Barriers to the adoption of B2B e-marketplaces by large enterprises: lessons learnt from the Hellenic Aerospace Industry[1]

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Abstract: This paper investigates the main barriers to the adoption of B2B e-marketplaces by large enterprises and at the same time the expected benefits that push in the opposite direction towards the adoption, through a case study conducted at the Hellenic Aerospace Industry (HAI), one of the largest industrial enterprises of Greece. The evidence collected from this case has been analyzed using various frameworks from the literature and also the innovation diffusion theory of Rogers, and shed light on the specificity of the large enterprises concerning e-marketplaces adoption.

Keywords: e-marketplaces (electronic marketplaces), e-business (electronic business), adoption, barriers, benefits, large enterprises, diffusion of innovation

INTRODUCTION

An e-marketplace is defined as an inter-organizational information system providing a 'virtual space' where multiple buyers and sellers can communicate (e.g. exchange information on products/services offerings, either generic ones required across industries or industry-specific ones, and their prices) and transact (e.g. sell and buy products/services and pay for them), very often supported by various additional required services (e.g. financial, transport, logistic, etc.) as well (Tumolo, 2001; Grieger, 2003; Stockdale and Standing, 2004; Wang et al., 2008). The high penetration of the Internet in the enterprises resulted in the establishment of a big number of Internet-based business-to-business (B2B) e-marketplaces. Some of them, called 'vertical', are industry-specific, while some others, called 'horizontal', cut across industries facilitating the purchase and sale of products and services used in several industries. B2B e-marketplaces also differ

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in their pricing mechanism: in some prices are fixed in electronic catalogues, while in others prices are established dynamically through seller or buyer auctions (Grieger, 2003). The relevant literature has for a long time strongly emphasized the big potential of B2B e-marketplaces, which constitute one of the most advanced forms of e-business, and the important benefits they can offer to both buyers and sellers: lower transaction costs, reduced inventory, higher efficiencies, more information and transparency, access to more buyers and sellers, lower marketing costs, higher sales, etc., finally resulting in more efficient and 'friction-free' markets (Malone et al., 1987; Johnston and Vitale, 1988; Bakos, 1991 and 1998; Tumolo, 2001; Baron et al., 2000; Amit and Zott, 2001; Barratt and Rosdahl, 2002; Turban et al., 2006; Wang et al. 2008).

However, it is widely accepted that this great potential of B2B e-marketplaces has not been fully realized, and that reality in this area is very much behind the expectations concerning both the number of participating enterprises and the level of transactions (Dai and Kauffman, 2002; European Commission, 2004; Turban et al., 2006; Howard et al., 2006; White et al., 2007; Wang et al., 2008). Although the e-marketplace industry was initially characterized by rapid growth, after 2000 it experienced a big shakeout and consolidation, with many mergers, acquisitions and closures. Booz Allen Hamilton, in a benchmark study concerning 'the state of electronic exchanges' in early 2000s, identified 2233 e-marketplaces (Laceter et al., 2001). However, according to e-Market Services (http://www.emarketservices.com/), a respectable non-profit organization funded by the trade promotion organizations of Canada, Ireland, Norway, Spain and The Netherlands and having as mission to make it easier for companies to use e-marketplaces in order to find new customers and suppliers for their international business, today there are only 616 e-marketplaces (308 of them located in Europe and 276 in North America). Numerous e-marketplaces started up in late 1990s, but later a lot of them, including important brand names in this area, such as Chemdex, MetalSpectrm, GoFish, E-Chemicals, etc., went out of business because they did not have the participation of sufficient buyers and sellers (Miller, 2001; Kjølseth, 2005; White et al., 2007). The European E-Business Report (European Commission, 2004) based on a survey of enterprises of the EU member states across multiple industries concludes that on average 11% of enterprises use e-marketplaces for at least part of their trading. The slow progress in this area is to a large extent due to a variety of technological, organizational, and legal factors that diminish the value offered by B2B e-marketplaces, and therefore reduce both the number of buyers and sellers participating in them, and the number and value of the electronic transactions they perform.

For the above reasons it is important to identify and understand in-depth the barriers to the adoption of B2B e-marketplaces by enterprises. However, although considerable research has focused on the benefits offered by B2B e-marketplaces, much less research has been conducted for identifying and understanding in depth the main barriers that hinder the participation of enterprises in B2B e-marketplaces and the realization of their potential benefits; furthermore, most of this research is focused on the barriers experienced by SMEs for adopting B2B e-marketplaces (Gulledge, 2002; Stockdale and Standing, 2004; Gengatharen and Standing, 2005), as analyzed in more detail in the next section, while the barriers experienced by the large enterprises have been researched only to a small extent (Howard et al., 2006). This focus is mainly due to the lower levels of adoption of ICT in general, and e-business and e-marketplaces in

particular, observed in SMEs in comparison with the larger enterprises (Stockdale and Standing, 2004; European Commission, 2003, 2004 and 2007; OECD, 2007). According to the 'Report of the Expert Group on B2B Internet trading platforms' (European Commission, 2003) in the four largest EU Member States (Germany, France, UK and Italy) the percentage of the large enterprises using B2B e-marketplaces is about 10%, while in the SMEs the corresponding percentage is less than 5%. However, it is important to investigate the main barriers experienced by the large enterprises for adopting B2B e-marketplaces, and propose actions for overcoming them, for two reasons:

i) The extent of B2B e-marketplaces adoption by the large enterprises, although much higher than in the SMEs, is still very low in absolute numbers (as mentioned above, only one out of ten large enterprises in the four largest EU Member States use B2B e-marketplaces).

ii) Due to the big volume of the purchases and sales of large enterprises, even a small increase in the use of B2B e-marketplaces by them would result in a significant increase of the overall number and the value of the transactions performed in the B2B e-marketplaces, and would attract to them — due to network effects — many additional enterprises of various sizes; we can expect that such a 'virtuous circle' would boost the whole digital economy.

Towards this goal, our paper contributes to the in-depth understanding of the barriers experienced by the large enterprises for adopting B2B e-marketplaces, which constitute the main negative factors hindering their adoption. At the same time, in order to have a complete view (and not only the negative dimensions), our paper contributes to understanding also the main benefits sought by the large enterprises from participating in B2B e-marketplaces, which on the contrary constitute the main positive factors pushing in the opposite direction and favoring the adoption. Our research has been based on a case study of the three failed pilot attempts of the Hellenic Aerospace Industry (HAI), one of the largest industrial enterprises of Greece, to adopt e-marketplaces. Its experience is analyzed using various frameworks from the literature. Taking into account that the adoption of a B2B e-marketplace constitutes a significant change of existing processes and work practices, we view it as an innovation decision, and we analyze it using the well-established innovation diffusion theory of Rogers (2003). Also, we compare the findings of this study with the ones of the studies of Stockdale and Standing (2004) and Howard et al. (2006) investigating the barriers and the benefits of participation in B2B e-marketplaces in the SMEs and large enterprises respectively. Finally, based on the conclusions drawn from this case study we developed a set of recommendations for B2B e-marketplaces operators in order to increase the participation of large enterprises.

It should be noted that this case study has been conducted in a particular national and sectoral context:

- In the national context of Greece, which is a 'late development' country of the 'semi-periphery' (Mouzelis 1986 and 2002), characterized by late industrialization and concomitant social and cultural transformation, so it lacks a culture and tradition of adoption and use of sophisticated technologies and business and technology innovation.
- In the sectoral context of the aerospace industry, which with respect to sales is characterized by 'oligopolio' conditions, selling to a limited number of customers sophisticated products and services of high value (that cannot be sold on-line over the Internet); similarly, with respect to procurement it is characterized by 'oligopsonio'

conditions (however, to a smaller extent), purchasing numerous sophisticated and specialized raw materials, spare parts and electronics of high value, each of them having a limited number of possible suppliers.

- In the context of the 'wider' public sector, since HAI is a state-owned company, which means high bureaucracy (e.g. many and complex public sector rules, regulations and laws concerning procurement and selling), legalism, inertia and risk avoidance (though large organizations of in general are characterized by complex processes, rules and inertia).

Such a context is interesting, since it can be found in many companies in numerous countries of the world. For this reason on one hand we discuss the possible effects of this particular context on the findings of our study, and on the other we have adopted an appropriate methodology in order to 'filter out' findings strongly related to this particular context and therefore less generalizable (described in more detail in the 'Methodology and Theoretical Foundations' section).

We expect that the results of this study will be interesting and useful to a wide audience:

- B2B e-marketplace operators,
- large enterprises,
- ICT companies dealing with e-marketplaces systems or enterprise systems (e.g. ERP),
- consulting companies, practitioners and researchers dealing with e-marketplaces,
- government organizations competent for the design and implementation of policies concerning the development of the 'digital economy'.

The structure of the paper is organized as follows: In the next section we present the background of this study concerning the conclusions of previous literature as to benefits and barriers of participation in B2B e-marketplaces. It is followed by an outline of its methodology and theoretical foundations. Next we describe and analyze—using various frameworks from the literature—the three pilot attempts of HAI to adopt e-marketplaces, with emphasis on the expected benefits, the main barriers that resulted in failure, and also on their comparison with the ones identified in other similar studies both in large enterprises and SMEs. Then we present a set of recommendations that B2B e-marketplace operators can follow in order to increase the participation of large enterprises. Finally we summarize the conclusions and lessons learnt.

BACKGROUND

Considerable research has been conducted in order to identify the benefits that can be offered to sellers and buyers by e-business in general and e-marketplaces in particular. Baron et al. (2000) conclude that B2B e-business can result in lower purchase costs, reduced inventory and higher efficiency in logistics for buyers, and in lower marketing costs and increased sales for sellers. Tumolo (2001) states that the basic benefits offered by the e-marketplaces are cost savings, increased operational efficiency and improved information. In particular, concerning the buyers the main benefits mentioned are: lower prices, capabilities of smaller orders aggregation so that each individual buyer receives high-volume discounts, selection among more suppliers, greater price transparency, quick information about prices, product availability and potential substitute products at a lower search cost and lower purchasing administrative costs; concerning the suppliers the main

benefits mentioned are: capability to expand their markets, acquire new customers, service customers at a lower cost, reduction of their dependence on sales forces, elimination of traditional market intermediaries and elimination of continually producing expensive catalogs. Turban et al. (2006), based on a review of the relevant literature, summarize the main benefits of e-business to organizations as follows: global reach, cost reduction, supply chain improvements, easier customization of products and services, improved customer service and relations, more capabilities for specialization, new business models and partners, rapid time-to-market, efficient procurement and an improved corporate image. Barratt and Rosdahl (2002) focus on the potential benefits offered to buyers and sellers by B2B e-marketplaces. They argue that the main benefits of B2B e-marketplaces for buyers are access to more suppliers and easier comparison of their products, services and prices, improved procurement processes, more opportunities for aggregate buying and therefore lower prices, better central monitoring of purchasing expenditures and decrease of 'maverick buying', disintermediation and lower inventory levels; for sellers the main benefits are access to more buyers and increase of sales, product catalogues cost reduction, reduced marketing and sales costs, standardised order processing, disintermediation and better forecasting capabilities. In the same paper it is also pointed out that B2B e-marketplaces offer to sellers a quick and effective solution for conducting e-commerce without having to make big investments for developing their own infrastructure, and also for achieving cheaper connectivity with their existing customers..

. Wang et al. (2008) from a recent review of e-marketplaces research conclude that the main benefits they offer to participants are 'transaction cost and inventory cost reduction, extended customer base, increased sales and network benefits (such as cash netting and transportation optimization)'. Also they remark that e-marketplaces can have an impact on competition and prices: due to the reduced search cost they can increase market efficiency, intensify competition and lower product prices; however, this impact benefits buyers more than sellers, so in some markets sellers might be reluctant to participate in e-marketplaces in order to avoid reductions in their profit margins.

Most of the research on the benefits from participating in B2B e-marketplaces is focused on the SMEs. Stockdale and Standing (2004), based on a review of relevant literature and a synthesis of their findings, identify the main potential benefits for the SMEs from participating in B2B e-marketplaces, which are shown in the following Table 1.

BSME1:	access to a wide range of markets
BSME2:	greater potential for partnerships
BSME3:	flexibility in administration and communication
BSME4:	convenience in interaction with customers and partners (24/7)
BSME5:	more and updated information
BSME6:	improved customer service
BSME7:	lower transaction costs
BSME8:	differentiation and customisation of products and services
BSME9:	capabilities for entering the supply chains of large enterprises

Table 1: Benefits of B2B e-marketplaces for SMEs according to Stockdale and Standing (2004)

However, the benefits of the large enterprises from participating in B2B e-marketplaces have been researched only to a small extent. Howard et al. (2006) examined four cases of e-hub adoption by two large car manufactures and two large component suppliers in the UK automotive sector; they identified the following realized benefits: indirect price reduction, more strategic and integrated approach to procurement, reduction of paper work and manual processes, cost and process transparency and electronic audit capabilities, control of maverick buying, reduction of delivery time, process standardization and collaborative online product development. Also, they identified some initially expected benefits that were not finally realized: direct price reduction and inventory cost reduction.

Amit and Zott (2001) move the discourse to a higher level: based on a broad theoretical foundation (concerning virtual markets, value chain analysis, Schumpeterian innovation, resource-based view of the firm, strategic networks and transaction cost economics) and on an extensive cases study (detailed study of 59 successful public e-business companies from USA and Europe) they developed a model of the value that can be created in e-business. According to this model there are four basic sources of value creation in e-business: efficiency, novelty, complementarities and lock-in; each of them is further analysed into a number of specific value drivers. The benefits and the impact of B2B e-marketplaces have also been researched from an economic perspective, reaching the conclusion that they can lead to more efficient and 'friction-free' markets (Malone et al., 1987; Bakos, 1991 and 1998).

Less research has been conducted on the barriers that enterprises face in the adoption of e-business in general and B2B e-marketplaces in particular. This research has identified various categories of barriers (Hsiao, 2003). A first category encompasses the technical barriers, which are mainly associated with network security, hardware and software compatibility and systems integration, database conversion, and network bandwidth and connectivity (Truman, 2000; Turban et al., 2006). A second category of barriers are the organizational ones, associated mainly with resistance to change, lack of training, lack of awareness concerning the potential benefits, lack of management commitment and problems in the integration of inter-firm business processes (Premkumar and Ramamurthy, 1995; Lee and Clark, 1997). A third category of barriers concerns dimensions of the collaboration between the enterprises, such as the lack of strategic alignment, the lack of trust, and various types of conflicts (Kumar and Crook, 1999; Hsiao, 2003). Finally, a fourth category of barriers is associated with the lack of required infrastructures (especially in some parts of the world), such as appropriate legal and regulatory frameworks, as well as financial, logistics, and telecommunications infrastructures (Farhoomand et al., 2000).

It should be noted that most of this research on the barriers that enterprises face for the adoption of B2B e-marketplaces is focused on SMEs, since, as mentioned in the Introduction, they are characterised by much lower levels of adoption of ICT, e-business and B2B e-marketplaces in comparison with the large enterprises. Gulledge (2002) investigates the barriers and problems experienced by SMEs, which face demands and pressures from large trading partners (usually manufacturers buying various materials and components from numerous SMEs-suppliers) to participate in e-marketplaces (usually controlled by consortia of such large enterprises - buyers); he concludes that the main

barriers for the such SMEs are the 'profit squeeze' (since such e-marketplaces intensify the competition between the potential SMEs-suppliers of the large enterprises, through various technologies, such as e-catalogues, e-auctions, real-time pricing, etc., finally resulting in a decrease of the profit margins of the SMEs) and the 'technology squeeze' (due to the plethora of technologies and standards of the various marketplaces, in which such an SME usually has to participate, in order to comply with the demands of its most important customers, resulting in high costs). Stockdale and Standing (2004), based on a review of relevant literature, conclude that there are eight basic barriers to the adoption of B2B e-marketplaces by SMEs, which can be grouped into two categories: internal barriers (associated with the interior of the SME) and external barriers (associated with the external environment of the firm), and are shown in Table 2.

Internal Barriers
BASME1: Lack of understanding of the nature of Internet as a trading channel and its interactions with the other 'traditional' trading channels
BASME2: Lack of participation in big value chains that would encourage (or even press) them to adopt B2B e-marketplaces
BASME3: Limited incentives and absence of culture for being the 'first mover'
BASME4: Lack of the other capabilities required for trading in wider markets (e.g. concerning import/export procedures, currency exchange, shipping services)
BASME5: Financial constraints
External Barriers
BASME6: Lack of widely accepted standards for the exchange of information with e-marketplaces (which results in each e-marketplace having different formats for information exchange with the participating enterprises)
BASME7: Lack of understanding of and supporting the special needs and peculiarities of the SMEs by most B2B e-marketplace makers
BASME8: External environment not favouring such innovations

Table 2: Basic barriers to the adoption of B2B e-marketplaces by SMEs according to Stockdale and Standing (2004)

However, even though some research has been conducted concerning the basic barriers that large enterprises face in implementing Electronic Data Interchange (EDI) (e.g. Barrett, 1999; Williams and Frolick, 2001; Asher, 2007), limited research has been conducted for identifying and understanding the main barriers that hinder the participation of large enterprises in B2B e-marketplaces. Howard et al. (2006) in their abovementioned paper from the analysis of four cases of e-hub adoption by two large car manufactures and two large component suppliers in the UK automotive sector also identified the following barriers: alignment of e-hubs with existing processes and structures, lack of standards impeding integration with e-hubs, multiple ICT legacy systems that should be replaced, high costs of subscription to e-hubs, general reservation over e-business, resistance from management having established strong purchasing relations, CEO difficulties in leading such innovations, inertia and lack of awareness, cultural mismatch between USA and European offices concerning e-hub, buyer-supplier mistrust, difficulties in using the new systems (e.g. bureaucratic logging-in processes) and perceived conflict with existing culture and working methods.

Only a small body of research work examines the adoption of B2B marketplaces in the public sector; thisresearch is more relevant to our study, since HAI is a state-controlled enterprise. Stowers (2001) examined how e-government can be a precursor to e-commerce, and listed lessons from private sector e-commerce efforts that can be applied to the development of government exchanges. These include the use of models that are familiar to consumers, the provision of value-added services, the focus on customer service, and the building of a community. Stowers describes the US public policy context, outlining principles such as the use of proven commercial applications, the outsourcing of transaction processing, the monitoring of investments for their return, and the management of the change process. Stowers's study includes a number of examples, including one concerning the auctions of government surplus goods (www.GSAauctions.gov). In contrast to HAI, this was implemented by hiring an outside contractor. Another study by Wyld (2001) focuses more on HAI's domain, by examining how auctions performed by public sector entities can leverage the power of e-commerce through the establishment of dynamic pricing. The examples he cites (procurement, disposition of surplus assets, and internal management) are similar to those undertaken by HAI. Wyld also categorises procurement exchanges into independent-led and industry consortium-led. In retrospect, HAI's decision to form an independent-led exchange was probably suboptimal, given the company's comparatively small size. Finally, a case study (Ferro et al. 2006) outlines the use of online auctions for the sale of surplus inventory and property by the New York State over a three year period. Research questions posed by the authors include the ability of governmental organizations to meet private sector standards as well as the measurement of investment returns and the role of transparency in the migration towards online models.

METHODOLOGY AND THEORETICAL FOUNDATIONS

Taking into account the aforementioned shortcomings and gaps of the relevant literature, the main research objective of this study is to contribute to a better in-depth understanding of the main barriers experienced by the large enterprises for adopting B2B e-marketplaces, which constitute basic negative factors hindering the adoption. At the same time, in order to have a complete view on this topic (and not only the negative dimensions, but also the positive ones as well), the second research objective of this study is to contribute to a better in-depth understanding of the main benefits sought by the large enterprises from participating in B2B e-marketplaces, which constitute basic positive factors pushing in the opposite direction towards the adoption.

In order to achieve these research objectives we adopted a case study approach (Benbasat et al., 1987; Lee, 1989; Yin, 2002). According to Yin (2002) the case study approach is the preferred research strategy for the in-depth study of complicated phenomena in organizations "when 'how' or 'why' questions are being posed, when the investigator has little control over events, and when focus is on a contemporary phenomenon within some real-life context". Since our investigation had all these characteristics we decided that a case study was the most appropriate approach. In particular, we studied the pilot attempts to adopt B2B e-marketplaces of the Hellenic Aerospace Industry (HAI), which is one of the largest industrial enterprises of Greece; as described in the next section, the HAI has all the typical characteristics of large

enterprises: high turnover, large number of employees, many activities, a complex organizational structure, complex internal processes and many rules and regulations, therefore it is an appropriate 'case' for our purpose.

This case study was combined with action research (Avison et al., 1999; Robson, 2004), which enables involvement of the researcher in the phenomenon under study, the collection of more evidence about it and finally a better and deeper understanding of it. Action research combines the traditional research objectives of description, understanding and explanation, with the promotion of change: the researcher participates in an action aiming at introducing a change, in cooperation with practitioners, and at the same time collects extensive evidence about this attempt from multiple sources, and then uses this evidence for theory development or testing. According to Avison et al. (1999) in action research "research informs practice and practice informs research synergistically", resulting in significant advantages: "In action research the emphasis is more on what practitioners do than on what they say they do". In this direction in the present study the third author, as part of a student summer internship initially and for the preparation of his degree thesis later, participated as a 'young member' (who can contribute fresh ideas) in a team of HAI, which was responsible for implementing three pilot projects aiming at the adoption of B2B e-marketplaces; this team consisted of HAI's experienced employees and lower managers coming from various affected and involved departments. In this way we managed to collect extensive evidence about both the expected benefits and the barriers of the participation of HAI in B2B e-marketplaces from multiple sources: from the direct participation in the team, from the observation of the other members of the team, from other HAI employees who were involved in these pilot projects as end-users, from interviews and discussions, and from relevant documents. This multiplicity of sources was very useful, as it gave us the opportunity to cross-validate and confirm our findings.

According to Yin (2002) an important advantage of the case study approach is that it can "benefit from the prior development of theoretical propositions to guide data collection and analysis". In this direction as theoretical foundation for the collection and the analysis of evidence concerning the barriers to the adoption of B2B e-marketplaces was used the framework of Hsiao (2003); this framework, as mentioned in the 'Background' section, identifies four basic categories of barriers to B2B e-marketplaces adoption, which are associated with technology, organization, collaboration and infrastructure respectively. Correspondingly, as theoretical foundations for the collection and the analysis of evidence concerning the benefits from the adoption of B2B e-marketplaces were used the framework of benefits from B2B e-marketplaces developed by Barratt and Rosdahl (2002) and the model of value creation in e-business developed by Amit and Zott (2001), which have been described in the previous 'Background' section.

Furthermore, taking into account that the adoption of a B2B e-marketplace is a significant change of existing processes and work practices, we view it as an innovation decision and we analyze it using the well established innovation diffusion theory of Rogers (2003). According to this theory five critical characteristics of an innovation, as they are perceived by its potential adopters, determine the degree of its adoption; we can see them with their definitions in Table 3.

Characteristic	Definition
Relative Advantage	The degree to which an innovation is perceived as better than the idea, work practice or object it supersedes
Compatibility	The degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters
Complexity	The degree to which an innovation is perceived as difficult to understand, implement and use
Trialability	The degree to which an innovation may be experimented with on a limited scale basis
Observability	The degree to which the results of an innovation are visible to others

Table 3: Characteristics of an innovation that determine the degree of its adoption according to the innovation diffusion theory of Rogers (2003)

We chose the innovation diffusion theory of Rogers (2003) as the basis of this analysis over the widely used technology adoption model (TAM) (Davis, 1989; Lee et al., 2003), because the former is more focused on innovation and provides a wider set of adoption determinants than the latter, enabling thus a more comprehensive analysis. In particular, while the TAM includes two main adoption determinants (ease of use and usefulness), the innovation diffusion theory includes five (see Table 3); also, two of the adoption determinants of the innovation diffusion theory correspond to a large extent to the ones of the TAM ('complexity' is related to 'ease of use', and 'relative advantage' is related to 'usefulness'), so the remaining three can be viewed as additional to the ones of the TAM. Therefore the innovation diffusion theory includes to a large extent the analysis dimensions provided by the TAM, and also provides some additional ones, so it allows a more multi-dimensional and comprehensive analysis of this HAI innovation of e-marketplaces adoption.

Also, taking into account the particular national and sectoral context of the HAI described in the 'Introduction', in order in order to 'filter out' barriers and benefits strongly related to this particular context and therefore less generalizable, we compared our findings with the corresponding ones of the study of Howard et al. (2006), which, as mentioned in the previous section, investigated the barriers and benefits of e-hub adoption by large enterprises (manufacturers and component suppliers) in the UK automotive sector. Also, we compared our findings with the ones of the study of Stockdale and Standing (2004), which, as mentioned in the previous section, investigated the benefits and the barriers of participation in B2B e-marketplaces for the SMEs. These two comparisons allowed us to determine a subset of the barriers/benefits identified in our study, which a) have been identified in the study of Howard et al (for large UK enterprises) as well, but b) have not been identified in the study of Stockdale and Standing (for SMEs), and also c) are clearly associated and rapidly increasing with large enterprise size, so they might be specific to large enterprises.

The implementation of our study included the following steps:

i. Initially the third author participated in the team established in HAI for preparing and implementing these three pilot projects of B2B e-marketplaces adoption; he

attended all the meetings of the team and collected their minutes as soon as they were finalized.

ii. After the end of these three pilots we conducted: i) seven semi-structured interviews with members of the team, which aimed mainly at a more detailed explanation and clarification of the main issues discussed in the meetings and mentioned in the minutes (concerning expected and realized benefits, difficulties, problems, etc.); all these interviews initially included questions on these main issues, and then questions based on the abovementioned frameworks of Hsiao (2003), Barratt and Rosdahl (2002), Amit and Zott (2001) and Rogers (2003), and also ii) nine semi-structured interviews with the main and most heavily involved users of the three investigated e-marketplaces; all these interviews included initially free-form descriptions of the problems each user faced, and then questions based on the above frameworks. Each interview lasted between half and one hour and was tape-recorded and then transcribed.

iii. A first coding of the team meetings' minutes and the interviews' transcripts was then performed manually, in which each of the three authors, using an open coding approach (Maylor and Blackmon, 2005), processed separately the above documents in order to identify the main barriers to B2B e-marketplaces adoption. Results were then compared and differences were resolved.

iv. A second manual coding of the team meetings' minutes and the interviews' transcripts followed, in which each of the three authors, using a similar open coding approach, processed separately the above documents in order to identify the main expected and realized benefits of B2B e-marketplaces adoption. Results were again compared and differences were resolved.

v. Next, the three authors together classified the identified barriers into the four categories proposed by the framework of Hsiao (2003),

vi. and also the identified benefits into the four basic sources of e-business value creation proposed by the framework of Amit and Zott (2001).

vii. Each of the three authors, based on the team meetings' minutes and the interviews' transcripts, assessed separately for each of these three pilot attempts of HAI to adopt B2B e-marketplaces the intensity of the abovementioned five characteristics proposed by the innovation diffusion theory of Rogers (2003) (Table 3) in a five levels scale (low, medium to low, medium, medium to high, high). Assessments were then compared and differences were resolved.

viii. Finally, the three authors together compared the identified barriers and benefits with the ones identified in the study of Howard et al. (2006) (for large UK enterprises) and in the study of Stockdale and Standing (2004) (for SMEs).

It should be noted that in the above steps iii, iv, and, vii the main differences that appeared between the authors mainly came from their varying backgrounds and experiences. The study's (younger) third author showed little 'patience' and understanding for organizational barriers, sometimes underestimating the bureaucracy and politics associated with many large enterprises. Furthermore, the technological background of the second author often made him overestimate the importance of technology, even in cases where the underlying causes were systemic in nature. Finally, the last two authors sometimes criticized the study's first author for being too ready to cede ground to HAI's arguments that in their opinion could be won.

THREE FAILED PILOT ATTEMPTS TO ADOPT E-MARKETPLACES

The management of the Hellenic Aerospace Industry (HAI) (www.hai.gr) launched a pilot project aiming at the introduction of e-marketplaces in the procurement processes of the company, and also in the processes of selling unused stock of high value (electronics, airplanes spare parts, etc.), since the core products and services of HAI are of very high value so they cannot be sold online over the Internet. The basic objective of the project was to improve and rationalize the existing procurement and selling processes through the use of e-marketplace technologies. According to the document of its terms of reference the main benefits aimed at were the reduction of the time needed to issue a purchase order, the overall administrative cost of a purchase order, the stock, the delivery time to HAI, the time required for selling unused materials and the amount of stocked materials. There was also a belief that the adoption of these new technologies would improve the central monitoring of the purchases, enhance the profile of the company, and allow HAI to gain a strategic advantage over its competitors. The roadmap toward the promising land of e-marketplaces included three different pilot subprojects:

- the adoption of a horizontal e-marketplace for the procurement of office supplies,
- the operation of e-auctions for selling unused stock of high value (e.g. electronics, airplanes spare parts, etc.), and
- the adoption of vertical e-marketplaces for the procurement of industrial materials and parts.

In the following four subsections initially we provide a basic profile of HAI and then we outline each of these three pilot subprojects and describe its results.

The Hellenic Aerospace Industry

The Hellenic Aerospace Industry S.A. (www.hai.gr) was founded in 1975 in order to provide services and products for meeting the needs of the Hellenic Armed Forces as well as other clients in the national and international market of military and civil aviation. It employs about 3,000 technical and administrative staff, who are working in 200,000 m^2 of production space. It is a state-owned company, so it has to apply many complex public sector rules, regulations and laws (e.g. concerning procurement and selling, etc.). The main areas in which HAI develops its activities include:

- aircrafts, engines, radar equipment and missiles MRO (maintenance, repair, overhaul), modification, modernization and upgrades;
- development, design, and manufacturing of electronic, optoelectronic, and telecommunications products, as well as C4I and satellite systems for military and civilian use;
- design and manufacturing of structural parts for military and civilian aircraft and engines;
- verification, repair and calibration of precision measurement and control instruments, devices and production equipment.
- technical and professional training in the entire spectrum of aeronautical specialties.

HAI operates in market segments, which are characterized by high and sophisticated technologies, strict international standards and strong competition. It has undertaken over the years a great deal of subcontracting work with major International Aerospace companies, such as Boeing, Airbus, Alenia, Lockheed Martin, Raytheon, EADS, etc., and has accomplished many original developments in military electronics, telecommunications equipment, night vision equipment, wind generators and composite material technology. For meeting the high requirements of these demanding markets HAI has an advanced quality system certified in accordance with the international standards ISO 9001:2000, ISO 9001:1994 & TickIT Guide and EN/AS 9100. Also, its internal operations are electronically supported by the highly mature and powerful ERP package SAP (www.sap.com), which is the market leader (Jacobson et al 2007) and offers high levels of functionality and adaptability.

Adoption of an Office Supplies Marketplace

The existing process of HAI for ordering office supplies is quite complex; it comprises a workflow of eleven (11) steps involving five documents and seven different persons. It is based on a stock of supplies kept at HAI and the processing of purchase request (PR) and purchase order (PO) documents. In order to streamline this process, an existing e-procurement platform, which had been developed by a specialized company abroad, was installed and configured according to the procurement chain of HAI; in this way an office supplies e-marketplace was created. It allowed the initiator of a supply request to logon to the system's web interface and choose from the basic supplier's list of available materials; the initiator could then create a shopping cart with all the requested materials and forward it for approval to the higher levels of the HAI hierarchy. This new procurement method would eliminate the stock and the associated cost in tied-up capital and space, since supplies could be delivered directly to HAI within a couple of days. In addition, all parties involved in the request could follow electronically the progress of their order.

In the pilot run of the system initially its users were trained, and then started performing 'virtual purchases' following all the steps required by the new procurement system; the only part of the process that was not executed was the final purchase order to the supplier.

One would expect that HAI could easily adopt the above new office supplies procurement process. Unfortunately for HAI that was not the case. The first problem that arose was the need to replace the previously existing PO and PR numbering format by the shopping cart number that was automatically created by the above e-procurement platform. The adoption of a new number format in the procurement system of HAI was not an easy task. The existing PO and PR codes were numbers with a specific format that had a specific meaning to every employee who was involved in the purchase chain; through the existing PR and PO number format the procurement personnel could decode the type of the material, the payment method, the particular sector that the materials should be sent, and other important elements. On the contrary the shopping cart reference number was missing all this data that was needed not only by the involved people, but also by the internal ERP of HAI (SAP); this highly complex internal information system kept track of all of the transactions that the company made, and its functioning was based on the use of those numbers. As a result, the integration and interoperability of these two

systems (the e-procurement platform and the internal information system (SAP)) was another difficult problem. The e-procurement platform could not be easily adapted (modification of the shopping cart number and assignment of an appropriate PO number according to the existing numbering format to every new shopping cart). Another negative factor was the hesitation and the unwillingness of some of the employees to learn and adopt this new system. If we add to the above negative factors the skepticism to the whole attempt due to the fact that, during the pilot project the HAI's basic supplier of the office supplies deployed its own e-shop that allowed its costumers to buy supplies directly through it, we can understand the reasons why this part of the pilot project was finally abandoned. In conclusion, in this pilot, the introduction of an office supplies e-marketplace platform showed potential for offering considerable benefits (improvement of procurement process, reduction of inventory, central monitoring capabilities). However, its incompatibility with the existing IS-supported PO and PR numbering format, which was supported by the internal IS of HAI, and the complexity of achieving integration and interoperability with it, the unwillingness of some employees to use it, and the deployment of an e-shop by a basic supplier, resulted in its abandonment.

Unused Stock Auctions

The second part of the pilot project involved the use of an e-auction platform for selling unused stock of high value; these materials were mostly high value raw materials, spare parts and electronics, mainly of USA origin, that had been bought by HAI for aircraft and aircraft engine maintenance and had been for a long time remained unused in HAI's high value stock. The value of this stock was several million Euros. These materials, spare parts and electronics could not be used, either because the corresponding aircraft or aircraft's engine/system for which they had been bought went out of service due to the expiration of their operational life, or because the ordered quantities were larger than the needed ones. An efficient way for selling this unused stock would be an electronic auction through the Internet, and the scheme chosen for the auction was a standard (English) auction in an e-auction environment. In this way it was expected to sell a higher proportion of this valuable unused stock in a shorter time and finally increase the revenue of HAI from it.

As soon as this decision was made, the legal department of HAI began to examine whether the conduct of such an e-auction was allowed by the existing legal framework of Greece and the USA laws controlling technology and military exports, and to seek the appropriate legal platform. As HAI is a defence industry owned by the Greek State it has to apply the complex public sector rules for procurements and sales, though it follows the private sector operation rules and regulations for personnel tenure and social security. The legal department and legal advisors concluded that there was no provision in the internal rules and regulations of HAI, and also there was no law in Greece that allowed this kind of electronic transactions. Even though there was a law that legally recognizes the electronic signatures as having the same validity with the 'hand-written' ones, there was a legal gap in recognizing the e-auction model to have the same validity as the traditional ones. In addition, according to the legal department and legal advisors, the USA law controlling arms and technology exports required did not allow HAI to sell such high technology materials, spare parts, electronics, etc. to any interested party, but only to parties that were approved by the USA; therefore for these sales HAI had to secure the

permission of the appropriate USA administration body, such as the Department of Commerce, the State Department, or even the Congress, before selling this unused stock. Consequently, the lack of relevant provisions in the internal rules and regulations of HAI, the lack of an appropriate Greek legal framework and the restrictions of the USA laws controlling arms and technology exports build significant barriers and reduce the usefulness of these e-auctions, which led HAI to abandon the second part of the pilot project. In conclusion, in this pilot the adoption of an e-auction platform seemed to have some potential for increasing buyers and sales of high value unused stock. However, its incompatibility with the regulations of HAI and the Greek and US legal framework, and the high complexity and difficulty of changing the corresponding laws, resulted in its abandonment.

Adoption of a Vertical Marketplace

The third part of the pilot project aimed at using vertical-sectoral e-marketplaces for the procurement of industrial materials and parts. In order to minimize risk, it was decided in this part to use e-marketplaces only for a limited number of steps of the procurement processes: for the Request for Availability (RFA) and for the Request for Quotation (RFQ); so this implementation was not covering the initial steps, starting at the point where a material request is initiated, and the final steps, ending when the request reaches the procurement department. The RFA had been planned to be used for obtaining information from suppliers about the availability of a certain type of industrial material or part in their stock, while the RFQ for asking a supplier for a binding response concerning the supply of a particular industrial material or part, which also include details, such as the quality, the guarantee, etc.; the response from the RFQ had been planned to be used for the final approval of the purchase.

An Internet-based search identified eleven (11) different vertical/sectoral e-marketplaces trading aircraft hardware, parts and electronics. The use of some of these e-marketplaces was free of charge, others provided only a free trial period, while the remaining ones required a subscription (usually a monthly charge).

The use of these vertical/sectoral e-marketplaces provided some immediate, tangible benefits. First of all, the time needed to obtain an RFA or an RFQ response was drastically reduced; the results of an RFA were available within a few seconds, because the e-marketplace played the role of a search engine for materials and suppliers, while the reply time for an RFQ was a couple of days in the worst case. Procurement personnel felt that this reduced time would decrease overstocking. Furthermore, in some cases the use of an e-marketplace was the only available option to obtain specific parts, because some industries sold their products only through existing e-marketplaces. In addition, if the same materials were available through multiple suppliers HAI could secure a better deal with respect to price and delivery time. Finally, those involved in the procurement chain experienced a reduction of costs associated with communications, fewer paper documents, and an improved quality of service.

However, some characteristics of these vertical-sectoral aerospace e-marketplaces prevented HAI from immediately adopting them:

- Training and adoption costs were higher than anticipated, because the steps needed for submitting an RFA or RFQ were different for each e-marketplace. Taking into account that HAI needs to use, not only one, but many e-marketplaces, the lack of

common procedural and technical standards for the communication and the exchange of information with these e-marketplaces cause problems and high additional costs to HAI, both for using them 'manually', and (to a much higher extent) for integrating them with its highly complex internal information system (SAP).

- Even though most e-marketplaces were strict concerning the input format they required (i.e. the steps for submitting an RFA or RFQ, the information to be provided in each step, its format, etc.), the results they provided were typically in an unstructured, messy and difficult to process form. According to the representatives of some e-marketplaces, this jumbled output format was an intentional design feature of these e-marketplaces aiming to prevent others from creating a competing e-marketplace by aggregating replies from multiple RFAs.
- The product information obtained was sometimes questionable. The personnel of HAI identified some discrepancies between the quality of products described in the e-marketplace and those finally delivered to HAI.
- The e-marketplaces did not provide a way to obtain a better price for large orders consisting of many different products (e.g. materials, parts, etc.) with a predefined delivery date and quality. Although some e-marketplaces provided differentiated prices for bulk purchases, these referred to a single product. Under the previous purchasing regime HAI's procurement personnel would like to negotiate a better price with a supplier by grouping together many smaller one-product purchases into a large multi-product order, but this critical capability was not offered by the e-marketplaces.
- Also, it was concluded that the benefit of access to large number of suppliers had been overestimated. Typically most (about 90%) of the suppliers identified in the RFAs in these e-marketplaces were already known; very few genuinely new providers were given in the RFA replies. The paucity of new suppliers in combination with the critical nature of the quality of these products to HAI, made management very sceptical when ordering from an unknown provider.

Because of the aforementioned barriers and limitations, the management of HAI decided to postpone the use of these vertical-sectoral e-marketplaces, waiting for future improvements in their operation, and a more widespread adoption of them by the aerospace industry. In conclusion, in this pilot the adoption of vertical-sectoral aerospace e-marketplaces showed potential for offering considerable benefits (decrease of delivery times and inventory of material and parts, paper documents and procurement costs). However, the high complexity resulting from the lack of common technological and procedural standards for the communication and the exchange of information with all e-marketplaces, in combination with some important weaknesses of these e-marketplaces (lack of support for different prices for large multi-product orders and negotiations on them, lack of trust to some of the proposed suppliers, provision of results in an unstructured and difficult to process form), resulted in its abandonment.

ANALYSIS - RESULTS

Barriers

From the analysis of the team meetings' minutes and the interviews' transcripts, following the steps described in the 'Methodology and Theoretical Foundations' section, nine basic barriers to the adoption of B2B e-marketplaces by HAI (BAi, i=1-9) were identified, which are shown in Table 4, with their classification according to the framework of Hsiao (2003). We can see that important barriers of all the four categories of this framework have been identified: three technological barriers (BA1, BA2 and BA3), three organizational barriers (BA4, BA5 and BA6), one barrier associated with collaboration with suppliers (lack of trust) (BA7) and another one associated with collaboration with the e-marketplaces (BA8), and also one infrastructural barrier (BA9). We remark that the predominant categories are the technological and organizational barriers, followed by the category of the collaboration-related barriers and finally the infrastructure-related ones. Therefore the main sources of barriers to the adoption of B2B e-marketplaces by HAI are associated with the technology and the organization of both HAI and these e-marketplaces. Also, we remark that from these nine basic barriers to the adoption of B2B e-marketplaces by HAI only BA6 (Hesitation and unwillingness of some employees) can be overcome — or at least reduced — through higher management support and pressure, while all the others are out of direct management control.

Barrier	Classification
BA1: Difficulties of integration with internal information systems	Technology
BA2: Lack of common technological standards for the communication and the exchange of information with all e-marketplaces	Technology
BA3: Lack of support for different prices for large multi-product orders and negotiations on them	Technology
BA4: Inconsistency with existing internal processes, rules and regulations	Organization
BA5: Lack of common procedural standards for the communication and the exchange of information with all e-marketplaces	Organization
BA6: Hesitation and unwillingness of some employees	Organization
BA7: Lack of trust to unknown suppliers	Collaboration
BA8: Results provided in an unstructured and difficult to process form	Collaboration
BA9: Deficiencies of the internal regulations and the legal framework	Infrastructure

Table 4: Barriers to the adoption of B2B e-marketplaces by Hellenic Aerospace Industry

It should be noted that some of the identified barriers might be affected to some extent by the particular context of this study described in the 'Introduction'. In particular, the intensity and negative impact of BA1 (Difficulties of integration with internal information systems) and BA6 (Hesitation and unwillingness of some employees) might be amplified by the national context of Greece, which, as mentioned in the 'Introduction', lacks a culture and tradition of using sophisticated technologies and making business and technology innovations. Also, the intensity and negative impact of BA4 (Inconsistency with existing internal processes, rules and regulations), BA6 (Hesitation and

unwillingness of some employees) and BA9 (Deficiencies of the internal regulations and the legal framework) might be amplified by the public sector context, which is characterized by complex and inflexible processes, rules and regulations, and also high organizational 'inertia' and resistance to change. Finally, BA3 (Lack of support for different prices for large multi-product orders and negotiations on them), BA8 (Results provided in an unstructured and difficult to process form) and BA9 (Deficiencies of the internal regulations and the legal framework) are probably related to a large extent to sectoral specificities of the aerospace industry and its e-marketplaces.

In order to 'filter out' barriers strongly related to this particular context the above nine barriers were compared with the barriers to the adoption of e-hubs by large enterprises (manufacturers and component suppliers) of the UK automotive sector identified in the study of Howard et al. (2006). From this comparison it was concluded that six of these nine barriers have been identified in Howard's et al. study as well: BA1 (Difficulties of integration with internal information systems), BA2 (Lack of common technological standards for the communication and the exchange of information with all e-marketplaces), BA4 (Inconsistency with existing internal processes, rules and regulations), BA5 (Lack of common procedural standards for the communication and the exchange of information with all e-marketplaces), BA6 (Hesitation and unwillingness of some employees) and BA7 (Lack of trust to unknown suppliers). This confirms that the remaining three of the barriers we identified, i.e. BA3 (Lack of support for different prices for large multi-product orders and negotiations on them), BA8 (Results provided in an unstructured and difficult to process form) and BA9 (Deficiencies of the internal regulations and the legal framework), are probably specific to the sectoral context of our case study (the aerospace industry and its vertical-sectoral e-marketplaces) and therefore less generalizable.

Also, the nine barriers we identified were compared with the eight basic barriers to the adoption of B2B e-marketplaces by SMEs identified by Stockdale and Standing (2004). From this comparison only one common barrier was identified: the BA2 (Lack of common technological standards for the communication and the exchange of information with all e-marketplaces). This leads to the conclusion that the basic barriers HAI faced in adopting B2B e-marketplaces are quite different from the ones faced by SMEs; this conclusion justifies the focus of the present study on the large enterprises. Also, we can conclude that if from the nine identified barriers BAi, i=1-9 (Table 4) we exclude BA2 (appearing in SMEs as well) and also BA3, BA8 and BA9 (not appearing in the above study of Howard et al. (2006) for the automotive sector), we expect that the five remaining barriers (BA1, BA4, BA5, BA6 and BA7) might be specific to the large enterprises. By examining the nature of these four barriers it is confirmed that they are clearly associated and rapidly increasing with large enterprise size:

- Large enterprises have big and complex internal information systems, so their integration with e-marketplaces is difficult, requires considerable effort, time and cost, so it constitutes a big barrier (BA1).
- Also, large enterprises are characterised by numerous complex internal processes, rules and regulations, which reduce their flexibility and increase the difficulty of introducing innovative practices, such as the use of e-marketplaces (BA4), and also the difficulties and problems in case of using several e-marketplaces with different procedural standards for communication and exchange of information (BA5).

- Furthermore, large enterprises employ large numbers of employees, so there is big 'inertia' against the significant changes of existing processes and work practices required for adopting e-marketplaces: many employees have to be trained and get accustomed with the e-marketplaces (so big effort and cost is required), and also there is increased probability that some of them will be unwilling or hesitant to use the e-marketplaces and cause problems or even failure of the whole attempt (BA6).
- The purchases and in general the undertakings of the large enterprises are large, so the risks for them from the lack of trust concerning the quality of products from unknown suppliers are quite high; also, large enterprises do not have the flexibility of SMEs in managing problems of poor quality or delayed deliveries from their suppliers (BA7).

For these reasons we expect that these five barriers might be specific to the large enterprises. Further research (e.g. through additional case studies, surveys, etc.) is required in order to test these conclusions in other contexts as well.

Benefits

From the analysis of the team meetings' minutes and the interviews' transcripts were identified seven main benefits that HAI expected from the adoption of B2B e-marketplaces, five of them as a buyer (BEBi, i=1-5) and two as a seller (BESi, i=1-2), which are shown in Table 5. From the whole evidence we collected in this case study we conclude that all these expected benefits in the three pilot projects of HAI were realized to a satisfactory extent, with the only exception of the BEB4 (find more suppliers), which was not realized to a satisfactory extent (most of the suppliers identified in the RFAs in these vertical-sectoral aerospace e-marketplaces were already known).

Benefits	Classification	Realized
BEB1 Improve procurement processes (decrease paperwork, administrative cost, search-request-reply-approval-delivery time)	Efficiency	Yes
BEB2 Reduce inventory	Efficiency	Yes
BEB3 Improve purchases central monitoring and decision making	Efficiency	Yes
BEB4 Find more suppliers	Novelty	No
BEB5 Achieve lower procurement costs and quicker delivery	Efficiency	Yes
BES1 Find more buyers of unused stock	Novelty	Yes
BES2 More sales of unused stock and higher revenue from them	Efficiency	Yes

Table 5: Expected and realized benefits from adoption of B2B e-marketplaces by Hellenic Aerospace Industry

In the second column of Table 5 we can see the classification of the identified benefits according to the model of the sources of value creation in e-business of Amit and Zott (2001). We remark that five of these benefits (all realized) are 'efficiency-related' and the remaining two (one realized and one expected but not realized) are 'novelty-related'; no benefits have been identified from the other two categories-sources of value

('complementarities' and 'lock-in'). Therefore we see that in these first attempts of HAI to adopt e-marketplaces, due to lack of experience in this area the full potential of these technologies was not exploited, since due to the large size of HAI mainly 'efficiency-related' benefits were aimed at and finally achieved, while the other categories-sources of value were neglected.

It should be noted that the above identified benefits might be affected to some extent by the particular sectoral context of this study described in the 'Introduction'. Previous literature (e.g. Grieger, 2003; Turban et al., 2006; Wang et al., 2008) has emphasized that e-marketplaces are more suitable and beneficial in sectors characterised by fragmented demand and supply. As mentioned in the 'Introduction' the aerospace industry with respect to sales is on the contrary characterized by 'oligopolio' conditions, selling to a limited number of customers sophisticated products and services of high value, which cannot be sold on-line over the Internet. Therefore enterprises of the aerospace sector cannot have the high levels of benefits that other sectors obtain from conducting electronic sales of their core products and services over the Internet; however, it can obtain lower levels of benefits from electronic sales of unused stock of high value raw materials, spare parts, electronics, etc. For this reason the only pilot implemented concerning the use of e-marketplaces by HAI as a seller aimed at selling such high value unused stock, so only two benefits of this type were identified (BES1 and BES2). In a different sector characterized by more fragmented demand (higher number of possible customers) and core products and services more appropriate to be sold over the Internet, we might find more and higher benefits from adopting e-marketplaces as a seller. Similarly, with respect to procurement the aerospace industry is characterized by 'oligopsonio' conditions (however, to a smaller extent), purchasing numerous sophisticated and specialized sector-specific raw materials, spare parts and electronics of high value, however each of them having only a limited number of possible suppliers. This was probably the reason for having not realized benefit BEB4 (find more suppliers) as mentioned above to a satisfactory extent, since most of the suppliers found in the vertical-sectoral aerospace e-marketplaces were already known. However, due to the numerous raw materials, spare parts and electronics required as inputs in the aerospace industry its vertical-sectoral e-marketplaces can offer significant efficiency-related benefits (e.g. decrease of paperwork, administrative cost, search-request-reply-approval-delivery time), such as the ones identified in our study.

In order to 'filter out' benefits strongly related to the particular context of this study the identified benefits were compared with the benefits from the adoption of e-hubs by large enterprises (manufacturers and component suppliers) of the UK automotive sector identified in the study of Howard et al. (2006). From this comparison it was concluded that four of these benefits (all of them realized) have been identified in Howard's et al. study as well: BEB1 (Improve procurement processes - decrease paperwork, administrative cost, search-request-reply-approval-delivery time), BEB2 (Reduce inventory – not realised in the automotive sector context), BEB3 (Improve purchases central monitoring and decision making) and BEB5 (Achieve lower procurement costs and quicker delivery). The remaining three of the benefits we identified, i.e. BEB4 (Find more suppliers) (expected but not realized), BES1 (Find more buyers of unused stock) and BES2 (More sales of unused stock and higher revenue from them), have not been identified in Howard's et al. study. This probably reflects

differences between the aerospace and the automotive sector. For instance, the aerospace sector is characterised by higher technological complexity than the automotive sector, which means more types and manufacturers of the numerous spare parts, electronics, etc., which are specific to particular aircrafts or aircrafts' engines/systems; for this reason in case that an aircraft or aircraft's engine/system goes out of service due to the expiration of its operational life all the corresponding spare parts, electronics, etc. (usually of high economic value) are useless, so it is of critical importance to sell them.

Also, the above identified benefits were compared with the nine basic benefits for SMEs from participating in B2B e-marketplaces identified by Stockdale and Standing (2004). From this comparison four common benefits were found (three of them realized, and one expected but not realized): BEB1 (Improve procurement processes), BEB4 (Find more suppliers) (expected but not realized), BEB5 (Achieve lower procurement costs and quicker delivery) and BES1 (Find more buyers of unused stock); they correspond to three out of the nine SMEs benefits identified by Stockdale and Standing: BSME1 (Access to a wide range of markets), BSME3 (Flexibility in administration and communication) and BSME7 (Lower transaction costs). This leads to the conclusion that the benefits of HAI from adopting B2B e-marketplaces are quite different from the ones found in SMEs; this conclusion provides an additional justification of the focus of the present study on the large enterprises.

From all the above comparisons we can conclude that we expect that a subset of the above benefits, which have been identified in our study and also in Howard's et al. study (for large enterprises), but not in the study of Stockdale and Standing (for SMEs), which includes BEB2 (Reduce inventory) and BEB3 (Improve purchases central monitoring and decision making), might be specific to large enterprises. It should be noted that by examining the nature of these two benefits it is confirmed they are both associated with efficiency and coordination problems caused by large enterprise size. Further research through additional case studies, surveys, etc. is required in order to test these conclusions in other contexts as well.

Innovation Analysis using the Theory of Rogers

Finally, the adoption of B2B e-marketplaces by HAI was viewed as an innovation decision and analysed using the innovation diffusion theory of Rogers (2003), which is a mature framework for studying the adoption of innovations and its determinants. As described in the 'Methodology and Theoretical Foundations' section, this theory posits that an innovation's adoption is determined mainly by a small number of critical characteristics of it: the innovation's relative advantage, its compatibility with existing practices, needs and values and also its complexity, trialability and observability Consequently, this additional analysis allows us to create a higher level and more compact view of these innovative attempts of HAI, one that incorporates and summarizes all the abovementioned barriers, benefits and in general the whole evidence we collected, and to identify the 'weak' dimensions of this innovation and the corresponding improvement priority areas in order to facilitate its adoption. Based on the views expressed by HAI employees, which have been recorded in the team meetings' minutes and the interviews' transcripts, for each of the above three pilot attempts of HAI to adopt B2B e-marketplaces was assessed the intensity of the five critical characteristics

proposed by this theory on a five level scale (low, medium to low, medium, medium to high, high); the results of this assessment are shown in Table 6.

Characteristic	P1: Office Supplies Marketplace	P2: Unused Stock Auctions	P3: Vertical Marketplace
Relative Advantage	medium to high	medium to high	medium to high
Compatibility	medium to low	medium to low	low
Complexity	medium to high	high	high
Trialability	high	high	high
Observability	medium to high	medium to high	medium to high

Table 6: Assessment of the intensity of the five critical innovation characteristics of the three pilot attempts of the Hellenic Aerospace Industry to adopt B2B e-marketplaces

As we can see in this Table, according to the perceptions of the interviewed employees of HAI, in all three pilots the adoption of e-marketplaces showed the potential to offer a 'medium to high' relative advantage in comparison with the existing practices; this is reflected in the benefits of HAI from the adoption of these e-marketplaces, which have been discussed in the previous section. However, in two of the pilots there was 'medium to low' compatibility to existing practices, while in the third one the compatibility was 'low' (since there are many vertical-sectoral aerospace e-marketplaces, each of them having their own technical and procedural standards for communication and information exchange, resulting in serious problems of compatibility with the practices and information systems of HAI), despite the fact that the majority of HAI's personnel have an engineering background, and even the administrative personnel have been influenced by the 'engineering mentality' of the company. Moreover, the adoption of e-marketplaces is characterised by 'medium to high complexity' in the first pilot, and by 'high' complexity in the second and the third (from technical, organizational and legal viewpoint); this high level of complexity is reflected in the barriers that HAI experienced, which have been discussed in the previous section. Concerning the triability of this innovation, it was assessed as 'high' in all pilots: as all these pilot projects clearly show it can be tried in a small scale, in order to evaluate its capabilities and its appropriateness for HAI, before proceeding to a larger scale adoption. Finally all the members of the project team find that this innovation is characterized by 'medium to high' observability, as its results are visible to a large proportion of HAI's employees and also to many external parties (mainly suppliers and buyers) enhancing the image of HAI. Therefore it can be concluded that the high complexity and the low compatibility with existing practices and systems are the main 'weak' dimensions of this innovation, which means that on these two areas our improvement efforts should focus.

RECOMMENDATIONS FOR B2B E-MARKETPLACES OPERATORS

Based on the findings of this study described in the previous section we developed a set of recommendations of actions that B2B e-marketplaces operators should take in order to increase the participation of large enterprises. In order to 'filter out' findings related strongly to the particular characteristics and context (national and sectoral) of HAI, these

recommendations are based on a subset of the barriers we identified, which i) have been identified by the study of Howard et al. (2006) in large enterprises of the UK automotive sector as well, and ii) are clearly associated and rapidly increasing with large enterprise size, so we expect that they exist — at least to some extent — in many large enterprises. It should be emphasized that even a small increase in the use of B2B e-marketplaces by large enterprises would result in a considerable increase of the overall number and the value of the transactions performed in them, and also would attract to them many additional enterprises of various sizes due to network effects, resulting in a significant boost of the whole digital economy.

In this direction our recommendations, which aim to reduce the above barriers, are:

- The technological infrastructure of B2B e-marketplaces should have appropriate structure and use appropriate technologies that allow the easy (with minimal effort and cost) integration of the big and complex internal information systems of the large enterprises; since most of them are based on ERP systems it is necessary for B2B e-marketplaces to monitor carefully the developments in this area. Taking into account that many significant ERP systems vendors (e.g. SAP) progressively move to web-service technologies and service-oriented architectures (Fuss et al., 2007), it would be useful for B2B e-marketplaces to move in this direction as well.
- The information systems of the B2B e-marketplaces should be highly flexible, so that they can be adapted to the different highly complex internal processes, rules and regulations of various participating large enterprises, and also have all the required functionality for covering their specific needs (e.g. support and improve the procurement and sales processes of the participating large enterprises, support central monitoring of all purchases, different prices for large multi-product orders (based on their total value), negotiations between buyers and sellers, etc.).
- It is necessary to develop common technological and procedural standards for the communication and the exchange of information with all B2B e-marketplaces, possibly based on the ebXML framework (Chappell et al., 2001; Choi et al., 2004), which will reduce dramatically the required integration effort and cost in the case of using several B2B e-marketplaces.
- The interfaces of the B2B e-marketplaces used by the employees of the participating enterprises should be user-friendly (i.e. enable completion of main tasks in a small number of steps, have structured and understandable screens, provide sufficient error messages, enable simple but effective log-in procedures, etc.); this would minimise the required training of the employees, and also their fears, hesitations and resistances.
- It is necessary that the B2B e-marketplaces generate and maintain high levels of trust between the participating enterprises, which is an important prerequisite for large enterprises to adopt them. For this purpose B2B e-marketplaces should have effective mechanisms for screening enterprises applying for registration and participation, rules of trading conduct, continuous assessment mechanisms of all participating enterprises, and also sanctions against enterprises not following the rules and exhibiting improper trading behaviour.

CONCLUSIONS AND LESSONS LEARNT

This paper investigates the main barriers to the adoption of B2B e-marketplaces by large enterprises, which constitute the main negative factors hindering the adoption. At the same time, in order to have a complete view (and not only the negative dimensions) it also investigates the main benefits for the large enterprises from participating in B2B e-marketplaces, which on the contrary constitute the main positive factors pushing in the opposite direction and favouring the adoption. Our research has been based on a case study of the three failed pilot attempts of the Hellenic Aerospace Industry (HAI), one of the largest industrial enterprises of Greece, to adopt e-marketplaces.

Our general conclusion is that there were several significant barriers to the adoption of B2B e-marketplaces by HAI, but also at the same time there are significant benefits to be gained. In particular, it has been found that the basic barriers faced by HAI for adopting B2B e-marketplaces were mainly of technological and organizational nature: difficulties of integration of its large and complex internal information systems with the e-marketplaces, lack of common technological and procedural standards for the communication and the exchange of information with all e-marketplaces, inconsistency with existing internal processes, rules and regulations, hesitation and unwillingness of some employees and lack of trust to unknown suppliers. Another interesting conclusion is that the barriers faced by HAI for adopting B2B e-marketplaces are quite different from the ones faced by SMEs according to the relevant literature, which justifies the focus of the present study on the large enterprises.

Also it has been found that HAI in its first attempts to adopt e-marketplaces, due to lack of experience in this area did not exploit the full potential of these technologies, focusing mainly on 'efficiency-related' benefits, while neglecting other possible categories of benefits associated with novelty, complementarities and lock-in. In particular, the main benefits HAI sought from participating in B2B e-marketplaces were: improvement of procurement processes (decrease of paperwork, administrative cost, search-request-reply-approval-delivery time), reduction of inventory, improvement of purchases central monitoring and decision making and also lower procurement costs and quicker delivery. These identified benefits of HAI are quite different from the ones found for the SMEs as reported in the relevant literature. These conclusions provide additional justification of the focus of the present study on the large enterprises.

Viewing the adoption of e-marketplaces by HAI as an innovation, we analysed it using the innovation diffusion theory of Rogers (2003) and concluded that it is characterized by medium to high relative advantage and observability and high trialability, which favour the adoption; at the same time it is characterized by high level of complexity and low level of compatibility with existing practices and systems (both of them being clearly associated with its large size), which greatly hinder the adoption.

However, it would be wrong to generalize indiscriminately our findings to the broader issue of B2B marketplace adoption by large enterprises. It should be taken into account that some of our findings might be associated with the specific characteristics and context (national and sectoral) of HAI. In particular, for some of its trading activities HAI is an 'oligopoly' and an 'oligopsonio', with many of its products and services being purchased by the Greek Air Forces and possibly some more large customers. In addition, HAI, as a state-owned company, is likely to suffer from the Greek public sector's endemic problems of bureaucracy, inertia, political meddling, legalism and risk

avoidance. Finally, one should also take into account cultural issues (Hsiao, 2003) associated with a company operating in a 'late development' country of the 'semi-periphery', lacking a tradition of adoption and use of sophisticated technologies and business and technology innovation. Therefore the barriers to and benefits from e-marketplaces adoption identified by this study might be affected to some extent by its particular context. On the other hand it should be noted that for these reasons the findings of this case study were further processed in order to 'filter out' the ones strongly related to the particular characteristics and context (national and sectoral) of HAI: in a first stage the identified barriers and benefits were compared with the ones identified by the study of Howard et al. (2006) in large enterprises of the automotive sector; then in a second stage it was examined which of them are associated and rapidly increasing with large enterprise size. Finally our main conclusions and recommendations were based on the subset of the initially identified barriers and benefits, which were retained after the filtering conducted in these two processing stages.

Further research (e.g. through additional case studies, surveys, etc.) is required for testing these conclusions in other contexts as well for understanding in depth the barriers and benefits of participating in e-marketplaces for enterprises of various sizes in various sectoral and national contexts. Also further research should be conducted in order to find ways of maximizing the benefits from the e-marketplaces by exploiting their potential for value creation (e.g. various ways of achieving novelty, complementarities, etc.) and also ways of overcoming the above barriers, e.g. procedural and technological standards for the communication and the exchange of information with the e-marketplaces, new architectures of internal information systems and e-marketplaces that enable an easier integration, new legislation, regulations and rules concerning electronic transactions via e-marketplaces or other electronic channels, methods of trust building in electronic transactions and strategies for reducing resistances to the introduction of such innovations.

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REFERENCES

Amit, R. and Zott, C. (2001). Value creation in e-business. Strategic Management Journal, 22, 493–520.

Asher, A. (2007). Developing a B2B E-Commerce Implementation Framework: A Study of EDI Implementation for Procurement. Information Systems Management, 24, 373–390.

Avison, D. E., Lau, F., Myers, M. D. and Nielsen, P. A. (1999). Action research. Communications of the ACM, 42(1), 94–97.

Bakos, J. Y. (1991). A strategic analysis of electronic marketplaces. MIS Quarterly, 15(3), 295–310.

Bakos, J. Y. (1998). The emerging role of electronic marketplaces on the Internet. Communications of the ACM, 41(8), 35–42.
Baron, J. P., Shaw, M. J. and Bailey Jr., A. D. (2000). Web-based E-catalogue systems in B2B procurement. Communications of the ACM, 43(5), 93–106.
Barrett, M. (1999). Challenges of EDI Adoption for Electronic Trading in the London Insurance Market. European Journal of Information Systems, 8(1), 1–15.
Barratt, M. and Rosdahl, K. (2002). Exploring business-to-business market sites. European Journal of Purchasing and Supply Management, 8(2), 111–122.
Bartels, A. (2004). Trends 2005: eMarkets Consolidation And Shakeouts Shrink the Number of eMarkets. Forrester Research, IT View Research Documents.
Benbasat, I., Goldstein, D. and Mead, M. (1987). The Case Research Strategy of Information Systems. MIS Quarterly, 11(3), 369–386.
Chappell, D., A., Chopra, V., Dubray, J., Evans, C., Harvey, B., McGrath, T., Nickull, D., Noordzij, M., Peat, B., van der Eijk and P., Vegt, J. (2001). Professional ebXML Foundations, Wrox Press, UK.
Choi, B., Raghu, T. S. and Vinze, A. (2004). Addressing a standards creation process: a focus on ebXML. International Journal of Human Computer Studies, 61, 627–648.
Culledge, T. (2002). B2B eMarketplaces and small- and medium-sized enterprises. Computers in Industry. v49, 47–58.
Dai, Q. and Kauffman, R. (2002). B2B E-Commerce Revisited: Leading Perspectives on the Key Issues and Research Directions. Electronic Markets, 12(2), 67–83.
Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319–340.
European Commission (2003). Report of the Expert Group on B2B Internet trading platforms. Brussels, Belgium.
European Commission (2004). The European E-Business Report 2004. Brussels, Belgium.
European Commission (2007). The European E-Business Report 2006/2007. Brussels, Belgium.
Farhoomand, A. F., Tuunainen, V. K. and Yee, L. W. (2000). Barriers to global electronic commerce: a cross-country study of Hong Kong and Finland. Journal of Organizational Computing and Electronic Commerce, 10(1), 23–48.
Ferro, E. and Dadayan, L. (2006) Can Government Be a Good eBayer? The Use of Online Auctions in the Sale of Surplus Property, *HICSS '06: Proceedings of the 39th Annual Hawaii International Conference on System Sciences.* Vol.4, pp. 68–68.
Fuss, C., Gmeiner, R., Schiereck, D. and Strahringer, S. (2007). ERP Usage in Banking: An Exploratory Survey of the World's Largest Banks. Information Systems Management, 24, 155–171.
Grieger, M. (2003). Electronic marketplaces: A literature review and a call for supply chain management research. European Journal of Operational Research, 144, 280–294.
Gulledge, T. (2002). B2B e-marketplaces and small and medium sized enterprises. Computer in Industry, 49(1), 47–58.
Howard, M., Vidgen, R. and Powell, P. (2006). Automotive e-hubs: Exploring motivations and barriers to collaboration and interaction. Strategic Information Systems, 15, 51–75.

Hsiao, R. (2003). Technology fears: distrust and cultural persistence in electronic marketplace adoption. Strategic Information Systems, 12(3), 169–199.
Jacobson, S., Shepherd, J., D'Aquila, M. and Carter, K. (2007).The ERP Market Sizing Report, 2006–2011. AMR Research – Market Services Report, Boston, MA.
Johnston, H. R. and Vitale, M. R. (1988). Creating competitive advantage with inter-organizational information systems. MIS Quarterly, 12(2), 153–165.
Joo, Y. and Kim, Y. (2004). Determinants of corporate adoption of e-Marketplace: an innovation theory perspective. Journal of Purchasing and Supply Management, 10, 89–101.
Kjølseth, B. B. (2005). The Evolution of e-Marketplaces: Are they Useful to Small Companies?", accessed for the eMarket Services website www.emarketservices.com
Kumar, R. L. and Crook, C. W. (1999). A multi-disciplinary framework for the management of inter-organizational systems. Database for Advances in Information Systems, 30(1), 22–37.
Laceter, T., Long, B., Vapers, C. (2001). B2B Benchmark: the state of electronic exchanges. Booz Allen Hamilton, USA
Lee, A. S. (1989). A Scientific Methodology for MIS Case Studies. MIS Quarterly, 13(1), 33–52.
Lee, H. G. and Clark, T. H. (1997). Market process reengineering through electronic market systems: opportunities and challenges. Journal of Management Information Systems, 13(3), 113–137.
Lee, Y., Kozar, K. A., Larsen, K. R. T. (2003). The technology acceptance model: past, present, and future. Communications of the Association for Information Systems 12(50), 752–780.
Malone, T. W., Yates, J. and Benjamin, R. I. (1987). Electronic markets and electronic hierarchies. Communications of the ACM, 30(6), 484–497.
Maylor, H. and Blackmon, K. (2005). Researching Business and Management. Palgrave-Macmillan, New York, USA.
Miller, J. (2001). Lessons from the e-marketplace shakeout. Pharmaceutical Technology, 25(5), 52–54.
Mouzelis, N. (1986). Politics in the semi-periphery: Early parliamentarism and late industrialization in the Balkans and Latin America. MacMillan, London, UK.
Mouzelis, N. (2002). From reform to modernization. Themelio Publications, Athens, Greece.
Organization for Economic Cooperation and Development (OECD) (2007). Science, Technology and Industry Scoreboard 2007. OECD Report, Paris, France.
Premkumar, G., and Ramamurthy, K. (1995). The role of inter-organizational and organizational factors in the decision mode for adoption of inter-organizational systems. Decision Sciences, 26(3), 303–337.
Robson, C. (2004). Real World Research — Second Edition. Blackwell Publishing, UK.
Rogers, E. (2003). Diffusion of Innovations — Fifth Edition: The Free Press, New York, USA.
Stockdale, R. and Standing, C. (2004). Benefits and barriers of electronic marketplace participation: an SME perspective. Journal of Enterprise Information Management, 17(4), 301–311.

Stowers, G. L. (2001). Commerce comes to government on the desktop: E-Commerce applications in the public sector. Abramson, M. A. and Means G. E. (editors). *E-Government 2001*. Rowman & Littlefield Publishers. 44–84.
Tumolo, M. (2001). Business-to-Business Exchanges. Information Systems Management, 18(2), 1–9.
Truman, G. E. (2000). Integration in electronic exchange environments. Journal of Management Information Systems, 17(1), 209–244.
Turban, E., King, D., Lee, J. and Viehland, D. (2006). Electronic Commerce – A Managerial Perspective 2006 – Fourth Edition. Pearson Prentice Hall, New Jersey, USA.
Wang, S., Zheng, S., Xu. L. Li, D. and Meng H. (2008). A literature review of electronic marketplace research: Themes, theories and an integrative framework. Information Systems Frontier, 10(5), 555-571.
Williams, M. L. and Frolick, M. N. (2001). The evolution of EDI for competitive advantage: The FEDEX Case. Information Systems Management, 18(2), 1–7
Whyte, A., Daniel, E., Ward, J. and Wilson, H. (2007). The adoption of consortium B2B e-marketplaces: An exploratory study. Strategic Information Systems, 16, 71–103.
Wyld D. C. (2001). The Auction Model: How the Public Sector Can Leverage the Power of E-Commerce through Dynamic Pricing.. Abramson, M. A. and Means G. E. (editors). E-Government 2001. Rowman & Littlefield Publishers.
Yin, R. K. (2002), Case Study Research: Design and Methods—Third edition. Sage Publications, California, USA.