \) has a significant and relevant coefficient (0.949); this result shows how the slope of the relation between efforts and operational integration increases after the Internet adoption (see equation E3). That proves the shift of such trade-off. Finally, criticality of the material is also significant in explaining the level of integration: the more the material is specific, customized, new and complex, the more companies pursue operational integration.

### Univariate Parameter Estimates

<table>
<thead>
<tr>
<th>Model</th>
<th>Parameter</th>
<th>B</th>
<th>Std. Error</th>
<th>T</th>
<th>Sig.5</th>
<th>F</th>
<th>Sig.5</th>
<th>R²</th>
<th>Durbin-Watson⁶</th>
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<td>3.135</td>
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<td>-0.727</td>
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<td>1.136</td>
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<td>( \ln(\text{efforts}) )</td>
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<td>( d* \ln(\text{efforts}) )</td>
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<td>Criticality</td>
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Table 4b: Multivariate regression model between Integration and Efforts⁷.

The simple dummy variable does not present a significant parameter (two-tailed significance 0.621). This result proves that the simple introduction of the Internet does not provide a higher level of integration if it is not supported by greater efforts. In a similar way, material relevance and supply market complexity seem not explaining the level of integration. This is quite surprising for what concerns the relevance aspect in terms of percentage of purchases and total costs, nature of the material, and relevance to

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⁵ Two-tailed significance.

⁶ The Durbin-Watson measure (DW) tests the residuals auto-correlation. With 144 cases and 7 parameters, 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).

⁷ Significant parameters are shown by italic numbers.
final product characteristics. These variables seem explaining operational integration less than material criticality.

The technological integration model is the less explained (54,6%). In that model, analogous considerations to the operational integration model can be drawn for what concerns the intercept, the dummy, the efforts, and the product characteristics. Exception is made in the $d* \ln(\text{efforts})$ parameter. Such parameter is not significant (two-tailed significance 0.752); it means that the Internet introduction in the relationship has not shifted, on average, the trade-off between technological integration and efforts. This result implies two possible conclusions: on the one hand, at this stage the Internet could not support appropriately the co-development process; on the other hand, companies could have not used the technology with the objective to increase collaboration in such activities.

The information sharing model is explained by the independent variables with a percentage of 60,5%. The effect of the first four parameters is similar to operational integration: the trade-off between information sharing and efforts exists, and such trade-off has been shifted through the use of the Internet; 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 integration (operational and technological). For what concerns material characteristics, only relevance seem explaining the higher level of information sharing.

Finally, not surprisingly the interpretation of the total integration model is similar to the multivariate model one. The variance explained is 70,2%. All the variables significantly explain the level of integration, excluded the usual dummy and supply market complexity. This result means that the overall level of integration is in trade-off with the efforts required by the relationship, such trade-off has been changed in slope through the Internet; although it is not moved up (the dummy presents a two-tailed significance of 0.416.
Material relevance and criticality all contribute in the explanation of higher levels of integration, while supply market complexity is not a driver in increasing coordination and collaboration.

Figure 8 clearly shows the underlying concept of the model; only the total integration model is provided, but analogous considerations could be drawn for the others, excluded technological integration that does not show 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, as 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 trade-off efforts-integration in the analyzed sample while keeping unaltered the minimum level of integration (intercept 0.947); though, as 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 it 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 level of coordination and collaboration with equal efforts than before or lower efforts with equal level of coordination and collaboration.

![Figure 9: 15 companies decreased their integration level with suppliers. Total model R²=0.81.](image)

Analyzing data in more detail and dividing the sample into companies that decreased the level of integration on one side, and those that increased the level of integration on the other side, the results are analogous. In particular, the 15 companies that emphasized the arm's length nature of the relationship or simply kept the same level of integration lowering the efforts invested into the relationship are shown in figure 9. The other 57 cases in the sample, which increased the level of collaboration, are shown in figure 10.
The biased proportion between companies emphasizing arm's length transactions (15) and companies emphasizing collaboration (57) do not confute the overall result. The multiple regression does not aim at proving markets or alliances preferences by companies, but proving the existence of the trade-off efforts-integration and its shift through the Internet adoption.

The overall results shown in this section prove the theoretical hypotheses underlying the model of collaborative markets as illustrated in section 5 (H2, H3, H4). On the one hand, the Internet emphasizes the difference between markets and vertical alliances providing a wider spectrum of levels of integration and shifting the trade-off efforts-integration. On the other hand, such shift opens new opportunities for intermediate relationships of collaboration in the short term, which are referred to as collaborative markets in this work.

Figure 10: 57 companies increased their integration level with suppliers. Total model $R^2=0.65$. 
The effects of the internet adoption in customer-supplier relationships
8. Conclusions and future developments

The research has clarified and systematized what are the main motivations driving companies to the adoption of the Internet in customer-supplier relationships; such motivations are different, but not mutually exclusive. Firstly, web-based technologies provide the opportunity to increase the supply process efficiency, both in terms of internal activities and in terms of external activities with the suppliers. Increased efficiency means, for example, lead times reduction, operational procedures costs reduction, and inventory costs reduction. Secondly, new technologies might allow reducing procurement costs by increasing market efficiency in terms of suppliers' search and selection, contract negotiation, and purchase price. Finally, the Internet adoption might increase supply process effectiveness in terms of quality, degree of innovation, time-to-market, and service level to the final consumer.

The second result is related to the second research question. In order to pursue the previously described objectives, according to the acquired material, companies still have to choose among different tools. Electronic catalogs are suited for low criticality materials where the firm pursues mainly internal process efficiency. Electronic auctions are powerful tools to increase competitiveness among suppliers for high volume purchases, thus significantly reducing procurement costs. Web EDI and team working tools surely support supply process efficiency and effectiveness, but they might increase procurement costs.

These are only some examples of the results related to the specific web-based tools; however, an interesting evidence shows that companies, regardless of their motivations, mostly adopt private exchanges rather than consortia initiatives or independent ones.

Finally, the most important result is related to the influence of the Internet adoption in customer-supplier relationships. Both case studies and survey evidences prove a clear divergence between arm's length relationships and more collaborative alliances. On the one hand the Internet provide higher transparency and standardization, thus increasing market efficiency. On the other hand, it supports higher levels of coordination and collaboration among trading actors. Such divergence opens the space for a new typology of relationship, which is referred to as collaborative market in this work.
A collaborative market relationship occurs where companies choose trading partners through a market-oriented approach, but new technologies allow them reaching 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 on the market. Collaborative markets are characterized by a set of collaboration services between customers and suppliers that might be classified as operational services, on the one hand, and technological services, on the other.

Although some barriers to collaborative market environments are still in place, the existence of such relationships should allow companies competing on their businesses by leveraging their dynamic collaborating networks.

Interesting future developments for further research arise quite spontaneously.

First of all, this research based the model of collaborative markets on a wide analysis mainly focused on vertical and consortium portals. Future research projects might aim at monitoring other initiatives and possibly creating new supply chain or collaboration services enabling coordination within customer-supplier relationships. The new emerging web services are an example of new technology applied to a private network enabling collaborative market relationships without the presence of any intermediary.

Another interesting topic might be the standards achievement theme within different specific industrial sectors, theme that is becoming more and more hot on managers and practitioners' agendas. As discussed within the work, standards are one of the biggest barriers, if not the biggest one, to the emergence of collaborative markets.

The entire research was based on a dyadic customer-supplier perspective and analyzed the effects of the Internet introduction within such a relationship. This is only a first step necessary to analyze the effects on entire supply chains. Future research projects might enlarge the perspective by considering both upstream and downstream tiers, and, most of all, analyzing portfolio strategies in managing complex networks of firms. In such a topic, companies are in relation with each other through a set of web-based tools different situation by situation. It becomes extremely important, then, to find the right balance among relationships, organizational structures, management practices, and technology tools.

Finally, it might be extremely interesting to analyze collaborative market opportunities within industries naturally characterized by possible short-term relationships between customers and suppliers. Some examples are the engineering industry or the construction industry where main contractors might present the need to create collaborative relationships with suppliers, but lasting only through the project life cycle. In such a context, collaborative markets tools might support numerous activities such as project management, collaborative design, project procurement, inventory management, and logistics and production scheduling. These activities could be performed in a collaborative supply chain environment, without high specific initial investments.
9. References


Cook T. D., Campbell D. T., 1979, Quasi-experimentation: design and analysis issues for field settings, Chicago: Rand McNally.


