

PUBLIC HEALTHCARE: CHANGES INTRODUCED WHEN IMPLEMENTING E-PROCUREMENT

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Abstract

The large and growing size of the healthcare public spending for goods and services worries the institutions of many European countries, including Italy, and asks for rationalization initiatives. In parallel, e-procurement solutions spread into Public Administrations (PA's) and introduce innovative processes, primarily in the purchasing phase.

In this scenario, e-procurement has the potential to enable significant efficiency improvements in the public healthcare sector, with the reduction of purchasing and administrative costs. However, most e-procurement initiatives met difficulties and did not fully delivered the expected benefits so far. This is mainly due to the healthcare procurement complexity, specific characteristics and peculiar needs, which involve different supplying methodologies in order to match each purchase type with the appropriate procurement solution. Nonetheless, this topic is seldom dealt with in the studies concerning e-procurement.

This paper draws a framework about e-procurement in healthcare spending and discusses an implementation experience by an Italian Local Healthcare Agency, which is particularly interesting for its long-lasting preliminary experimentation and intended widespread diffusion.

A research was promoted to identify and assess the changes that an extensive adoption of e-procurement introduces in organization and performance, by comparing the old and new methodologies to manage healthcare procurement. The results suggest that implementing e-procurement in a peculiar structure like a public Healthcare Agency can introduce significant changes in purchasing phase and in invoice processing, regarding organizational dimensions and performance measures. At the same time, using different solutions within an integrated approach seems to be a positive choice, as it maximizes the procedural simplifications and the efficiency improvement, without any detriment to the supply quality level needed to deliver critical healthcare services.

Keywords: public e-procurement, healthcare, changes, efficiency, integrated approach.

1 INTRODUCTION

The large and growing size of healthcare public spending for goods and services worries the institutions of many European countries, including Italy, and asks for rationalization initiatives. In parallel, e-procurement solutions spread from business-to-business (B2B) transactions among Companies to business-to-government (B2G) ones, introducing innovative processes in Public Administrations (PA's), with network-based electronic instruments (public e-procurement), mostly in the purchasing phase. In this scenario, two recent European directives (2004/18/EC and 2004/17/EC), according to i2010 eGovernment Action Plan, committed Member States to give the capability of carrying out 100% of procurement electronically to all their PA's, with the threshold of at least 50% of spending managed electronically.

The e-procurement should enable significant efficiency improvements in public healthcare sector, with the reduction of purchasing and administrative costs. However, most e-procurement initiatives – at the country, regional and local levels – met difficulties and did not fully delivered the expected benefits so far. This is mainly due to the healthcare procurement complexity, in terms of variety of goods and number of suppliers, and to the resistances of public institutions to technology-based process innovation. In healthcare, a different approach to the e-procurement opportunities is required, to take into account the specific characteristics and peculiar needs of particular supplies.

The main issue is the highly composite structure of the spending, which includes standard supplies for the whole Public Administration together with very specific purchases, and involves different supplying processes. This issue must be considered together with the statement that a single e-procurement tool cannot meet and support the full spectrum of requirements and processes (Kim & Shunk 2004, Federici et al. 2004). Introducing e-procurement tools in the healthcare sector asks for a detailed analysis of this spending variety, in order to match each purchase type with the appropriate organizational and technological e-procurement solution. The nature of the need (e.g. operating room specific devices) must be clearly defined and purchases must be planned consistently, in order to jointly support healthcare performance and procurement economy.

So far, the e-procurement subject has been discussed mainly by works from other disciplines (like administrative law and PA management), while the innovations in technology and organization have been considered mostly in relation with private operators, particularly marketplaces. A minority of articles deals with the public sector and they are mostly related to the analysis of policies and behaviour of central PA's and central procurement Authorities. More rare are the works on the public healthcare sector, particularly at the local operating level, where policies are often pushed down by a higher authority and approaches to e-procurement are very different.

This paper deals with this topic with an explorative approach, contributing a framework of healthcare spending characteristics together with a taxonomy of e-procurement tools in public healthcare sector, and a discussion on an experience of e-procurement implementation by an Italian Local Healthcare Agency (LHA – Azienda Sanitaria Locale, ASL), which is considered one of the most advanced by the Italian Central Procurement Agency (CONSIP). This experience is particularly interesting for its long-lasting preliminary experimentation, the differentiation of tools according to the specific purchase characteristics and its intended widespread diffusion.

A research was promoted, together with the same LHA and CONSIP, to identify and evaluate in detail the changes that a widespread adoption of e-procurement introduces in organization and performance, by comparing the old and new methodologies to manage healthcare procurement. The research results suggest that implementing e-procurement in a public operating structure with peculiar characteristics like a Healthcare Agency can introduce localized but significant changes in purchasing phase and invoice processing, regarding: number of tasks, elapsed time and use of the human resources. At the same time, using different solutions within an integrated approach seems to be a positive choice, as it maximizes the procedural simplifications and the efficiency improvement, without any detriment to the supply quality level needed to deliver critical healthcare services.

After a brief literature review about e-procurement, this paper will propose a framework of healthcare spending characteristics and of e-procurement in public healthcare sector, and will discuss the research context, objectives, methodology and empirical results, providing some hints on the matter.

2 LITERATURE REVIEW

A huge amount of studies have been produced on e-procurement by researchers of other disciplines, like administrative law or PA management. There are also several studies on the e-procurement issue in the perspective of organization and/or Information System (IS). Most of them are related to the private sector, as they analyze models and tools adopted by firms to gain efficiency in the buying processes, with special attention to marketplace-based solutions. Rossignoli (2004) makes a review (with a company case) on the coordination role of Information and Communication Technologies (ICT) in e-marketplaces, where it can facilitate the emerging of new relations within and among organizations. Kim and Shunk (2004) propose a detailed description of the different forms that e-procurement systems can assume in the private sector and also report a rich collection of procurement process taxonomies (mainly intended in a narrow sense, linked to the purchasing phase only).

A minority of studies deals with e-procurement in the public sector, mostly with a central government point of view and considering e-procurement as a part of the innovations provided by the new Internet-based technologies to government management (e-government). Devadoss *et al.* (2002) regard e-procurement as a part of e-government and – discussing a Singaporean case – deal with the social and organizational factors that take a role during its development and implementation, following the perspective of structural analysis. Zulfiqar *et al.* (2001) also view e-procurement inside the e-government framework and investigate the influences of three issues (on the same case from Singapore): technical challenge, user preferences, institutional arrangements.

Others studies devoted to public e-procurement are applied at the highest level of Central Procurement Authorities. Hardy and Williams (2005) compare three national cases (from Australia, Italy and Scotland), under a social constructionist and actor-network perspective. In each case they analyze the issues of policy, practice and actors, arguing that the public e-procurement processes are linked with broader policies (e-procurement depends on government reform policy) and that e-procurement applications evolve differently from similar designs, according to the context and without a linear model of implementation. Somasundaram and Damsgaard (2005) investigate the Danish experience in order to identify six policies, challenging common wisdom, to cope with obstacles that frequently stop the diffusion of public e-procurement towards local administrations. Panayioutou *et al.* (2004) propose a detailed study of the changing occurred in the Greek governmental purchasing processes, when on-line procedures were implemented in place of paper-based ones. This research is probably the most similar in methodology and objectives to the one presented here; although focused on Central government (while this paper is on a local agency), it models both the old and new processes and analyzes a set of indicators to identify the benefits coming from the e-procurement implementation.

Less frequent papers discuss local government (where e-procurement can be introduced both as an internal choice or as a mandatory innovation pushed down by central government) and equally infrequent studies deal with the specific issue of public healthcare e-procurement. The most interesting indications emerging from these studies (Federici 2005; Federici *et al.* 2004) are the following: e-procurement must be seen as an end-to-end process, more comprehensive than just the purchasing phase; savings are more sizeable in administration and management than in purchasing price reduction, especially for specific goods.

3 HEALTHCARE SPENDING AND E-PROCUREMENT

3.1 Healthcare spending

More than 23% of the public healthcare spending in Italy is for the "purchasing of goods and services", frequently named as "intermediate healthcare consumptions" (2004, source: Regional Healthcare Services Agency, Agenzia per i Servizi Sanitari Regionali – ASSR). When referred to the whole

Italian *National Healthcare System*, this component reaches a huge absolute dimension – 20,6 € in the year 2004 – with an increasing trend both in absolute terms (it more than doubled from 1997 to 2004) and in percent on the total spending.

The spending for goods and services varies largely among the Italian regions and the market is further influenced by other complexity factors:

- about 350 diverse healthcare structures – besides the LHA's, there are: "Aziende Ospedaliere" (AO, Hospital Agencies) and "Istituti di Ricovero e Cura a Carattere Scientifico" (IRCCS, scientific institutes for research, hospitalization and health care), with different degree of autonomy, organizational structures, statutes (Cicchetti 2004) and procurement needs (thereby asking for a complex and strongly personalized offering);
- about 500 thousand, highly differentiated suppliers (multinationals, mid-size national Companies and local SME's).

The main issue, however, is the composite structure of the spending, which includes standard supplies for the whole Public Administration (PA), together with highly specific purchases. Introducing e-procurement tools in the healthcare sector asks for a detailed analysis of spending variety, in order to match each purchase type with the appropriate electronic procurement tool, by clearly defining the nature of the need (e.g. operating room specific devices) and planning purchases consistently, thereby supporting both healthcare performance and economy of procurement.

Healthcare spending for goods and services can be classified into three items:

- *common* for the whole PA (about 25% of total healthcare spending for goods and services), independent from the type of buying Administration (e.g.: phone services, office materials);
- *common-but-differentiated* (25% of total), existing for all the Administrations but highly differentiated by buying sector (e.g. in healthcare sector: maintenance and cleaning of hospital buildings);
- *healthcare-specific* (more than 50% of total), composed by drugs and medical devices (appliances and materials that, separately or jointly, are used in case of injury, disease, handicap, physiological application or surgical operation).

This diversity and the complexity factors indicated above must be taken into account to devise innovative ways to manage procurement before choosing the most appropriate IT solutions, in order to improve quality and efficiency of supplies, while rationalizing and reducing spending. A fundamental issue is that *healthcare specific* goods require high quality level of each item together with a rapid and controlled logistic, while these aspects – although important – are less critical for *common* goods. Furthermore, healthcare specific goods and healthcare *common-but-differentiated* spending often have very specific characteristics, with limited offering standardization.

3.2 e-Procurement and e-procurement tools

The term "procurement" is often used in a narrow sense, being associated with the sole purchasing phase, like for example in Panayioutou *et al.* (2004). Consequently, the term "e-procurement" becomes a synonym of a class of electronic tools that directly link buyers and suppliers on the same network to make a deal. According with other texts (Somasundaram 2004, MacManus 2002), and with the operation of a healthcare agency, in this paper "procurement" indicates a broader process (see fig. 1), that starts with a need for a good or service and ends with its use and the payment for its supply.

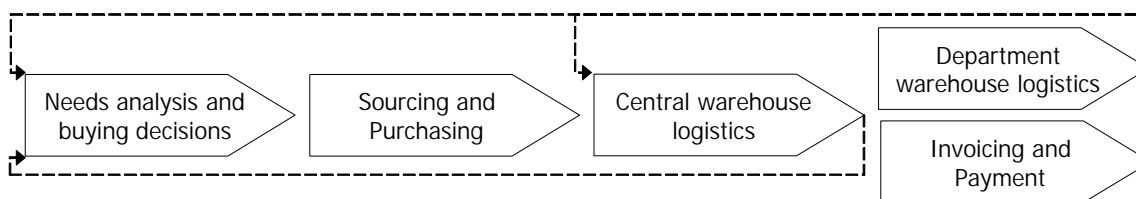


Fig. 1. Procurement taxonomy in healthcare sector.

The procurement process then includes: analysis of the needs (both coming from central warehouse or departments), purchase programming, sourcing choice (where and how to buy), purchasing act

(through a tender or a direct order), incoming material handling and central warehouse logistics, department warehouse replenishment, inventory control, invoice processing and payment.

An e-procurement system then deals with the whole procurement process and not just with its purchasing phase. Consistently, the term "e-procurement" indicates here the organizational solutions supported by ICT-based tools, that allow electronic forms of procurement, potentially more effective and efficient than traditional ones, where a more or less broad and profound process redesign is required, taking into account the whole life-time of a product or service.

e-Procurement solutions include tools in two main areas, which must be used in a complementary way to streamline the whole procurement process:

- *e-purchasing* includes widely different tools which allow to fully manage the purchasing phase, from finding a product to invoicing and payment:
 - platforms that allow to perform on-line tenders (from initial notification of documents up to the contract closing), by reproducing the administrative procedures on the web (*e-tendering*), and to analyze spending and measure suppliers' performance, in order to optimize the supplier-product-service mix;
 - *marketplaces* and *electronic catalogues* support the sourcing activity and the full direct order management, from purchase request issuing to spending authorization, to order progress monitoring (*e-requisitioning*);
 - tools for electronic invoice exchange and processing (*e-invoice*) and for the liquidation activity, usually connected to the banking system (*e-payment*);
- *e-logistics* is the optimized management of inventories (in healthcare structures: pharmacy and supply office) and internal goods flows, based on Intranet / Extranet technologies, integrating Supply Chain Management (SCM) solutions, capable to directly link both internal and external players and also to facilitate invoice check and need analysis.

3.3 Correlation between spending items and tools

Healthcare structures deliver critical and specialized services (vs. the rest of PA): more than in other sectors, it is paramount to safeguard high quality standards for many goods and services purchased (for their impact on the service quality), together with economy and timeliness of purchases, transparency of activities and conformance to competition principles among Companies. The large differences among the three spending categories indicated above and the availability of diverse electronic tools ask for a profound reflection on which solution suits most each type of good / service, according to a segmented approach (see fig. 2).

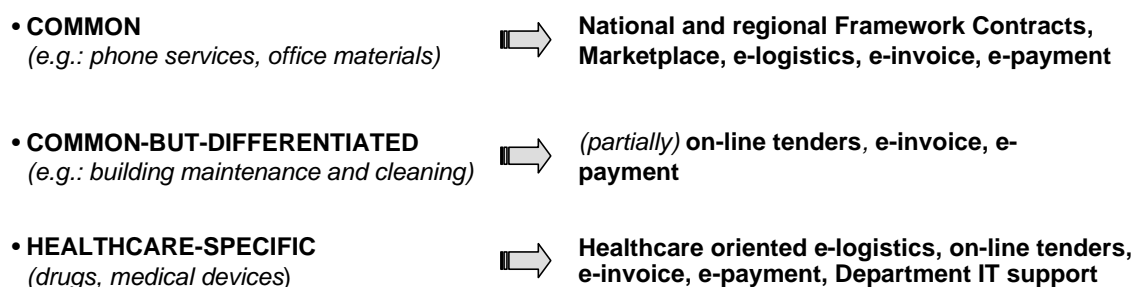


Fig. 2. A taxonomy of healthcare spending items and best related e-procurement solutions.

Goods and services within the *common* spending can be standardized for the whole PA (large utilization, wide offering, repetitive purchasing quantities). They are perfectly compatible with *e-requisitioning* tools, like the marketplaces and the e-catalogues based on framework contracts negotiated by a single body (at national, regional or local level), that aggregate fractions of public demand, knock-down large standard supply contracts, perform unified tender procedures for a number of "client" entities (CONSIP 2003) and lower eventually both the supply final price and administrative cost. The best opportunity for a local agency – in terms of reduction of purchase price, administrative costs and delivery time – is therefore to turn to one of these tools. Last but not least, e-logistics, e-invoice

and e-payment can improve supply management and further reduce its administrative costs.

The *common-but-differentiated* spending consists of supplies which must absolutely guarantee the fulfilment of specific needs to the healthcare buyer. It requires the presentation and evaluation of (even complex) projects, for which it's difficult to define criteria for automatic score attribution. The traditional procedure can be substituted by a tender partially performed on-line, moving the call, presentation, intermediate and final communications phases onto the web (with clear benefits in terms of administrative time and cost reduction), while keeping the offers evaluation phase off-line. e-Invoice and e-payment can also provide efficiency improvements.

To adequately manage the *healthcare-specific* spending, a wider e-procurement approach must be used: just looking for the lowest purchasing price can be counterproductive (Borgonovi 2004), since the requested goods and services are highly specific and high quality levels are required. Benefits can then be obtained by reengineering the internal processes, merging several methodologies and tools on the whole procurement cycle – healthcare oriented e-logistics, on-line tenders, evolved forms of marketplace, e-invoice and e-payment – and providing adequate IT supports to each healthcare cost centre (e.g. hospital wards).

4 CASE DESCRIPTION

An interesting case – for its scope, early start and first results – is that of the LHA of Viterbo, which, after many different experiences, since 2004 is managing a wide plan for extensively introducing e-procurement.

The LHA of Viterbo – like other similar structures (Cicchetti 2004) – is organized in three areas: hospital services, territory services, administration services. With about 3.200 administrative and healthcare employees, it provides healthcare to the province of Viterbo (859 hospital beds), with a production value of about 350 €m, determined according to the individual spending allocated for each citizen of the province (a total of 297.686 people as of December 31, 2001).

With the aim of gaining efficiency and reducing the spending for goods and services procurement, since 2000 the LHA of Viterbo has managed several experimental projects on e-procurement, in partnership with Italian public as well private subjects (Federici 2005):

- the first initiative, in the year 2000, was a trial of a marketplace promoted by a private merchant. Despite some positive results, this experience ended quite early, when the marketplace platform failed because of the low volume of transactions;
- in 2002, when the tools indicated below were still under construction and not yet addressed to the healthcare sector, the LHA started to use the *Public Electronic Catalogue* of the goods and services which could be purchased at predefined conditions through the *Framework Contracts* ("Convenzioni Quadro") negotiated by CONSIP and the *Marketplace for the Public Administration* ("Mercato Elettronico per la Pubblica Amministrazione", MEPA), also created and managed by CONSIP (the LHA of Viterbo was one of the first 20 Italian PA's that took active part in the MEPA implementation). Both these tools were delivered to the Italian PA's alternatively in *tying* or *untying* mode (Anton and Yao 1989), depending on their level (central or local) and on the provisions of each annual national and/or regional financial act;
- in 2003 a first platform for e-tenders was tested, which was later dismissed because of its lack of functionalities. It has been recently replaced by a new one, that allows to manage a tender, both partially (leaving offers evaluation off-line) or fully electronically, but does not yet support the competitive on-line prices reduction (*e-auction*);
- the LHA also carried out two different projects on e-logistics, both promoted by private companies and based on wide outsourcing solutions supported by extranet platforms. One of them involved the central and the departments' warehouse logistics for the common goods and for the non specific devices normally used in hospital wards for the routine healthcare (e.g.: gauzes, disinfectants...). The other project coupled the supply of the specific medical devices used in the operating rooms with their overall logistics management. It was based on the innovative "intervention-based" concept of linking procurement to the surgical operations performed (having defined the

surgical protocols that indicate the types and quantities of the medical devices needed for each type of operation), instead of the traditional "stock-based" approach to purely manage the inventory levels.

These pilot projects, all driven by the Procurement and Logistics (P&L) Department of the LHA, responded to its goal of improving the entire procurement cycle, but had diverse origins: some derived from new public procurement rules, some were promoted by a supplier of IT solutions. For each experience, the P&L Department structured then a review activity to evaluate the results in detail (they were interesting, but often different in nature and dimension from those foreseen) and to analyze the obstacles met (technological, organizational and also normative, like for any innovation), in order to make the best decision on an intended wide adoption of e-procurement.

After these pilot experiences, since 2004 the LHA of Viterbo has launched an extensive programme with the purpose of innovating the end-to-end procurement process (as shown in fig. 1), through the adoption of diverse solutions, coherently with the different specific requirements. The first completed steps were the implementation of multiple e-procurement solutions in two segments of the broad procurement process: purchasing phase and invoice processing. Other ongoing actions are involving the full deployment of the *e-Logistics* outsourcing model for common goods and non specific devices, and of the *Operating room e-procurement*.

4.1 Research presentation

When the first actions of the e-procurement adoption plan started, a research was promoted by the same LHA together with CONSIP and the University of Tuscia to investigate the outcomes of a wide implementation of different e-procurement solutions in a local healthcare agency.

Since the assessment performed of the e-procurement initiatives is based on a comparison between the new procedures and the equivalent traditional ones (that are not yet discarded), this paper refers to the first completed steps of the research, related to the new solutions fully implemented. The new procedures examined here, each based on a different e-procurement solution, are five: four located in the purchasing phase – two related to e-tendering and two to e-requisitioning – and one in invoice processing. The research will proceed next year on the other solutions under implementation.

The research questions were:

- In which terms were the procurement process changed when implementing e-procurement in the analyzed phases?
- Within the framework of an integrated approach, can the adoption of different e-procurement solutions be considered a positive choice?

4.2 Methodology and Data collection

The first step of the research, after the definition of the boundaries for the end-to-end procurement process to be considered, was the identification and the drawing of two set of workflows: for the traditional (T) paper-based procedures and for the innovative (I), ICT-based ones. Each workflow broke down each procedure into elementary tasks, according to these preliminary choices:

- adoption of a high level of granularity for the task definition (they were identified as "elementary activities done each by a single role") and for the effort quantification (in minutes);
- use of the "UML-activity" (Unified Modelling Language) notation, with a reduced set of components (action state, flow, decision, begin state, end state) to draw simplified, but standard, representations, which could be read also by non-experts;
- repeated checks with the subjects directly involved, to verify the correctness of each workflow drawn.

The decision of initiating with a comprehensive workflow drawing derived from the objective of pointing out the effective changes – in term of organization and performance – that the e-procurement implementation can introduce. The issue under this choice, that required the indicated checks, was that the actual practice of the traditional procedures often diverges from the one established, while the in-

novative one underwent a sequence of adjustments in their go-live period.

Once the correspondence between each workflow model drawn and the reality was verified, with the responsible of each involved office and with the employees in charge of the interested tasks, the data collection started. To answer the research questions, about 60 individual interviews with the same subjects were performed, in order to find for each task of the traditional and innovative workflows:

- the office charged;
- the role of the people involved;
- the number of persons (with the same role) engaged;
- the minimum, standard and maximum elapsed time (in calendar days), from the beginning of each task to the beginning of the following one(s);
- the minimum, standard and maximum effort (in minutes).

Data collected were cross-checked and, in case, reviewed with the interested subjects, then keyed in a database.

Among the overall 46 workflows so far identified, 9 (4 traditional and 5 innovative) have been considered in this first phase of the research (the number is odd, since one traditional workflow was compared with two innovative ones). The 9 considered workflows are formed by a total of 492 elementary tasks performed by 16 diverse roles.

4.3 Research findings

As stated above, the analysis regarded the comparison of 5 workflow pairs – each related to a traditional paper-based procedure and to an innovative one, based on e-procurement tools – that represent homologous segments of the end-to-end procurement cycle in the purchasing phase (#1 and # 3 related to e-tendering; #2 and #4 related to e-requisitioning) and in invoice processing (#5).

Although very different, the compared procedure pairs (see table 1) receive the same input at the same stage of the procurement cycle and produce the same output in the same overall context (normative, good or service to be purchased, value of the purchase...). Since most of their workflows present more than one possible path for the presence of decision points with two or more alternatives, the "typical" path (i.e., the most frequent one) was considered for the analysis.

COMPARISON	VERSION	PROCEDURE	DESCRIPTION	ICT TOOLS
1	T	Tender over threshold	Public tender for purchases of goods and services for amounts higher than the threshold set by the European Union (EU). Totally paper-based procedure	Office automation (word processing, spreadsheet...)
	I	Online tender over threshold	Public tender for purchases of goods and services for amounts higher than the threshold set by the EU. Web-based procedure from initial notification, receipt of bids, intermediate communications, up to award notification. Evaluation of the bids can be performed off-line. Call must be published as for off-line tender	Platform for e-tendering Office automation
2	T	Tender over threshold	<i>see above</i>	
	I	Direct Order on e-catalogue	Purchase (also for amounts higher than the EU threshold) fully performed on the e-catalogue for PA's managed by CONSIP, which includes goods and services already negotiated through Framework Contracts. A limited choice of items is available.	Web-based catalogue

COMPARISON	VERSION	PROCEDURE	DESCRIPTION	ICT TOOLS
	3	T	Negotiated procedure	Restricted tender procedure with few invited participants (faster than normal tender). To be adopted only in specific cases and under EU threshold. Totally paper-based procedure
I		Request for Quotation (RfQ) on MEPA	Restricted tender procedure fully performed on CONSIP Marketplace for PA's with few participants selected by LHA (among the suppliers admitted by CONSIP), that can be asked for (and can submit) a technical tender To be adopted under EU threshold.	e-Marketplace (with special functions for tender asking and submitting)
4	T	Small direct purchase	Purchase directly performed with a single supplier. To be adopted for very small buying (under the threshold of €5.000) and only in specific cases. Totally paper-based procedure	Office automation (word processing, spreadsheet...)
	I	Direct Order on MEPA	Purchase directly performed on CONSIP Marketplace with a supplier already admitted by CONSIP, and only of goods or services allowed. To be adopted under EU threshold	e-Marketplace platform (with cart function)
5	T	Invoice processing	Paper-based procedure of: invoice acquisition, checks (on the accounting system and with orders and transport documents) and submitting of verified invoices to the persons in charge of payment	Office automation (word processing, spreadsheet...) Accounting system
	I	LIQUIWEB	After keying in the incoming invoice data, totally paper-less checks (on the accounting system and with orders and transport documents) and submission of verified invoices	Intranet application for invoice processing Accounting system

Table 1. Matching between the equivalent procedures considered.
(Legend: T: Traditional, I: Innovative)

In order to point out the changes introduced when implementing e-procurement solutions, the quantitative comparisons between the workflows of equivalent procedures (presented in table 2) has been set up on the following items:

- three organizational dimensions: number of the performed tasks, number of the offices and number of the different roles involved;
- two performance indicators: total elapsed time and total effort, calculating for each of them the standard value and the range between maximum and minimum values.

The table reveals several changes brought in with the implementing of e-procurement solutions that are already running. In more detail:

- the number of tasks is almost always (unless in the comparison #4) lower in the innovative (I) paperless workflows (in three cases by more than 30%): this indicates that the new flows are generally simpler;
- the number of offices involved is equal in the two versions of the workflows, except in comparisons #2 and #3 where, respectively, all the evaluation and a large part of it is performed in the innovative procedures by CONSIP for all PA's;
- the number of roles involved is lightly lower in the innovative (I) workflows; tenders over threshold are an exception, since the online process asks for a technical pre-classification of tenders submitted, performed by an expert on the field of the purchasing goods, that is not provided for in the equivalent (T) one;
- the length of workflows (total elapsed time) is largely (sometime considerably) reduced with e-procurement, in both standard value and min-max range: this means that supply contracts can be closed in a shorter and more predictable time, which is very important for critical services, like in healthcare;
- the total effort requested to achieve the same target is always lower, often significantly, for e-

procurement workflows (I). In 3 cases out of 5, the range reduction is greater than for standard value: this suggests that, besides the efficiency improvement, the use of resources could be better programmed. Even if not showed in the table, the distribution of the total effort among the highest and lowest roles is quite similar in the two versions of workflows, but for #2 and #3, where in the (I) procedures there is no Commission for evaluation of the bids.

COMPARISON (#)	VERSION	WORKFLOW	TASKS (number)	OFFICES INVOLVED (number)	ROLES INVOLVED (number)	TOTAL ELAPSED TIME (days)		TOTAL EFFORT (minutes)		
						Standard	Range	Standard	Range	
1	T	Tender over threshold	53	9	8	325,0	124,0	9.538	8.435	
	I	Online tender over threshold	51	9	9	237,0	100,0	8.080	6.850	
			<i>Difference (abs.)</i>	-2	0	1	-88,0	-24,0	-1.458	-1.585
			(%)	-3,8%	0,0%	12,5%	-27,1%	-19,4%	-15,3%	-18,8%
2	T	Tender over threshold	53	9	8	325,0	124,0	9.538	8.435	
	I	Direct Order on e-catalogue	16	7	7	35,5	23,0	606	381	
			<i>Difference (abs.)</i>	-37	-2	-1	-289,5	-101,0	-8.932	-8.054
			(%)	-69,8%	-22,2%	-12,5%	-89,1%	-81,5%	-93,7%	-95,5%
3	T	Negotiated procedure	50	8	8	282,0	104,0	6.066	6.065	
	I	RfQ on MEPA	34	7	7	103,0	44,0	3.768	4.158	
			<i>Difference (abs.)</i>	-16	-1	-1	-179,0	-60,0	-2.298	-1.907
			(%)	-32,0%	-12,5%	-12,5%	-63,5%	-57,7%	-37,9%	-31,4%
4	T	Small direct purchase	13	3	4	22,0	10,0	399	207	
	I	Direct Order on MEPA	13	3	3	9,5	7,0	261	171	
			<i>Difference (abs.)</i>	0	0	-1	-12,5	-3,0	-138	-36
			(%)	0,0%	0,0%	-25,0%	-56,8%	-30,0%	-34,6%	-17,4%
5	T	Invoice processing	15	6	6	11,0	0,0	559	309	
	I	LIQUIWEB	10	6	5	10,0	0,0	426	185	
			<i>Difference (abs.)</i>	-5	0	-1	-1,0	0,0	-133	-124
			(%)	-33,3%	0,0%	-16,7%	-9,1%	0,0%	-23,8%	-40,1%

Table 2. Comparison results between pairs of workflows of equivalent procedures.
(Legend: T: Traditional, I: Innovative)

Overall, the adoption of e-procurement solutions in the examined procedures leads to relevant efficiency improvements (although of largely different dimensions), that could be used to eventually materialize administrative cost reductions and/or service enhancements, according with organizational and normative restrictions and policies not dealt with in this paper.

The measured results, anyway, originate more from a cleaning-up of the workflows and from the use of faster communication tools than from the performing of a deeper redesign action, as suggested by the involvement of the same offices and roles (not shown in the table) in each workflow pair and by the similarity in the number of tasks (it must also be observed that the examined workflows are referred to procedures heavily conditioned by laws and rules, that limit the redesign depth). The largest

differences (and the best results) are found in those comparisons – #2, where a tender paper-based procedure is replaced by an e-requisitioning solution, and partially #3 – in which the new solutions (up to now used only for common spending) lack some activities – sourcing, evaluating and admitting suppliers, classifying goods and services –, that are performed in advance by an external subject (CONSIP), for the buyer LHA. This answers the first research question, about the changes introduced when implementing e-procurement in the analyzed phases.

To answer the second research question, about the adoption of diverse e-procurement solutions, it must be firstly considered that all the differences between a traditional and an innovative workflow are (sometime considerably) in favour of the latter. Secondly, it can be seen by cross-reading the two last tables that it is impossible to adopt the most favourable solutions (like Direct Orders on e-catalogue and on MEPA) in all the cases, because of law restrictions and goods availability, whereas on the other hand, the allowed choice of a wider utilization of the online tender platform would be counterproductive. Within the framework of an integrated approach, the adoption of multiple e-procurement solutions (based on e-tenders, marketplace and e-catalogue) can therefore be considered a positive choice in the present context.

5 SUMMARY AND CONCLUSIONS

Procurement in the healthcare sector is quite different from the rest of Public Administration: much wider number of goods and sellers, technical characteristics and peculiarities of goods and services, impact of timeliness and quality standards of purchases on the production of critical and specialized services. The present paper deals with this yet neglected topic, from the point of view of a Local Agency, quite different from the one usually considered and it suggests that:

- healthcare spending is highly varied and can be segmented in three categories: *common, common-but-differentiated, healthcare-specific*;
- procurement is a process broader than purchasing that asks for diverse ICT-based solutions;
- to properly respond to the variety of needs and contexts in healthcare, it is reasonable to use jointly different e-procurement solution all along the end-to-end procurement process.

It also provides a discussion on a particularly interesting experience of e-procurement by an Italian Local Healthcare Agency, where multiple solutions are already in exercise and where a research was promoted to identify and assess the changes introduced in the purchasing phase and in invoice processing while implementing e-procurement.

The first results of the research – based on the comparisons between five pairs of a traditional procedure and the equivalent innovative one – offer rather interesting suggestions on the possibility of reaching a good degree of simplification, significant efficiency improvements and length reductions, without any detriment to the supply quality level needed in healthcare, by adopting a right mix of e-procurement solutions, even without a deep process redesign, that presently is highly constrained in the cases examined. The improvements might even be increased in the future, by removing some law restrictions and/or catalogue limitations, which at the present time prevent a wider utilization of the most favourable solutions for a Local Agency (like Direct Orders on e-catalogue and on MEPA).

Even if data collection was accurate and verified, it must be noticed that the research is based on an explorative approach and has some important limitations:

- the results are possibly influenced by the previous initiatives undertaken in the LHA, the ways of implementing e-procurement and the national and regional policies; they should rather be considered as hints to be further investigated, then as-is reproducible indications;
- the cases examined are in just two segments (purchasing and invoice processing) of the end-to-end procurement cycle, different results could be obtained by analyzing other procurement phases;
- the research did not consider some relevant issues, that were out of the scope of its initial step and may represent interesting fields of further study:
 - the changes in skills that should occur for each involved role, in order to properly perform the e-procurement tasks (e.g., as it is usual in process innovation, knowledge and aptitude of former employees are not always suitable to support the introduction of new methodologies);

- the supply-side investigation, as the analysis performed was fully demand-oriented: from a better knowledge of the suppliers' behaviour and reactions, the healthcare e-procurement cycle could be probably further improved.

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