OPTIMIZING E-PROCUREMENT IN HOSPITALS: A PRACTICAL FRAMEWORK

Christos BIALAS, Lecturer, Department of Applied Informatics, University of Macedonia, Thessaloniki, Greece
Department of Accounting and Finance, Alexander TEI of Thessaloniki, Greece

Vicky MANTHOU, Professor, Department of Applied Informatics, University of Macedonia, Thessaloniki, Greece

Constantinos J. STEFANOU, Professor, Department of Accounting and Finance, Alexander TEI of Thessaloniki, Greece

Although hospitals need to utilize expertise and technology in order to enhance their sourcing processes, the diffusion of e-procurement appears to be relatively slow. Case study based research identified the need for practical frameworks aiming at providing healthcare practitioners with simple to implement approaches for initial e-procurement rollouts as well as for the improvement of ongoing e-procurement efforts.

The goal of the current study was to provide procurement managers in hospitals with a decision support model in order to complement their judgment, knowledge and experience with readily available tools and techniques for the purpose of optimizing their e-procurement efforts. The indicative application of the proposed methodology at a major public hospital in Greece shows a more than three-fold increase in cost savings, thus supporting the value of the suggested framework.

Keywords: hospital e-procurement, hospital e-sourcing, ABC-XYZ Analysis

INTRODUCTION

Managing the supply chain efficiently has a significant impact on an organization’s performance [1], however it has proven to be a task of high complexity [2]. Especially in the healthcare industry, supply chain management (SCM) is characterized by an additional dimension of complexity, as it can impact people’s wellbeing and even people’s lives [3]. Considering the technology advances in various supply chain related areas, such as inventory management and procurement, research needs to provide healthcare practitioners with tools and techniques to improve the efficiency and effectiveness of the supply chain by reducing associated costs and improving patient safety [4]. In this context, the presented case study focused initially on examining the role of procurement enabling technologies such as e-sourcing and e-purchasing as part of the hospital–supplier integration in the healthcare environment. Based on the initial findings and based on the quantification of the benefits of e-procurement technologies implemented in a major Greek public hospital, a practical framework for the improvement of e-procurement performance was proposed and validated.

The General Hospital KAT (GHK), a major Greek public hospital, was selected for the case study, as it is considered to be among the pioneers of utilizing e-enabling technologies for procurement in the Greek healthcare sector. The major drivers for the introduction of e-sourcing and e-purchasing at the GHK were the expected cost savings due to lower purchasing prices and reduced administrative costs, and the reduced purchasing cycle times. Furthermore, the streamlining of the procurement processes resulting in freeing up resources for more value added activities and the improved ability to monitor and control these activities were targeted. The cost of the implementation of e-procurement tools did not represent a barrier, as no investment needed to be made in infrastructure, information systems or software development. GHK utilized solutions readily available by Application Service Provid-

ers (ASPs) on a subscription basis and did not perform any type of business process reengineering.

In the two years following the implementation of the e-sourcing tools, GHK’s procurement department extensively used e-auctions and e-RFx (electronic Request for Proposal/Quote/Information/Tender) as part of the procurement department’s sourcing activities for the procurement of medical, surgical, IT-related and other supplies. As a result of this, GHK managed to:

- generate cost savings
- drastically reduce the average time between the invitation and the response from the suppliers
- significantly increase the average number of invitations by tender

This success was attributed among others to the high user acceptance and upper management support. However, it should be noted that the adoption of e-procurement technologies did not lead to any organizational or process changes. Thus, the strategic impact of e-technologies on SCM effectiveness and patient safety in a healthcare setting could not be verified. Regarding the key aspect of cost savings, it should be pointed out that the total cost reduction due to the new purchasing prices achieved compared to the previous purchasing prices obtained by using the traditional purchasing tools, was calculated to be 6.19%. However, examining the results on an item by item basis, the price reductions were ranging from insignificant levels (close to 0%) to very high levels (up to 46%).

Thus, it became evident that the savings potential due to the adoption of e-procurement technologies varies widely depending on the categories of purchased items that are targeted, revealing an opportunity for the optimization of e-procurement implementation and performance.

PRACTICAL FRAMEWORK FOR E-PROCUREMENT OPTIMIZATION

The case study showed that the implementation of e-procurement tools is largely intuitive and lacking
methodological foundation. Thus, a methodology for categorizing the various items that are procured through the purchasing department based on their suitability for e-procurement had to be defined, allowing hospital procurement managers to focus on the items that were expected to yield more cost savings, rather than waste their time on items, where the achieved benefits would be incremental. A widely employed technique for the classification of items, especially in the areas of purchasing and inventory management, is the ABC Analysis [5,6]. This classification method can divide the items according to their purchasing value (price per unit multiplied by the purchasing quantity) into the following three categories:

- A (very important items),
- B (moderately important items) and
- C (marginally important items).

There are no fixed thresholds for each of these classes, however A-items generally account for about 10 to 20% of the items, but for 70 to 80% of the purchasing value. B-items are moderate in terms of percentage of total items and purchasing value and C-items may represent 50 to 60% of the items, but only 5 to 10% of the purchasing value [7]. Although those percentages may vary based on the specifics of each company and the industry sector it belongs to, in most cases relatively few items will account for a large share of the purchasing value [8].

The ABC Analysis approach however is one-dimensional, as it is based on one single metric (in this case the purchasing value), and may not capture additional relevant aspects of an item [9]. Thus, multiple criteria for classifying items should be used, as has been stressed in the literature [10,11,12]. In order to address this issue, besides the purchasing value, a second criterion impacting the suitability of items for e-procurement activities should be identified. Based on the analysis of the achieved cost savings on an item by item basis and based on consultations with the hospitals procurement specialists, the criterion with the highest impact was found to be the price sensitivity of an item, which indicates whether the price of an item is relatively constant or subject to fluctuations. Items with a rather constant price behavior were expected to yield lower cost savings compared to items with fluctuating or irregular price patterns. Thus, a two dimensional classification methodology was introduced (ABC-XYZ Analysis), in order to classify items based on the relevant characteristics of purchasing value and price sensitivity, which would allow their differentiated treatment from an e-procurement perspective.

Consequently, the proposed framework suggests the initial classification of purchased items by means of a classic ABC Analysis based on their purchasing value. Following that, the ABC Analysis is expanded into an ABC-XYZ Analysis by taking the price sensitivity of the items into account. The resulting ABC-XYZ matrix serves as the basis for the identification of the item classes that should be included in e-procurement efforts and of the item classes that should be left out, as the expected cost savings would not justify the required effort for applying the e-sourcing tools.

**RESULTS AND VALIDATION OF THE PROPOSED FRAMEWORK**

For the purpose of applying the suggested framework in GHK, the ABC Analysis of the purchased items was based on their accumulated purchasing value (purchased quantity multiplied by the price) of the previous twelve months and the classification thresholds were set as follows:

- A: 0 - 70% of the accumulated purchasing value
- B: 70 - 90% of the accumulated purchasing value
- C: 90 - 100% of the accumulated purchasing value

The ABC analysis aimed at drawing the procurement managers’ attention on the critical few (A-items) and not on the trivial many (C-items), as shown in the graph that resulted from the analysis of the data (Figure 1).

In order to incorporate the aspect of price sensitivity, an XYZ Analysis was performed in addition to the ABC analysis. Based on the historical purchasing data of the past three years, the XYZ classes were defined as follows:

![Figure 1. ABC Analysis on Purchasing Value](image-url)
• X: Relatively constant price, fluctuations are rather rare
• Y: Fluctuations in price, usually for trend related or seasonal reasons.
• Z: Irregular price pattern

Utilizing the data contained within the hospital’s Enterprise Resource Planning (ERP) system, the materials’ price history of the past three years was analyzed. An item was categorized as a constant price item (X-item) if the percentage variance between the obtained price on a purchase order and the obtained price on the previous purchase order did not show a variance exceeding 5%. Using the 5% threshold for the variance resulted in a categorization of approx. 60% of the items as X-items, which was deemed as adequate for the purposes of the ABC-XYZ Analysis. The remaining 40% of items were categorized as either Y- or Z-items. Since both classes are of increased relevance for the optimization of e-procurement, there was no further effort put into distinguishing items within those two classes, as their treatment would not be differentiated. The combination of these two classification schemes resulted into the following classification matrix (A-X, B-X, C-X, A-Y/Z, B-Y/Z, C-Y/Z) as shown in Figure 2.

<table>
<thead>
<tr>
<th>XYZ Analysis</th>
<th>A (≈10% of items)</th>
<th>B (≈20% of items)</th>
<th>C (≈70% of items)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X (=60% of items)</td>
<td>High purchasing value</td>
<td>Middle purchasing value</td>
<td>Low purchasing value</td>
</tr>
<tr>
<td>(≈6% of items)</td>
<td>Constant price pattern</td>
<td>Constant price pattern</td>
<td>Constant price pattern</td>
</tr>
<tr>
<td></td>
<td>(≈12% of items)</td>
<td></td>
<td>(≈42% of items)</td>
</tr>
<tr>
<td>Y/Z (=40% of items)</td>
<td>High purchasing value</td>
<td>Middle purchasing value</td>
<td>Low purchasing value</td>
</tr>
<tr>
<td></td>
<td>Fluctuating or irregular price pattern</td>
<td>Fluctuating or irregular price pattern</td>
<td>Fluctuating or irregular price pattern</td>
</tr>
<tr>
<td>(≈4% of items)</td>
<td>(≈8% of items)</td>
<td></td>
<td>(≈28% of items)</td>
</tr>
</tbody>
</table>

Based on the ABC-XYZ Analysis, all active purchased items of the hospital were assigned to one of the resulting 6 classes. The proposed approach suggests that procurement managers should focus their e-procurement efforts primarily on items assigned to the categories A-Y/Z and B-Y/Z (grey shaded areas in Figure 2) in order to optimize e-procurement performance, as these are the areas where the highest cost savings potential is expected. Thus, the imple-mentation of the ABC-XYZ Analysis for the hospital’s purchased items identified that the target group of items with the highest saving potential represented approx. 12% of the total purchased items. For a hospital with over 2,000 active purchased items, such as GHK, this would mean that the procurement process should be enriched with e-procurement tools for approx. 250 items in order to optimize the cost reduction potential. It should be pointed out that the categorization of particular purchased items into those classes does not have to be uniform across hospitals, as it depends on parameters that can vary from hospital to hospital. As this categorization is dynamic, it is important to actualize the item classification within consistently defined periodic intervals in order to include possible changes promptly.

In order to initially validate the proposed approach at GHK, the following two parameters were checked. First it was examined whether the results achieved as part of the ongoing e-procurement efforts up to the point of the current study would fall in line with the proposed methodology. More specifically, among the items that were procured using e-sourcing tools, the top 10 items and the bottom 10 items regarding the cost savings achieved were identified and positioned in the ABC-XYZ matrix, based on their classification in respect to their purchasing value and their price sensitivity. The results showed that each one of the top 10 items was classified as A-Y/Z or B-Y/Z item, whereas not a single item out of the bottom was 10 assigned to these two classes. This provided a first positive indication regarding the validity of the assumption, that the highest e-procurement related cost savings were associated with items of high purchasing value and non-constant price patterns. The second check consisted in the selection of the next fifty e-sourcing activities to be performed in GHK by using the ABC-XYZ classification methodology and the calculation of the resulting cost savings. Based on the methodology, items were selected that belong to the A-Y/Z and B-Y/Z classes, such as heart valves, vascular surgery implants, bandages and syringes. On the other hand, items categorized in the remaining four classes, such as blood sampling bags, x-ray supplies, printing supplies and apparel clothing were left out. The average percentage of cost savings achieved as part of these activities was measured to be 20.89%, suggesting a more than three-fold increase compared to the 6.19% measured for all e-sourcing activities that had been performed so far at the hospital without the use of any supporting
methodology. This measurement, inconclusive due to the small size of the events monitored, provides an additional positive indication in support of the proposed framework.

**DISCUSSION**

The case study revealed that the approach to e-procurement activities in the health sector is largely intuitive and is lacking methodological foundation. This aspect negatively impacts the adoption of e-sourcing and e-purchasing tools in hospitals, despite the fact that their implementation leads to cost savings and process improvements. The proposed framework provides hospital purchasing managers with a hands-on approach in order to identify and focus their e-procurement efforts on the relatively few items that have the most potential for cost savings. In order to allow for easy implementability, it utilizes readily available data contained within standard reports offered by a hospital’s ERP System. The initial application of the proposed methodology achieved a three-fold increase in cost savings, while demanding a relatively low implementation effort, as it allowed for a targeted concentration on the few items that were expected to produce the maximum results, leaving out the many items, where no significant improvements were expected.

Overall, the implementation of the proposed framework and the resulting quantifiable improvements presented in this study, strengthen the case that simple methods, tools and techniques, rather than complex algorithms, should be adopted within e-procurement practice in order to increase the impact on supply chain performance. Thus, the current study provides healthcare practitioners with a decision support model in order to complement their judgment, knowledge and experience with readily available tools and techniques for the purpose of improving their procurement decisions, and it aspires to increase the adoption of e-sourcing and e-procurement tools in hospitals.

Regarding the limitations of the study, it should be pointed out, that since the study was undertaken at one hospital, replicating the study across multiple institutions is needed in order to increase its generalizability.

**References**