



Analysis of E-marketplace Attributes: Assessing The NATO Logistics Stock Exchange

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Abstract

E-marketplaces can be beneficial when used for the procurement of maintenance, repair and operating (MRO) supplies. Our study identifies both effectiveness- and efficiency-related attributes of e-marketplaces for procurement. We then examine these attributes using an actual e-marketplace for MRO items in a military setting. In our research, we surveyed users of the NATO logistics stock exchange (NLSE) to obtain perception ratings of both the importance and performance by the NLSE on each of these attributes. The resulting classification of e-marketplace attributes both indicates which attributes are highly valued by users, as well as identifies on which attributes an organisation such as the NLSE should focus its efforts for higher user satisfaction. Efficiency-related attributes appear to be most valued by NLSE users.

Keywords: e-Marketplaces, MRO, Military Logistics, Procurement, NATO

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Introduction

Studies on e-procurement and e-marketplaces are mainly focussed on the procurement of raw materials and production goods (Harink, 2003). Research on e-procurement and e-marketplaces rarely addresses the procurement of maintenance, repair and operating (MRO) supplies (Croom, 2000; Eng, 2004). A considerable share of companies' procurement activities, however, is allocated to the procurement of MRO items. Typically, MRO items account for 80% of the procurement department personnel workload while representing only 20% of the organisation's purchasing dollars (Van Weele, 2005). Due to the low contribution to total purchasing turnover, MRO procurement usually receives little management attention. As a consequence, MRO items tend to be procured in an uncoordinated and decentralized manner, barely providing added value to the company (Croom, 2000). Moreover, Van Weele (2005) argues that MRO procurement is complex and problematic (due to the large assortment of relatively cheap items, many suppliers, and irregular demand). Several authors see the potential of e-marketplaces for reorganizing the MRO supply chain (e.g., Puschmann & Alt, 2005; Shevchenko & Shevchenko, 2005).

Despite considerable investment and high expectations of savings from e-procurement, however, evidence of such benefits is still minimal (Howard, Vidgen & Powell, 2006). In a number of cases, the realised benefits are absent or differ significantly from the expected benefits (Dubelaar, Sohal & Savic, 2005). Subramaniam and Shaw (2004) report that users of different forms of e-procurement are unsure of several factors: the value provided, the factors that affect the value, and how to measure this value. Croom and Johnston's study (2003) could find little measurement and evaluation of e-commerce performance. According to Murtaza, Gupta and Carroll (2004), many e-marketplaces have failed to deliver their promised benefits. Other authors agree that one procurement tool cannot meet all business requirements, and that a portfolio approach is required for exploiting the potential of different e-procurement tools and e-marketplaces (Bartezzaghi & Ronchi, 2004; Kim & Shunk, 2004; Knudsen, 2003). To survive, e-marketplaces should not only offer "core services," but also "value added" services—such as credit, financing and tax activities, transportation and storage, inventory management and reverse logistics (Daniel, Hoxmeier, White & Smart, 2004; Kathawala, Abdou & von Franck, 2004; Shevchenko & Shevchenko, 2005). As transaction characteristics and user needs for non-production goods are varied, the challenge imposed on e-marketplaces to successfully manage MRO procurement is even greater (Subramaniam & Shaw, 2004). Therefore, further research on the contribution of e-marketplaces to the procurement of MRO items is warranted.

This study aims at evaluating the positive effects of e-marketplaces on MRO procurement from a defense logistics user perspective—more specifically, it focuses on the NATO Logistics Stock Exchange (NLSE). The NLSE is a web-based, virtual business place for co-operation in logistics; it links together the armed forces and defence industries of NATO member states that wish to participate. The materials that can be exchanged through the NLSE are defined as, "all active and inactive, consumable and repairable items that have been codified with a NATO Stock Number (NSN), excluding: food, clothing, medical items, ammunition, fuel, crypto and live animals". (p. #). From lifecycle perspective, the NLSE users focus on the replenishment (or resupply) phase and disposal phase of fielded systems, not on initial supply for new military

systems. According to the definition of Kathawala et al. (2002), the NLSE can be characterized as both an “aggregator,” where prices are pre-negotiated, and as a “matcher,” where buyers and sellers negotiate prices real-time. The NLSE is a web-based IT system that is managed by the NATO Maintenance and Supply Agency (NAMSA) in Capellen, Luxembourg—making it a third party e-marketplace. Established in 1958, the NAMSA is NATO’s principal logistics support management agency. The NAMSA’s main task is to assist NATO nations by organizing common procurement and supply of spare parts and by arranging maintenance and repair services necessary for the support of various weapon systems in their inventories. This assistance is available whenever two or more nations operate the same system and have made a conscious decision to use the NAMSA’s support facilities. The NAMSA’s main role is in consolidating nations’ requirements, centralizing logistics management activities, conducting international competitive bidding processes and controlling the cost and quality of the services rendered to customers. The NAMSA’s aim is to ensure that customers receive the very best logistics support available to guarantee the operational readiness of their various weapon and equipment systems. The NAMSA can be accessed easily by users through a secured Internet connection at <https://www.natolog.com>.

Based on the applicable literature, our study proceeds as follows. We first identify the different attributes of e-marketplaces that contribute to effective and efficient MRO procurement. We then report the results of a survey of 64 users of the NLSE regarding these attributes. By applying an importance-performance analysis (IPA) and revised importance analysis (Matzler, Sauerwein, & Heischmidt, 2003), we gain important insights into how the different attributes are valued. This study aims at identifying key benefits (in terms of user value) of e-marketplaces in order for resources to be effectively targeted to deliver these benefits. It also formulates implications for the NLSE as well as further research directions.

Literature Review

Procurement of MRO Supplies

Supplies that are consumed by a firm rather than used to form part of its output are commonly known as MRO supplies, indirect goods or non-production goods. Common problems associated with MRO items are: disproportional workload, an extensive range of items and suppliers, many company-specific items (such as spare parts), and a low and irregular demand for items (Le Sueur & Dale, 1998; Van Weele, 2005). According to Subramaniam and Shaw (2004), MRO procurement suffers from inefficient buying, redundant and disconnected processes and maverick buying (i.e., purchasing outside of the official procurement processes). Puschmann and Alt (2005) state that paper-prone and labour-intensive processes for MRO procurement cause large inefficiencies and considerable error potential. A study about Greek government purchasing (Panayiotou, Gayialis & Tatsiopoulos, 2004) reveals significant delays in the MRO procurement cycle due to mistakes in procurement requisitions, unnecessary and iterative steps in the procurement process, a large number of controls, checking and authorisation, and same-data entry into different applications. Moreover, the use of large numbers of (copies of) documents and the lack of standardisation leads to poor dissemination of information across companies. Le Sueur and Dale (1998) report mismatching invoices in the procurement system.

Kim and Shunk (2004) mention that procurement of indirect goods has received far less attention from organisations than that of direct goods, resulting in little procurement process standardisation for indirect goods. MRO procurement is associated with a significant waste of money, time and personnel capacity, a non-availability of supplies when required, the holding of excessive stocks, and unsatisfied internal customers.

Electronic Marketplaces

The rise of the Internet and the rapid spread of electronic business across world markets have left few industries unchanged (Howard et al., 2006). Internet technology enables enterprises to create marketplaces in which electronic transactions between buyers and sellers can take place (Eng, 2004). These marketplaces are called electronic marketplaces or e-marketplaces. According to Daniel et al. (2004), e-marketplaces enable automated transactions, trading or collaboration between business partners. E-marketplaces can be categorised: by trading mechanism, by ownership (buyer, seller, third-party), by number of owners (one vs. a consortium of owners), by business model, by trading entities (private or public), by type of goods sold (direct or indirect) or by industry orientation (horizontal, vertical or diagonal). Dubelaar et al. (2005) add customer environment (B2B vs. B2C) as an extra categorization. As mentioned above, Kathawala et al. (2002) distinguish aggregators, in which prices are pre-negotiated, from matchers, in which buyers and sellers negotiate prices in real-time. Murtaza et al. (2004) classify e-marketplaces based on the type of supplied goods (direct vs. indirect goods) and buyer/supplier relationship (one-time vs. long-term). This model is depicted in Figure 1. "E-distributors" should be applied when a consumer is spot-sourcing for bottleneck products, while e-procurement should be applied for the systems contracting strategy for routine products.

		Supply	
		Indirect Goods	Direct Goods
Relationship	One-time	E-Distributors <i>Matching, Dynamic pricing</i>	Exchanges <i>Matching, Dynamic pricing</i>
	Long-term	E-procurement Aggregation, Fixed/negotiated pricing	Consortia Aggregation, Fixed/negotiated pricing

Figure 1. Classification of E-marketplaces
(Murtaza, 2004)

Effective and Efficient E-procurement

In general, purchasing performance is considered to be the result of two elements: purchasing effectiveness and purchasing efficiency (Bartezzaghi & Ronchi 2004; Van Weele, 2005). Purchasing for military organisations can especially be viewed in terms of these two metrics.

Table 1 lists the expected benefits of e-marketplace usage on purchasing effectiveness and efficiency.

Table 1. Expected Benefits of E-marketplace Usage on MRO Procurement

Purchasing effectiveness	Purchasing efficiency
Increase in product quality	Reduction of product search time
Reduction of product prices	Reduction of negotiating time
Improvement in delivery performance	Reduction in procurement process costs
Improvement in internal customer satisfaction	Reduction of order processing time
Reduction of stock levels	Reduction of payment processing time
Reduction of excessive stocks	Reduction of maverick buying
Reduction of number of stock-outs	Reduction of number of authorisation stages
Reduction of procurement process failures	Reduction of paperwork
Increase of negotiating power	Improvement in information exchange with partners in the supply chain
Increase in demand forecasting accuracy	
Increase in number of potential suppliers	
Reduction of switching costs between suppliers	
Increase in product selection	
Increase in synchronisation of activities and responsibilities between procurement personnel and internal customers	

Effectiveness refers to the degree to which a previously established goal has been met (Van Weele, 2005). Purchasing effectiveness is often evaluated by the quality of purchased products and services, the costs associated with the purchase and stocks, and customer satisfaction. Purchasing effectiveness is further enhanced by the degree of purchasing clout, the options available to the purchaser and the ease of switching suppliers.

Efficiency refers to the relationship between planned and actual sacrifices made in order to realize a previously established goal (Van Weele, 2005). Purchasing efficiency typically includes the time involved and the number of steps required to complete an order. E-marketplaces will likely be seen as beneficial when they improve the effectiveness as well as the efficiency of the procurement process.

Impact on Purchasing Effectiveness

Effectiveness of the procurement process measures the direct outcome of the procurement process: to what extent the procured item is of the required quality, is affordable and is delivered at the right time and place. Procurement process effectiveness involves the quality of purchasing decisions (Kalakota & Robinson, 2001). Bartezzaghi & Ronchi (2004) conclude that one significant objective (when organisations are aiming for procurement process effectiveness for non-critical materials) is improvement in product quality. Howard et al. (2006) develop a framework for assessing the dissonance between expected and realised benefits of e-marketplaces, and recognise product quality as a motivation for e-marketplace adoption.

According to Panayiotou et al. (2004), the largest savings in business-to-government e-procurement of indirect goods stem from lower product prices due to centralised spending. Murtaza et al. (2004) point to the aggregation of demand within the organisation that can lead to lower product prices. A survey among 92 companies towards main objectives for e-business implementation revealed that 70% of the respondents aim at product price reduction (Croom, 2005).

E-marketplace adoption increases the number of distribution channels and provides organisations the opportunity to transport items outside the internal transportation channels. Bartezzaghi & Ronchi (2004) find that, from a buying perspective, improved delivery performance is a significant benefit of adopting e-marketplaces. Croom and Johnston (2003) focus on the procurement function as an internal service provider for the employees within an organisation. They conclude, based on a qualitative study involving 97 organisations, that the adoption of e-procurement can lead to increased internal customer satisfaction on the availability of goods, the responsiveness of the procurement department (speed), flexibility (range of products) and care (fast problem resolution).

Considering trends in the development of business-to-business e-Hubs, Shevchenko and Shevchenko (2005) identify inventory management as an added value provided by e-marketplaces. For structured procurement at a large manufacturer of heavy equipment, Subramaniam and Shaw (2004) show that the value of e-marketplaces stems mainly from

inventory savings. Michaelides, Ho, Boughton & Kehoe (2003) report that e-marketplaces provide real-time insight in stock levels at supply-chain partners—enabling lower stock levels in the entire supply chain and, thus, at the individual organisations' warehouses. One of the main advantages of the e-business adoption for two Italian motorcycle companies has been the optimization of the number of warehouse spare parts (Muffatto & Payaro, 2004). Eng (2004) distinguishes the possibility of communicating both “stock-outs” as excessive stock levels with partners in the supply chain through e-marketplaces.

Subramaniam and Shaw (2004) further show that the added value of e-marketplaces lies in the reduction of transaction errors, especially for low and moderate demand levels of MRO supplies. Muffatto and Payaro (2004) report a reduced number of mistakes related to procurement after e-business adoption. Croom (2005) argues that a major impact of e-business comes from its role as a mechanism for improved control of supply through collaborative demand forecasting. Based upon extensive literature reviews and case studies in the Italian motorcycle industry, Muffano and Payaro (2004) confirm that the next step in the evolutionary path of e-marketplaces is a stronger collaboration within the supply chain. This enables better demand planning based upon analysis of historical demand data.

Subramaniam and Shaw (2004) report that better information visibility of business processes leads to more negotiating power for the buying organisation. Puschmann and Alt (2005) support this view, stating that the lower transactional burden in the procurement process frees time for the procurement department to focus on negotiating—for instance, when spot-sourcing for bottleneck products or establishing long-term contracts with suppliers (systems contracting) for routine products.

Several authors (Murtaza et al., 2004; Kathawala et al., 2002) emphasize e-marketplaces' potential to provide buyers with increased access to products and vendors. According to Eng (2004), e-marketplaces remove geographical barriers; therefore, buyers can more easily find supply options and explore new markets. Subramaniam and Shaw (2004) assert that switching costs between suppliers are practically absent through the use of e-marketplaces.

Croom (2000) describes how the procurement function can be fragmented across the organisation in large enterprises. Also, a lack of direct contact between procurement personnel and internal customers often occurs at such organisations. E-marketplaces, by delivering transparent information in real-time, can increase coordination between procurement personnel and internal customers and synchronise their activities and responsibilities. Subramaniam and Shaw (2004) argue that e-marketplaces support complex coordination within the organisation. During the fulfilment of an order, for instance, procurement personnel frequently need to communicate and exchange information with the internal customer. A web-based procurement system can provide real-time and effective information exchange at lower communication costs.

Impact on Purchasing Efficiency

Bartezzaghi & Ronchi (2004) distinguish procurement process efficiency from procurement process effectiveness. They conclude that companies adopting e-marketplaces for procurement of non-critical materials aim at increasing procurement process efficiency and lowering

procurement process costs. A main attribute of increased procurement process efficiency is the reduction of product searching costs and time: e-catalogues should be defined and uploaded by the supplier or third party without requiring the customer to be highly involved. Puschmann and Alt (2005) emphasize that products with a high degree of coordination effort with the supplier but with a low frequency order are not suitable candidates for e-procurement.

Croom (2005) concluded that an important objective of e-business is an overall reduction of procurement process costs. Knudsen (2003) assesses the value of e-marketplaces on “rents” (above normal rates of return) and concludes that the main value-adding mechanism for e-MRO procurement lies in the reduction of transaction costs. Dubelaar et al. (2005) investigated companies adopting e-marketplaces and found few differences between expected and derived procurement process-cost reduction.

Murtaza et al. (2004) focus on the “facilitation” functionality of e-marketplaces for increasing the efficiency of the procurement process; e-marketplaces enable automated posting of RFP/RFQ, bidding and negotiating. Subramaniam and Shaw (2004) argue that this “market-making” functionality of e-marketplaces can replace a number of human-intensive tasks. For instance, Panayiotou et al. (2004) expect the Greek government to save 20% on human resources utilisation when evaluating tenders. Moreover, e-marketplaces employing the aggregation mechanism for systems contracting (thus, pre-negotiated, fixed, product prices) reduce the entire negotiating process.

Principal actions in the settlement phase are order generation, order placement, order tracking and items receiving (Kim & Shunk, 2004). Extensive literature is available on the contribution of e-marketplaces to order process automation; these studies focus mainly on the benefits of reducing manual actions and removing unnecessary, iterative, steps in the purchase order process (Dubelaar et al., 2005; Murtaza et al., 2004; Shevchenko & Shevchenko, 2005). Invoice verification (i.e., matching the invoice with the submission of the order and delivery of the product) is an e-marketplace effect that especially contributes to a lower transactional burden (Puschmann & Alt, 2005). Also, Kathawala et al. (2002) conclude that Grainger.com, a successful third-party MRO Hub engaging in systematic sourcing with buyers, offers added value to its customers by providing further streamlining of the procurement process through payment automation. When deciding on the adoption of e-marketplaces for the procurement of indirect goods, Kim and Shunk (2004) strongly recommend an organisation integrate the e-marketplace within its back-office purchasing or financial system.

A study in automotive industries revealed that improved procurement efficiency in general—and control over Maverick spending in particular (i.e., off-process procurement, such as cash purchases of low-value items with subsequent reimbursement)—are benefits that have both been realised as expected for non-production goods (Howard et al., 2006). Croom and Johnston (2003) found that employees with access to e-procurement systems appreciate their “ease and speed of use” and now refrain from such maverick purchases.

Another way of increasing the efficiency of the MRO procurement process is by lowering the number of authorisation stages. Based on a benchmark study of five companies that successfully implemented e-marketplaces for indirect procurement, Puschmann and Alt (2005) found the

reduction of authorisation stages is an e-marketplace effect that significantly contributes to more efficient MRO procurement. Moreover, Kim and Shunk (2004) state that e-procurement systems can provide automatic requisition approval based upon authorisation rules. Puschmann and Alt (2005) show that the implementation of e-marketplaces has provided organisations the opportunity to redesign existing business processes and focus on elimination of paperwork. Howard et al. (2006) have conducted a case study at Ford motor company demonstrating that minimising paper transactions is a benefit both expected and realised.

In the empirical study by Croom (2005), 46% of the respondents expected the adoption of e-procurement to improve the information flow with their supply-chain partners. Muffato and Payaro (2004) report increased knowledge transfer about suppliers, products, product prices and inventory levels between supply-chain partners through e-marketplaces. Eng (2004) concludes that the improved information flow offered by e-marketplaces contributes to the cooperation between supply-chain partners.

Methodology

We have identified a large number of effectiveness- and efficiency-related benefits of e-marketplace procurement that may reduce MRO problems. To assess both the importance and performance of these benefits, a survey was conducted among users of the NATO Logistics Stock Exchange (NLSE), an e-marketplace focussed on MRO supplies. A structured questionnaire was considered appropriate, given the geographical distribution of NLSE users (Europe, USA and Canada) and the need for anonymity. Users of the NLSE were asked to state the importance and performance (from a procurement perspective) of all 23 e-marketplace attributes (as listed in Table 1) based upon a 5-point Likert scale (Matzler, Bailom, Hinterhuber, Renzl & Pichler, 2004). Prior to conducting the survey, the researchers submitted a clear and concise formulation of the questionnaire items to be checked and verified by personnel of the NAMSA that manage the NLSE. The collection of responses took place in four iterations from April to late September 2006. During the NLSE User Conference (held 10 and 11 April 2006 at the NAMSA's premises in Capellen, Luxembourg), a presentation was given on this study, and the questionnaire was distributed in hardcopy. Between May and August 2006, the questionnaire was submitted three times per e-mail to all NLSE users listed in the NAMSA's database.

In the main section of the questionnaire (reproduced in Appendix 1), respondents were asked to state their opinion on the importance of each of the 23 attributes for electronic markets in general, and the performance of the NLSE on that attribute in particular. Answers could be given on a 5-point scale, where: 1 = "very low," 2 = "low," 3 = "not low, not high," 4 = "high," 5 = "very high." The total number of valid responses (i.e., from respondents with actual experience in the NLSE from a procurement perspective) was 64 ($n = 64$). The number of NLSE users is estimated at 180 ($N = 180$). The NLSE survey response rate is calculated as $(n/N) \times 100\% = 36\%$.

Analysis

The original importance/performance analysis (Martilla & James, 1977) yields insights on which quality (product or service) attributes a firm should focus in order to achieve customer satisfaction. Based upon customer-perceived importance and performance of these quality attributes, a two-dimensional matrix can be constructed with the means of the performance and importance dividing the matrix into four quadrants. Attributes with high importance and high performance represent opportunities for gaining or sustaining competitive advantage. The company should “Keep Up the Good Work.” A firm should immediately pay attention to attributes with a high importance and a low performance: “Concentrate Here.” Attributes of low importance and of low performance deserve no extra effort; instead, they should remain a “Low Priority.” Low importance and high performance are indications of a “Possible Overkill” and imply that resources committed to these attributes could be better employed elsewhere.

Implicitly, two assumptions underlie the traditional IPA: (1) attribute performance and attribute importance are independent variables, and (2) the relationship between attribute performance and overall customer satisfaction is linear and symmetric. Recently, however, theoretical and empirical work has shown that both assumptions are not valid per se, which calls into question the applicability of the traditional IPA (Matzler et al., 2004). Therefore, we have conducted a revised importance-performance analysis for our study that is based upon the three-factor customer satisfaction model (Kano, 1984) and the calculation of an implicit attribute importance (Matzler et al., 2003).

As the importance of an attribute can be seen as a function of the performance, Matzler et al. (2003) explain that the relative importance of an attribute cannot be represented correctly by an explicit, self-stated, importance. In order to take the importance-performance relationship into account, an implicit importance needs to be measured that is based upon the correlation between the performance of the attribute and an external criterion, such as the overall customer satisfaction. The stronger this correlation, the more important the attribute (Anderson & Mittal, 2000). Based upon the three-factor customer satisfaction model and the calculation of an implicit attribute importance, Matzler et al. (2003) have proposed the revised Importance matrix, as depicted in Figure 2.

Implicit Importance (Derived Importance)	High	IV High implicit importance/ low explicit importance = “Excitement factors”	I High implicit importance/ high explicit importance = “Performance factors”
	Low	III Low implicit importance/ low explicit importance = “Performance factors (un- important)”	II Low implicit importance/ high explicit importance = “Basic factors”
		Low	High
		Explicit Importance (Self stated importance)	

Figure 2. Revised Importance Matrix
 (Matzler et al., 2003)

The three quality attributes are mapped in the importance matrix as follows:

- Basic factors (low implicit importance, high explicit importance)—Customers regard these attributes as important (high explicit importance), but customer satisfaction will not be increased if a basic factor is fulfilled (low implicit importance).
- Excitement factors (high implicit importance, low explicit importance)—These attributes are not regarded as important by customers (low explicit importance), but if they are delivered, they generate customer delight (high implicit importance).
- Performance factors—These show a linear relationship between attribute performance and overall customer satisfaction. They can be important (high implicit importance, high explicit importance) or unimportant (low implicit importance, low explicit importance).

Results

The implicit importance of each e-marketplace attribute is calculated as Pearson’s correlation coefficient, r , between the attribute performance values and the overall customer satisfaction, while controlling for the self-stated importance for this attribute. Table 2 shows the calculated implicit importance as well as the self-stated (explicit) importance scores.

Table 2. Explicit (self-stated) Importance and Implicit Importance for E-marketplaces' Attributes

	Attribute	Explicit import	Implicit import		Attribute	Explicit import	Implicit import
1.	Reduction of product search time	4,14	0,181	13.	Improvement in delivery performance	3,84	0,209
2.	Reduction of negotiating time	3,87	0,071	14.	Improvement in internal customer satisfaction	4,02	0,151
3.	Reduction of order processing time	4,27	0,317	15.	Reduction of stock levels	3,87	0,484
4.	Reduction of payment processing time	3,84	0,365	16.	Reduction of excessive stocks	3,81	0,296
5.	Reduction of Maverick buying	3,69	0,389	17.	Reduction of number of stock-outs	3,84	0,199
6.	Reduction of the number of authorisation stages	3,80	0,017	18.	Increase in demand forecasting accuracy	3,70	0,238
7.	Reduction of paperwork	4,09	0,126	19.	Increase in number of potential suppliers	3,70	0,049
8.	Reduction of procurement process costs	4,20	0,165	20.	Increase in product selection	3,61	0,014
9.	Increase of product quality	3,82	0,245	21.	Reduction in switching costs between suppliers	3,70	0,174
10.	Reduction of product prices	4,02	0,292	22.	Improvement in information exchange with partners in the supply chain	3,98	0,172
11.	Increase of negotiating power	3,69	0,152	23.	Increase of synchronisation of activities and responsibilities between procurement personnel and internal customers	3,60	0,071
12.	Reduction of procurement process failures	3,98	0,298				

With the calculated scores for the implicit attribute importance, an importance-performance matrix can be constructed (Figure 3). The position of the grid is determined by the two overall mean values for explicit attribute importance and implicit attribute importance, which are 3,87 and 0,20 respectively.

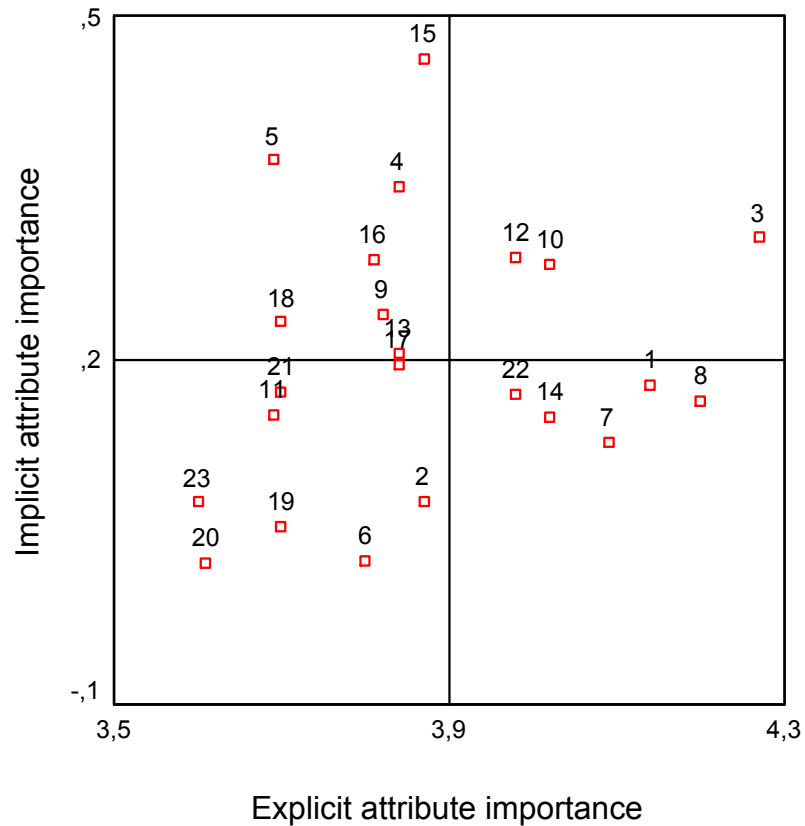


Figure 3. Importance-performance Analysis
 (Numbers Correspond to the Attribute in Table 2)

Discussion

The results of the importance-performance analysis can be analyzed and interpreted by classifying the e-marketplace attributes and distinguishing between the impact on purchasing effectiveness and purchasing efficiency, as shown in Table 3.

Table 3. Classification of Attributes

Attribute	Purchasing effectiveness	Purchasing efficiency	Classification
Reduction of product search time		Efficiency	Basic
Reduction of paperwork		Efficiency	Basic
Reduction in procurement process costs		Efficiency	Basic
Improvement in internal customer satisfaction	Effectiveness		Basic
Improvement of information exchange with partners in the supply chain		Efficiency	Basic
Reduction of order processing time		Efficiency	Important
Reduction of product prices	Effectiveness		Important
Reduction of procurement process failures	Effectiveness		Important
Reduction of payment processing time		Efficiency	Excitement
Reduction of maverick buying		Efficiency	Excitement
Increase in product quality	Effectiveness		Excitement
Improvement in delivery performance	Effectiveness		Excitement
Reduction of stock levels	Effectiveness		Excitement
Reduction of excessive stocks	Effectiveness		Excitement
Increase in demand forecasting accuracy	Effectiveness		Excitement
Reduction of negotiating time		Efficiency	Unimportant
Reduction of authorisation stages		Efficiency	Unimportant
Increase of negotiating power	Effectiveness		Unimportant
Reduction of number of stock-outs	Effectiveness		Unimportant
Increase in number of potential suppliers	Effectiveness		Unimportant
Increase in product selection	Effectiveness		Unimportant
Reduction of switching costs	Effectiveness		Unimportant
Increase in synchronisation of activities	Effectiveness		Unimportant

Basic factors (low implicit importance, high explicit importance) are reduction in product search time, reduction of paperwork, reduction of procurement process costs, improvement in internal customer satisfaction and improvement of information exchange with partners in the supply chain. The NAMSA must ensure that these attributes meet the performance level that is expected by the customer. Most of the attributes in the basic-factor segment imply a positive impact on purchasing efficiency. Users appear to view these attributes as potential dissatisfiers. However, performance above a certain threshold in these areas does not automatically increase customer satisfaction.

Important performance factors (high implicit importance, high explicit importance) are reduction of order processing time, reduction of product prices and reduction of procurement process failures. Merely three out of the 23 attributes are considered as an important-performance factor. A reduction of process time and process failures will result in more satisfied users. A better performance directly means a higher level of customer satisfaction. The NAMSA could, therefore, focus on these attributes, since an increase of performance on these attributes will likely lead to increased overall customer satisfaction.

Excitement factors (high implicit importance, low explicit importance) are reduction of payment processing time, reduction of maverick buying, increase in product quality, improvement in delivery performance, reduction of stock levels, reduction of excessive stocks and an increase in demand forecasting accuracy. Most of the excitement factors are associated with an improvement in purchasing effectiveness. The importance of excitement factors depends on their performance, as an excellent performance has a greater impact on overall customer satisfaction than a poor performance. Obviously, users are surprised by the performance of the NLSE in these areas. The NLSE could consider improving these excitement factors, although the handling of commitment to the basic and important performance factors should take priority.

Table 4 summarizes the performance factors, their related attributes and the recommended focus for the NLSE:

**Table 4. Classification of E-marketplace Attributes,
 including Recommended Customer Satisfaction Strategy**

Performance factor	E-marketplace attributes	Recommended customer satisfaction strategy for the NLSE
Basic factors	reduction of product search time, reduction of paperwork, reduction of procurement process costs, improvement in internal customer satisfaction and improvement in information exchange with partners in the supply chain	Primary focus. Continuously ensure these attributes meet the expected performance level.
Important performance factors	reduction of order processing time, reduction of product prices and reduction of procurement process failures	Primary focus. Continuously ensure these attributes meet the expected performance level.
Excitement factors	reduction of payment processing time, reduction of Maverick buying, increase in product quality, improvement in delivery performance, reduction of stock levels, reduction of excessive stocks and increase in demand forecasting accuracy	Secondary focus. Can lead to higher satisfaction if basic factors and important performance factors are fulfilled.
Unimportant performance factors	reduction of negotiating time, reduction of number of authorisation stages, increase of negotiating power, reduction of number of stock-outs, increase in number of potential suppliers, increase in product selection, reduction of switching costs between suppliers and increase in synchronisation of activities and responsibilities between procurement personnel and internal customers	Unimportant. Focus on the other attributes.

Unimportant performance factors (low implicit importance, low explicit importance) are reduction in negotiating time, reduction of number of authorisation stages, increase of negotiating power, reduction of number of stock-outs, increase in number of potential suppliers, increase in product selection, reduction of switching costs between suppliers and increase in synchronisation of activities and responsibilities between procurement personnel and internal customers. Most of the unimportant performance factors, too, are associated with an improvement of purchasing effectiveness. The impact of these factors on overall customer satisfaction can be considered marginal.

Conclusions and Implications

The buying and handling of MRO supplies are traditionally associated with inefficient and ineffective procurement processes. E-marketplaces could be beneficial for the procurement of MRO supplies. So far, few studies have reported on MRO procurement, particularly in relation to e-marketplaces. Our study identified 23 theoretical attributes of using e-marketplaces for procurement of MRO items. These attributes are further examined from both the importance and performance perspective, using the NATO Logistics Stock Exchange—an actual e-marketplace for MRO items in a military setting. It was found that users expect a minimal performance in attributes that are likely to improve the purchasing efficiency. However, users classify the purchasing effectiveness attributes as unimportant factors and, in other cases, as excitement factors. The management of the NLSE (the NAMSA) could focus on other attributes in its attempt to improve internal user satisfaction. Users value a reduction of order processing time, a reduction of product prices and a reduction of process failures.

Electronic marketplaces and MRO procurement are rather comprehensive concepts in the field of supply chain management. To contribute to the theoretical knowledge in these areas, the scope of our study was restricted. It is recommended that further research include other types of e-marketplaces, for example: supplier-owned or buyer-owned e-marketplaces, private e-marketplaces, non-governmental e-marketplaces, e-marketplaces focusing on non-MRO items, and B2C e-marketplaces.

Distinguishing between “core services” and “value added services” provided by e-marketplaces could be a useful research avenue as well. Daniel et al. (2004), Kathawala et al. (2004) and Shevchenko and Shevchenko (2005) stated that e-marketplaces should also offer “value added” services such as credit, financing and tax activities, transportation and storage, inventory management and reverse logistics tools in order to survive.

MRO items can be classified as either non-critical (with a low supply risk) or bottleneck (with a high supply risk). Non-critical items require efficient processing, product standardization, order volume and inventory optimization. On the other hand, the procurement of bottleneck items requires assurance of supply, vendor control, security of inventories and backup plans (Kraljic, 1983; Olsen & Ellram, 1997; Gelderman & Van Weele, 2003; 2005). Future studies may assess the benefits of e-market places by departing from the distinction between non-critical and bottleneck items.

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Appendix 1 Questionnaire

We would like to know your opinion on 23 attributes of electronic marketplaces in general and the NLSE in particular. For each attribute, you are asked to state your opinion on:

the *importance* of that attribute for electronic markets in general, and

the *performance* of the NLSE on that attribute.

The answers are measured on a 5-point scale, where:

1 = “very low”

2 = “low”

3 = “not low, not high”

4 = “high”

5 = “very high”

Please give your answers by encircling the answer of your choice.

All questions should be answered from NSLE users’ buying perspective.

Attribute	Importance of this attribute in general	Performance of the NLSE on this attribute
Reduction of product search time	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Reduction of negotiating time	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Reduction of order processing time	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Reduction of payment processing time	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Reduction of maverick buying (maverick buying = employees buy articles from a source other than the supplier with whom the company has negotiated a framework agreement)	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Reduction of the number of authorisation stages	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Reduction of paperwork	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Reduction of procurement process costs	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Increase of product quality	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Reduction of product prices	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Increase of negotiating power	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Reduction of procurement process failures	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Improvement in delivery performance	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Improvement in internal customer satisfaction	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Reduction of stock levels	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Reduction of excessive stocks	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Reduction of number of stock-outs	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Increase in demand forecasting accuracy	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Increase in number of potential suppliers	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Increase in product selection	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Reduction in switching costs between suppliers	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Improvement of information exchange with partners in the supply chain	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Increase in synchronisation of activities and responsibilities between procurement personnel and internal customers within the organisation	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
How satisfied are you on the NLSE on a scale from 1 to 10? (overall satisfaction)		