



The evaluation of e-commerce impact on business efficiency

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Abstract

Purpose – The paper aims to determine and assess the cost positions that mostly impact the company total cost efficiency in supply chain management under theoretical and empirical background.

Design/methodology/approach – In the paper, the systemic and logical analysis of e-commerce expert research made over the past several years was used. For the empirical research, the data of a wholesale company cost structure and processes management was used.

Findings – Major findings allow stating that e-commerce adoption in business has a positive impact on business efficiency in several areas. The quantitative and qualitative analysis of e-commerce impact on business efficiency shows that the main cost positions, which directly depend on e-commerce adoption and use, and experience quite big changes, are average cost of inventory management, the cost of materials ordering process, and the cost of labour.

Research limitations/implications – The presented empirical research confirms the theoretical implications of e-commerce impact on business efficiency. Using this information, the future research should be made on evaluation of indirect e-commerce impact on business efficiency.

Practical implications – The empirical research of e-commerce adoption in a wholesale company confirms that the main areas where e-commerce has an important positive impact on business efficiency are the cost of inventory management, the cost of materials ordering process and the cost of labour.

Originality/value – The e-commerce impact on business result analysis is improved by detailed costs, which depend on e-commerce adoption, analysis and definition of e-commerce impact on business results, by evaluating the business efficiency in quantitative and qualitative forms.

Keywords Electronic commerce, Business performance, Supply chain management, Costs

Paper type Research paper

Introduction

E-commerce evolution is related to rapid perfection of information technologies, the growing possibilities of their adoption in various areas, and the decrease of their usage cost. Though e-commerce boom in 2000-2002 ended in bankruptcies of large companies who based their business solely on e-commerce, the impact of that boom on e-commerce spread was minimal. Today, e-commerce decisions more and more often are treated not as a competitive advantage, but as a necessity, which helps to avoid the lagging behind competitors. Since, mid-1990s, e-commerce conception has evolved from separate electronic transactions in goods purchase or resource supply based on business-to-customer or business-to-business models, to dynamic business ecosystems based on the merger of separate markets and value chains, which are created in the



network communication framework. Within the aspect of business processes, e-commerce can be defined as the use of electronic networks with the objective to simplify and fasten all phases of business processes – from the production of goods to their sale and delivery.

Today more and more companies become interested in e-commerce as one of the instruments for business efficiency improvement. E-commerce is no longer treated as only a marketing instrument. It becomes an important part of business performance that can generate significant additional value for company and other subjects in the value-added chain. The important role of e-commerce occurs in supply chain management where there are lot of possibilities to improve business processes by using modern technologies, which are based on e-commerce philosophy. Most of e-commerce implementation decisions in business processes are based on the possibility to reach significant cost efficiency, which means bigger company profitability and higher level of competitiveness on the market.

Various authors (Benjamin and Elsie, 2003; Brown, 2001; Cloete *et al.*, 2002; E-Business Watch, 2003; Nienhaus *et al.*, 2003; Subramani, 2003) try to state how e-commerce decisions may impact company cost efficiency. In most cases e-commerce is treated as a more perfect technological tool for recurrent processes realisation, which helps to reduce some cost positions or to avoid them at all. The main problem in this research area is to determine those cost positions with the purpose to find out the real impact of e-commerce on business. The reason of this problem importance is the complexity of e-commerce decisions which may impact various business processes depending on company process structure, implemented e-commerce decisions, parallel modern technologies used in company, and other elements which create the totality of company performance. Such point of view conditions the question: “what cost positions play the main role in creating business efficiency in company?” This viewpoint highlights the need for further theoretical and empirical research in the area of e-commerce impact on cost efficiency.

The aim of this study is to analyze various viewpoints in the area of e-commerce impact on business cost efficiency and to identify the main (strategic) areas of e-commerce impact on cost efficiency. The study is realized by analyzing theoretical findings in the defined study area and by making empirical research of a chosen wholesale company. As the total impact of e-commerce decisions has a wide area of assertion, the study area is limited to the analysis of e-commerce impact on cost efficiency in supply chain management with the purpose to make a more definite analysis of possible cost efficiency despite the fact that such analysis will not cover all possible results of e-commerce implementation. The choice of supply chain management research is based on the preliminary analysis of theoretical literature, which, in most cases, allows stating that supply chain management is the primary business area for e-commerce decisions implementation than the purpose of e-commerce implementation is the need for cost efficiency. For this reason, supply chain management can be treated as an “experimental” business area for e-commerce decisions, and this conditions the possibility to determine the changes in cost positions after the first attempt to implement e-commerce decisions in company performance.

The objective of this paper is to determine and assess the cost positions that mostly impact the total company cost efficiency in supply chain management on theoretical and empirical background.

The structure of this study is as follows. In the first part of the study, the presumptions of e-commerce impact on business efficiency are discussed with

the purpose to determine how the impact of e-commerce decision implementation on business efficiency in the context of cost management can be measured. In the second part, the thorough analysis of literature is made with the goal to identify the main areas where e-commerce may have an impact on supply chain management cost and efficiency. In the third part, the results of empirical research are presented, which confirm the statements of theoretical analysis of e-commerce impact on business efficiency in supply chain management.

The presumptions of e-commerce impact on business efficiency

One of the main areas of business efficiency improvement, using modern technologies, is cost minimization decisions. E-commerce can be treated as an instrument for technological performance improvement, which allows reducing the cost of labour power and capital. While analysing the e-commerce impact on business results, it is reasonable to segregate different areas of e-commerce use in business:

- e-commerce in supply chain management known as business-to-business e-commerce; and
- e-commerce in relation with customers known as business-to-customer e-commerce.

In this paper, the main research area is business-to-business e-commerce and its impact on business efficiency through supply chain management improvement because business-to-business e-commerce is considered to be the most common e-commerce form in business practice. E-Business Watch (2003) research of e-business shows that this type of commerce is used in more than 70 per cent of all e-commerce users across the old European Union countries (EU-15), and even more than 50 per cent of those users prefer e-commerce adoption in supply chain management.

The e-commerce impact on company performance may be expressed in various ways: in the context of cost, competitiveness, process automation, optimisation, etc. But if there is a need to make thorough assessment of e-commerce impact, the optimal choice for it is business efficiency measurement in the context of e-commerce decisions implementation. In common business, efficiency in economics is interpreted as the relation between output and input in the process of product manufacturing. Such conception of business efficiency is presented by Christensen and Hansen (1996), who state that efficiency in manufacturing should be treated as the relation between production and cost:

$$\text{Efficiency} = \frac{\text{Any expression of created value}}{\text{Any expression of experienced cost}} = \frac{\text{Production}}{\text{Cost}} \quad (1)$$

As it may be seen, this definition can be adopted in any business area and in any case of value creation. It allows stating that given definition is universal and is not limited to any additional presumption. In the theoretical analysis of efficiency, which is made by Hong Kong Productivity Council (2004), the efficiency is unambiguously associated with the relationship between output and input with the accent of value-added concept (the absolute difference between output and input):

$$\text{Efficiency} = \frac{\text{Output} - \text{Input}}{\text{Input}} + 1 = \frac{\text{Value-added}}{\text{Input}} + 1 \quad (2)$$

Added value may be interpreted in the context of the analysed object. As Virtel (2001) states, added value is identified as the difference between company income and cost. Brown (2001) treats the added value as the value that is created by a company by the difference between all benefit that company receives and all resources. In that case, benefit and resources are not only changes that may be seen in company financial reports, but also external effects, for example, impact on environment. In this context, the conclusion is made that “business efficiency in a company should be treated as the relation between the value that is created for consumer and the resources that were used for value creation”.

Using this definition of business efficiency, it may be stated that e-commerce impact on business may be closely related to business efficiency changes in two ways:

- (1) e-commerce can be treated as a tool for output amount improvement; and
- (2) e-commerce is also a tool for input reduction.

The output amount improvement is mainly based on marketing decisions (new product creation, easier reach of consumers, new markets, etc.). In this paper, the main attention is paid to economic aspects of e-commerce impact on business efficiency. Thus, marketing decisions are ignored. This leads to concentration on e-commerce impact on business efficiency by reducing input.

In economic literature, business efficiency improvement in the context of input minimization is often related to the use of new technologies. New technologies in modern economics are treated as one of the main factors that influence changes of production supply curve. Such changes are based on presumption that new technologies allow cost economy, and this conditions the conclusion that adoption of new technologies in company performance are closely related to business efficiency improvement by minimizing the cost. As it was stated before, the cost minimization is mainly connected to business-to-business e-commerce form. For this reason, further research is mainly based on the analysis of business-to-business e-commerce impact on business efficiency, ignoring business-to-consumer e-commerce form that mostly impacts the output, but has only a limited impact on input minimization.

E-commerce impact on business efficiency may be analysed through the change of output dependency on input, as it is stated by Mahadevan (2002). Because of such point of view, technological progress, which stimulates the growth of output while keeping the same level of input (Figure 1), is considered to be the main factor for business efficiency improvement.

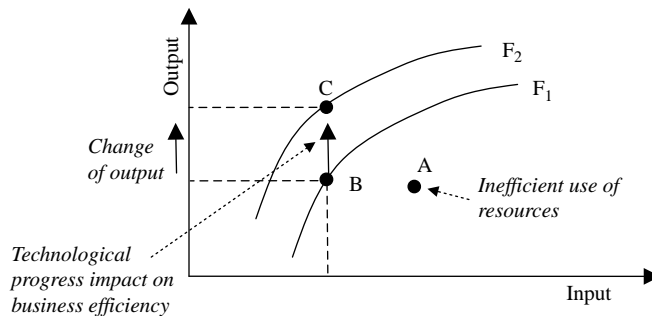


Figure 1.
Change of business efficiency by technological progress: relation of output and input

As Mahadevan (2002) states, the output may be expressed as a function whose independent variable is a complex of input elements. In such case, the change of input amount influences the change of output amount. The F_1 curve presents the efficient relation between output and input. In the current situation (point B), the company is unable to generate the output amount that is above curve F_1 , and the output amount that is below curve F_1 conditions the creation of insufficient value. The technological progress, as Mahadevan (2002) states, forces the change of efficient relation between output and input, and curve F_1 changes its position to curve F_2 . The result of such change is growing output while keeping the same amount of input. This can be concluded by stating that technological progress creates possibility for companies to improve the level of output by leaving the same level of input.

But in the context of business-to-business e-commerce impact on business efficiency, Mahadevan's (2002) propositions must be adjusted to previous conclusions made in this paper that business-to-business e-commerce firstly impacts input level, and the change of output level is only the consequence (lower need of input creates spare resources that can be used for company growth). Thus, the e-commerce impact on business efficiency may be expressed by using Mahadevan's (2002) model, but with applying some changes, as seen in Figure 2.

The proposition that e-commerce impacts business efficiency by the change of input level allows stating that e-commerce (as one of technological progress elements) influences the efficient performance curve F_1 and its move to position F_2 , but the primary result of this move is not the growth of output (as in Mahadevan's (2002) model), but the reduction of input while keeping the same level of output. While business efficiency is treated as the output/input ratio, the change of current position from point B to C results in business efficiency growth. It confirms the e-commerce relation with business efficiency through cost minimization.

As it was mention at the beginning of this chapter, the main area where business-to-business e-commerce creates additional value for company by reducing cost, is supply chain management. For this reason, further on in this paper, the research of e-commerce impact on business efficiency is narrowed to e-commerce impact on supply chain management cost, which allows more thorough analysis of various e-commerce adoption factors that may influence company cost structure and business efficiency.

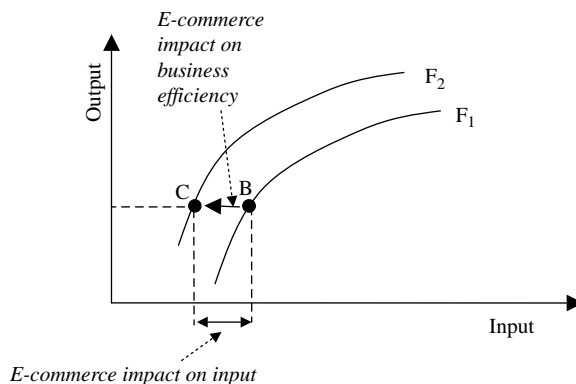


Figure 2.
Change of business efficiency by e-commerce: relation of output and input

Areas of e-commerce impact on business efficiency in supply chain management

In the context of supply chain management cost reduction, it is clear that one of the most important factors is the use of modern technologies. It is significant to link this factor with the adoption of business-to-business e-commerce, but it is also meaningful to assess the fact that e-commerce is not only the adoption of modern technologies in a company. Baolin (2004) and Fraser (2000) affirm that e-commerce can be interpreted as the new business philosophy that changes the ordinary performance principles.

The analysis of economic literature allows concluding that e-commerce creates the additional value for three subjects:

- (1) *Companies*. E-commerce relieves the transaction execution and other operations. It has a direct impact on company cost and business efficiency. Lewis (2001) states that e-commerce gives the possibility to present easier company products and services on international market, to shorten the manufacturing cycle, to improve the spread of information, to create new informational products and new placement channels, etc.
- (2) *Suppliers*. Biro and Messnarz (2000) state that the use of modern technologies allows simplifying the communication with company partners: modern technologies reduce the cost of communication; communication becomes more expeditious; the possibility appears to transmit more and higher quality information (comparing with the traditional forms of communication – fax, post or phone). Besides, e-commerce for business partners allows shortening the supply chain and reducing cost of transaction.
- (3) *Consumers*. Lower company cost has a positive impact on final prices of company goods or services. It also simplifies searching, ordering and receiving (if product can be transformed to digital form) processes of products to consumers (Clegg *et al.*, 2002; Pautasso and Alonso, 2004).

Many e-commerce experts (Strauss and Frost, 2001; Fraser, 2000; Lewis, 2001; Ranganathan *et al.*, 2004; Iannella, 2004; Buffett and Spencer, 2004; Sieber and Sabatier, 2003; Benjamin and Elsie, 2003; Ihlstrom and Nilsson, 2003) agree that supply chain management is the main area where e-commerce can generate a big positive change of business efficiency. Supply chain management in manufacturing and wholesale is the main area for business-to-business decision adoption that allows reaching real growth of business efficiency on cost minimization background.

It is clear that the best results of business-to-business e-commerce impact on business efficiency is generated by companies performing in those business sectors where the information and the speed of its transition have a big impact on business success (Icasati-Johanson *et al.*, 2003; Sadeh *et al.*, 2003). The information factor, as Biro and Messnarz (2000) state, is very important in electronic component and freight services where usually the existing high level of competition and information becomes the main success factor. Besides, in electronics industry, the importance of information grows because of rapid improvement of products and services that generate the need for companies to constantly analyse new information and to be always ready to present new products on the market (Nienhaus *et al.*, 2003). On the other hand, the lowest cost reduction benefit after business-to-business e-commerce adoption is generated in coal mining industry (Subramani, 2003). This industry sector has long-lasting traditions,

and the limited number of buyers and sellers; therefore, the information asymmetry that can generate the use of information management is minimal. Besides, the intermediation structure in coal mining industry is strong and hardly can be changed because of e-commerce decision adoption because it requires not only the additional information about alternative intermediation channels but also huge investment for changes in supply chain realization.

The analysis of different impact of e-commerce decision adoption on business efficiency in various sectors allows concluding that the benefits of e-commerce use in business mostly depend on the information factor. In modern economy, information assumes the new meaning: it becomes an expensive and very useful product characterized by exceptional features that are not typical to other types of goods:

- Information can be multiplied and can be used by unlimited number of people, while the owner does not lose the information and can also use it for his own needs. In this case, the problem of information limitation does not exist.
- Information distribution does not require high cost, but the production of information remains an expensive process, and it conditions the high cost of information, while the marginal cost of information unit distribution is minimal, and the information can be distributed to unlimited number of consumers.

Biro and Messnarz (2000) stress the dual information meaning in e-commerce:

- It is a product, which ownership conditions higher performance efficiency (information about the situation on the market, competitors' performance, market situation change forecast, etc.).
- Lower asymmetry of information stimulates competition, and companies are forced to look for new competition advantages because on the market where all participants have the needed information the significance of information becomes lower.

Information also is the basic factor in supply chain. The summary of Brookes and Wahhaj (2000), Coppel (2000), Biro and Messnarz (2000), Deise *et al.* (2000), Fensel and Bussler (2002), van Slyke and Belanger (2003) researches allows stating that the company, which relocates supply chain management in electronic environment, can generate the cost economy in four positions, which are connected to the growing efficiency of information reception and transition:

- (1) To lower the cost of materials ordering process.
- (2) To lower the average material inventories that allow reducing average manufacturing cost.
- (3) Faster and cheaper identify suppliers who can or are ready to supply cheaper materials or can shorten the number of intermediaries.
- (4) To stimulate the competition between suppliers that would generate the positive direct impact – lower prices of materials in case of competitor price war, and indirect impact – lower prices of materials in case of higher efficiency of supplier performance.

The economy of materials ordering process is firstly evaluated as a positive factor in e-commerce adoption (Molla and Licker, 2001; Cavalieri *et al.*, 2003; Iivari and Janson, 2003). The cost of ordering process consists of order submission documentation, correspondence, document storage and labour expenditures. It is noticed that very often company managers, who evaluate the benefit of e-commerce adoption, pay attention only at that sort of cost and ignore other positive aspects of e-commerce (Cloete *et al.*, 2002). In this case, the benefit of e-commerce can be evaluated in simple mathematical calculation:

- The use of information technologies allows lowering the cost of correspondence. Orders can be transferred through electronic channels (most often – through internet). In that case, the cost of order transmission is equal to the due of internet services provider, which compared with the cost of post or phone is much lower.
- The use of computer allows fastening the order document filling procedures. Standard or specialized computer programmes give a possibility to create order documents templates, and allow preparing order documents faster than manually.
- Electronic document is transferred to supplier in minimal time span (in seconds), so practically electronic transfers eliminate the factor of order submission term, which has a big impact on supply management.
- The possibility to fasten the order document filling and transferring processes directly impacts the labour intensity; therefore, company needs fewer workforces in supply management area.

In the analysis of material ordering process, the cost economy often omits real labour expenditure economy, which may have a critical impact on e-commerce adoption in supply chain management need for small companies.

As Deise *et al.* (2000) state, it is clear that for the company, which has a lot of suppliers, electronic order system allows to reduce the number of workers in supply management area because the bigger part of orders can be more or less automated (for example, order can be automatically sent once a month; in this case it is enough to ratify the number of needed materials), so it requires less labour for order control processes. But in the case of a small company, as Fensel and Bussler (2002) state, the possibility of labour force reduction can be limited: if a company has only one worker in supply management, then, even total automation of material order processes would require one worker for process control and additional specialist for adopted information technologies maintenance. In this case, the e-commerce adoption may even have a negative impact on cost and business efficiency.

The reduction of average inventory is realized because of the faster information transition, which is guaranteed by the electronic channel use in supply management. The cost benefit of order information transition is reached not only in order processing management, but also in inventory management. In the traditional inventory management system, the size of inventory depends on the time gap between two orders. This time lag consists of the following critical stages (Deise *et al.*, 2000):

- *Order submission.* Company evaluates its inventory level and the prognosis of its depletion and on the basis of these indicators prepares order documents and sends them to a supplier.

- *Order confirmation.* Supplier receives order documents from the company and formalizes them in their own order system.
- *Order forwarding.* Supplier, using the information he got from the company about the order conditions, prepares the needed materials and sends them to the company.
- *Order receiving.* Company gets the ordered materials from the supplier and adds the information about the received material to the inventory management database.

One of the elements of inventory order time gap is the time needed for ordering process realization. In the traditional supply chain management, this time gap is inevitable because the preparation of documents and their transition are time-adoptive processes. In case of e-commerce adoption in supply chain management, as stated above, the material ordering process time gap is close to zero.

It is achieved because of the electronic information management and transition systems, which reduce the labour and time intensity for document processing, eliminate information about the order transition time and reduce the time for order confirmation process because electronically transferred information can be automatically added to supplier order management system.

The additional positive impact of e-commerce adoption in supply chain management in case of inventory management is a possibility to improve inventory management precision and expedite the correction of individual order components (size, time, etc.) because faster ordering process enables to reduce the time gap between two orders, and this allows reducing average inventory level. For this reason, it is important to evaluate the e-commerce impact on supply chain management in the following aspects:

- Lower maximum inventory, which means fewer warehouses and less cover inventory (the additionally stored inventory, needed to cover the unexpected deficit of inventory). For wholesalers, the e-commerce benefit is very important because the cost of warehousing has a big impact on the final cost of production.
- Lower average inventory and labour intensity mean lower need for workforce in supply management. This impact, as Smaros and Holmström (2000) state, is not very important for small companies where only a few workers in supply management area are needed to control supply system without reference to the size or type of supplied materials.

Suppliers can be identified faster and cheaper because of the higher information flow, which is created by using electronic channels. Higher information flow allows company to communicate not only with the nearest or easily reached supply intermediaries but also directly with manufacturers or intermediaries who are closer to manufacturer in supply chain.

Economics theory and today's business practice show that in the traditional supply chain there usually exist one or more intermediaries – wholesalers. This conditions higher prices for final buyer because every intermediary looks for financial benefit. Smaros and Holmström (2000) state that in electronic environment, the final buyer can choose the supplier easier and in some cases can even deal with the manufacturer. This point of view shows that electronic environment (the base for e-commerce decisions realisation) creates the possibility to avoid intermediaries. As Virtel (2001) notes, there

exists mutual benefit: a manufacturer can assess higher price (closer to retail prices) and a buyer can buy a product for lower price than usual (closer to wholesale price level). It means that intermediary benefit can be distributed between manufacturer and buyer.

Thus, it can be concluded that in such situation, if other factors influencing demand-supply mechanism are not analysed, the final buyer gets the product for lower price than the traditional supply chain could guarantee. But it is necessary to state that in reality intermediaries exist in spite of e-commerce spread, especially in consumer commodities sector because manufacturer still cannot guarantee efficient distribution of products (e-commerce decisions are not able to reduce the transaction cost as much as it is necessary for manufacturer to successfully distribute products among end-users). Practically manufacturer keeps the interest to use intermediaries for product distribution in different geographical areas or consumer segments. It means that e-commerce adoption in business creates the possibility to shorten the supply chain (but not to avoid it) and it has a positive impact on product prices and supply process quality.

The competition between suppliers can be stimulated by the lower information asymmetry. Information asymmetry in economy is treated as the situation in the market when buyers and sellers dispose different amount of information, and the lack of information on one side of transaction leads to the risk to choose not the optimal choice. In the context of supply chain management, information asymmetry means that buyer, looking for needed product, gets only part of information about the existing alternatives and will not be able to choose the best product all the time (Jennex *et al.*, 2004). This situation is ordinary in traditional market where buyer often chooses not the best product for his satisfaction but the product which the buyer is well informed about and which can be easily reached. Such situation appears because of the high cost of information about the alternative product search, and this process is time intensive.

In electronic environment the search of information becomes cheaper and easier, and it means the real possibility to have the whole information about alternative products (Schreyer, 2000). Having this information, buyer can make a thorough analysis and choose the product, which fulfils the buyer's needs the most. This situation in electronic environment usually is realized by creating a new intermediate element in the value creation chain – the informational environment that provides the information about product supply in market for buyers and product demand in market for sellers. This kind of information can be accumulated and transformed into the form, acceptable to both, buyers and sellers. The informational environment practically can be realized in two main forms (Stiroh, 1999):

- (1) As commercial intermediaries, performing broker functions. These intermediaries collect information about the buyers and sellers in market and help them to find appropriate decision for adequate salary.
- (2) As electronic databases where the information about buyers and sellers in market is collected. In this case, buyer or seller is looking for an appropriate alternative by oneself, using the information in database. This information, depending on the creators of database interests, can be taxable, free for limited number of users (determined by specific criteria) or totally free. Such kind of database can be compared with traditional exchange market that guarantees absolute elimination of space dimension in trading deals.

Concluding the theoretical analysis of e-commerce impact on business efficiency in supply chain management cost reduction area, it can be stated that e-commerce adoption directly changes supply chain management processes, and has an impact on business cost structure, and because of changes in cost structure, it has an impact on business efficiency. The analysis of e-commerce experts' research allows stating that the total impact of e-commerce adoption in supply chain management on business efficiency is positive, and this the main reason for e-commerce spread over almost all business sectors. To prove this statement, the results of empirical research of e-commerce impact on business efficiency are presented in this paper.

E-commerce impact on business efficiency: empirical evidence

The theoretical background of e-commerce impact on business efficiency through reduction of supply chain management cost allows stating that e-commerce decision adoption in business generates the financial benefit for a company, which can be expressed as higher return connected to lower average cost of production. To ensure this theoretical prediction, the experiment of e-commerce decision adoption in supply chain management in one Lithuanian company was made. The experiment was made in the company, which performance area is wholesale of computer equipment.

Methodological notes

The objectives of this empirical research were as follows:

- to determine the main areas where e-commerce impacts business efficiency in the area of supply chain management; and
- to assess the level of e-commerce impact on business efficiency in previously determined areas.

The basic principle of experimental research is the characterization of dependent and independent variables and the assessment of their changes after the change of independent variables, which are isolated from external environment. In the analysis of e-commerce impact on business efficiency through supply chain management the experiment of simple form was used when the comparison of analysed object characteristics is made before and after the experiment. This method limits the possibility to clearly assess the impact of external factors (because there are no control groups of similar objects), but the decision to choose this methods was influenced by objective factors:

- it was necessary to make an experiment in a company that was going to implement e-commerce decisions in supply chain management; and
- the analogous object in Lithuania, in the same market as the experiment object, was hard to find.

The chosen experiment object before the experiment (in the year 2002) is characterized by the following features:

- The beginning of operation is 1998.
- Number of employees is 55.
- Yearly income is 130 million LTL.
- Business area: wholesale of computer components.

- Geographical area: Lithuania, Latvia, Estonia, and Russia (Kaliningrad region).
- Customers: about 500 companies (5 per cent are large wholesale and retail companies, 90 per cent are computer equipment producers and 10 per cent are small retailers).
- Suppliers: about 100 companies (60 per cent of them are companies from China, Taiwan, the other 40 per cent are from Western Europe).

The choice of experiment object was influenced by the following factors:

- the company must perform in business sector, which is open for e-commerce decisions;
- the company must be big enough to allow analysis of various cost position changes in supply chain management during the experiment; and
- the company supply chain should be related to international markets because it highlights more clearly the e-commerce impact on supply (orders and transportation) terms.

The experiment was started in July 2002 and finished in November 2004.

The aim of assessment of e-commerce impact on business efficiency in supply chain management is based on the need to make quantitative valuation of various e-commerce element impact on company cost structure and size. For this reason, the calculations of cost changes in different positions were made with the assumption that those changes were impacted by e-commerce implementation. The calculations of business efficiency are made as follows.

Business efficiency:

$$BE = \frac{TR}{C} \quad (3)$$

where BE – the business efficiency; TR – the total revenue (company turnover; output); C – the cost (the individual position of company costs).

The change of business efficiency:

$$\Delta BE\% = \frac{\Delta BE}{BE_1} \cdot 100 \text{ per cent} = \frac{(TR_1/C_1) - (TR_2/C_2)}{(TR_1/C_1)} \cdot 100 \text{ per cent} \quad (4)$$

where $\Delta BE\%$ – the change of business efficiency (in percentage); ΔBE – the change of business efficiency (in absolute terms); TR_1 – the total revenue at the beginning of experiment; TR_2 – the total revenue in the end of experiment; C_1 – the cost at the beginning of experiment; C_2 – the cost in the end of experiment.

Almost all cost positions are measured in terms of money. In case of the lack of financial information about any cost position, the business efficiency was analysed by measuring the relative change of cost (i.e. if e-commerce system conditioned the reduction of cost position five times compared to primal level, then, it is treated as the reduction to 20 per cent of its usual level which is equated to 100 per cent at the beginning of the experiment). In this case, the business efficiency is calculated using the following formula:

$$BE = \frac{TR}{C\%} \quad (5)$$

where $C\%$ – the comparative cost of cost position (in percentage).

The final result of this study is to determine the cost element, which was mostly impacted by e-commerce implementation and had the biggest impact on company overall business efficiency growth conditioned by cost reduction.

The results

The start-up situation in supply chain management in the analysed company is shown in Figure 3.

At the beginning of the experiment, in the product flow management area, there were 13 workers: seven supply managers and six trade managers who were responsible for active trade. The main information flows in supply and material management area before the e-commerce decision adoption are described in the following way:

- The main information that determines the supply and material management performance is received from the buyers (the buyers' need for particular products) (1). For information transition, indirect contact (phone) and remote contact (fax, e-mail) instruments are used. In case when remote contact is used and where the additional information flow is excluded, the ratification of information is received (trade manager always informs the buyer about the received order) (2).
- After the trade manager receives the information about the order from the buyer, he contacts the warehouse about the condition of materials needed to execute the order (3). In case the needed materials are omitted, the information about those materials is transferred to supply manager (4), who constantly monitors the level of various materials in the warehouse (9).
- Supply manager, after the analysis of the buyer's order, delivers the order of materials to suppliers (5) using the same instruments as the trade manager, namely, the buyer contact. In any case, supplier informs the supply manager about the ratification of the order and order characteristics (price, time for order execution, etc.) (6).

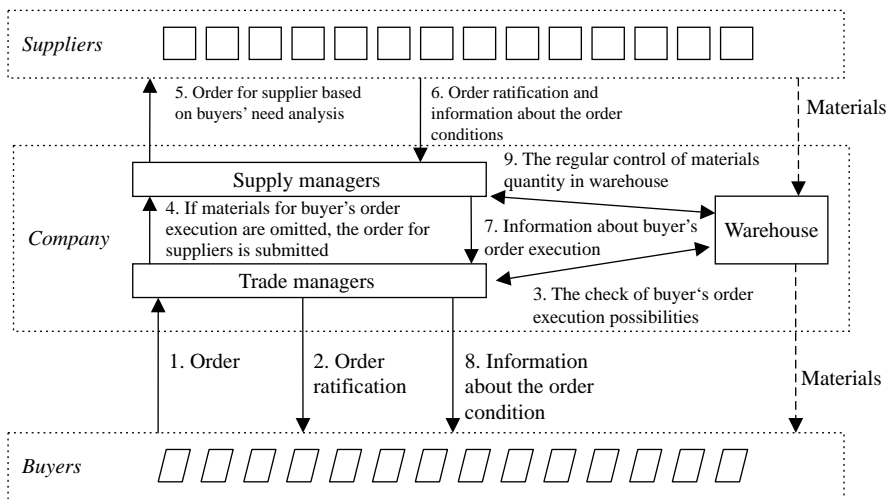


Figure 3. Supply and material management in the company before e-commerce decision adoption

- Supply manager receives the information from suppliers and sends it to the trade manager (7), who informs the buyer about the terms of the order (price, time for order execution, etc.) (8).

Physical material flows depend on information flows and information characteristics: the materials move from suppliers to company warehouse depending on the orders for suppliers, and from company warehouse to buyers – depending on the buyers' orders and supplier commitment realization.

After the e-commerce decisions were adopted in the analyzed company, the physical material flows remain the same except their rhythm. Meanwhile, there are significant qualitative changes in the information flows, which condition absolutely new information movement system (Figure 4).

After the implementation of e-commerce decisions system in supply and material management, which cover all sell and supply transactions, the information flows can be grouped in the following three categories:

- (1) The regular information about the warehouse state refreshed in e-commerce system. In e-commerce system, there exists the whole information about the state of the company warehouse including material nomenclature, inventory level, reserved quantity, forthcoming materials and other important information.
- (2) The processing of buyer order. Buyer, connected to the e-commerce system, can get the whole information about the materials in the company warehouse (quantity, prices, etc.) and information about the materials already ordered from suppliers. Using this information, the buyer can plan his orders for the company and process transactions with his own buyers, knowing the exact information about the prices of separate products and possible delivery terms. Such information relieves the company buyer from resource planning and sets up conditions for more efficient inventory management. The use of e-commerce

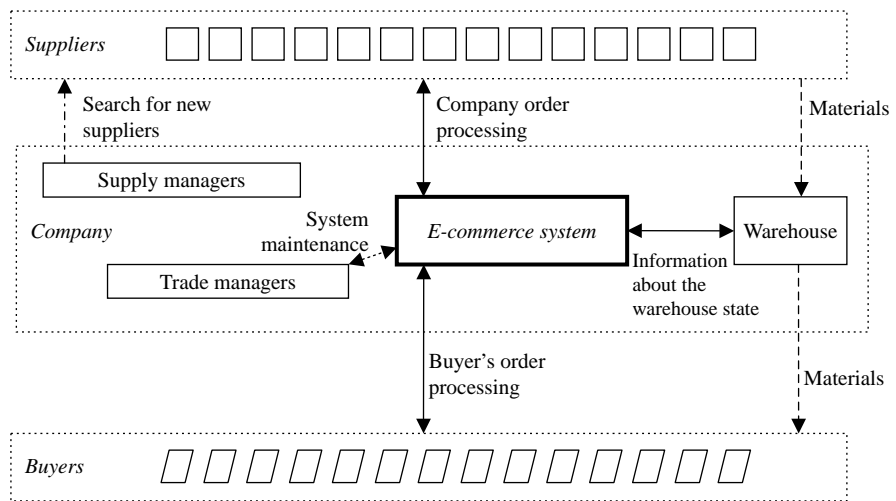


Figure 4. Supply and material management in the company after e-commerce decision adoption

system allows omitting such information flows as order ratification and information about its condition because e-commerce system gives this information automatically (buyer can get the current information about his order execution any time whenever he gets connected to e-commerce system).

- (3) The processing of company order. Parallel to the buyer order submission flows, in e-commerce system, there are also changes in the management of information flows of company orders for suppliers. There, the information flows also tend to be reduced because the main part of information is automatically accumulated in e-commerce system database and can be presented at request.

After the comparison of the analysed company supply and material management systems before the e-commerce adoption experiment and after it, the following changes can be determined:

- (1) Reduces the scope of communication through the phone, fax or post. It conditions the reduction of communication cost. Here, it is important to note the fact that, in the end of experiment, e-commerce system was used by the 80 per cent of suppliers and 90 per cent of buyers. For the communication with other suppliers and buyers, still the traditional communication tools were used.
- (2) Reduces the headcount of supply and trade managers. After the experiment, the need for active trade managers disappeared because trade managers were needed only for e-commerce system maintenance and relations with the buyers who do not use e-commerce system support. The functions of supply managers also changed: they spent the biggest part of their work time for new supplier and material search.
- (3) Expands the quantity of useful information in case of company and its buyers. In e-commerce system, the amount of accumulated information was several times bigger than the amount of information that company workers and buyers had had before the experiment.
- (4) Reduces the average inventory. Firstly, it is important to note that it had a big impact on the average inventory level reduction regarding the market environment changes (more companies are interested in refusing direct contacts with foreign traders and using the services of intermediaries in Lithuania; that creates the possibility to reduce average inventory and to reduce the time gap between orders). But the other factor – e-commerce impact – which influenced the reduction of average inventory, cannot be overlooked. More efficient order management and thorough information about the materials in the warehouse give an opportunity to make more accurate order planning and to harmonize it with the selling, hence, the buyers can lower their inventory. Nowadays, in the computer equipment trade sector, there exists a lot of companies with minimal inventory – in most cases, the inventory is equal to the products needed for exposition. The final effect of these processes on business efficiency is identified in two ways:
 - by reducing the cost of asset that is needed for inventory keeping (the company simply needs less asset); and

- by reducing current asset that can be treated as money invested in accumulated inventory (presuming that current asset is formed from short-run bank loans, which cost is expressed in the form of interest).
- (5) It is also important to mention that e-commerce adoption stipulated shorter material delivery time. If the total delivery time (from the order submission to the inventory receiving) before the experiment lasted at least one week, then, after the e-commerce system adoption, it usually did not exceed two days.
- (6) The only negative e-commerce adoption in supply chain management impact on business efficiency factor, determined by the experiment, is the cost of e-commerce system maintenance. In the case of the analysed company, that cost reached 10,000. Litas in the end of the experiment. This type of cost can be grouped into three categories:
- the cost of system technical maintenance;
 - the cost of regular renewal (which is necessary because of the rapid change of information technologies); and
 - the cost of licences for software.

Besides, it is important to mention that e-commerce system adoption required quite big investment that exceeded 300,000. Litas (including stuff training, technical change of business processes and other necessary tasks).

The quantitative analysis of e-commerce decision adoption impact on business efficiency is presented in Table I. Trying to present more precise conclusions of the e-commerce adoption in supply chain management experiment, the quantitative measurement of business efficiency was made for every cost position, which is directly connected to the e-commerce adoption, and the total business efficiency change was calculated. The business efficiency is calculated as the relation between output (turnover) and input (individual cost position). As the turnover of the analysed company before and after the experiment changed only less than 2.3 per cent, it is presumed, that practically the change of business efficiency is generated only by the change of input (cost).

Variable	Value before the experiment (in one year)	Value after the experiment (in one year)	Change of business efficiency (per cent)
Yearly turnover, thousand LTL	130,000.0	133,000.0	
Labour cost, thousand LTL	331.1	203.7	66.3
Average cost of inventory (including inventory storage cost), thousand LTL	1,785.0	1,050.0	73.9
Cost of communication by phone, fax, etc.	100.0	20.0	411.5
Cost of e-commerce system maintenance, thousand LTL	2.4	120.0	-98.0
<i>The change of efficiency including labour, inventory and system maintenance cost positions</i>			
Total expenditure, thousand LTL	2,118.5	1,373.7	57.8
<i>The change of efficiency including all company's cost positions</i>			
Total expenditure, thousand LTL	113,100.0	112,355.3	3.0

Table I.
The change of company
business efficiency after
e-commerce decision
adoption

The presented quantitative analysis of e-commerce impact on business efficiency, based on supply chain management cost reduction, shows that in case of individual cost position analysis, the biggest impact is generated by the positive change of communication cost (business efficiency in this case grows more than five times), meanwhile, it is necessary to consider the fact that communication cost makes less than 5 per cent of the total company cost structure; therefore, the actual growth of business efficiency based on communication cost is not big.

The results of the experiment spotlight the big e-commerce adoption impact on the inventory cost (business efficiency in the case of this cost category is up to 73.9 per cent). Inventory cost is the essential element in the structure of the company cost that depends on e-commerce adoption. The efficiency of inventory cost is calculated presuming that the average current asset (used for inventory accumulation in company warehouse) is 4.5 per cent (equal to short run bank loan interest rate) plus 2 per cent of inventory ordering cost (mainly transportation) and plus 4 per cent of long-term asset (used for inventory management – depreciation). In case of e-commerce adoption in supply chain management, the average level of inventory was reduced from 17 to 10 million Litass, and this resulted in the change of the average inventory cost from 1.785 to 1.050,000. Litass (as may be seen in the table).

The evaluation of the total three cost position (labour cost, inventory cost and e-commerce system maintenance cost) impact on business efficiency shows a positive result: the business efficiency grows by 57.8 per cent. This result allows concluding that e-commerce decision adoption in a company supply and material management system generates quite a big and positive impact on all cost positions, which are directly related to e-commerce adoption. But in case of the total company cost analysis before and after the experiment, it is clear that cost positions, which are directly related to e-commerce adoption, are not the main company cost positions, and, for that reason, the total analysed company business efficiency grows only by 3.0 per cent. In the analysis, it is presumed that the cost positions, which are not directly linked to e-commerce adoption, remain unchanged during the experiment. For this reason, the given evaluation of business efficiency must be treated as a hypothetical one because it does not include any possible indirect impact on company cost structure.

In the assessment of e-commerce decision adoption impact on business efficiency it is necessary to pay attention at the impact that is inexpressible in a quantitative form. The main factors of this impact are the bigger and more intensive information flows, which relieve the management of almost all business processes, and make faster order execution, which can be treated as the competitive advantage.

The comparison of results of theoretical and empirical researches in e-commerce impact on business efficiency confirms that main cost positions, which depend on e-commerce adoption, are cost of inventory management and the cost of material ordering process. But there are some important differences in the results of theoretical and empirical studies.

Firstly, the theoretical viewpoint tends to ignore the effect of labour cost minimization. In some cases, this cost position may be treated as a component of other cost positions (i.e. inventory management cost). But, as the results of the empirical research show, labour cost minimization is an important cost element in the process of e-commerce implementation in supply chain management. For this reason, there

appears the need to consider this cost position as one of the main cost positions in business efficiency improvement process by using e-commerce.

The other important difference between the theoretical and empirical researches is the unequal treatment of growing suppliers' competition, and faster and cheaper identification of alternative suppliers. Those two elements in the theoretical study are treated as being the main elements in business efficiency improvement, but the empirical study disclaims it. This may be the result of the specific strategy of the analysed wholesale company, which is based on the long-term relationship with suppliers. As follows, it can be stated that changes in suppliers' competition and their tendency to lower prices depends on the purchaser's strategy, and this element has a limited impact on the purchaser's business efficiency, and depends on additional presumptions (i.e. purchaser's business strategy or philosophy).

Concluding the empirical analysis of e-commerce impact on business efficiency in case of supply chain management cost reduction, it can be stated that e-commerce decision adoption has a positive impact, which is quite strong in the processes directly depending on the e-commerce adoption, and the total impact on business efficiency depends on the company cost structure.

Conclusions

- (1) The treatment of e-commerce as one of today's business necessities creates the interest of quantitative and qualitative evaluation of e-commerce impact on business results. One of the most appropriate methods of e-commerce impact on business results evaluation is the analysis of e-commerce impact on business efficiency, which is treated as the relation between business output (turnover) and input (individual cost position). Such point of view enables to determine the changes in business cost structure based on the adoption of e-commerce decisions.
- (2) The theoretical analysis of e-commerce adoption in supply chain management allows stating that most of the authors accents four essential cost-related positions where e-commerce can make an impact on business efficiency:
 - cost of material ordering process;
 - average inventory level that influences the average cost of inventory keeping;
 - process of search and identification of suppliers; and
 - supplier competition level.

As is it stated in the theoretical literature, e-commerce has a positive impact on business results in all those areas.

- The empirical study of e-commerce impact on business efficiency in supply and material management area shows that the cost positions, which directly depend on e-commerce adoption, use to experience quite big changes, and it has a positive impact on business efficiency (the change of supply-related cost resulted in 57.8 per cent, and the total of 3 per cent of business efficiency growth).
- The results of e-commerce impact on business efficiency study at the theoretical and empirical level confirm the importance of cost in inventory management and

material ordering process areas, but create uncertainty in assessing the role of the growing supplier competition, faster and cheaper identification of alternative suppliers, and labour cost. Those positions are differently treated in the literature and in the practical performance, and this means that there is a conceptual gap between theoretical and practical analysis of e-commerce impact on business efficiency in supply chain management.

- The empirical research also allows stating that the cost positions, which directly depend on e-commerce adoption, are not the main part of company cost structure, and this means the lower total growth of business efficiency. As a result, the narrowly concentrated e-commerce decisions (in this case – decisions on supply management) have a limited impact on the total business efficiency. Such results can be treated as a critical proof against the idea of e-commerce as a business philosophy, which has an essential impact on all business processes. But it is important to state that in current research, the indirect impact was ignored, which may have a strategic impact on various business processes depending on company processes structure. For this reason, there appears the need for further research in the area of indirect impact of e-commerce on business efficiency.

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