

QUANTIFYING THE BENEFITS OF USING E-MARKETPLACE IN CONSTRUCTION COMPANIES

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Abstract

The procurement process is critical for construction companies. In order to improve it, many are resorting to e-marketplaces although they usually do not know exactly how much they can gain by doing so. This paper describes a study that quantified the benefits of using an e-marketplace to support the procurement process of a construction company. In this study, 25 construction companies were studied, all of which use Iconstruye, Chile's main e-marketplace in the construction industry. The research shows that the adoption of an e-marketplace reduces turnaround time, errors and urgent orders, and irregular purchases. In general, a more reliable procurement process directly contributes to a leaner construction process by reducing upstream variability, procurement cycle times and the need for large inventories on site. Users also perceive an improvement in certain global indicators when using an e-marketplace.

KEY WORDS

e-marketplace, construction procurement process, supply process, lean construction.

INTRODUCTION

The construction industry is one of the main movers behind the economic development of any country. In the U.S., in 1997, the construction sector represented 10% of the Gross Domestic Product (GDP) (Allmon et al. 2000). In the European Union the construction sector is the largest sector of the economy, contributing approximately 11% of the GDP (Bourdeau, 2000). In Chile this sector has contributed, on average, 8.4% of the GDP for the past seven years. Furthermore, the construction sector requires a large quantity of materials, machinery and services from other productive sectors, producing a multiplying effect in the economy.

Supply is one of the main processes of the construction companies because they need a wide range of materials and services in order to execute their projects. The aim of supply is to deliver the correct quantity of a quality product, at the correct time, in the correct place, and at the best price. The vital nature of supplies in a construction project is summarized in the following points (Alarcón et al, 1998):

Supply must support the construction processes, providing the necessary supplies and resources when they are required, so as not to affect the programming of the project. The high relative value of supplies with respect to the total cost of the project (between 50% and 70% of the total cost of the project) makes it imperative to have strict and constant control of what is being purchased.

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Any type of supplies can be vital, due to the relationships of precedence and interaction between the different areas of the project. This paper analyses the benefits that have accrued as a result of using e-marketplace to carry out the procurement process, based on a study of a representative sample of construction companies that have adopted this means of making their purchases.

E-MARKETPLACE IN THE CONSTRUCTION INDUSTRY

In economics, a market is defined as a virtual meeting-place of supply and demand. E-marketplaces fulfill the same purpose. E-marketplaces are a Business to Business relationship model (B2B) in which multiple organizations, both sellers and buyers, can communicate, collaborate, and perform commercial transactions by means of a Web platform which is common to all those participating in the market. The main advantage of the e-marketplace compared with other B2B models is that it allows a purchasing company access to multiple selling companies and to selling companies access to multiple purchasing companies. Some examples of e-marketplaces include farms.com, specialized in agricultural products in the U.S., convisint.com, which specializes in the automotive and healthcare industries, and Aeroxchange.com, which specializes in aviation supplies.

E-marketplaces may be horizontal or vertical (Issa et al. 2003). Horizontal markets are those that provide a common service to companies of many industries. By contrast, vertical markets operate in a particular industry, developing functions, transactions and contents in a specific sector of the economy.

In order to be successful, an e-marketplace must meet the following conditions:

- It must have a critical mass of participants, both buyers and sellers.
- It needs a large volume of transactions to achieve economies of scale that allow diminishing charges.
- It must ensure transparency and confidentiality in commercial transactions.
- For a vertical market it is necessary for the operator to be familiar with the industry in which it is going to work.
- It must have tools that are easy to use and that meet the clients' requirements.
- It must have the ability to provide personalized solutions for each business need.
- It needs trained personnel who are capable of providing adequate training for new users of the e-marketplace and for solving clients' problems as quickly as possible.

Implementing an e-marketplace is much more than simply implementing a new system. It implies a new way of working, which calls for profound changes in processes and in the way of thinking and acting (Neef, 2001). However, the construction industry does not favor the implementation of these initiatives, being characterized by a strong resistance to change, attributable to the strong, rigid nature of construction culture (Aouad, 2002). Some factors that may explain this resistance to change in construction companies are:

- The high degree of fragmentation in the industry, which produces interruptions that make communication/ coordination difficult between the various phases of construction projects and their disciplines and sub-systems (Rivard et al, 2004).
- Strong price competition within the sector, which prevents many companies from making investments to improve their processes.
- Every project is different, so that each is basically a prototype and they are of relatively short duration, meaning that there is high turnover in the work force.
- The work force is not highly-trained and this leads to fear of new technologies.
- Each job is carried out in a different place, meaning that it is difficult for all of them to have the necessary infrastructure to use an e-marketplace (a broadband connection and computers).

THE CASE STUDY: ICONSTRUYE

Despite the difficulties of introducing new technologies in the construction industry, there is a vertical e-marketplace in Chile called Iconstruye, owned by the Chilean Chamber of Construction, which has over 600 clients.

Iconstruye acts as a neutral facilitator in business relations between companies, providing technology and services that make the business cycle more efficient, quick, and transparent. Iconstruye has experienced steady growth in the number of its clients, as shown in Figure 1, and the amounts traded since the year when it was set up, as shown in Figure 2, which currently correspond to 20% of the total purchases of the construction sector in Chile.

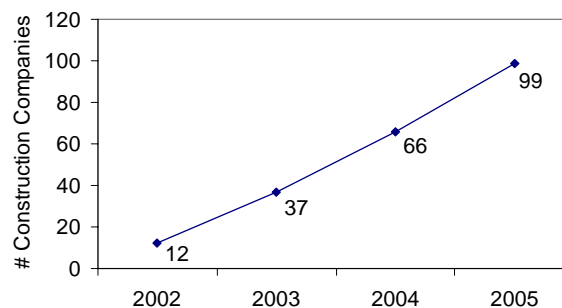


Fig. 1: Enrollment of Purchasing Companies – Accumulated

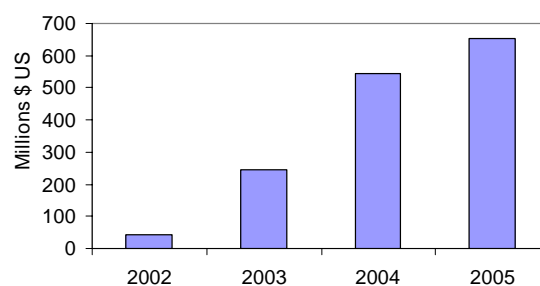


Fig. 2: Amounts Traded Annually

AIMS AND METHODS

The aim of this research was to measure the benefits of using some e-marketplace to support the supply process of construction companies. More than 70 professionals and executives from 25 companies that use the iconstruye e-marketplace were randomly selected to complete a questionnaire that would allow estimating the benefits of using the e-marketplace. Each company answered the questionnaire individually in the presence of a researcher. The data compiled with the questionnaire was complemented with information obtained from the Iconstruye database, to verify some of the data collected with the questionnaire.

THE TRADITIONAL SUPPLY PROCESS

The supply process may be understood as all the activities required to obtain the appropriate supplies and services for a project, on the requested date, with the quality and in the quantities needed, in the appropriate place, and at a reasonable price (Al-Khalil et al, 2004). The supply process may be centralized (Figure 3), which means that a central office makes all the purchases of a company. In contrast, in the decentralized procurement process (Figure 4), each project is responsible for all its purchases, depending on its own requirements. However, there is no “recipe” or method to tell which of the two models works best, since each has advantages and disadvantages, as shown in Tables 1 and 2.

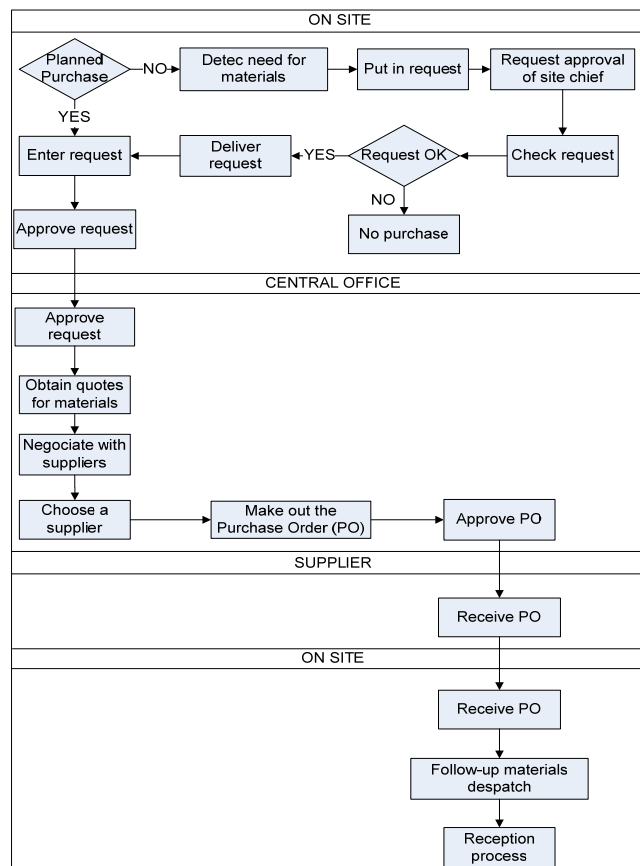


Figure 3: The Centralized Supply Process

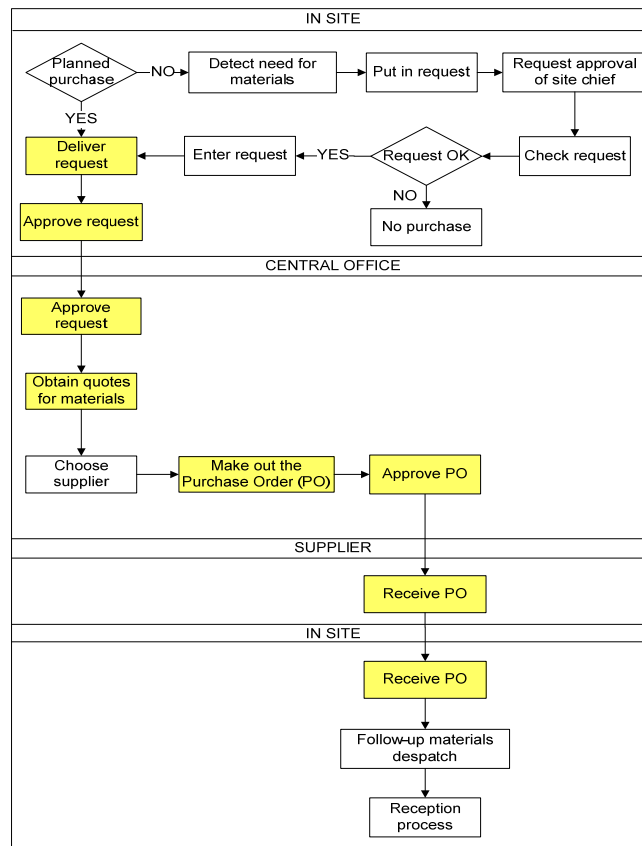


Figure 4: The Centralized Supply Process with E-Marketplace

Table 1: Centralized Purchases

Advantages	Disadvantages
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- Better prices due to volume discounts.
 - Greater bargaining power with suppliers.
 - Avoids price anomalies and competition for scarce commodities between jobs (Serpell, 2002).
 - Standardized procedures (Serpell, 2002).
 - Increased level of inventories.
 - For orders delivered to warehouse, the company has to pay for the transport to the building sites.
 - Greater administrative difficulties (errors in the type of product sent, mistakes in quantity delivered, etc.).
 - The sites have to compete to ensure that the head of procurement in the central office listens to their requests.

Table 2: Decentralized Purchases

Advantages	Disadvantages
<ul style="list-style-type: none"> • Greater speed in purchasing due to reduced bureaucracy. • Greater ability to react in emergencies (e.g. urgent orders) than the centralized model (Pooler 1997). • Better knowledge of the needs of the particular job. 	<ul style="list-style-type: none"> • Loss of savings on volume purchases. • Different prices for the same product when this is purchased from different suppliers. • Different quality for similar products.

The traditional approach in which a company makes its purchases has several drawbacks:

- The existence of a large number of manual processes, a considerable amount of paper work and a large number of validations and signatures which are carried out physically and are based on physical information.
- The information on the stages of the process are completed un-integrated, with no repository in which one can have access to all the information and the relationships between the different data and sources of information. This results in disconnection between the central office and the building sites.
- Lack of control and transparency, due to the fact that the stages of the process are scarcely visible to the other members of the organization.

- A reactive process, in other words, the need to purchase arises as a result of the lack of supplies.
- Lack of materials is one of the main Reasons for Non Completion of planned activities in companies using the Last Planner System.
- Nearly 80 % of the order of materials are labeled urgent in most companies.
- The generation of reports is a long, arduous process with relatively unreliable results, susceptible to typing errors and manipulation of the information.

THE PROCUREMENT PROCESS USING AN E-MARKETPLACE

The use of an e-marketplace to make purchases allows automating a series of activities in the supply process, as shown in Figure 4, for the model of centralized purchasing, where the colored rectangles show the activities in the process that are carried out via the e-marketplace. The case of decentralized purchases is very similar to that of centralized purchases, with the main difference that all the activities take place on-site.

The automation of the supply process produces an important reduction in the problems presented by traditional supplying and a series of benefits, as shown below:

- Access to a larger number of suppliers (Neef 2001)
- Reduction in administrative expenses in the procurement process (Issa et al. 2003)
- Reduction in prices of goods and services (Subramaniam et al. 2003)
- Establishment of long-term relationships with suppliers (Issa et al, 2003)
- Time savings (Hitech, 2001)
- Reduction in last-minute purchases (Neef, 2001)
- Reduction in inefficiencies and errors, as a result of less paper work and repetitive steps involved in the procurement process (Neef, 2001)
- Reduction in the costs of searching for the best price for a product (Dai et al, 2002)
- Decrease in inventories (Issa et al, 2003).

In the case of Iconstruye, requests are made in the Orders for Materials (OM), which is presented in a single format. Once the OM has been generated, it goes through an approval process to obtain the go-ahead from the supervisor or administrator, after which the purchase is negotiated.

Quotes may be made on-line in the case of Integrated Suppliers (IS), i.e., those that belong to the Iconstruye business community. For the other suppliers, quotes must be made in the traditional way, but they can be entered in the system in order to generate a comparative table of offers.

Iconstruye's Purchases module formalizes and controls the procurement process by submitting each Purchase Order (PO) generated in the system to an approval process, where it is checked and signed by each responsible person defined by the company. In this way, every PO sent to a supplier, whether integrated or not, has the approval of the company. For the integrated suppliers, the POs are sent via the e-marketplace.

RESULTS

In order to quantify the benefits of using the e-marketplace in construction companies, the performance indicators shown in Table 3 were defined for the supply process to determine how they would change for the companies using Iconstruye. The results are shown in Figure 5, which took a base value of 100% for each indicator, and shows the

value of the indicators compared with the base value and how much each of them had improved.

Table 3: Performance Indicators

Name of Indicator	Definition
Lead time (Tt)	Defined as the time taken from when a request is entered until the Purchase Order (PO) for that order is sent to the supplier
Errors in OM	$\text{OM with errors (\%)} = \frac{\text{Quantity of OM with errors}}{\text{Total quantity of OM}} \times 100\%$
Errors in PO	$\text{PO with errors (\%)} = \frac{\text{Quantity of PO with errors}}{\text{Total quantity of PO}} \times 100\%$
Urgent Orders (UO)	<p>An UO is any order that exceeds the minimum cost and means an additional effort to buy it, producing the risk that it will not get to the building site.</p> $\text{UO (\%)} = \frac{\text{Quantity of UO}}{\text{Total quantity of OM}} \times 100\%$
Irregular Purchases	<p>Irregular purchases are those made without respecting the internal procedures of the company</p> $\text{Regularizations (\%)} = \frac{\text{Quantity of regularizations}}{\text{Total quantity of PO}} \times 100\%$

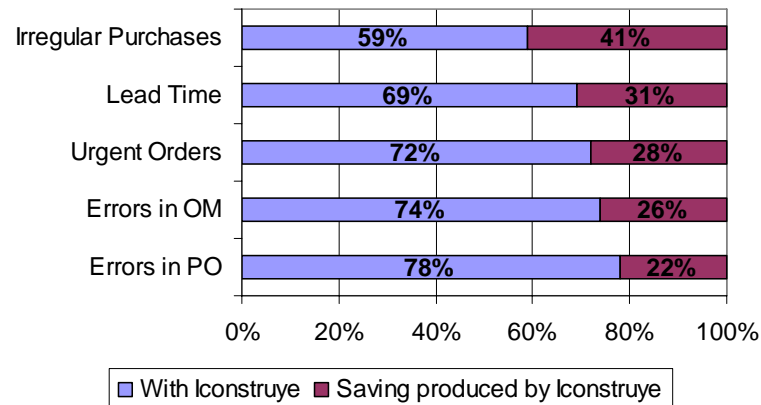


Fig. 5: Fall in Performance Indicators Due to Use of E-Marketplace

The perception of the companies using Iconstruye regarding possible benefits that may be obtained by using the e-marketplace was also measured on a Likert scale of (1) Very Negative to (5) Very Positive.

- *Reduction in administrative expenses.* Authors Subramaniam (2003) and Neef (2001), among others, maintain that the use of the e-marketplace reduces costs, due to the greater speed with which commercial transactions take place and the reduction in paperwork.
- *Increase in productivity:* Good supply management contributes to the elimination of inefficiencies in the workforce (Thomas et al, 1989). On the other hand, some authors, such as Brynjolfsson (2000), Teicholz (2004), and Samuelson (2002) maintain that the use of Information Technology to support processes produces an increase in the productivity of companies.
- *Increase in transparency:* Alarcón (2003) maintains that the transparency of a process seeks to make the main flow of the operations or activities involved in the process visible and comprehensible to all employees. The use of an e-marketplace should produce an increase in the transparency of the purchasing process, because with this tool any member of the organization with access to Internet can consult all the information related with the supply process, thus reducing possible points of corruption.
- *Increase in control:* due to the formalization of the purchasing process in organizations, as a result of the approval process for documents on-line (requests for supplies, purchase orders, reception of products, and invoices for payment). Also, the related information is stored and can be consulted by the different players in the company.
- *Reduction in prices of products:* Subramaniam (2003) maintains that the organizations using some system of e-procurement can obtain price reductions in two ways: (1) by consolidating orders, thanks to the centralization of the information about purchases and (2) by increasing competition among their suppliers.

The results may be seen in Figure 6, which shows the distribution of replies obtained and the average perception per indicator.

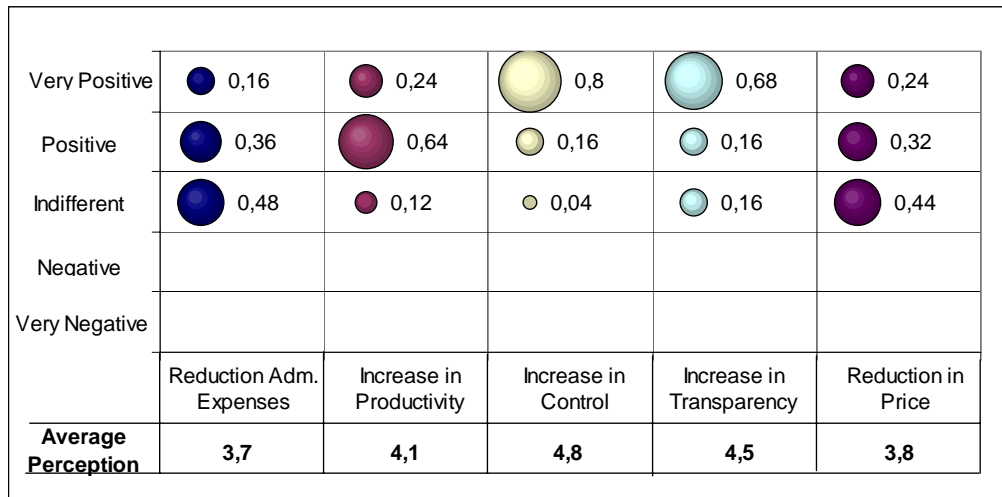


Fig. 6: Distribution for Perception of Global Indicators

CONCLUSIONS

The present study has shown that, despite the characteristics of the construction industry that hinder the implementation of e-marketplaces, there are many companies that have adopted this new technology and have experienced important benefits. Figure 5 shows that the companies that were studied have significantly reduced the proposed indicators, which means that they have improved the performance of their procurement process.

It is important to note that for all the global indicators considered, the average mark was over 3, as shown in Figure 6, meaning that the e-marketplace has not had negative effects in any company. The perception of the clients of the impact that the e-marketplace has had on the global indicators is consistent with that shown in Figure 5. Even though the study did not measure the impacts on site of the implementation of the e-marketplace, the authors believe that directly contributes to the implementation of Lean Construction principles such as: increased process transparency, reduced process cycle time, reduced upstream variability, reduced inventories and waste of materials. Considering data available on the impact of procurement in overall construction performance (Alarcon et al 2005) it is reasonable to expect that indirect impacts of improvements in the procurement process can be even more significant than the impacts on the process itself.

It is also worth noting that the companies involved in the study might have greater benefits if they made better use of the opportunities offered by Iconstruye, because not all the organizations use all the functions of the e-marketplace. For example, there are still some companies that continue seeking quotes by telephone or fax, or practically none use the tools for reception of materials, which would allow them to keep better control of these.

Finally, although the conclusions of this study are based on the experience of iconstruye and the Chilean construction industry, we believe our main conclusions are also applicable to other countries. However, the role of the Chilean Chamber of Construction was important in iconstruye's success, and not all countries have such a strong association.

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