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Determinants of suppliers' level of use of B2B e-marketplaces

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Abstract

Purpose – The purpose of this paper is to investigate the influence of various factors on suppliers' level of use of business-to-business (B2B) e-marketplaces by examining three basic variable domains; suppliers' internal environment, their external environment and the characteristics of the adopted B2B e-marketplace.

Design/methodology/approach – A conceptual framework is developed based on extended literature review and examined on data collected from 87 suppliers that currently use Greek B2B e-marketplaces. Factor analysis and multiple discriminant analysis are applied to test the framework and its related hypotheses.

Findings – Several hypotheses are formulated leading to the development of the proposed "B2B e-MarkFLU" conceptual framework. The research results show that factors from all the examined variable domains influence suppliers' level of use of B2B e-marketplaces. However, the B2B e-marketplace's characteristics are regarded as the most important of the three categories because of its higher impact on the involved suppliers, whereas the factors from the external environment have the lowest impact.

Originality/value – The research helps to fill an existing gap in the study of B2B e-marketplaces' post-adoption stage, as there have been extremely limited empirical studies after their adoption phase. To our knowledge, this paper comprises the first empirical attempt aimed to investigate thoroughly the three aforementioned variable domains by researching suppliers' active participation in B2B e-marketplaces.

Keywords Business-to-business e-marketplaces, Business-to-business marketing, Post-adoption stage, Level of use, Suppliers, Business-to-business e-commerce, Electronic commerce

Paper type Research paper

1. Introduction

Business-to-business (B2B) e-marketplaces were first introduced in the early 1990s and offered essential solutions to the market's crucial demands for alternative communication and collaboration e-business processes. They are defined as:

> [. . .] intermediaries that allow multiple buyers and suppliers to meet on an electronic platform that rests on the Internet infrastructure in order to exchange information about products/services, conduct transactions online and adhere to other value-added services; constituting an increasingly important application for Information Technology (IT) (Choudhury *et al.*, 1998; Hadaya, 2006).

Epigrammatically, they enable firms to trade and cooperate with each other more efficiently by acting as mediators between supply and demand.

As a result of the great advantages that promise their use, various enterprises have adopted them aiming to take advantage of the provided functionality. Consequently, B2B e-marketplaces have also received considerable attention from the academic community and many researchers have investigated them in diverse scientific fields,

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such as information systems' (IS) research (Bakos, 1998; Premkumar, 2003), supply chain management (SCM) (Eng, 2004; Grieger, 2003), operational research (Lee *et al.*, 2006) and others.

Concerning their business-oriented investigation, there have been three main research streams (Koppius, 2002). In the first stream, B2B e-marketplaces are compared with the electronic markets and the electronic hierarchies in order to examine how IT influences the final choice of each of these electronic coordination mechanisms. In this stream, B2B intermediaries are also compared with other non-electronic (traditional) markets (Bakos, 1991). According to Hadaya (2008), the starting point of this scientific stream was Bakos' (1991) exanimation of how, by reducing search cost, e-market systems affect prices, sellers' profit and buyers' welfare, as well as Malone *et al.*'s (1987) comparison between electronic markets and electronic hierarchies. Concerning the second stream, it covers B2B e-marketplaces' study from an institutional point of view, by identifying their value proposition, their roles, as well as their business functions and the characteristics that define their structure (Hadaya, 2008; Ordanini *et al.*, 2004). According to this stream, B2B e-marketplaces can be distinguished based on four basic characteristics:

(1) the types of goods they trade;
(2) their ownership model;
(3) the price discovery strategy they support; and
(4) their core service offerings (Hadaya, 2008).

Finally, the third stream covers the surveys that examine the factors that hinder or drive firms' adoption (Eng, 2004; Yu, 2007) and issues related to how to operate B2B e-marketplaces (Hazra *et al.*, 2004; Lee *et al.*, 2006). Additionally, in this scientific stream, surveys concerning the identification of B2B e-marketplaces' critical success factors (Choudhury *et al.*, 1998; Fairchild *et al.*, 2004) and strategies that can be implemented to increase their competitive advantage (Le, 2002; Standing *et al.*, 2006) are also included (Hadaya, 2008).

Up till now, though, the vast majority of empirical studies regarding the examination of B2B e-marketplaces have been based on Roger's (1995) diffusion of innovation theory with a limited focus on the adoption stage of the assimilation process, where enterprises make the decision whether to accept them (Hadaya, 2008). In contrast, the objective of this paper is to investigate B2B e-marketplaces on their post-adoption stage. Specifically, this study examines the factors that influence suppliers' level of use of B2B e-marketplaces, which is the research question of this paper, focusing on the investigation of three basic domains:

(1) suppliers' internal environment;
(2) their external environment; and
(3) the characteristics of the applied B2B e-marketplace.

For this reason, a conceptual framework is developed and tested on data collected from Greek B2B intermediaries.

The paper is organized in five sections. In Section 2, the extant literature is provided followed by the description of the variables and their relevant hypotheses that are included in the emerged "B2B e-MarkFLU" conceptual framework. In Sections 3 and 4,

the applied methodology and the survey's results are presented correspondingly. The final section concludes with a discussion commenting on the data gathered, paper's contribution, its limitations and provides further research directions.

2. Literature review and research hypotheses formulation

In this research paper our concern centers on the following question: which are the factor affecting suppliers' level of use of B2B e-marketplaces? As far as we are concerned, the post-adoption stage of B2B e-marketplaces; regarding the examination of firms' level of use, is limited to only five empirical studies (Table I). However, none of them has thoroughly investigated enterprises' active participation in a B2B e-marketplace. In particular, they focused on specific factors without testing meticulously variables from the three basic variable domains, which are:

(1) firms' internal environment;

(2) firms' external environment; and

(3) the characteristics of the adopted B2B e-marketplace.

In order to fill this existing gap, a systemic approach of these domains is introduced as it is believed that they play a vital role in suppliers' business behavior in a B2B e-marketplace.

Source	Entity examined	Statistically confirmed factors	Non-statistically confirmed factors
Hadaya (2006)	All involved participants together (buyers and suppliers)	Level of dependence on strategic partners Level of collaboration with strategic partners Competitive pressure Previous use of e-commerce services Level of provided e-services' complexity	Bargaining power over strategic partners Partners' pressure
Son and Benbasat (2007)	Buyers	Products' characteristics Demand uncertainty e-marketplace volatility	IT capabilities Competitive pressure Partners' pressure Participation in professional and trade associations
Rao *et al.* (2007)	Buyers	Perceived benefit use Perceived risk use Organizational e-readiness	
Truong (2008)	Buyers	Organizational e-readiness	
Hadaya (2008)	Suppliers which participate in vertical B2B e-marketplaces	Partners' pressure Support from technology experts Technological readiness	Characteristics of B2B e-marketplace

Table I.
Previous empirical studies

In the subsequent paragraphs, 11 related variables of the three domains and their corresponding hypotheses are presented; based on extended literature review of B2B e-Marketplaces' business model and emerging concepts of B2B e-commerce.

Internal factors

The internal environmental factors emerged from the literature are:

- funds' availability;
- organizational e-readiness;
- top management strategic support; and
- products' characteristics and demand uncertainty.

And they are presented as follows.

Funds' availability. It is generally accepted that the adoption and use of B2B e-marketplaces require the analogous experience and knowledge from the involved firms. Specifically, enterprises should be crewed with expertise and skilled staff in order to have a seamless and effective use of the applied e-services (Ravichandran and Lertwongsatien, 2005; Wang and Cheung, 2004). However, due to relevant scarcity, firms should spend substantial financial resources in order to educate their current workforce to the B2B e-marketplace's specific requirements or to be crewed with the necessary employees (Bradford and Florin, 2003).

Furthermore, according to previous studies, the capability to spend money is considered as one of the most important factors for the adoption and use of e-business applications (Pflughoeft *et al.*, 2003; Wymer and Regan, 2005). There have been many circumstances where firms were not able to cover such expenses and as a consequence they lagged behind compared to their competitive business environment. As a result, it can be assumed that the more financial resources a firm have, the higher the use of the B2B e-marketplace.

Taking into consideration the above literature, in this paper, it is considered as "funds' availability" "the supplier's intention to invest providing additional financial resources for its technical and advisory support, as well as for its crew with the required skilled staff in order to take advantage of the provided B2B e-marketplace services". Hence, the arguments presented lead to the first hypothesis.

Availability:

H1. Funds' availability provided by the supplier positively influences the level of B2B e-marketplace use.

Organizational e-readiness. Many researchers have confirmed that the adoption and level of use of e-business services rely heavily on firm's existing IT infrastructure (Gengatharen and Standing, 2005; Hadaya, 2006; Haug *et al.*, 2011; Johnson, 2010; Oliveira and Martins, 2010; Wang and Cheung, 2004). Characteristically, Hadaya's (2008) study on B2B e-marketplace post-adoption stage proved that there is a positive relationship between supplier's technological infrastructure and the level of their B2B e-marketplace use. However, as it was previously mentioned, the mere presence of such an infrastructure is not enough; as enterprises should be able to provide substantial financial resources and be crewed with the relevant staff in order to take advantage of the IT capabilities (Stockdale and Standing, 2004; Wang and Cheung, 2004).

For example, Rao *et al.* (2007) and Truong (2008) confirmed the positive relationship between employees' experience in IT issues and the level of B2B e-marketplace use.

Based on the above literature, in this paper, "organizational e-readiness" is considered as "the level of supplier's capability in technological, financial and human resources in order to take advantage of the provided B2B e-marketplace services". Thus, the arguments presented lead to the second hypothesis:

H2. Supplier's organizational e-readiness positively influences the level of B2B e-marketplace use.

Top management strategic support. Firm's strategy is a vital factor for its e-business success and has been thoroughly examined by various researchers (Teo and Too, 2000). For example, Daniel *et al.* (2004) referred that the applied e-business strategy affects not only firm's possible participation in a B2B e-marketplace, but also the type of the intermediary adopted. Nevertheless, firm's strategy is strongly related to top management, as the latter is responsible for the selection, delimitation and application of enterprise's e-business plan. Many studies have confirmed that the use of e-business applications is positively related to the level of firm's top management support (Chong and Pervan, 2007; Premkumar and Ramamurthy, 1995).

Taking into consideration the above literature, in this study, it is considered as "top management strategic support" "the series of actions taken by highly ranked employees in order the supplier being able to take advantage of the provided B2B e-marketplace services". Hence, the arguments presented lead to the third hypothesis:

H3. Top management strategic support positively influences the level of B2B e-marketplace use.

Products' characteristics and demand uncertainly. The exchange of products through a B2B e-marketplace is the main reason for the adoption and use of a B2B intermediary. It is broadly accepted that each participant, either supplier or buyer, is interested for certain goods with specific characteristics in order to fulfill its business needs. Consequently, the wide diversity of firms' intentions has been a topic of interest in e-business. Several researchers have investigated the influence of products' characteristics on various B2B e-commerce aspects (Doolin *et al.*, 2003; Huang *et al.*, 2004). For example, Homs (2001) confirmed that the particular characteristics of the products of each industry play an important role for the potential adoption and use of a B2B e-marketplace. However, Malone *et al.* (1987) were the first who concluded that there is a negative impact of products' description complexity on e-business applications' adoption. According to these researchers, the complexity of products' description refers "to the amount of information needed in order to specify the attributes of the products in enough detail to allow participants to make a trade" (Malone *et al.*, 1987).

On the other hand, apart from complexity of products' characteristics, the level of provided e-services is greatly influenced by the demand. According to Claycomb *et al.* (2005) and Grewal *et al.* (2001), the demand uncertainty is a deterrent factor for enterprises' trade through an e-business initiative. Additionally, Son and Benbasat (2007) also confirmed the negative impact of demand uncertainty on the adoption and the extent of B2B e-marketplace use.

Based on the above literature, in this study, it is considered as "products' characteristics and demand uncertainty" "the amount of information provided for the

description of products' characteristics and the level of demand uncertainty from transaction to transaction taking place in the B2B e-marketplace". Thus, the arguments presented lead to the fourth hypothesis:

H4. Products' characteristics and demand uncertainty negatively influence the level of B2B e-marketplace use.

External factors

Based on literature review, the external factors that emerge are:

- governmental pressure;
- partners' pressure; and
- competitive pressure.

And they are presented in detail in the following paragraphs.

Governmental pressure. The investigation of governmental pressure on firms' adoption and use of e-business applications has been broadly examined by various researchers (Wagner *et al.*, 2003; Zhu *et al.*, 2004). For example, Zhu *et al.* (2003) confirmed that the use of e-services is greatly influenced by the governmental pressure. Similarly, Wang and Cheung (2004) proved that perceived governmental influence on firm's adoption of e-services is greatly on adopters compared to non-adopters.

According to Oxley and Yeung (2001), government can support relevant actions with three different ways. First, by instituting relevant laws; second, by providing specific incentives, mostly economic; and third, by adopting IT infrastructure and skilled workforce in order to develop analogous e-services and trade online with the firms.

To date, however, there has not been any study that has confirmed the impact of governmental pressure on B2B e-marketplace post-adoption stage concerning the level of intermediary's use. Some researchers, such as Gengatharen and Standing (2005) and Stockdale and Standing (2002), have approved governmental influence on B2B e-marketplace pre-adoption and adoption stages; whereas Yu (2007) verified that the level of governmental pressure positively influences the continuance of B2B e-marketplace utilization.

Therefore, in this paper, "governmental pressure" is approached as "the level of governmental support that a supplier receives through the institution of an analogous legal framework, as well as the provision of relevant motives in order to take advantage of the provided B2B e-marketplace services". Thus, the arguments presented lead to the fifth hypothesis:

H5. Governmental pressure positively influences the level of B2B e-marketplace use.

Partners' pressure. Many studies have investigated the impact of partners' pressure on adoption and use of B2B e-commerce (Ghobakhloo *et al.*, 2011; Oliveira and Martins, 2010; Stockdale and Standing, 2004; Wagner *et al.*, 2003; Zhu *et al.*, 2003). Concerning the business model of B2B e-marketplaces, the most important studies have been Hart and Saunders (1998), Kioses *et al.* (2006) and Wang *et al.* (2006) efforts; which all of them confirmed partners' positive influence on firms' e-services adoption. However, there is a limited investigation on the post-adoption stage where only Hadaya's (2006, 2008) empirical studies have confirmed partners' impact on B2B e-marketplaces' level of use.

In general, partners' pressure tends to be multidimensional, as it may be comprised from one to three sub-factors:

(1) the level of firm's dependency on its partners;

(2) the buying power over its partners; and

(3) the level of influence from its partners.

However, it should be mentioned that every researcher may include one or more of these sub-factors to its investigation. For example, Claycomb *et al.* (2005) and Kioses *et al.* (2006) examined one sub-factor, whereas Hadaya (2006) combined all of them.

Based on the above literature, in this study, "partners' pressure" is considered as "the level of supplier's influence from its partners in order to take advantage of the provided B2B e-marketplace services". Hence, the arguments presented lead to the sixth hypothesis:

H6. Partners' pressure positively influences the level of B2B e-marketplace use.

Competitive pressure. Another broadly examined external factor in B2B e-commerce examination is the pressure exerted from firm's competitors. Consequently, several researchers have investigated the impact of competitive pressure on firm's e-commerce behavior (Chong and Pervan, 2007; Ghobakhloo *et al.*, 2011; Oliveira and Martins, 2010; Wagner *et al.*, 2003; Wymer and Regan, 2005). Regarding B2B e-marketplaces' adoption stage, the most prominent studies have been Son and Benbasat (2007), Wang *et al.* (2006) and Yu (2007) efforts, which all of them confirmed competitors' positive influence on their adoption. Concerning the post-adoption stage, Hadaya's (2006, 2008) both studies confirmed the impact of competitive pressure on B2B e-marketplaces' level of use.

However, it should be mentioned that competitive pressure has been approached by two basic different perspectives. The most prominent is based on the influence exerted from competitive enterprises which force firm to use e-services in order not to lag behind (Ordanini, 2006; Standing *et al.*, 2006; Zhu *et al.*, 2004). The other perspective refers to the utilization of such e-services because of firm's mimetic behavior (Grewal *et al.*, 2001; Teo *et al.*, 2003).

Taking into consideration the above literature, in this study, "competitive pressure" is considered as "the level of influence exerted from competitive enterprises to the supplier in order to take advantage of the provided B2B e-marketplace services". Hence, the arguments presented lead to the seventh hypothesis:

H7. Competitive pressure positively influences the level of B2B e-marketplace use.

Characteristics of the applied B2B e-marketplace

Concerning the B2B e-marketplace's characteristics domain, the emerged factors are:

- B2B e-marketplace's mission and provided e-services;
- operational rules;
- ownership status; and
- profile and extent of participating firms;

And they are presented as follows.

B2B e-Marketplace's mission and provided e-services. B2B e-marketplace's mission and provided e-services are regarded as basic elements of its business activity.

According to Brunn *et al.* (2002), Alt and Zimmerman (2001) and Pateli and Giaglis (2004), both of them determine not only B2B e-marketplace's position in its industry, but also they can partially specify the level of its success.

In specific, B2B e-marketplace's mission denotes the strategic role of the platform. It may also indicate the level of added value that B2B e-marketplace is possible to provide to its members. Furthermore, it specifies in which buyers and/or suppliers is targeted, the geographic area covered, its future intentions, etc. Without a clearly determined business plan B2B e-marketplace is inevitable to thrive (Brunn *et al.*, 2002). Similarly, Cohan (2000) stated that it is vital for every e-business model to clearly specify its scope.

Concerning provided e-services, they range from low complexity functions, such as e-catalogues and statistic reports, to fully integrated collaborations services, such as e-procurement and Continuous Replenishment Program (CRP) facilities. Each B2B e-marketplace is intended to provide the highest levels of functionality in order to increase its members' base and as a result its liquidity and profit. According to Gengatharen and Standing (2005), Kollmann (2001), O'Reilly and Finnegan (2005), White *et al.* (2007) and Yu (2007), the level and range of provided e-services can influence the adoption and therefore the use of a B2B e-marketplace.

Therefore, in this study, it is considered as "B2B e-marketplace's mission and provided e-services" "the level of supplier's perceived satisfaction from B2B e-marketplace's mission and provided e-services" leading to the eighth hypothesis:

H8. B2B e-marketplace's mission and provided e-services positively influence the level of B2B e-marketplace use.

Operational rules. B2B e-marketplace's operational rules, namely the legal and regulatory framework which defines the basic axes of the intermediary's functionality, are considered as fundamental elements for its smooth operation. Particularly, operational rules clearly specify key functional issues, such as: registration and application principles, pricing policy, accessibility rights, alternative payment options, etc. According to Ramsdell (2000), involved firms' agreement to the B2B e-marketplace operational rules is vital for its success. For example, the adoption of a wrong pricing policy can create competitive disadvantage to the B2B e-marketplace (Miller, 2001; Karpinski, 2001). Similarly, the demand for a high e-service fee without a clear business reward may discourage a firm to use the B2B intermediary (Kollmann, 2001). Especially, the SMEs are extremely vulnerable to the applied pricing policy due to their limited financial resources (Stockdale and Standing, 2004).

Concerning the available payment options, it is believed that it is much preferable for a B2B e-marketplace to provide various payment options in order to satisfy every involved enterprise. For example, small firms are discouraged to adopt a B2B e-marketplace when they have to pay in advance for a service; without having the ability to explore its usability at first (Korchak and Rodman, 2001).

Similarly, the limited accessibility rights can exclude the entry to the strategic partners of an enterprise; resulting to the withdrawal of the enterprise as well. Thus, the B2B e-marketplace must carefully examine all the relevant parameters in order to enlarge its member base and as a result its profitability.

Therefore, in this study, it is considered as "operational rules" "the level of supplier's perceived satisfaction from the provided legal and regulatory framework

that defines B2B e-marketplace's functionality". Thus, the arguments presented lead to the ninth hypothesis:

H9. Operational rules positively influence the level of B2B e-marketplace use.

Ownership status. Ownership status is considered as one of the key elements of e-business models. Alt and Zimmerman (2001), Brunn *et al.* (2002) and Pateli and Giaglis (2004), in their studies, referred to its significance for the smooth operation of every type of e-business initiative. Concerning the B2B e-marketplaces, Gengatharen and Standing (2005) confirmed the high impact of the owners and administrators to their success. Similarly, Chung *et al.* (2001) and Kathawala *et al.* (2002) referred to the vital role of ownership status to B2B intermediaries. Specifically, B2B e-marketplace holders should provide reliability to all the involved members; guarantee the smooth operation of the provided functionality and minimize opportunistic actions (Gengatharen *et al.*, 2005; Ramsdell, 2000; Stockdale and Standing, 2002).

Taking into consideration the above literature, in this study, "ownership status" is considered as "the level of supplier's perceived satisfaction from the management and actions of the B2B e-marketplace owners". Hence, the arguments presented lead to the tenth hypothesis:

H10. Ownership status positively influences the level of B2B e-marketplace use.

Profile and extent of participating firms. B2B e-marketplace's ability to incorporate and maintain a large number of firms on its e-business model is considered as a vital factor for its success, as the larger the participants' base the more possibilities the B2B e-marketplace has to gain profit (Brunn *et al.*, 2002; Fairchild *et al.*, 2004). On the other hand, the large members' base is also a benefit for the involved enterprises; as every participant has various available business options to transact. According to Brunn *et al.* (2002), the value that a B2B e-marketplace offers to its members is proportionally increased by the analogous enlargement of its members' base.

Additionally, the participation of internationally successful firms plays a pivotal role in the B2B e-marketplace's success (Son and Benbasat, 2007). These firms are characterized for their high business activity. This is the main reason why B2B intermediaries try to convince these firms at first; aiming that these can force their partners to adopt the provided e-services (Brunn *et al.*, 2002). For example, Stockdale and Standing (2003) confirmed that the firm which has more buying power can convince its partners to adopt e-business services.

Based on the above literature, in this study, it is considered as "profile and extent of participating firms" "the perceived significance to the suppliers of the existence of large number and worldwide leading enterprises in the B2B e-marketplace". Hence, the arguments presented lead to the 11th hypothesis:

H11. Profile and extent of participating firms positively influence the level of B2B e-marketplace use.

To investigate suppliers' active involvement in B2B e-Marketplaces, a three-level participation approach is developed based on a previous process applied by Grewal *et al.* (2001) and Son and Benbasat (2007). Specifically, the participation level of a supplier is classified as:

(1) trial stage, when the firm has conducted a few transactions and is still evaluating the pros and cons of this mean of doing business;

(2) low-use stage, when it has used B2B e-marketplaces, but not as many as to being considered as an important part of its business activity; or

(3) commitment stage, when the firm has made a full commitment, because using the provided B2B e-marketplace services has become an important part of its operations.

Furthermore, in conformity with prior research studies (Fichman and Kemerer, 1997; Son and Benbasat, 2007), it is assumed that there is a linear progression through the three participation stages.

Taking into consideration the aforementioned 11 research hypotheses and after being combined with the three-level participation approach, the proposed "B2B e-MarkFLU" (B2B e-marketplace: factors affecting suppliers' level of use) conceptual framework is formulated (Figure 1).

3. Research methodology

To test the "B2B e-MarkFLU" framework and its related hypotheses, an electronic questionnaire was developed and administered from July 2009 to February 2010 to all the active suppliers participating in Greek B2B e-marketplaces. Particularly, its questions were designed on the basis of a comprehensive literature review and prior surveys approved for their validity and reliability. Regarding questionnaire's distribution, each B2B e-marketplace took the responsibility to send it to its members. The respondents included namely CEOs, CIOs and Sales Managers. However, prior to its distribution, the questionnaire was pretested in order to identify possible problems in terms of clarity and accuracy. Specifically, four academics and two practitioners reviewed the items' classifications to ascertain the precision of the instructions and the content validity. Moreover, a pilot test using a sample of ten suppliers helped to identify

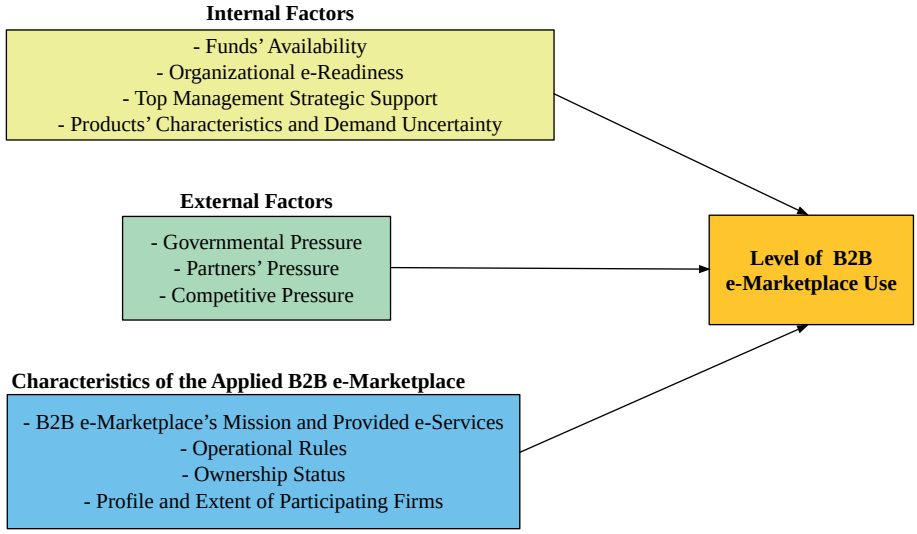

Figure 1.
Proposed "B2B e-MarkFLU" conceptual framework

possible problems in terms of clarity and accuracy. Thus, the feedback from the pilot testing was very useful in redesigning and refining the questionnaire.

Out of the 800 questionnaires e-mailed to all the active population, a total of 87 firms replied representing a response rate of 10.88 percent, which appears to be typical compared to similar research studies taking place in the specific scientific field (Grewal *et al.*, 2001; Hadaya, 2008; Le *et al.*, 2004; Rao *et al.*, 2007; Yu, 2007). Additionally, the dataset examined for potential bias by contrasting early with late respondents, following a method suggested by Armstrong and Overton (1977). This method has been widely adopted in e-commerce research (Claycomb *et al.*, 2005; Le *et al.*, 2004; Molla and Licker, 2005; Rao *et al.*, 2007; Zhu and Kraemer, 2005). Early respondents are defined as those who had completed the questionnaire within the initial ten days, while late respondents are those who completed the survey after this period; being motivated by a follow up e-mail notification. The comparison was made with respect to three questions concerning their demographic data:

(1) the number of employees;

(2) the 2008 annual turnover; and

(3) the period of the first participation in the B2B e-marketplace.

No such bias was revealed in terms of the number of employees ($\chi^2 = 9.893$, df = 5, $p = 0.078$), the 2008 annual turnover ($\chi^2 = 2.697$, df = 3, $p = 0.441$) and the period of the first participation in a B2B e-marketplace ($\chi^2 = 4.408$, df = 3, $p = 0.221$), as the differences between the two groups were statistically non-significant applying the χ^2 statistics at the significant level of 0.05.

Furthermore, in order to test the "B2B e-MarkFLU" framework, a data analysis is conducted in two stages. The first step employed factor analysis using principal component analysis (PCA) and orthogonal rotation (VARIMAX) to examine the data validity and reliability, as well as latent factors being developed; followed by multiple discriminant analysis in order to examine these factors which correspond to the 11 research hypotheses. These methodology steps have been previously applied in relevant scientific researches (Molla and Licker, 2005; Premkumar and Ramamurthy, 1995).

Operationalization of the variables

For each independent variable, a multiple-item scale is developed aiming at tapping the underlying theoretical dimension, where each item is measured based on a five-point Likert scale. Wherever possible, existing items which were proven to be reliable and valid are adapted from previous research studies; otherwise, new items are developed. In specific, six items are used to measure "top management strategic support" and "B2B e-marketplace's mission and provided e-services", five items are applied to measure "organizational e-readiness" and "competitive pressure", four items are used to measure "governmental pressure", three items are applied to measure "funds' availability", "products' characteristics and demand uncertainty", "partners' pressure", "operational rules" and "ownership status", whereas two items are used to measure "profile and extent of participating firms". Details of the scales are provided in the Appendix.

Regarding the dependent variable, as it was previously mentioned, a three-level participation approach is applied in order to capture the different levels of suppliers' B2B e-Marketplace use; following a process applied by Grewal *et al.* (2001) and Son and Benbasat (2007). These participation levels are:

(1) the trial stage;
(2) the low-use stage; and
(3) the commitment stage.

And suppliers were asked to choose one out of the three categories that best described their perceived active involvement in a B2B e-marketplace (Appendix).

Validity and reliability of measurement instrument

Following Hadaya's (2008) and Premkumar and Ramamurthy's (1995) approach, three separate factor analyses for the multi-indicator items are performed representing the internal, the external and the B2B e-marketplace's characteristics variable domains. Specifically, the factor analysis using PCA and VARIMAX are applied in order to test the validity of the variables, classify and reduce questions into latent factors; and calculate factor loadings.

Nevertheless, in order to test the appropriateness of the data for factor analysis, several measures are applied in advance to the entire population of the three matrixes. Particularly, Bartlett's tests of sphericity ($p = 0.000$) confirm the statistical probability that the correlation matrixes have significant correlations among the variables, whereas the results of Kaiser-Meyer-Olkin (KMO) measures of sampling adequacy (MSA) are 0.852, 0.802 and 0.817 in correspondence, which are meritorious. Moreover, the MSA values all exceed 0.50 for both the overall tests and each individual variable (Hair *et al.*, 2006). All these measures indicate the suitability of factor analysis to the three variable domains.

By applying the Kaiser eigenvalues criterion separately to the aforementioned variable domains; four, three and four factors extracted that collectively explain 74.266, 70.495 and 72.161 percent of the variance in all items correspondingly (Table II). Regarding construct validity, which testifies how well the results obtained from the use of the measure fit the theories around which the test is designed (Crabbe *et al.*, 2009), it is tested by the use of two broadly applied tests, convergent and discriminant validity. In specific:

> [. . .] convergent validity is demonstrated if the items load strongly (>0.50) on their associated factors, whereas discriminant validity is achieved if each item loads stronger on its associated factor than on any other factor (Hair *et al.*, 2006).

Table II shows that all items have loading greater than 0.50. Additionally, they load stronger on their associated factors than on other factors. Thus, convergent and discriminant validity are demonstrated. The 11 latent factors proved to be relatively easy to interpret owing to the strong variable loadings (Table II). Finally, construct reliability is assessed using Cronbach's α. Table II also shows that all values ranged from 0.706 to 0.936; exceeding the limit of 0.70 (Hair *et al.*, 2006).

4. Results

Multiple discriminant analysis is used to analyze the proposed "B2B e-MarkFLU" framework and its research hypotheses. Specifically, the simultaneous estimation method is selected and applied; compared to stepwise estimation approach, "as it is more preferable when, for theoretical issues, the researcher wants to include all the independent variables in the analysis" (Hair *et al.*, 2006). However, some basic assumptions are tested regarding the appropriateness of discriminant analysis before the data were analyzed. First, the normality of the distribution is examined. The results

Factors	Factors' coding	Number of items	Mean	SD	Cronbach's α	Eigenvalues	Variance explained	Cumulative variance	Minimum factor loading
Internal environmental factors									
Funds' availability	F1	3	2.72	1.22	0.936	7.654	45.022	45.022	0.805
Organizational e-readiness	F2	5	3.21	1.02	0.928	2.122	12.480	57.501	0.721
Top management strategic support	F3	6	2.75	0.82	0.885	1.739	10.230	67.732	0.516
Products' characteristics and demand uncertainty	F4	3	3.37	1.05	0.706	1.111	6.534	74.266	0.632
External environmental factors									
Governmental pressure	F5	4	1.76	0.73	0.809	4.712	39.269	39.269	0.693
Partners' pressure	F6	3	3.16	0.94	0.846	2.162	18.016	57.286	0.809
Competitive pressure	F7	5	2.68	0.81	0.867	1.585	13.209	70.495	0.644
Characteristics of the B2B e-marketplace									
B2B e-marketplace's mission and provided e-services	F8	6	2.92	0.79	0.826	6.087	43.480	43.480	0.581
Operational rules	F9	3	2.85	0.86	0.806	1.486	10.614	54.094	0.650
Ownership status	F10	3	3.14	0.90	0.880	1.308	9.340	63.434	0.646
Profile and extent of participating firms	F11	2	3.57	1.01	0.929	1.222	8.727	72.161	0.901

Table II.
Validity and reliabilty analysis

indicate that overall the normality assumption can be realistically accepted. Second, the correlation matrix of all the independent variables is tested in order to check for possible multi-collinearity problems. Despite the strong correlations between some of the variables, none of them is significantly close to 0.90 (Hair *et al.*, 2006). Consequently, no multi-collinearity problem is detected. Finally, Box's M test is applied in order to verify the similarity of the dispersion matrices of the independent variables among the groups (Hair *et al.*, 2006) (Table III).

The results from the discriminant analysis show that only the first function has statistically significant elements concerning the relationship between the 11 independent variables and the dependent variable (Table IV). Moreover, this function explains 72.8 percent of the total variance.

Therefore, the study produces a model that is satisfactorily significant in discriminating the three levels of suppliers' B2B e-Marketplace use. Specifically, the standardized discriminant coefficients and discriminant loadings for the independent variables are presented in Table V. Following Hair *et al.* (2006) guidelines, variables with discriminant loadings greater or equal to 0.4 are identified as significant contribution to the function and acceptable. Six out of the 11 variables are found to exceed the cut-off value and they are, in descending order:

Table III.
Box's M test

Box's M	194.462
F approx.	1.111
df1	132
df2	7.221×10^3
Sig.	0.183

Table IV.
Wilks' lambda

Test of functions	Wilks' lambda	χ^2	df	Sig.
1 through 2	0.577	43.457	22	0.004
2	0.850	12.874	10	0.231

Table V.
Multiple discriminant analysis results

Variables	Discriminant coefficient	Discriminant loading	Level 1: trial stage Mean (SD)	Level 2: low-use stage Mean (SD)	Level 3: commitment stage Mean (SD)
F1	0.322	0.527	2.22 (1.32)	2.60 (1.10)	3.39 (1.17)
F2	0.461	0.398	2.73 (1.02)	3.22 (0.97)	3.56 (1.03)
F3	0.205	0.583	2.34 (0.80)	2.68 (0.72)	3.23 (0.85)
F4	− 0.382	0.026	3.22 (1.01)	3.44 (1.05)	3.33 (1.14)
F5	0.387	0.505	1.47 (0.56)	1.70 (0.68)	2.14 (0.80)
F6	0.153	0.368	2.78 (0.95)	3.15 (0.90)	3.48 (0.94)
F7	0.309	0.525	2.47 (0.84)	2.53 (0.74)	3.18 (0.76)
F8	0.270	0.675	2.42 (0.77)	2.87 (0.70)	3.41 (0.76)
F9	0.408	0.320	2.51 (1.09)	2.87 (0.75)	3.09 (0.85)
F10	0.455	0.651	2.43 (0.91)	3.18 (0.76)	3.59 (0.90)
F11	0.047	0.384	3.24 (1.05)	3.50 (0.98)	3.98 (0.97)

(1) B2B e-marketplace's mission and provided e-services;
(2) ownership status;
(3) top management strategic support;
(4) funds' availability;
(5) competitive pressure; and
(6) governmental pressure.

Moreover, these variables also have high discriminant coefficients indicating that they are important discriminators by both criteria. As a result, *H1*, *H3*, *H5*, *H7*, *H8* and *H10* are supported, whereas *H2*, *H4*, *H6*, *H9* and *H11* are rejected. Mean and standard deviation from the three participation levels are also presented in Table V aiming to provide a better understanding of the discriminant analysis results.

Furthermore, another important test is to examine the ability of discriminant functions to classify accurately. The detailed classification results are presented in Table VI. The overall proportion of correct classifications is 56.3 percent which is characterized as mediocre, but at the same time as normal due to the significantly unequal cell sizes of the three participation levels (Hair *et al.*, 2006).

5. Discussion and conclusion

This paper has presented the outcomes of a systemic investigation of factors influencing suppliers' level of use of B2B e-marketplaces, exploring the three aforementioned variable domains; that are:

(1) firms' internal environment;
(2) their external environment; and
(3) the characteristics of the B2B e-marketplaces through the development and examination of the "B2B e-MarkFLU" conceptual framework.

Based on extended literature review of B2B e-marketplaces' business model and emerging concepts of B2B e-commerce, 11 related variables of the three domains and their corresponding hypotheses were formulated and examined on data collected from suppliers that currently use Greek B2B e-marketplaces.

The results indicate significant implications for both researchers and practitioners. In the subsequent paragraphs, the theoretical and managerial implications, as well as the study's limitations and future research directions are described.

Theoretical implications

A thorough literature review revealed a significant number of studies related to the adoption stage of B2B e-marketplaces (i.e. the time where companies are asked to decide

	Level 1: trial stage	Level 2: low-use stage	Level 3: commitment stage	Total
Level 1: trial stage	11 (64.7%)	5 (29.4%)	1 (5.9%)	17 (100%)
Level 2: low-use stage	12 (25.0%)	23 (47.9%)	13 (27.1%)	48 (100%)
Level 3: commitment stage	3 (13.6%)	4 (18.2%)	15 (68.2%)	22 (100%)

Table VI. Classification accuracy of the multiple discriminant analysis

whether or not to adopt them), whereas only five empirical researches have examined their post-adoption stage. However, none of them has thoroughly investigated suppliers' active participation in a B2B e-marketplace, as they have focused on a partial vision of limited variables influencing its level of use. Moreover, the literature review has shown that the research community is yet to invent a common language in relation to terminology for discussing and analyzing the e-marketplace's business model. In this research paper, B2B e-marketplaces are distinguished from e-markets or e-hierarchies approaches, and are defined as intermediaries that allow multiple buyers and suppliers to meet on an electronic platform.

The proposed framework and its empirical examination in the Greek environment pursue to address the gap on this field through a systemic investigation of the impact of factors affecting B2B e-marketplace's level of use, especially for suppliers in the post-adoption stage. The "B2B e-MarkFLU" conceptual framework, further to its value in providing extended literature review for current and future research on B2B e-marketplaces, has also yielded some implications for researchers on the specific field, providing vital insights to the academia for further scientific investigation. To our knowledge, this is the first attempt where such a comprehensive conceptual framework is developed on B2B e-marketplace's post-adoption stage.

Furthermore, the survey's results present significant theoretical implications, providing new perspectives regarding suppliers' active behaviour in a B2B intermediary. The survey's findings indicate that firms get influenced by all the investigated domains. However, the factors concerning the characteristics of the B2B e-marketplace are regarded as the most important of the three categories, because of their higher impact on the involved enterprises. Thus, despite the fact that previous researches acknowledged the vital role of external environment on firm's adoption of B2B e-marketplaces (Wang *et al.*, 2006; White *et al.*, 2007), this empirical research reveals that the specific features of each intermediary play a more important role in the post-adoption stage. Consequently, B2B e-marketplaces that invest on these characteristics have more chances to maintain and extend their suppliers' potential; and as a result to increase their liquidity and profit.

Additionally, the results confirm that the external factors have the lowest impact among the three examined variable domains. Thus, no matter how much pressure do suppliers get from their external environment, their actual involvement in a B2B e-marketplace is primarily affected by the specific characteristics of the B2B intermediary.

Regarding firm's internal business environment, the impact of "top management strategic support" reveals the high dependence of the enterprise on the strategic actions taken by the executive managers. Additionally, the importance of "funds' dispensation availability", which refers to the firm's main intentions to provide additional financial resources/investments, confirms that the economic robustness is a vital factor for enterprise's untrammeled operation (Pflughoeft *et al.*, 2003; Wymer and Regan, 2005). Both of them indicate the vital role the top management has in the way their firm approach its B2B e-marketplace involvement.

This study sets the groundwork for further scientific research and improvement, providing new inferences and insights on the post-adoption stage of B2B intermediaries' examination, in comparison with the existing literature (Hadaya, 2006, 2008; Rao *et al.*, 2007; Son and Benbasat, 2007; Truong, 2008).

Managerial and scientific implications

Practitioners are also expected to benefit from the work presented in this paper. More specifically, the research provides several implications for every involved entity; that are B2B e-marketplaces, currently participating suppliers, potential adopters and government. First, it provides to the B2B e-marketplace valuable information and a clear picture of the impact of several factors on its level of use by suppliers and its post-adoption stage in general. B2B e-marketplace top management can evaluate these results and follow certain strategies to improve its functionality and as a consequence enlarge its suppliers' base and increase its profit. For managerial standpoint, the findings of this survey imply that suppliers tend to be more affected by intermediaries' characteristics. As a result, B2B e-marketplace's provision of an attractive e-trade environment with highly customized e-services may enhance even more the wealth of its e-business model. Second, active suppliers have confirmed evidence of the factors that impact on the level of their B2B e-marketplaces' use. Based on these findings, they may change their present utilization in order to get benefited more from the provided functionality. Third, non-participants, either suppliers or buyers, that are indecisive about the possible adoption of a B2B e-marketplace have a comprehensive view of the way modern B2B e-marketplaces operate; thus, they can avoid many obstacles which are difficult to be predicted in a potential entrance. Especially buyers can follow certain practices to obtain the most of a possible membership. Forth, government gets informed about one of the most prominent existing B2B e-business models. Therefore, it may pursue analogous strategies by enacting certain laws in order to smooth the progress of B2B e-marketplace's procedures aiming at improving competitiveness, pushing even more firms to adopt and use B2B intermediaries; and as a consequence acquire administrative and economic benefits.

Finally, the proposed "B2B e-MarkFLU" framework and survey's results could be further utilized by researchers in other countries to explore B2B intermediaries and facilitate their projects. For instance, the impact of several factors on B2B e-marketplace's level of use might be useful to the development and support of their own theoretical or empirical study. Finally, the multi-item questionnaire developed could be applied in further empirical studies, as it has passed various reliability and validity tests.

Limitations and future research directions

Despite its meaningful implications, the survey has two limitations that need to be recognized. First, since the study conducted in suppliers using Greek B2B e-marketplaces, caution must be exercised when generalizing these findings to suppliers operating in different cultural and institutional environments. Second, the response to the questionnaire only from CEOs, CIOs and sales managers might bias the survey, even though these were selected because they had the knowledge and the experience required to provide more accurate information than any other employee in their firm.

Concerning future research, additional tests and refinements of the proposed "B2B e-MarkFLU" framework would be extremely useful in advancing the knowledge of the factors that influence B2B e-marketplaces' level of use. Particularly, future study could proceed in five directions. First, the involvement of buyers that currently use B2B e-marketplaces would improve the research survey, as it could offer the

opportunity for a discrete examination between the two entities (suppliers and buyers). Such a process it is certain that it would provide a deeper and much richer understanding of the B2B e-marketplaces' post-adoption stage. Second, the framework and the questionnaire could be tested in other countries with different degrees of institutional and cultural variation. Thus, the results provided may raise valuable information for cross-country comparisons. Third, a longitudinal study with repeated data collection would provide more convincing proofs about the power of the survey. Fourth, the proposed framework could be examined from different perspectives; such as firm's size, applied e-services, horizontal versus vertical B2B e-marketplaces, etc.; in order to reveal possible differences, as well as similarities concerning the possible impact of the hypothesized factors. Fifth, the potential confirmation of other influential factors that could be added to the research framework, it is definite, that it would offer a more holistic view of the post-adoption stage of B2B e-marketplace and may provide additional important insights into the scientific community and managers as well.

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Further reading

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Appendix. Measurement items

(Apart from "participation level", where suppliers were asked to choose one out of the three categories that best described their perceived active involvement in a B2B e-Marketplace; a five-point Likert scale was used as follows: 1 – strongly disagree/not at all, 2 – disagree/to a small extent, 3 – neither agree nor disagree/to a moderate extent, 4 – agree/to a considerable extent, 5 – strongly agree/to a great extent).

Participation level (PL)

Trial stage:

- We have registered in the B2B e-marketplace, but we are still searching for its usefulness.
- We have scarcely made transactions via the B2B e-marketplace.
- We are still evaluating the pros and cons of B2B e-marketplace services in order to ascertain their usefulness for the firm.

Low-use stage:

- We have made a few transactions via the B2B e-marketplace.
- Doing business via the B2B e-marketplace has still not become an important part of our business operations.

Commitment stage:

- We are making transactions via the B2B e-marketplace whenever necessary.
- Doing business via the B2B e-marketplace is an important part of our business operations.

Funds' availability

Your firm intents to provide additional substantial resources for the use of the B2B e-marketplace services, concerning the:

FA1: human resources support.

FA2: educational-advisory support.

FA3: technical support.

Organizational e-readiness (OER)

Your firm is currently prepared for the use of the B2B e-marketplace services, concerning its:

OER1: IT resources.

OER2: human resources.

OER3: financial resources.

OER4: previous experience.

OER5: your firm is familiar with the B2B e-commerce applications.

Top management strategic support (TMSS)

TMSS1: the basic business aims of your firm are carried out through the use of B2B e-marketplace services.

The use of B2B e-marketplace services:

TMSS2: is a strategic decision for your firm.

TMSS3: is a priority for your firm's e-commerce strategy.

TMSS4: the resources (IT, human and financial) that your firm uses for the utilization of the B2B e-marketplace services are significant.

Top management of your firm:

TMSS5: supports the use of B2B e-marketplace services.

TMSS6: is experienced in B2B e-marketplace services.

Products' characteristics and demand uncertainty (PCDU)

PCDU1: the products that your firm sold through the B2B e-marketplace require a large amount of information to be described.

The volume of products that your firm sold through the B2B e-marketplace:

PCDU2: fluctuates a lot over time.

PCDU3: is difficult to accurately estimated for the next transactions.

Governmental pressure (GP)

GP1: government supports the use of B2B e-marketplace services.

GP2: government guarantees with an analogous legal framework e-business transactions.

Government supports the use of B2B e-marketplace services by providing:

GP3: educational-advisory support.

GP4: financial assistance or other relevant incentives.

Partners' pressure (PP)

PP1: your partners prompt your firm to use the B2B e-marketplace services.

PP2: your partners support the use of B2B e-marketplaces services for your business transactions.

PP3: your partners use the B2B e-marketplace services.

Competitive pressure (CP)

CP1: your competitors have benefited from the use of B2B e-marketplace services.

CP2: your competitors use the B2B e-marketplace services.

CP3: the competition have influenced your firm to use B2B e-marketplace services.

CP4: firms of your industry use B2B e-marketplace services.

CP5: firms of your industry have benefited from the use of B2B e-marketplace services.

B2B e-Marketplace's mission and provided e-services (MPS)

MPS1: B2B e-marketplace's scope conforms to your firm's utilization.

MPS2: your firm is content with the number of the products provided in the B2B e-marketplace.

MPS3: your firm is content from the quality of the products provided in the B2B e-marketplace.

MPS4: the B2B e-marketplace is experienced and up-to-date to the characteristics of your industry.

MPS5: your firm is satisfied from the number of the provided e-services.

MPS6: your firm is satisfied from B2B e-marketplace's security mechanisms.

Operational rules (OR)

Your firm is satisfied from the B2B e-marketplace, concerning the applied:

OR1: terms and conditions.

OR2: payment options.

OR3: pricing policy.

Ownership status (OS)

The ownership status of the B2B e-marketplace:

OS1: guarantees the smooth operation of the provided e-services.

OS2: provides reliability to all the involved members.

OS3: your firm trusts the administrators of the B2B e-marketplace.*Profile and extent of participating firms (PEPF)PEPF1: the participation of a large number of firms in the B2B e-marketplace is significant for your firm.*

PEPF2: the participation of worldwide leading firms in the B2B e-marketplace is significant for your firm.

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