ISCTE Business School
Instituto Universitário de Lisboa

# IMPACTS OF ELECTRONIC INVOICING IN THE PORTUGUESE HEALTHCARE SECTOR: POTENTIAL SAVINGS ON ACCOUNTS PAYABLE

Filipa Gomes Pereira

Dissertation submitted as partial requirement for the conferral of Master in Management

Supervisor:

Prof. Inês Marques

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Department of Engineering and Management

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## Acknowledgments

I would like to thank people who positively contributed for the conclusion of this dissertation.

I would like to thank my thesis supervisor, Professor Inês Marques for the time spent and her contribution and advices for the development of this work. Her support was important to keep motivated during these months.

To Maria Celeste Silva, a great professional and friend, always available to take my doubts and to help me. Her support was crucial to establish the contact with the entities studied and to obtain data needed.

I would like to thank Maria de Lurdes Teodósio, for her continuous support and assistance, before contacting the healthcare entities and after, during the answering period. Her help was crucial in obtaining data from her colleagues.

Another person that I would like to thank is my father. All the support given to me and his technical contributions during the development of this dissertation were very important to achieve the final result.

I would like to thank my family, my boyfriend Luís and my friends for their patience during this period and their motivation in my work.

To conclude, I would like to thank to Mrs. Darcília Rocha, Mrs. Joaquina Matos, Mr. Jorge Fonseca, Mr. Júlio Paulo, Mr. Miguel Zegre and Mr. Rui Mota. Their collaboration was essential for the development of this work, without their availability this project would not be possible.

## Abstract

The manual processes for exchanging commercial and financial documents between an entity and its suppliers create inefficiencies in the supply chain. However, there are electronic solutions able to eliminate errors and decrease the costs in accounting departments.

This work aims to study the potential savings of migrating from manual to electronic invoicing process in accounts payable operations, on the Portuguese healthcare system. Besides invoices, other commercial documents are taking into account during this process: purchase orders and transport guides. There are considered three suppliers' types: medicines and medical devices, utilities and services. The study includes seven healthcare entities belonging to Portuguese Health Service (Centro Hospitalar de Lisboa Central, Centro Hospitalar de Lisboa Norte, Centro Hospitalar de Lisboa Ocidental, Centro Hospitalar do Porto, Hospital Professor Doutor Fernando Fonseca, Centro Hospitalar de Trás-os-Montes e Alto Douto) and two service providers (Indra and Saphety). Data was collected by two different questionnaires, sent by electronic mail to each entity.

In order to migrate to an electronic process for receiving invoices, it is needed an Electronic Data Interchange technology. The results show that the Ministry of Health is able to save around €2,435,249, considering the seven entities, in the first year of implementation. In a horizon of three years, the potential savings are €8,435,249. In addition, the usage of electronic data interchange allows the Ministry of Health to use a business intelligence technology and create policies with a higher degree of accuracy.

**Keywords:** Electronic invoice; Electronic Data Interchange; potential savings; automation

**JEL codes:** I10; M15

## Resumo

O processo manual de troca de documentos comerciais e financeiros, entre empresas e os seus fornecedores, cria ineficiências na cadeia de abastecimento. No entanto, existem soluções eletrónicas capazes de eliminar erros e diminuir custos nos departamentos de contabilidade.

Este trabalho tem como objetivo o estudo da potencial poupança originada pela migração do sistema de faturação manual para o eletrónico, nas contas a pagar do sistema de saúde português. Além das faturas, são tidos em conta outros documentos comerciais: as ordens de encomenda e as guias de transporte. São considerados três tipos de fornecedores: medicamentos e dispositivos médicos, *utilities* e serviços. O estudo inclui sete entidades de saúde pertencentes ao Sistema Nacional de Saúde (Centro Hospitalar de Lisboa Central, Centro Hospitalar de Lisboa Norte, Centro Hospitalar de Lisboa Ocidental, Centro Hospitalar do Porto, Hospital Professor Doutor Fernando Fonseca, Centro Hospitalar de Trás-os-Montes e Alto Douto) e dois prestadores de serviços (Indra e Saphety). Os dados foram recolhidos através de dois questionários diferentes, enviados, por correio eletrónico, para cada entidade.

De forma a migrar para um processo eletrónico na receção de faturas, é necessária a tecnologia *electronic data interchange*. Os resultados mostram que o Ministério da Saúde é capaz de poupar cerca de 2.435.249€, considerando as sete entidades, no primeiro ano de implementação. Num horizonte de três anos, as potenciais poupanças são 8.435.249€. Para além disso, a utilização de *electronic data interchange* permite ao Ministério da Saúde o uso da tecnologia *business intelligence* e criar políticas com maior grau de precisão.



**Palavras-chave:** Fatura eletrónica; *Electronic Data Interchange*; potenciais poupanças; automatização

**Códigos JEL :** I10; M15

## Acronyms

ACES – *Agrupamentos de Centros de Saúde* (Groups of Health Centres)

ACSS – *Administração Central do Sistema de Saúd*e (Central Administration of Health System)

AEP – *Associação Empresarial de Portugal*

AP – Accounts Payable

AR – Accounts Receivable

ARS – *Administrações Regionais de Saúde* (Regional Administrations of Health)

ASN – Advance Shipping Notice

B2B – Business to Business

B2C – Business to Consumer

B2G – Business to Government

BI – Business Intelligence

CAQH – Counsel for Affordable Quality Healthcare

CEN – *Comité Européen de Normalisation* (European Committee for Standardization)

CH – *Centro Hospitalar* (Hospital Centre)

CHLC – *Centro Hospitalar de Lisboa Central*

CHLN – *Centro Hospitalar de Lisboa Norte*

CHLO – *Centro Hospitalar de Lisboa Ocidental*

CHP – *Centro Hospitalar do Porto*

CHSJ – *Centro Hospitalar de São João*

CHTMAD – *Centro Hospitalar de Trás-os-Montes e Alto Douro*

CII – Cross Industry Invoice

CPI – Consumer Price Index

DA - Despatch advice

DL – Decree Law

EC – European Commission

ED – European Directive

EDI – Electronic Data Interchange

eIDAS - Electronic Identification and Signature

e-invoice – electronic invoice

e-invoicing – electronic invoicing

E-mail – Electronic mail

EPE – *Entidade Pública Empresarial* (State-Owned Enterprise)

ERP – Enterprise Resource Planning

ERS – *Entidade Reguladora da Saúde* (Health Regulator Entity)

EU – European Union

G2B – Government to Business

GDP – Gross Domestic Product

H – Hospital

HFF – *Hospital Professor Doutor Fernando Fonseca*

HR – Human Resources

HTML – HyperText Markup Language

IAPP – International Accounts Payable Professionals

INE – *Instituto Nacional de Estatística*

INFARMED - *Autoridade Nacional do Medicamento e Produtos de Saúde*

IOFM – Institute of Finance & Management

IP – *Instituto Público* (Public Institute)

IPO – *Instituto Português de Oncologia* (Portuguese Oncology Institute)

IT – Information Technology

JPEG – Joint Photographic Experts Group

MS – *Ministério da Saúde* (Ministry of Health)

NHS – National Health Service

OCR – Optical Character Recognition

OECD – Organization for Economic Cooperation and Development

PDF – Portable Document Format

PO – Purchase Order

PPP – *Parceria Público-Privada* (Public-Private Partnership)

SME – Small and Medium Enterprise

SNS – *Serviço Nacionl de Saúde* (Portuguese Health Service)

SPA – *Sector Público Administrativo*

SPMS – *Serviços Partilhados do Ministério da Saúde* (Shared Services of Ministry of Health)

TAWPI - The Association of Work Process Improvement

TIFF – Tag Image File Format

TXT – Text

ULS – *Unidade Local de Saúde* (Health Local Unit)

VAT – Value-Added Tax

Vs - Versus

XML – eXtensible Markup Language

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# 1. Introduction

Electronic commerce has changed the way how economy and society work, bringing more innovative, agile and efficient solutions in business relationships. Although electronic commerce is usually more used between an enterprise and its final consumer, it also has several benefits when applied on transactions between two business entities, automating the processes, especially the way in which commercial and financial documents are exchanged (OpenText, 2017). The dematerialization of these documents allows to work with electronic formats of documents and its automation provides several benefits in terms of efficiency and efficacy, eliminating costs and errors (GXS, 2008) and achieving higher accuracy (OpenText, 2017).

Amongst the documents traded during the order-to-payment cycle, the invoice is considered the "key in collaboration between companies" (Bertelè & Rangone, 2008). The implementation of an electronic invoicing (e-invoicing) model brings diverse advantages for the adopting companies (Bertelè & Rangone, 2008), leading to significant cost savings per invoice (around 64% for those who receive an invoice) (Koch, 2016). Besides the benefits from e-invoicing adoption, there are still some barriers that businesses face to adhere. In order to overcome them, some European measures were taken as an incentive for the European Member States. As part of the European Union (EU), Portugal is subject to these rules, including the Directive 2014/55/EU which defines that all contracting authorities and entities are obliged to receive and process electronic invoices according to the European standard until 2018.

The healthcare sector is considered one of the most important sectors for the economy, especially in developed countries (Associação Empresarial de Portugal - AEP, 2013). In Portugal, the healthcare sector constituted 9% of Gross Domestic Product in 2015 (Organization for Economic Cooperation and Development -OECD, 2017). This public sector is characterized by having both high costs and low efficiency, being exposed to great pressures to reduce its expenditures, due to budget constraints. In terms of invoice volume received, this industry, in average, represents from 5 to 13%, in a business to business (B2B) context (Koch, 2016).

## 1.1. Problem Statement

The manual process for exchanging commercial and financial documents creates inefficiencies for the accounting departments of the national healthcare system, increasing the costs on this matter. In the majority of the entities being part of the Portuguese healthcare system, the invoices are in a paper-based format and the data from the different documents is inserted

manually in each entity´s ERP (Enterprise Resource Planning). Due to this fact, the data transaction quality between one hospital (H) and the suppliers is poor, being possible to occur mistakes that can be irreversible. Through these processes, the information is inefficiently coordinated. As a consequence, this leads to high administrative expenses, conflicts between stakeholders and stock breaks.

### 1.2. Goals

The main goal of this thesis is to study the potential savings of migrating from manual to electronic invoicing process in accounts payable (AP) in the Portuguese healthcare system. For this, seven healthcare public entities are analysed, as well as respective suppliers of medicines, medical devices, utilities and services. Although the focus of this work is electronic invoicing, other commercial documents, such as orders and logistic documents are also considered. The way these entities interchange those documents is investigated through surveys. Electronic Data Interchange (EDI) is an important concept that allows the implementation of electronic invoicing and other commercial documents in the supply chain.

This work considers the cost savings when adopting an electronic invoicing model. Since this analysis is focused on the relation between the entity and the respective supplier, the accounts payable and the respective received invoices are considered.

In addition, this thesis aims to investigate electronic invoicing from a management perspective, focusing on financial and economic benefits, rather than from engineering perspective, focused on the technological component.

### 1.3. Study Relevance

This study intends to quantify the financial impacts of implementing an electronic invoicing approach in Portuguese public healthcare entities supply chain. The data obtained in this study has the goal to calculate the cost reductions when manual to electronic processes are changed. From the selected healthcare public entities evidence, extrapolation can be done for the remaining ones, showing the global financial impact in the Portuguese Health Service (SNS). The implementation of EDI/Electronic invoicing in all healthcare public entities brings a new economic and even political dimensions to the project. Through the analysis of the commercial documents data flow interchanged between each public entity and the suppliers, it is possible to know immediately, for example, what medicines are being consumed in each entity, by region and at a national level. These tools can change the way Ministry of Health (MS) accesses

this type of data, bringing a much more efficient cost control of the process in real time and even detect unusual medicines consumptions tendencies, bringing an economic and political perspective and impact.

### 1.4. Structure of the Work

This thesis is composed by 9 chapters. The current chapter presents the goals of this work and the relevance of it to the literature. Chapter 2 develops a literature review in which previous studies related with the topic are presented, in order to be aware of what has been done by other authors and how the studies are conducted. The third chapter aims to deepen the knowledge about electronic invoicing, giving a contextualization about the topic in general terms, in Europe, in Portugal and in the healthcare sector. Chapter 4 presents the tradable documents during the order to payment cycle as well as the type of processes by which they can be exchanged. The fifth chapter aims to understand the different entities and the suppliers of the Portuguese healthcare sector that are relevant to this work. Chapter 6 describes the data collection: which entities are part of the study and how the data was collect from each one. The results are presented and discussed in chapter 7. Chapter 8 introduces the concept of business intelligence and its contribution for the MS if applied to healthcare entities. The conclusion is done in chapter 9, jointly with the studies' limitations and recommendations for future work.

# 2. Literature Review

Information Technology (IT) applied in healthcare entities is increasing popularity among scientists. However, current studies in the public healthcare sector regarding e-invoicing are generally focused on the relations between hospitals and the user. Also, there are academic studies about the information systems used in hospitals which guarantee the proper functioning of the communication and information transmission.

One of the goals of this thesis is to fill a gap between the studies and projects done in Portugal, focusing on the relations of public healthcare entities and corresponding suppliers regarding electronic invoicing.

This chapter explores the literature related to the topic of this thesis. It is divided into two sections. Section 2.1. is focused on literature related to e-invoicing and automation of processes, and Section 2.2. focus on studies developed on electronic components in the Portuguese healthcare sector.

## 2.1. E-invoicing and Processes Automation

Koch (2016) develops a business case for issuers[1] and recipients[2] of electronic invoicing in order to find the potential savings that this process can offer. The example used by the author is based on a company with 5,000 employees and staff costs of €60 per hour. For the issuers' perspective, the author takes into account the following steps during the process: print, envelope and send; payment and reminders; remittance and cash management; archiving. Figure 1 shows the average costs calculated for paper and electronic automated invoices for issuers. An invoice issued in paper format costs €11.10 while an electronic invoice (e-invoice) issued in the automated process costs €6.60. The savings per invoice, when adopting electronic invoicing, are around 59% comparing with a paper-based model. The phase of printing, enveloping and sending differs €3.90 and it is the most significant in terms of savings, followed by remittance and cash management where the automated process allows to save €1.50 per invoice. The cost by having a third party as a service provider is €0.30 in the automated process.

[1] An issuer is the person who issues the invoice i.e. the supplier.
[2] A recipient is the person who receives the invoice i.e. the buyer.

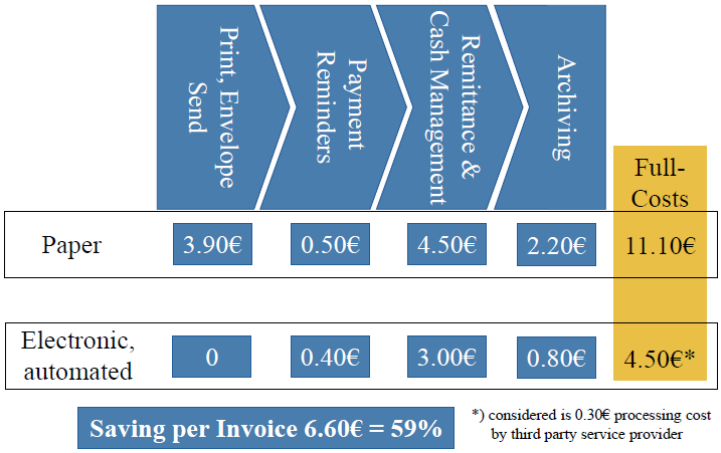



**Figure 1 - Saving Potential for Invoice/Bill Issuers**

*Source: Koch (2016)*

In a recipient perspective, Koch (2016) considers six steps during the process: receive; entering and codification; validation and matching; dispute management; payment & cash management; archiving. The cost per task is presented in figure 2. The cost of receiving an invoice in paper is €17.60 and in electronic format is €6.40. The savings of using an automated process is €11.20 per invoice, which represents 64% of the costs when using the traditional paper-based model for invoicing. When using electronic invoicing, both reception and entering codification have null costs. In an automated process, both steps of validation and matching and the payment and cash management are €2.80 per invoice cheaper than in manual process (€5.60 in the total). In this recipient perspective, the cost of a service provider as an intermediary is €0.40 per electronic invoice.

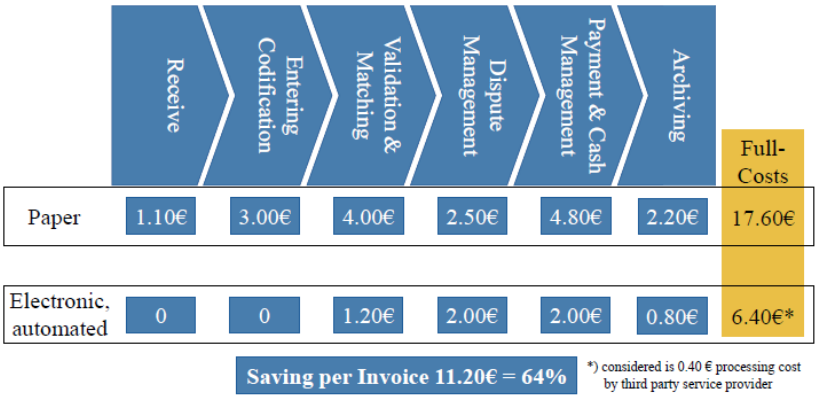



**Figure 2 - Saving Potential for Invoice/Bill Recipients**

*Source: Koch (2016)*

The invoices analysed in this study have an average size of 1.5 pages and the indirect savings are not considered in calculations. In order to calculate the volume of invoices, the author built ked-metrics based on the number of employees in an organisation and the industry where it

operates. Table 1 shows the range of amount of paper invoices that an employee can issue and receive per year as well as the direct staff costs per invoice. According to Koch (2016), in an accounts payable department, an employee is able to process just from 5,000 to 15,000 paper invoices per year where the direct staff costs per unit vary between €5 and €15. Regarding the accounts receivable (AR) department, from 7,500 to 30,000 paper invoices can be processed per employee, per year. Each invoice costs between €2.50 and €10. Analysing table 1 and figures 1 and 2, it is possible to conclude that staff costs are significant when issuing or receiving an invoice. Assuming a recipient perspective, these costs can vary from 28% to 85%[3] while in an issuer view from 23% and 90%[4].

| Department | Paper invoices processed per year per employee | Direct staff costs per invoice |
|---|---|---|
| Accounts Payable | 5,000-15,000 | EUR 5 - 15 |
| Accounts Receivable | 7,500-30,000 | EUR 2,50-10 |

**Table 1 - Paper Invoices Processed per Employee and its Costs**

*Source: Koch (2016)*

After estimating the costs that companies incur with paper invoices and the efficiencies of electronic invoicing, Koch (2016) considers the costs for adopting an automated process. For small companies, the author assumes the usage of a website as a platform for electronic invoicing purposes and, hence, there are not implementation costs for a software. The running costs on this implementation for small companies are moderate or even non-existent. However, in the case of large entities, a service provider is needed for the integration with internal systems from the own company and respective supplier. In this business case, the costs of having a third party as a service provider vary between €0.20 and €0.80 per invoice. In addition, these costs depend on the upstream and downstream nodes of the supply chain (suppliers and customers, respectively) due to their requirements and integration systems. The author estimates that, on average, with the adoption of electronic invoicing, future internal costs on issuing or receiving invoices will be between 40 and 50% of the past costs, suggesting gains in efficiency.

This report gives a strong base for the methodology to apply when estimating the potential savings of electronic invoicing adoption rather than using paper-based processes. Koch (2016) defines the tasks performed when receiving an invoice and the estimation of costs per invoice

[3] 5/ 17.60 = 0.28 and 15/17.60 = 0.85
[4] 2.5/11.10 = 0.23 and 10/11.10= 0.90

received. These costs are estimated, in this work, for entities belonging to the Portuguese healthcare sector.

Cardoso (2012) focuses his study on EDI and electronic invoicing in the case of a Portuguese company. The author proves the benefits and efficiency gains for the company when integrating tradable documents via EDI with the internal system. The costs and benefits of electronic invoicing are analysed, in a recipient perspective. In order to calculate the benefits and efficiency gains of electronic invoicing, the following indicators are considered: percentage of orders sent by the company via EDI and paper, and the respective cost; number of suppliers with e-invoicing model; number of e-invoices per year (monthly estimative) and per hour; percentage of e-invoices over the total of invoices received from suppliers; time consumed during the processing of paper compared with electronic invoices. The company provided the unit costs for both electronic and paper-based invoices (recipient view). In order to estimate the total savings on the adoption of e-invoicing, the author considers the total amount of invoices in 2012, according to equation 1:

$$\begin{aligned} &\boldsymbol{Total\ Savings}\ \mathbf{2012} \\ &\quad = (\boldsymbol{unit\ cost\ paper\ invoice} \times \boldsymbol{invoice\ volume}\ \mathbf{2012}) \\ &\quad - (\boldsymbol{unit\ cost\ electronic\ invoice} \times \boldsymbol{invoice\ volume}\ \mathbf{2012}) \end{aligned} \tag{1}$$

The intermediate calculations are the multiplication of unit cost per total amount of invoices. The final value for total savings results from the difference of total costs of received invoices in paper format and electronic format. The author shows that the electronic invoicing and dematerialization of processes have brought considerable advantages to the company, in terms of direct costs and efficiency gains.

To conclude, Cardoso (2012) is more focused on an engineering approach rather than on a management strategy. However, the author follows the methodology applied in the Billentis[5] report (2016). The indicators studied by the author give an orientation to choose the right ones for the present work.

Banwart (2012) shares a case study about a healthcare organization called Resurrection Health Care[6]. This case study aims to show how this organization streamed its accounts payable

[5] It is a small and highly specialised company in fields such as electronic billing and invoicing, accounts receivable and payable automation, e-business and replacement of paper-based processes with electronic and automatic processes. It publishes market reports on these subjects every year which can be found in the following link: http://www.billentis.com/index_e.htm.

[6] It is now known as Presence Health, after the merger with Provena Health.

operations. The search for efficiency, using available technology, led the accounts payable operations department to explore alternatives for the invoicing processes. The initial motivation was to achieve efficiency by the elimination of paper and the opportunity to allocate full-time employees elsewhere. In order to evaluate the possibilities for cost saving, the AP department invited three main third service providers to present their proposals, using a sampling of invoices. This sampling is composed of 100 documents "reflecting a typical range of formats, including possible errors and inconsistencies, which we might handle on a given day" (Banwart, 2012). After considering all the options, the AP department chose the best candidate based on the software's ability to reduce costs during the accounts payable process. The differentiated factor between software proposed by the service providers was the capacity to integrate with the existing systems and to extract key information from various formats. The implementation of the best software took about one month and a half and the real results could be observed after this period. The author highlights the following achievements from this implementation: reduction of the permanent hourly AP staff by about 40%; reduction of paper-based processing rate from 87% to 10%; field extraction rates of 94% on purchase order (PO)-based invoices; quicker minimum standard invoice cycle time; ability to work with more suppliers to obtain prompt payments discounts; quicker identification of possible duplicate payments; transparency of information; scalable and searchable archive, eliminating the need for physically stores paper files. In addition, the scalability capacity of the application allowed leveraging the initial design and development work during the merger between the two entities. The system was expanded smoothly with the increase of invoices volume and the efficiency and productivity gains were verified.

IOMA, Business Intelligence at Work (2010) explores the effects of automation on AP operations through a survey of over 450 AP departments. In this survey, it is asked to each department calculates some key metrics and analyse them according to their department's level of automation. Table 2 shows the average costs to process a PO invoice[7], by three levels of automation: high, medium and low. When there is a high level of automation, the average cost is $6.99, while with low automation the cost is $11.62 per PO invoice. This means that the adoption of a high automated process can reach a direct cost saving of $4.63. The author argues that the "key to cutting costs using automation" (IOMA, Business Intelligence at Work, 2010) is the elimination of paper invoice and it is possible by two ways: Optical Character Recognition

[7] "An invoice with an accompanying purchase order" ( IOMA, Business Intelligence at Work, 2010)

(OCR) – eliminating the manual work inserting the invoice data; EDI – using electronic invoicing.

| Level | Average |
|---|---|
| High | $6.99 |
| Medium | $9.54 |
| Low | $11.62 |

**Table 2 - Average Cost to Process PO Invoice, by Level of Automation**

*Source: IOMA, Business Intelligence at Work (2010)*

Another improvement from the automation on AP departments is the shorter cycle time (number of days that the vendor takes to pay). It takes, on average, 8.6 days and 5.4 days to make a payment with low and high automation, respectively. The staff productivity is also improved because it is not necessary to route invoices by hand with a high automation of AP operations. Table 3 shows the average number of payments, per month per AP staffer, by level of automation. A staff member, in one month and with high automation can process more 2,717 payments of PO invoices than with low automation. Regarding non-PO invoices, the difference between both automation levels is 1,329.

| Type of invoice/Automation level | High | Medium | Low |
|---|---|---|---|
| PO invoices | 3,647 | 1,865 | 930 |
| Non -PO invoices | 2,263 | 1,414 | 934 |

**Table 3 - Average Number of Payments per Month per AP Staffer, by Level of Automation**

*Source: IOMA, Business Intelligence at Work (2010)*

To conclude, error rates are lower with higher automation. This difference occurs due to verification and quality assurance features of processing systems and its capacity to test and ensure that PO invoices are complete and accurate.

Bohn (2010) argues that "technology holds the key to transitioning accounts payable from a cost centre into a profit centre and making the AP professional's job strategic and even more relevant" (Bohn, 2010). The challenge is to find the appropriate solution for each company, since there is not "one size fits all" (Bohn, 2010). In 2009, a study was conducted by the International Accounts Payable Professionals (IAPP) land Software Inc. and IAPP's sister organizations, International Accounts Receivable Professionals and The Association of Work Process Improvement (TAWPI). Table 4 shows the results of the survey done during this study regarding the cost of processing an invoice, through different channels.

| Method/Price | $1-2 | $3-4 | $5-7 | $8-10 | $11-12 | $13+ |
|---|---|---|---|---|---|---|
| Electronic data interchange (EDI) | 69% | 26% | 5% | 0% | 0% | 0% |
| E-mail (electronic mail) | 18% | 24% | 27% | 17% | 2% | 11% |
| Electronic invoicing solution | 46% | 21% | 18% | 7% | 0% | 7% |
| Fax | 19% | 21% | 23% | 21% | 5% | 11% |
| File upload | 43% | 29% | 19% | 7% | 0% | 2% |
| Paper | 7% | 22% | 21% | 22% | 8% | 20% |
| Spreadsheet | 28% | 24% | 20% | 16% | 0% | 12% |
| Other | 45% | 9% | 18% | 9% | 9% | 9% |
| Don't know | 27% | 7% | 33% | 7% | 7% | 20% |

**Table 4 - Average Cost to Process Invoices via Different Channels**

*Source: Bohn (2010)*

Table 4 shows that the paper invoice is the most expensive solution, followed by the usage of spreadsheets. EDI is the cheapest solution (69% of the responders spend $1-2 with this solution and the maximum cost it reaches is $7). In addition, 46% of electronic invoicing solutions implemented cost around $1-2. The survey indicates that 71% of the receipt of invoices is done via EDI, however, the usage percentage of other automated processes still remains lower. Sprau (2010) points out that the main obstacle for a paperless processes adoption is the fear to lose customers if asking them something new. However, Sprau (2010) argues that, in general, 80% of invoices came from 20% of suppliers, which means that they will be willing to adhere due to the huge value of the business.

The Institute of Finance & Management (IOFM) studies the impact of AP automation and the benefits that go beyond cost savings, through a survey. Among the responders, there are companies of all sizes and different industries. Hay (2014) argues that the companies which are achieving the greatest advantages have higher level of automation. The most used technologies are: automated workflow (58%) within ERP or as a stand-alone or separate service, and front-end imaging (53%). The vendor portals and Web-based EDI represents only 31% of the implemented solutions. Hay (2014) concludes that top-performing AP departments have some benefits: a procurement advantage, due to a better cost analysis and contract management; cash management advantage as a result of a better forecasting and working capital management; discount advantage and the avoidance of late-payments penalties; better compliance with government regulations; cost advantage.

Merisalo (2015) publishes a study based on a report conducted by the Counsel for Affordable Quality Healthcare (CAQH) Index about the untapped cost-savings potential of automation, regarding healthcare registration. This research includes healthcare providers (40 million) and

health plan payer organizations (4 billion). In order to estimate costs and potential savings, three transactions are considered: eligibility and benefit verification; prior authorization; prior authorization attachments. The usage of the technology EDI for these transactions between both parties, allows to create cost savings. According to CAQH Index (2014), providers and health plans could save up $8.3 billion per year by automating the core patient access function. In order to access potential savings' values, the costs of manual versus (vs) electronic processes are compared. Marisalo (2015) argues that savings are generated from the elimination of time spent on phone or sending fax messages and related salary, benefits, and overhead costs tied to that time.

### 2.2. Portuguese Healthcare Sector

In the Portuguese healthcare sector, there have been some developments in the documents' dematerialization. These investments are recognised by the healthcare system users. One major example is the move to electronic receipt for medical prescription. The usage of this electronic document is mandatory in Portugal since 2016 (Ordinance no. 284-A/2016). Hence, this process dematerialization becomes an object of study in literature.

Silva (2016) considers the receipts and invoices as a sensible subject due to its importance and impact in final accounts of a pharmacy. In the pharmacy studied by the author the receipts are generally electronic and the majority of manual receipts are only applied in the case of system failure or for doctors with less than 40 monthly prescriptions. The dematerialized receipt [8] can be sent via email, mobile phone message or downloaded from the web by the user. This new receipt also includes a treatment guide that can also be printed. The electronic receipt allows the user to dismiss medicines, allowing to get it in other dates and places, during its validity term. According to Silva (2016), the electronic receipt allows pharmacies with small stocks to make the sale even if they do not have the specific amount that comes in the prescription. This is possible because the consumer can buy the number of units that he wants instead of the whole amount that comes prescribed in the receipt. In addition, there is a positive environmental impact with the decrease of paper usage. Although the focus of the study is not the electronic receipt, the author reports on an internship experience in the pharmacy.

Geada (2013) presents a case study in a Portuguese hospital with the goal of evaluating the impact of electronic public procurement on the efficiency of the purchasing processes. For the

[8] A medical receipt in electronic format

analysis, the author choses the two services that have a higher cost of goods and services acquisition in that hospital (clinical pathology and blood bank). In order to evaluate the impacts, the author analysed the results obtained after the implementation of electronic procurement. The respective costs invested in the modification of internal procedures, human resources (HR) and in the platform are also estimated. The data was collected by interviews, questionnaires and surveys. The results show gains from manual to electronic processes in terms of costs, transparency and in competition promoting. However, the efficiency of this model is called into question due to the increase in the time spent in operations, especially between the authorization procedure and the adjudication. The author does not specify reasons for this fact.

Gonçalves (2010) develops a case study in a consulting company in the area of dematerialization of processes, specifically in electronic procurement (DigitalFlow platform). The sample is taken from the Portuguese healthcare sector. Data was collected by open interviews to contracting authorities, providers and a consultor of projects implementation. The goal of this study is to explore the new needs from clients, using the platform, in order to satisfy them. Gonçalves (2010) identifies two types of users: positive and negative. The first group identifies advantages on the adoption of the project while the latest group revels more resistance for the implementation. Contracting authorities consider as main advantages of the new model the facilitation of communications, transparency and safety. Providers argue that the platform turns the process less bureaucratic and erratic. However, disadvantages are also identified: for contracting authorities, the internal networking is slow and there is a duplication of information printed (due to the resistance to new technologies). Consultors argue that there is a need of involving the project manager and superiors in the process of change, otherwise the employees feel demotivated. In addition, the author concludes that interviewed considers the tool expropriated to reality due to the lack of criteria choice and that a system of proposals evaluation is needed.

### 2.3. Closure of Chapter 2

The literature presented in this chapter aims to explore existing articles with the topics of automation (related with e-invoicing) and with the Portuguese healthcare sector. Table 5 summarizes the contents of each article as well as the methodology used to collect data. This thesis aims to fill a gap on the literature: study electronic invoicing impacts in the Portuguese healthcare sector. The automation and dematerialization of the processes is a core subject during this work in order to explain cost savings from electronic invoicing adoption. Since this subject

is not already explored in the Portuguese healthcare sector, this work is a contribution for the literature, serving as a guidance for all entities of the sector.

In addition, other articles on the literature were analysed in order to give theoretical framework on the subject that will be exposed in the next two chapters.

| Authors | Contents | Data collection |
|---|---|---|
| Koch (2016) | Saving potential of electronic invoicing: comparison of costs per task between paper and electronic invoices<br>Direct staff costs per invoice | Business case |
| Cardoso (2012) | EDI functioning (engineering approach)<br>Benefits and efficiency gains of electronic invoicing: Calculation of total savings of a Portuguese company | Business case |
| Banwart (2012) | Case study about, implementing a software on the AP department: positive achievements | Business case |
| IOMA, Business Intelligence at Work (2010) | Automation of AP operations: Average cost to process a PO invoice and average number of payments, by level of automation | Survey |
| Bohn (2010) | Invoicing solutions: average cost to process invoices via different channels | Survey |
| Hay (2014) | AP automation and the benefits beyond cost savings | Survey |
| Merisalo (2015) | Cost savings potential of automation: CAQH Index | Survey |
| Silva (2016) | Dematerialized receipt | Internship |
| Geada (2013) | Impact of electronic procurement on the efficiency of the purchasing processes | Interviews and surveys |
| Gonçalves (2010) | Dematerialization of processes and introduction of electronic procurement: needs of clients | Interviews |

**Table 5 - Summary of Chapter 2**

# 3. Contextualization on E-invoicing

## 3.1. Definitions

The term electronic invoice is used for the Business-to-Government (B2G[9]) and for Business-to-Business [10] contexts (Koch, 2016). According to European legislation (Directive 2014/55/EU), an electronic invoice is an invoice that has been issued, transmitted and received in a structured electronic format. Hence, it allows its processing to be automatic and electronic. The Council Directive 2010/45/EU establishes that the integrity, authenticity and legibility should be ensured. The assurance can be made by reliable audits or by the existing technologies, such as EDI and advanced electronic signatures.

The Electronic Data Interchange is an electronic transfer, from one computer to another, of administrative and commercial data using an agreed standard to design an EDI message (94/820/European Commission (EC)). This message is defined as a set of information which is structured in agreed formats and capable of being read by a computer. This is able to be automatically and unambiguously processed (Expert Group, 2009).

An advanced electronic signature is defined by the Electronic Identification and Signature (eIDAS) (Regulation 910/2014) as a data in electronic form which is logically associated or attached to other data, in the same form, and which is used by the signatory to sign. To be considered an advanced electronic signature by the law, it must meet four requirements: "a) it is uniquely linked the signatory; b) it is capable of identifying the signatory; c) it is created using electronic signature creation data that the signatory can, with a high level of confidence, use under his sole control; d) it is linked to the data signed therewith in such a way that any subsequent change in the data is detectable." (Regulation 910/2014).

The e-invoicing term can assume two different approaches, depending on the author. On the one hand, an e-invoice is a document that is manually or automatically generated from an IT system. This document can be sent from the issuer in the electronic format as a file containing an extension such as Text (TXT), Portable Document Format (PDF), Joint Photographic Experts Group (JPEG), Tag Image File Format (TIFF), HyperText Markup Language (HTML). In this approach, a scanned paper invoice is considered as an electronic invoice. On the other

[9] "Business to government refers to business selling products and services to government"

[10] Business to business is a type of transaction that exists between businesses, such as one involving a manufacturer and wholesaler, or a wholesaler and a retailer.

hand, another approach assumes that electronic mails (e-mails) attachments are not treated as an electronic invoice since they do not permit the data to be automatically processed in the payment system (Koch, 2009).

Among existing models or adoption paradigms about the topic, two main groups can be identified: electronic invoicing models "in a broad sense" and "in a strict sense". In the former group, the term e-invoicing implies "the integration and the dematerialisation of the order-payment cycle" (Bertelè & Rangone, 2008). This means that the concept covers all the process from the beginning, with the creation of an order, to the closure, to the payment moment. E-invoicing, in this context, includes all commercial, logistics, administrative and financial operations. In the latter group, electronic invoicing consists on the solutions for automating and digitalising the processes from the invoice issuance to its archive. Here, the invoice can be seen as "the request for payment" (Nienhuis & Bryant, 2010).

## 3.2. Advantages and Barriers of E-invoicing

### 3.2.1. Reasons for Adopting E-invoicing

The increasing of migration to electronic invoicing and the growing interest for this matter are based in several reasons that allow enterprises to improve their solutions, bringing direct and indirect benefits. The most important benefit is the cost savings, which can be reached by using e-invoicing in the billing process.

Regarding the direct added value, Bertelè & Rangone (2008) recognize two classes of performance: efficiency and effectiveness. Efficiency considers the resources that are used during the process cycle (from the order to the archive). The adoption of electronic invoicing in the billing process allows a reduction of space needed to archive the documentation and expenses related with printing, dispatching and certificates (Bertelè & Rangone, 2008). E-invoicing also "reduces the total costs by eliminating millions of papers that are exchanged every year" by enterprises (Tait, 2009), according to Veselá & Radiměřský (2014). Another way electronic invoicing improves efficiency is by freeing personnel of administrative tasks, decreasing the costs with human resources (Veselá & Radiměřský, 2014). The fewer administrative errors and the elimination of postal delays also lead to lower operational costs (Berez & Sheth, 2007; Hani, 2001; Haq, 2007).

The other class of performance is effectiveness. E-invoicing is capable of increasing the accuracy and promptness of the process. Due to the easier access to information, which is

available in real time (Veselá & Radiměřský, 2014), there is higher transparency in the billing process. Using this electronic document, the approval cycles become faster (Keifer, 2011). The payments accelerate and cause an improvement on cash flow and a reduction on credit losses (Salmony & Harald, 2010).

Finally, there is an environment benefit by reducing the paper consumption and energy costs for transportation (Veselá & Radiměřský, 2014).

### 3.2.2. Barriers for Adopting E-invoicing

Besides the benefits that come from the migration for e-invoicing, there are still some barriers that enterprises need to face during the adoption process. These barriers can differ depending on the country and the enterprises' size (Koch, 2016).

The non-homogeneous legislative framework or confusing legal requirements can be seen as the main obstacles for the adoption of e-invoicing in many countries (Bertelè & Rangone, 2008; Koch, 2016). Due to a plethora of standards (Edicom, 2016) across the European Union, the Parliament and the European Council endorsed the Directive 2014/55/EU whose goal is to create international standard rules for e-invoicing.

The existence of too many standards can lead to a complex and expensive integration with external players. This happens when the word *standard* assumes its full sense – "semantic and process standard" (Bertelè & Rangone, 2008). In this case, the documents should be "read according to the process perspective, i.e. activities and players, and contain all information needed to facilitate integration" (Bertelè & Rangone, 2008) and it should exist a "complete agreement on semantics (e.g. product and player identification codes)" (Bertelè & Rangone, 2008).

The divergence in requirements of trading partners regarding methods and formats can also emerge. This barrier can be overcome by creating standards between partners or by e-invoicing network operators who reduce the complexity of end-users (Koch, 2016).

Bertelè & Rangone (2008) present three main classes of internal barriers. They argue that there is a substantial lack of awareness of electronic invoicing in its broad sense, leading to an incapacity of considering the value added by electronic invoicing projects due to the absence of integration and dematerialisation of the trade process. The authors also refer that, although there is a growing awareness of the importance of a vision by process, there is still a "resistance to management by process" (Bertelè & Rangone, 2008). The third barrier is the "resistance to

supply chain collaboration" (Bertelè & Rangone, 2008) with suppliers, customers and service providers.

According to the same authors, since the electronic invoicing projects in broad sense are complex, the top management should be entirely involved, considering the trade process as a single activity which is affected to all company functions. At the same time, the collaboration with customers, suppliers and service providers should be reinforced. In this adoption process and in order to face these barriers, there is a need for changing the organizational culture and model. In this process, management attention and decisions are required (Koch, 2016).

### 3.3. E-invoicing in Europe

#### 3.3.1. Invoice/Bill Volumes

The European invoice/billing volume has been growing in the last years. According to the report from Billentis, the total European invoice/bill volume is estimated to rise to 37 billion in 2017, of which one half corresponds to the volume sent in a business to consumer (B2C)[11] context. The remaining 50% correspond to the amount of invoices/bills sent to public sector and enterprises (B2G/Government to business /B2C).

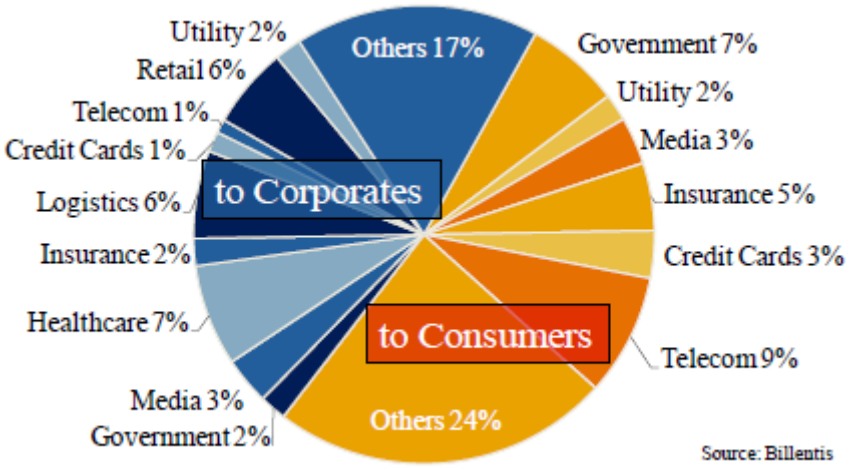



**Figure 3 - Invoice/Bill Volume per Industry (Issuer View)**

*Source: Koch (2016)*

Figure 3 shows the percentage of the total invoices sent by each industry. The industry names represent the issuer while the recipients are in the middle of the graph (corporates and

[11] "Business to consumer (B2C) is business or transactions conducted directly between a company and consumers who are the end-users of its products or services" (Investopedia, 2017).

consumers). This figure shows that 7% of total invoices are sent by healthcare industry to corporates. Figure 4 indicates the percentage of the total invoice volume received, assigned to each industry, in a B2B context. It is important to highlight that the healthcare industry represents from 5 to 13 % of the total invoice volume received, depending on the country. The remaining volume is dispersed by the other existing industries.

| Industries with high inbound volume | % of all B2B invoices, indication |
|---|---|
| Healthcare | 5-13%, depending on the country |
| Retail | 10% |
| Public sector: National Government, regions & municipalities | 9-15% |
| Buyer Clubs, Trade (to buy wholesale) | 5% |

**Figure 4 - Invoice Volume by Industry (Recipient View)**

*Source: Koch (2016)*

### 3.3.2. E-invoicing

The practice of e-invoicing across European countries has been a priority to the Digital Single Market. Despite the positive growth rates of using electronic invoicing (Koch, 2016) and all the efforts done by the European Commission to promote e-invoicing and the automation of the processes, the formats and channels used by companies still differ, depending on the country and size.

Figure 5 summarizes a study conducted by Ibi Research, in 2011 and 2015, about the invoice exchange methods used in Germany. Data was collected by a survey headed mainly to companies located in Germany and the other participants from Austria and Switzerland. In this survey, the participants could give multiple answers, choosing more than one method.

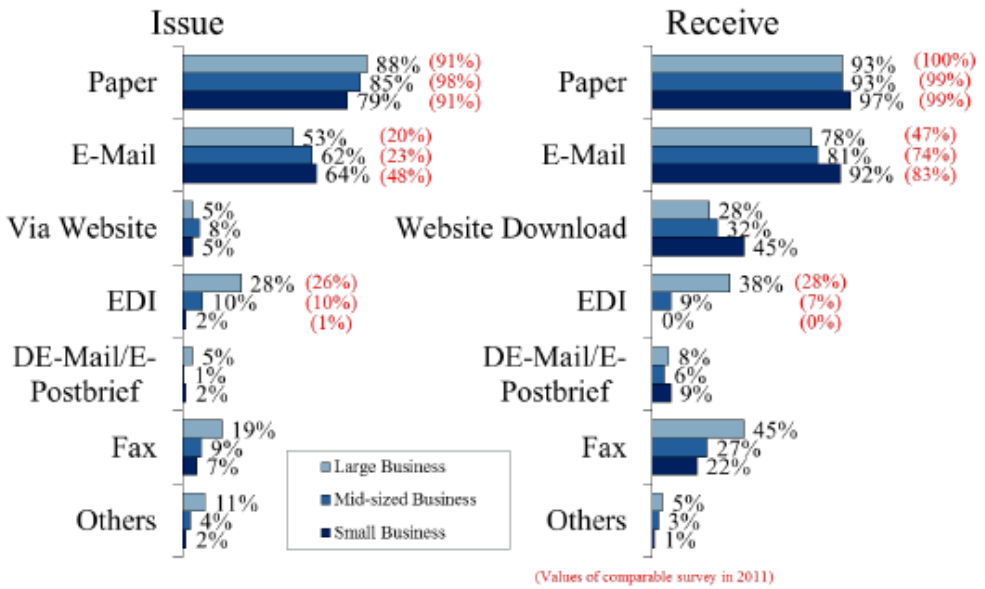



**Figure 5 - Invoice Exchange Methods in 2015**

*Source: Koch (2016)*

The results taken from this study give the European market picture regarding electronic invoice channels used by small, mid-sized and large businesses. The use of multiple channels exchange is notable in the presented scenario, where paper invoices dominate. The e-mail is more used than EDI for all size business, despite the increasing of EDI usage by large companies. However, these companies still often accept e-mails from Small and Medium Enterprises (SMEs).

Stakeholders have been considering e-invoicing in structured format (to exchange, process and archive) as a long-term intention. EDI and, years later, eXtensible Markup Language (XML[12]) are the preferred e-invoice formats (Koch, 2016). This preference is observed in large enterprises while mid-sized and smaller companies still use documents in a PDF format due to the cheaper transport and archiving. However, their cost savings are limited because the process is not automated (Koch, 2016).

Figure 6 shows that in recent years a solution which combines PDF and XML invoices has emerged among enterprises. This can happen in two ways: two separate files or a PDF file with a XML data set embedded in it. According to Koch (2016), the aim of this solution is to reduce the dominance of image-based PDFs. The solution also benefits from the fact of being extensible to all sizes enterprises' requirements.

[12] It is a standard language which enables different types of computer to exchange structured data.

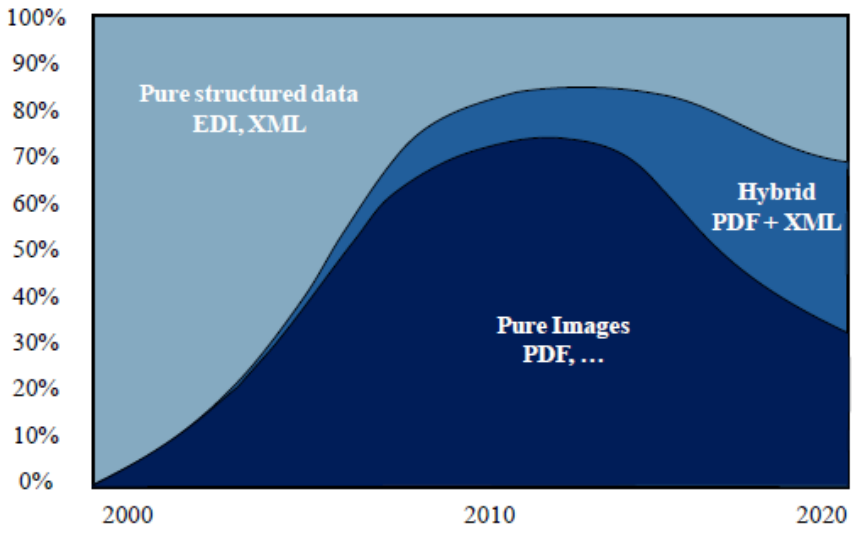



**Figure 6 - Proportion of Different Invoice Formats**

*Source: Koch (2016)*

Koch (2016) also argues that the public sector should be the booster of structured e-invoices adoption, defining some requirements regarding this matter. In some countries, such as Austria, it is mandatory to Governments' suppliers to send invoices in electronic format and PDFs are not allowed.

### 3.3.3. European Agenda on E-Invoicing

#### 3.2.3.1. European Measures

The *Digital Agenda for Europe* is one of the seven flagship initiatives of *Europe 2020 Strategy*, launched in March 2010 by the European Commission. The Communication "Reaping the benefits of electronic invoicing for Europe" of 2 December 2010 states the following priority actions:

- "Ensure legal certainty and clear technical environment
- Encourage open and interoperable e-invoicing solutions
- Support uptake by setting up organisational structures, including national fora and European Multi-Stakeholder Forum" (European Commission, 2010).

In order to foster uptake, there were established four main priorities in this Communication:

a) "Ensure a consistent legal environment for e-invoicing": The European Council has been creating European Directives (EDs) with the main goal of harmonizing and clarifying the understanding of new e-invoicing rules across Member States and

overcoming the question of different national rules on the subject and creating agreement on legal framework across Member States.

b) "Achieve mass adoption by reaching SME's who represent 99 percent of European Businesses": Since SMEs are the big major part of total businesses, the European Union seeks to promote the use of information and communication technology among enterprises. The principle of 'Think Small First' is applied and it is asked to Member States and standard bodies to follow this perspective.

c) "Stimulate an environment that creates maximum reach": The European Committee for Standardization (CEN) is responsible for creating a Code of Practice aiming to increase the interoperability of e-invoicing, clearly defining the roles and responsibilities of trading parties and service providers. The proposed actions in the Code of Practice should achieve an alignment, between both parties, on addressing and routing, risk management, communication workflows, roaming agreements and security requirements.

d) "Promote an e-invoice standard data model": Due to the lack of a general used standard regarding e-invoicing, the UN/CEFACT Cross Industry Invoice (CII) should be accepted and used as a semantic data model. CEN should design implementation guidelines according to the invoice data set proposed by the Expert Group. This measure aims to ensure technology neutrality and to facilitate semantic interoperability. The international standards organisations should work together on this matter.

In June in 2013, a new communication was made by the European Commission, called "end-to-end procurement to modernise public administration". E-invoicing in public procurement allows the automation of archiving, contributing to the simplification of the process. Moreover, end-to-end procurement makes management more efficient and promotes information transparency (European Commission, 2013).

Despite all the efforts to uniform standards across the EU Member States, there is still a "complexity in terms of cross-border interoperability" (European Commission, 2017). The EC issued the Directive 2014/55/EU in order to promote electronic invoicing in public procurement. This directive shall appeal CEN to outline a common standard at semantic level taking into account the core elements of an e-invoice. The European standard chosen should complies the criteria defined in the same Directive, Article 3.

In addition, the Directive 2014/55/EU establishes as mandatory for all contracting authorities and contracting entities to receive and process electronic invoices according to the European

standard, with outset in November 2018. This common standard will be defined and published by CEN until 27 May 2017.

#### 3.2.3.2. Portuguese Measures

Portugal, as one of EU's Member States, is subject to European rules and directives. Even so, each country shall manage the implementation of new rules according to the own degree of development on this matter.

The Portuguese government created the Decree Law (DL) 198/2012 in order to establish some control measures when issuing invoices or other important fiscal documents. This DL defines the new electronic communication system with the Portuguese Tax and Customs Authority.

The Ordinance No. 302/2016, in Portugal, takes the standard XML format from which is possible to export easily a set of predefined requirements for accounting records in a format readable, called SAF-T (PT). The actors affected must comply this ordinance until January 1, 2017. The data structured in Article 3 of this Ordinance takes effect on July 1, 2017.

In addition, the e-invoice system, created in 2013 in Portugal, won the Innovation in Public Administrations award, considering the Portuguese development as an international reference. Portugal also stood out by its simplified regime of proof of export in which time and costs are reduced significantly (in 2015).

## 3.4. Healthcare Sector

### 3.4.1. Healthcare Sector Estimates

The healthcare sector is considered one of the most important sectors for the general wellbeing and for economy, especially in developed countries (AEP, 2003). Each country has its own system and financial sources. In Portugal, the National Health Service (NHS) follows the Beveridge model, which means that it is financed by taxes and all citizens can have access to it (World Health Organization, 2014).

The current expenditures in the healthcare sector in Portugal represented 9% of Gross Domestic Product (GDP), in 2015, in which 5.9% is supported by the Government (OECD, 2017). This means that the healthcare sector in Portugal is more than 60% financed by Public entities. According to *Instituto Nacional de Estatística* (INE), 31.3% of this expenditure is applied in hospitals (INE, 2014). Hence, this sector represents a high weight on total budget of the Portuguese Government.

Based on the Billentis' report (figure 4 and table 3), the healthcare sector represents 7% of total invoices sent and 5-13% of total received, in Europe. However, each invoice issued or received brings costs for the entities involved and, due to the high level of public expenditures, there is an incentive to adopt the electronic invoicing.

### 3.4.2. Healthcare Sector and Electronic Processes

In Portugal, there is an increasing attention to the information systems in hospitals, due to the competitiveness between them (Balloni, 2006). According to INE, the proportion of electronic clinic processes duplicated from 2004 to 2014. (42% to 83%). However, according to Saphety (2015), it is time to go further and provide economies of scale and optimize the internal workflows.

Despite electronic invoicing and its direct saving costs, there are still other ways to improve the whole cycle, from the order to the payment. The optimization of internal resources, the automation and simplification of processes, the increasing on speed, transparency and control on invoicing and payment cycles have impact on the improvement of healthcare services. The administrative expenditures can also be reduced by the elimination of tasks (Saphety, 2015).

## 3.5. Beyond E-invoicing

The adoption of e-invoicing has been supported by legislations and several initiatives in order to create efficiency in the supply chain, reducing errors and creating cost savings. This electronic tool also eliminate errors and agile the processes, eliminating the physical archive, when paper invoices are not used. However, "pure e-invoicing services are no longer sufficient" (Koch, 2016).

Although electronic invoicing is generally treated as the "key in collaboration between companies" (Bertelè & Rangone, 2008) there are other documents that should be taken into account when analysing the optimization of order-to-payment cycles. Through a process dematerialization, using automated collaborative interfaces, companies can achieve higher levels of operational optimization. According to Saphety (2015), it is created a "scale effect" in the ecosystem where the player operates. For this to happen, established standards and interoperability between different systems are needed.

### 3.6. Closure of Chapter 3

According to different authors, e-invoicing have several benefits for enterprises in their invoices' management process. However, SMEs still use paper (and PDF files) when issuing and receiving invoices. Although large enterprises have a higher usage of EDI in this process, there is still a long way to go through regarding invoicing dematerialization and automation. There are some barriers for the adoption of electronic invoicing, since confusing legal frameworks to the own resistance management from companies. In order to promote electronic invoicing and face these barriers, the EC developed some incentive measures and legal framework. Portugal adapted this legislation accordingly.

The application of electronic invoicing in the healthcare sector can bring benefits to the sector since it represents 7% of total invoices sent and 5 to 13% of total invoices received, in Europe. In Portugal, these numbers are unknown, however, since this sector is mainly financed by the State and its expenses represent a high percentage (9% in 2015) of the Portuguese GDP, e-invoicing adoption can bring significant cost savings and other benefits.

Figure 7 summarizes this chapter and its main ideas.

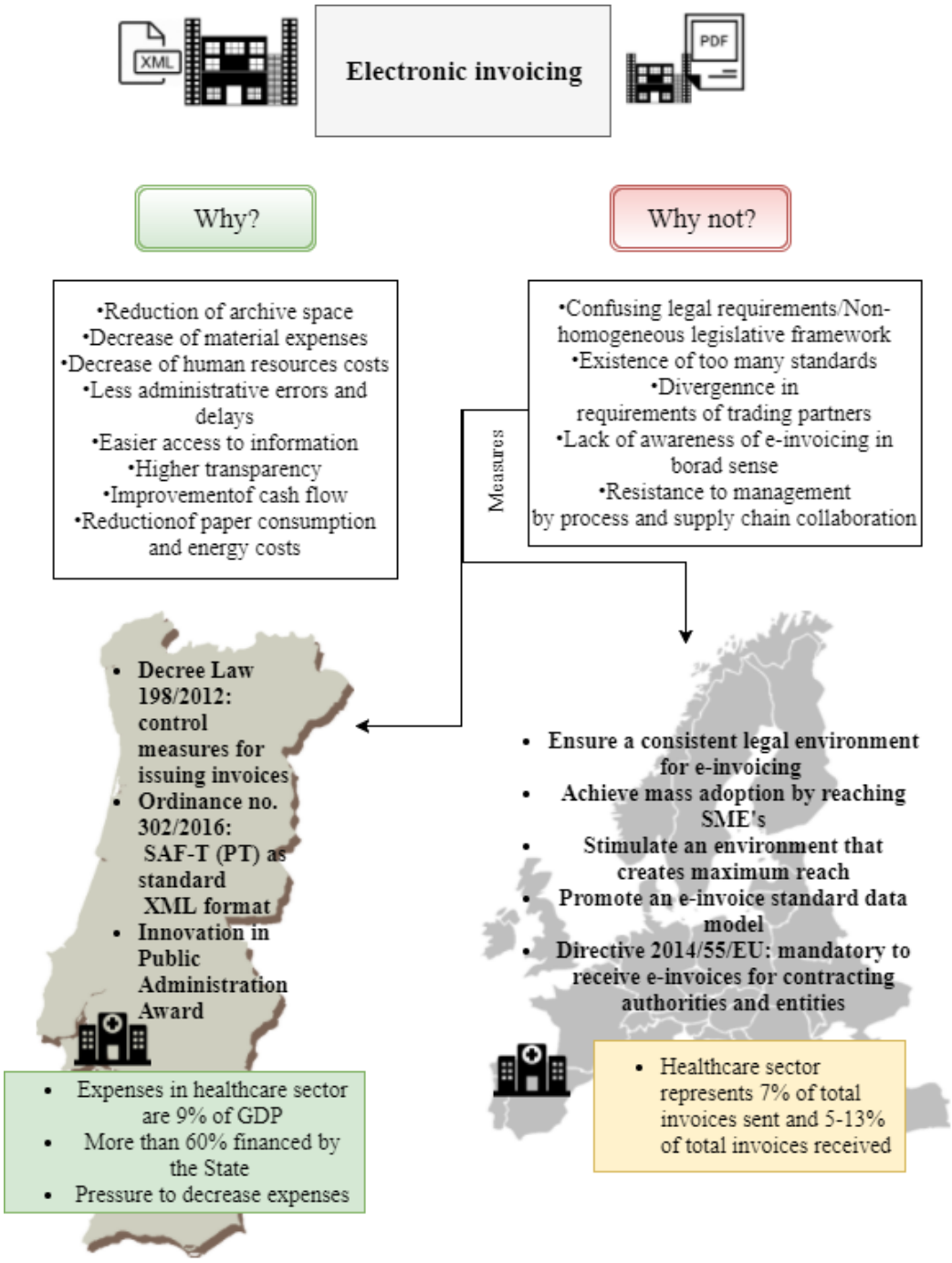



**Figure 7 - Summary of Chapter 3**

# 4. Invoicing and Exchange Process

The exchange of commercial documents between an entity and its stakeholders can be divided in two types: accounts payable[13], and accounts receivable[14]. For the scope of this work, only accounts payable is considered, focusing on the purchase process in the buyer's side.

## 4.1. Commercial Documents

During the goods and services acquisition process, there are different documents traded between the parties involved in order to formalize the processes. A commercial document registers certain aspects of a commercial transaction occurred. The main documents are the purchase order, the advance shipping notice, the invoice, debit and credit notes (OpenText[15], 2017). The last three are also considered financial documents.

**Purchase order**– A PO is a document issued and sent by a buyer to a seller, formalizing the desire to acquire certain items or services. Each PO shall indicate the quantity and description of the goods to be purchased, the terms of delivery and payment as well as the tax data of both parts (invoicexpress, 2017). This commercial document allows to have control under the purchasing of products and services to external suppliers (Dobler & Burt, 1996).

**Transport guide/Bill of lading** – A transport guide or bill of lading is a transport document that accompanies the movement of goods in the national territory that can be object of operations carried out by taxable persons. This document is the legal proof of the goods transportation (invoicexpress, 2017).

The Tributary and Customs Authority considers as legal transportation documents the invoices, delivery notes, transport guides, return notes or the Equivalent Document, if they contain the elements presented in the Article 4 of the *Regime de Bens em Circulação*.

**Despatch advice (DA)/Advance Shipping Notice (ASN)** – A Despatch Advice/ASN is a message that enables a shipper to provide information about the content of a shipment to a receiver (GS1 Global, 2016). For each PO, the supplier can make different deliveries, according to the availability of the goods. In this way, DA/ASN can be seen as a notification of pending

[13] Documents exchanged between the entity and its suppliers
[14] Documents exchanged between the entity and its clients
[15] "OpenText operates the world's leading B2B network. It connects more than 600,000 businesses that execute in excess of 16 billion transactions per year to facilitate the mission-critical transfer of goods, money, and information between customers, suppliers, and service providers" (OpenText, 2016).

deliveries, similar to a packing list. It is usually sent in an electronic format, and is a common EDI document (Gilmore, 2010).

**Invoice –** An invoice is a document of accounting value that attests to a commercial transaction between two persons or companies. It should contain information about the product or service provided, as well as the amount and value of this transaction according to the payment terms (invoicexpress, 2017).

**Credit note –** A credit note is a commercial document used to settle accounts, cancelling one or more invoices (invoicexpress, 2017). It is used to credit a certain amount to the buyer's account, allowing the buyer to recover the value reported by mistake. These mistakes can occur in situations where the invoice amount is overstated, the correct discount rate was not applied, the goods spoiled within guaranty period or when the buyer's specifications were not met (Business Dictionary, 2017).

**Debit note –** A debit note is a commercial document which informs the amount that the buyer owes to the seller. Similar to the credit note, it works as a rectifying document.

### 4.2. Exchange of Documents

The process of purchasing goods and services to external entities goes through different general steps until the archive.

Monitoring and inventory management are important to place an order when required (Mathew, et al, 2013). The buyer shall issue a purchase order and complete all the items of the document such as the code number, the description of the product, the quantity and the price. The PO is sent by the buyer to the supplier.

After the PO is confirmed, the supplier issues a transport guide with the information needed and required to transport the goods to the right location. During an automated process, the document ASN is sent to the client before the transportation of the goods (GS1, 2016). When the invoice is issued by the supplier, the buyer should confirm the information and the payment terms in order to finalize the process, paying for the acquisition of goods or services. Finally, the documents are archived and they are available for consultancy in the case of need.

### 4.2.1. Manual Process

The manual process is the traditional one which is used by most part of organizations (GXS, 2008). However, there is a tendency to change for an automated process, due to its efficiency gains.

In the manual process, the operations in the AP department need a high human intervention. Organizations have their own informatics systems (the ERP) in which the companies are able to manage their core business processes. Usually the inventory system is one of the ERP modules. In general, the inventory system emits an automated alarm, notifying the buyer to issue the PO (GXS, 2008). When the inventory system is not integrated with the accounting system, the buyer has to insert the necessary data in the purchase system to create the PO.

The PO is usually sent to the supplier in PDF format, via e-mail. Another way to send it is via fax or by post mail (including the printing phase). The supplier, after receiving the PO, inserts the data, manually, into the sales order system, generating an invoice (OpenText, 2017). The supplier prints both the transport guide for goods and the invoice which is sent to the buyer. The buyer´s AP department receives the mail with the invoices, opens the mail, checks and removes undesired attachments, stamps the invoice and sends it for validation and approval (Koch, 2016). The internal approval workflow process can be digitalized (the invoice is digitalized in a PDF format and the approval is done using a workflow software and digital signatures) or totally manual, in which the paper invoices travel through the different approval responsible.

In this process, the received invoice has to be compared with the corresponding PO. If the validation shows no mistakes, and the invoice is approved, the data from different fields of the invoice (defined previously according the business rules defined by the company) are manually introduced in the ERP, and the paper invoice archived in appropriated stores. Figure 8 illustrates how a PO and an invoice are generated and exchange between the buyer and the supplier.

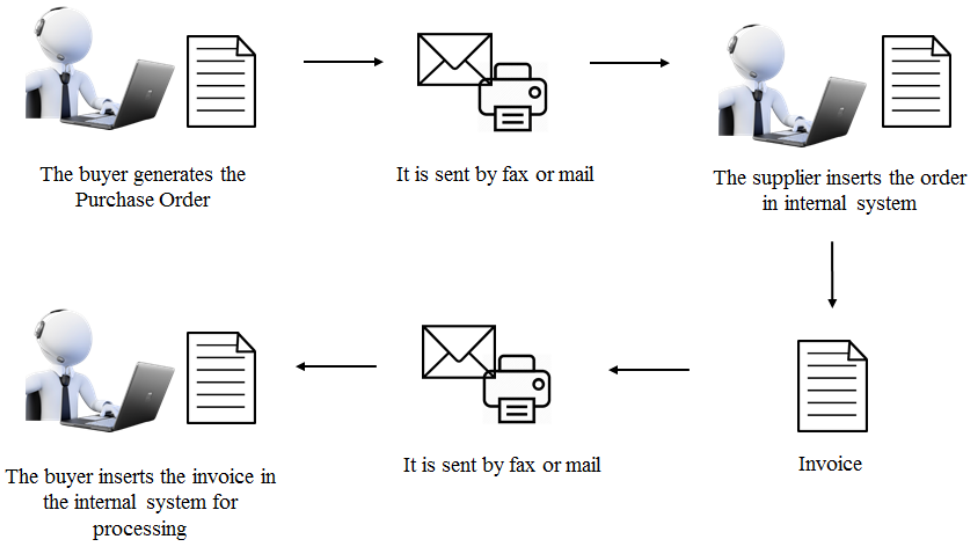



**Figure 8 - Manual Exchange Process**

*Modified from: OpenText (2017)*

The manual process can be a longstanding process. The exchange of paper documents can add weeks to the process due to its transportation system and all the manual procedures that are subject to several errors (GXS, 2008). These inefficiencies can also signify huge costs for the company. The manual process revels being more costly due to different sources of costs. The more evident cost, although not the most costly, is related with materials and direct human resources, since this process includes the printing of the different documents and the corresponding physical archives, using dedicated resources that can be allocated to other functions inside the company (OpenText, 2017).

Since the process depends on human resources, it is subject to mistakes in entering data, leading sometimes to situations of duplicate payments, late payment penalties, overpayments, missed discounts or forgotten credit notes. These errors and discrepancies across the documents cause direct money wastes for the organization that can be irreversible. Due to the fact of being a time consuming process, it can have negative consequences to the own buyer´s inventory that, in urgent situations, can stay out of stock.

In terms of transparency and control over the processes, a manual AP system is not efficient and the huge amount of papers makes the physical space of operations disorganized. This disorganization can also lead to security risks since the manual system is more exposed to security problems such as data theft or data loss.

The high amount of documents exchange between the companies and external parties and the lack of a joined store for each PO and correspondent transport guide and invoice, create inefficiencies because it is hard to have access to the whole process of an order.

The non-correspondence data between the PO and the invoice, by the reasons previously discussed, can be responsible for the highest costs in the process. It was already seen the possible stock break in the buyer side. Sometimes the issues of non-correspondence can be solved by a phone call or e-mail, exchanged between AP buyer´s department and the supplier. Moreover, the subject must involve a buyer´s higher hierarchy people, increasing the costs. Most probably, one small percentage is not able to be resolved by business standards, and lawyers and court have to be involved (Koch, 2016).

| Recipient Process | Manual work and problems with paper based processes |
|---|---|
| **1. Receive** | • Opening mail<br>• Check and remove undesired attachments<br>• Entrance stamp<br>• Forward to AP department |
| **2. Entering Codification** | • Entering to AP system<br>• 10% of entered data statistically viewed with errors<br>• Delayed entering during peak season or permanently<br>• Alternative scanning solves just a small part of the problem |
| **3. Validation and Matching** | • Discrepancy in VAT compliance is detected at the late stage<br>• Line items in an invoice quite often contain a discrepancy with the order or contract terms.<br>• Manual matching is time-consuming and expensive |
| **4. Dispute Management** | • The dispute resolution with the supplier is often done today by phone, unstructured email or fax<br>• Dispute resolution can be very time consuming |
| **5. Payment and Cash Management** | • Time consuming and costly circulation within the company for payment release; discounts are typically missed<br>• Manual work for payment order and risk of errors<br>• Cash Manager without the full transparency for all pending invoices |
| **6. Archiving** | • Hundreds or thousands of folders with paper invoices with high demand for storage capacity<br>• High costs for manual search<br>• Traditionally 6 copies on industry average not all clearly stated as "copy" |

**Table 6 - Manual Work and Problems with Manual Process when Receiving an Invoice**

*Source: Koch (2012)*

Table 6 summarizes the problems with paper based invoicing process, dividing it by the six steps of receiving an invoice.

### 4.2.2. Automated Process

The migration from manual to automated processes comes from the need of finding better solutions for decreasing the inefficiencies of traditional procedures used to exchange documents.

The exchange of documents in electronic formats allows companies to reduce costs, increases process speed, decreases errors during the process and improves the relationship among business partners. Although the documents sent by e-mail are considered as electronic documents, they need a human intervention and management, including human resources in the process and maintaining the risk of incurring in errors (OpenText, 2017).

The automated process implies the introduction of a new component: EDI. This process enables the integration of buyer's and suppliers' systems, allowing an electronic exchange of documents. The parties involved should follow the pattern formatting rules in order to the data to be recognized and translated in both internal systems.

In this process, there is a dematerialization and an automation of documents exchange. This process is usually done by using a service provider in the middle (an EDI "broaker"). The buyer's ERP is integrated with the service provider B2B EDI platform (OpenText, 2017). The format of integrated documents shall follow the one defined by EU. However, the system must be flexible enough to work with different formats, according to the type of ERP used by the buyer.

Business rules must be defined by the buyer for the received documents (especially ASN and invoice) in order to be implemented in service provider platform. There are some fields on those documents that are mandatory. One of the mandatory fields for Portuguese Public Administration is the "Commitment number" – *Número de Compromisso* which falls in the scope of this work. This field is essential to manage and interconnect the documents received by the buyer with the issued PO.

The suppliers shall be also connected with the service provider platform. The supplier's connection process is also known as *rollout* (OpenText, 2017). It is important for buyers to have the highest percentage of sent and received documents full integrated with their ERP because some buyers have hundreds or even thousands of suppliers and this process can take some time.

In order to accelerate the connection of suppliers with the guarantee to the buyer of a full document integration, the service provider´s platform allows suppliers to be connected using different formats:

- Integrating ERP systems to the platform. In this way, supplier receives electronic PO and debit notes directly in its ERP, or through an electronic documents approval workflow. After the approval, PO data can be integrated in its ERP without any manual procedure. In the other direction, supplier sends electronic ASN, invoices and credit notes documents directly from the ERP. This solution allows machine to machine integration, being the most effective and low cost process. However, taking in consideration the need of document integration in the ERP, the connection of each supplier takes some time, delaying the speed of the rollout.
- Using a portal provided by the platform for those suppliers that do not have the ERP integrated with service provider platform. The buyer still sends electronic PO and credit notes from its ERP but suppliers will receive those documents in a portal. The platform advises the supplier that is receiving documents from a certain client, usually by e-mail with a link to the platform. By clicking the link, the supplier is driven to the portal where the documents are loaded, and access them. In the other direction, supplier can fill in the portal the data regarding the documents to be sent to the buyer. The documents layout in the portal shall be defined between the buyer and the service provider. In order to make the process easier, and if it is agreed between buyer and service provider, the supplier is able to produce ASN and invoice from the PO received. In this way the main data to be included in those documents is automatically filled and the supplier only has to edit the changes needed. Possible errors are thus avoided by manual data introduction. The only problem for the supplier is the need to issue the documents from their ERP and to repeat the procedure in this semi-automatic way. The PDF of the documents produced by ERP can be added to the portal. The buyer receives all these documents integrated in ERP. This process speeds up the connection of suppliers to the buyer, as the documents layout in the portal is the same for each supplier.
- Finally, for small size suppliers or only with intention to speed up the rollout, to guarantee full documents integration with buyer´s ERP, some service provider´s platform allows suppliers to send the documents in PDF format to a dedicated e-mail address, or even in paper for a dedicated mail box. In this latter case, a digitalization of the document shall be done, and, in both cases, the fields of the documents needed to be

integrated with buyer´s ERP shall be captured by an OCR process. The PDF of those documents as well as the Meta data captured are integrated in the platform and sent electronically to the buyer´s ERP. From the suppliers point of view there are no process changes and the buyer fulfils the goal of receiving all documents electronically.

Figure 9 shows the documents exchange in an automated process, contracting a service provider as an intermediary.

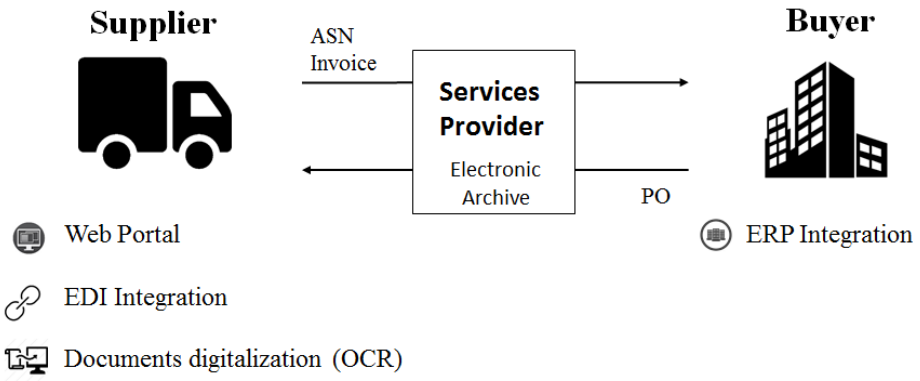



**Figure 9 - Automated Exchange Process**

*Modified from: Saphety (2015)*

All parts get high value for money. The relation between buyer and suppliers turns to be much more transparent, turning their acceptance much faster, speeding up payments and improving the cash flow.

A supplier is attracted to adopt an automated system due to several benefits. Regarding to e-invoicing, the payments are faster since it eliminates the delays resulted from mailing, routing, sorting and rekeying paper documents. The day's sales outstanding can be reduced and the supplier's cash flow is improved. The number of invoices rejected also decreases since the errors during the process are eliminated. The costs on the AR department are also reduced and the productivity increases due to the savings generated and the fact that is not necessary to enter in contact with the buyers asking for the reception of documents (OpenText, 2017).

To conclude, the customer satisfaction increases because this process is faster and easier, avoiding the slow invoice processing and payments issues. Since the relation with the suppliers is optimized, the buyer is able to improve the own operations with customers.

### 4.3. Closure of Chapter 4

Besides invoices, there are other commercial and financial documents exchanged between businesses (PO, transport guide, bill of landing, DA, ASN, credit and debit notes). The interchange of this documents is usually manually, however this type of process revels to be costly and inefficient for both buyer and supplier. The electronic exchange is processed without direct human intervention, decreasing the chance for mistakes occur. A service provider's platform allows to integrate both buyer and supplier internal systems, automating the process and achieving a higher efficiency in the process. Figure 10 summarizes the manual exchange process (outside the arrows) and the automated exchange process (inside of arrows) with a service provider intervention.

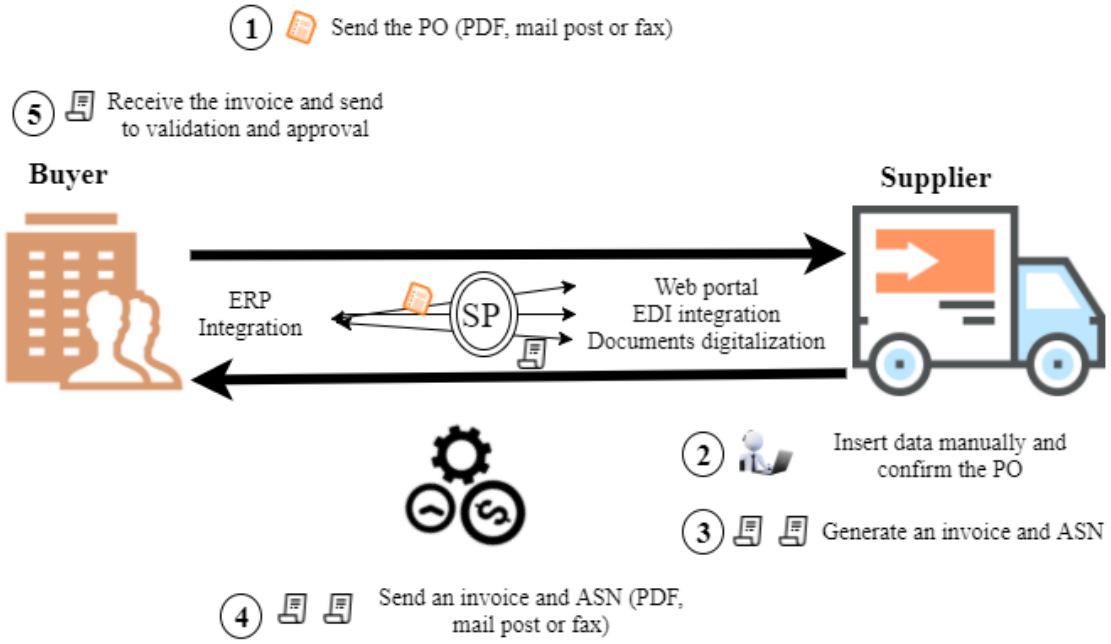



**Figure 10 - Summary of Chapter 4**

# 5. Portuguese National Health Service

## 5.1. Entities

### Ministry of Health

The Ministry of Health is a governmental department which is responsible for creating national health policies, guaranteeing the respective execution as well as the sustainable usage of the resources available for the effect and the evaluation of the corresponding results obtained. It is up to the MS to regulate, plan, finance, orient, evaluate, inspect and audit the National Health Service (SNS, 2017). According to the Ministry of Health Organic Law and the respective organization chart, the MS leads the central services of State direct administration and the organisms, peripheral organisms and the State- Owned sector which belong to the indirect State administration (Articles 4 and 5).

### Portuguese Health Service

The Portuguese Health Service consists of a set of all public healthcare entities that are governed by specific legislation, such as hospitals, local health units, health centres and groups of health centres. These entities are subject to Ministry of Health. The SNS is responsible for assuring individual and collective health protection. It was created in 1979 by Law n. 56/79 of 15th September within the scope of the Ministry of Social Affairs. It entitles financial and administrative autonomy. In order to guarantee an efficient management, the SNS is organized by regions and sub-regions (SNS, 2017).

### Central Administration of Health System (ACSS – *Administração Central do Sistema de Saúde*), Public Institute (IP – *Instituto Público*)

ACSS is a public institute founded in 2007. It has financial and administrative autonomy and it is part of the indirect State administration. ACSS is endowed with jurisdiction over the entire continental territory. In order to achieve the efficiency needed for assuring an integrated management of resources of SNS, this organism takes various actions, as the following (according to the Ministry of Health Organic Law):

- To plan and coordinate the financial resources of the SNS according to MS policies
- To develop human resources policies in the healthcare sector, including professional regulation
- To define financing models for contracting health care and follow-up of a program contract implementation with SNS's hospitals

- To coordinate the management of facilities and health equipment within the SNS
- To provide the SNS with adequate information and communication systems and purchasing rationalization mechanisms through the Shared Services of Ministry of Health (SPMS – *Serviços Partilhados do Ministério da Saúde*)
- To coordinate and centralize the elaboration of information and statistics on production, welfare performance, financial and human resources
- To manage the SNS's control and monitoring centre
- To manage the integrated health care access management system in the SNS
- To coordinate and assure the MS and SNS budget elaboration
- To act as the national point of contact for cross-border healthcare
- To prepare an implementation of the Public Health Initiatives Program

**SPMS, State-Owned Enterprise (EPE- *Entidade Pública Empresarial*)**

The SPMS was created in 2010 and its legal nature corresponds to an EPE This entity aims to provide specific shared services in the healthcare sector, in the areas of purchase, logistics, financial services, systems and technology, and human resources to establishments and services which are part of the SNS, regardless its legal nature. This is also extensible to MS's organisms and services and to any other entities operating in the healthcare sector. SPMS allows to create efficiency, centralizing, optimizing and rationalizing the acquisition of goods and services. It is responsible for acting with a defined strategy on purchases, for pre-contracting procedures, internal logistics, payments and performance monitoring. Regarding to financial and accounting matters, the SPMS should cooperate and share its knowledge and information. It also plans and prepares the health budget, contracts management, analytics and general accounting, payment and treasury (SNS, 2017).

**Regional Administration of Health (ARS –*Administração Regional de Saúde, IP*)**

The ARSs were created with the aim of assuring an efficient management of resources across the national territory. Each ARS is responsible for guaranteeing the access of the population to healthcare services to population of the correspondent geographic area. These organisms must adequate the resources to the specific geographic needs, execute and monitor programs and policies in the respective area.

According to the Organic Law, these organisms have the following attributions:

- To implement the national health policy, in accordance with global and sectoral policies, aiming at its rational planning and optimization of resources;

- To participate in the definition of inter-sectoral planning coordination measures, with the goal of improving the delivery of healthcare;
- To ensure the regional planning of human and material resources, including the execution of the necessary investment projects, the institutions and services health care providers, supervising their affectation;
- To provide guidance, technical support and evaluation of the performance of healthcare institutions and services in accordance with the policies set out and with the guidelines and standards issued by the relevant central services and bodies in the various policy areas;
- To allocate financial resources to institutions and services that are integrated or financed by the SNS and to monitor and evaluate their performance, in accordance with the guidelines defined by the ACSS, IP;
- To develop, consolidate and participate in the management of the national network of continued integrated care, according to the defined guidelines.
- To coordinate at regional level the management of the national network of palliative care, according to guidelines defined at national level.

There are five ARSs in the Portuguese continental territory: ARS Norte, ARS Centro, ARS Lisboa e Vale do Tejo, ARS Alentejo, and ARS Algarve. Geographic location is the criterion applied for the distribution of entities among these five associations. Tables 7-11 are the entities that belong to each ARS, respectively, and their classification, in terms of legal statutes.

| ARS | Entity | Number of Units | Classification |
|---|---|---|---|
| **ARS Norte, IP** | ACES | 21 | |
| | CH Póvoa de Varzim/Vila do Conde | 2 | EPE |
| | CH de Entre Douro e Vouga | 3 | EPE |
| | CH de Vila Nova de Gaia/Espinho | 3 | EPE |
| | CH do Médio Ave | 2 | EPE |
| | CH do Porto | 4 | EPE |
| | CH Tâmega e Sousa | 2 | EPE |
| | ULS do Nordeste | 3 | EPE |
| | ULS do Alto Minho | 2 | EPE |
| | ULS de Matosinhos | 1 | EPE |
| | CH Trás-os-Montes e Alto Douro | 5 | EPE |
| | CH São João | 2 | EPE |
| | Hospital da Senhora da Oliveira Guimarães | 1 | EPE |
| | H. de Magalhães Lemos | 1 | EPE |
| | H. Santa Maria Maior | 1 | EPE |
| | H. de Braga | 1 | PPP |
| | IPO do Porto | 1 | EPE |

**Table 7 - Entities of ARS Norte, IP**

*Source: SNS (2017)*

| ARS | Entity | Number of Units | Classification |
|---|---|---|---|
| **ARS Centro, IP** | ACES | 6 | |
| | CH Tondela Viseu | 2 | EPE |
| | CH Leiria | 3 | EPE |
| | CH e Universitário de Coimbra | 6 | EPE |
| | Instituto Português de Oncologia de Coimbra Francisco Gentil | 1 | EPE |
| | CH Cova da Beira | 2 | EPE |
| | CH Baixo Vouga | 3 | EPE |
| | H. Distrital Figueira da Foz | 1 | EPE |
| | H. Doutor Francisco Zagalo | 1 | SPA |
| | H. Arcebispo João Crisóstomo | 1 | SPA |
| | H. Luciano de Castro | 1 | PPP |
| | Centro Medicina de Reabilitação daRegião Centro - Rovisco Pais | 1 | SPA |
| | ULS de Castelo Branco | 1 | EPE |
| | ULS da Guarda | 2 | EPE |

**Table 8 - Entities of ARS Centro, IP**

*Source: SNS (2017)*

| ARS | Entity | Number of Units | Classification |
|---|---|---|---|
| **ARS Lisboa Vale do Tejo, IP** | ACES | 15 | |
| | CH de Lisboa Norte | 2 | EPE |
| | CH de Lisboa Ocidental | 3 | EPE |
| | CH Lisboa Central | 6 | EPE |
| | H. de Cascais - Doutor José de Almeida | 1 | PPP |
| | H. Doutor Professor Fernando Fonseca | 1 | EPE |
| | H. Beatriz Ângelo | 1 | PPP |
| | H. de Vila Franca de Xira | 1 | PPP |
| | H. Garcia de Orta | 1 | EPE |
| | CH Barreiro Montijo | 2 | EPE |
| | CH de Setúbal | 2 | EPE |
| | CH do Oeste | 4 | SPA |
| | CH Médio Tejo | 3 | EPE |
| | H. Distrital de Santarém | 1 | EPE |
| | CH Psiquiátrico de Lisboa | 1 | SPA |
| | Instituto de Oftalmologia Doutor Gama Pinto | 1 | SPA |
| | IPO de Lisboa | 1 | EPE |

**Table 9 - Entities of ARS Lisboa e Vale do Tejo, IP**

*Source: SNS (2017)*

| ARS | Entity | Number of Units | Classification |
|---|---|---|---|
| **ARS Alentejo, IP** | ACES | 4 | |
| | ULS do Norte Alentejano | 2 | EPE |
| | H. de São Paulo | 1 | PPP |
| | ULS do Litoral Alentejano - H. Litoral Alentejano | 1 | EPE |
| | ULS do Baixo Alentejo - H. José Joaquim Fernandes | 1 | EPE |
| | H. Espírito Santo | 1 | EPE |

**Table 10 - Entities of ARS Alentejo, IP**

*Source: SNS (2017)*

| ARS | Entity | Number of Units | Classification |
|---|---|---|---|
| **ARS Algarve, IP** | ACES | 3 | |
| | CH do Algarve | 3 | EPE |
| | Centro de Medicina Física de Reabilitação do Sul - São Brás de Alportel | 1 | SPA |

**Table 11 - Entities of ARS Algarve, IP**

*Source: SNS (2017)*

Tables 7-11 list the following type of entities: hospitals, hospital centres (CH – *centro hospitalar*), local health units (ULS- *unidade local de saúde*), groups of health centres (ACES – *agrupamentos de centros de saúde*), and oncology institutes (IPO – *Instituto Português de Oncologia).* This information is based on the following definitions:

**H** – In general terms, a hospital is a health centre establishment with hospitalization, outpatient clinic and means of diagnosis and therapy, aiming to provide curative and rehabilitation medical assistance to the population. It is also responsible for collaborating in disease prevention, teaching and scientific research (MS, 2006).

**CH** – It results from the integration of autonomous hospital establishments in a single legal entity. These units provide the same services (or their substitutes). The CHs have the same scheme of organs and legal regime as hospitals. The main goals of this integration is to achieve economies of scale, increase efficiency and promote shared administrative services. (*Entidade Reguladora da Saúde* - ERS, 2015).

**ULS -** This entity was created aiming to promote the interconnection of the primary, hospital and continuing health care services (Campos & Simões, 2011). This concept is related with a vertical integration of the processes aiming to aggregate inputs, provision and management of services. (Grone & Garcia-Barbero, 2011). The ULS is considered an entity with a statute of State-owned enterprise (DL no. 12/2015 of 26$^{th}$ January).

**ACES -** Health care services with administrative autonomy, constituted by several functional units which group the structures of one or more health centres. Its main purpose is to guarantee the provision of primary health care services in a given geographical area (DL no. 28/2008 of 22$^{nd}$ February).

**IPO** – An IPO is considered an EPE on a multidisciplinary oncologic centre responsible for providing health services in oncology specialization. It develops activities in areas of research, teaching, prevention, diagnosis, treatment, rehabilitation and continuity of healthcare. It is

subject to the National plan for oncology (Rules of procedure of *IPO de Lisboa Francisco Gentil, EPE,* 2017).

Entities can be classified according to: IP, EPE, Public-private Partnership *(*PPP – *Parceria Público- privada),* Public Administrative Sector *(*SPA – *Sector Público Administrativo).*

**IP –**IPs are collective legal persons, endowed with organs and own assets. In general, an IP should fulfil the requirements on which administrative and financial autonomy depends on. An IP only has administrative autonomy in exceptional cases (Law no. 3/2004 of 15th January).

**EPE -** The State owned sector integrates State-owned and private enterprises. Article 3rd: State-owned enterprises: 1 – State-owned enterprises are considered the societies, under the terms of commercial law, in which the State or other State owned entities may exercise, individually or jointly, directly or indirectly a dominant influence by virtue of any of the following circumstances: A) Obtain of the majority of the capital of the voting rights; B) The right to appoint or remove a majority of the members of the administrative or supervisory bodies. 2 – The entities with a business nature regulated in the Chapter III (EPEs) are also considered State-owned enterprises. (DL no. 558/99 of 17th December).

An EPE hospital is a collective legal person with a business nature with administrative, financial and patrimonial autonomy (DL no. 233/2005of 29th December). This document establishes that the main object of an EPE hospital is the health care provision to population, in particular to the beneficiaries of SNS, health subsystems or from external entities contracting its health care services, and all citizens in general (Article 2 of the Annex II). The second point of the same Article adds another object: the development of research, training and teaching activities. EPE hospitals' participation in the training of health professionals depends on their formative capacity and may be subject to program contracts in which the respective financing forms are defined.

An EPE is integrated in the SNS and can be a hospital, a hospital centre, an oncology institute or even a local health unit (DL no. 18/2017 of 10th February).

**PPP –** DL no. 86/2003 of 26th April establishes the concept for public-private partnership as a contract or a union of contracts, through which private entities (private partners) are obligated, towards the public partner, on a lasting basis to ensure the sustainable development of an activity aimed at satisfying a collective need, and where the responsibility for investment and exploration belong to the private partner. According to the Article 4th, the increasing of

efficiency when allocating public resources and an improvement of service are the aims for these contracts.

**SPA-** DL 18/2017 defines that a hospital which is part of the public administrative sector is a public institute with a special regime, under the terms of the law, integrated in the indirect State administration, and with administrative and financial autonomy and own capital.

### 5.2. Suppliers

A supplier is a person or an entity that delivers goods or services. These stakeholders are crucial for the well-functioning of organizations since they are the source of materials and services needed for the organization operates.

The SNS counts with several suppliers to operate and develop the different activities. For this work, it is important to highlight the following types of supplies: medical devices, medicines, utilities and services.

**Medical device** – It is any instrument, apparatus, equipment, software, material or item used alone or in a combination. It includes the software intended by its manufacturer to be used specifically for diagnostic or therapeutic purposes and which is necessary for the proper functioning of the medical device in which the main intended effect on the human body is not achieved by pharmacological, immunological or metabolic means. Although its function may be supported by such means, intended by the manufacturer to be used by human beings for the purpose of: diagnosis, prevention, control, treatment or attenuation of a disease; diagnosis, control treatment, mitigation of compensation of an injury or disability; study, replacement or alteration of anatomy or physiological process; design control (DL no. 145/2009 of 17th June).

**Medicine –** It refers to a substance or combination of substances with curative or preventive properties of diseases for humans or their symptoms or, which may be used or administered to humans in order to establish a medical diagnosis or, by exerting a pharmacological action, immune or metabolic, to restore, correct or modify physiological functions (DL no. 20/2013 of 14th February). According to DL no. 46/2012 of 24th February, the regulation, supervision and the quality assurance of both medical devices and medicines are responsibility of the National Authority of Medicine and Health Products, Public Institute (INFARMED, IP– *Autoridade Nacional do Medicamento e Produtos de Saúde, IP*).

**Supplies and external services –** External entities which supply different kind of services to the SNS's entities. Table 12 shows the different type of services**.**

| Total of supply and External Services |
|---|
| **Supply and External Services I** |
| Electricity |
| Fuels |
| Water |
| Other fluids |
| Tools and utensils for quick wear |
| Books and technical documentation |
| Office material |
| Items to offer |
| Incomes and rents |
| **Supply and External Services II** |
| Representation expenses |
| Communication |
| Insurance |
| Royalties |
| Merchandise transportation |
| Transport of persons |
| Journeys and stays |
| Commissions |
| Fees |
| **Supply and External Services III** |
| Litigation and notary |
| Conservation and repair |
| Advertising and marketing |
| Cleaning, hygiene and comfort |
| Surveillance and Security |
| Specialized jobs |

**Table 12 - List of Supply and External Services per Type (I, II, III)**

*Source: SNS (2017)*

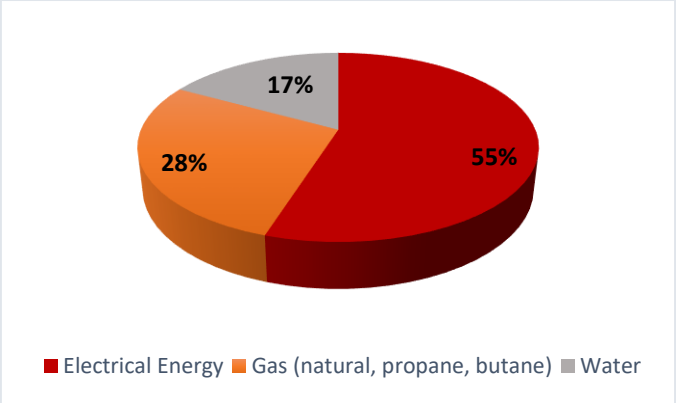
**Utilities –** It refers to electrical energy, gas and water suppliers for all SNS entities. Utilities are part of the supply and external services I. According to the ACSS's Report and Accounts of 2015, the total cost with utilities, in 2014, was 65 million euros in 70% of SNS hospital entities (ACSS, 2016).

| Utilities | Annual expenditure ( in million euros) |
|---|---|
| Electrical Energy | 35,711.520 |
| Gas (natural, propane, butane) | 18,227.678 |
| Water | 11,046.064 |
| **Total** | **64,985.262** |

**Table 13 - Annual Expenditure with Utilities In 70% of SNS Hospital Entities, in 2014**

*Source: ACSS (2016)*

Graph 1 presents the weight of each utility as a percentage in the total expenditure for 70% of SNS's hospital entities. The costs with the consumption of electrical energy represent more than half of the total costs with utilities while the expenditure with water corresponds to a smaller slice of the bill (17%) (ACSS, 2016).




**Graph 1 - Weight of Each Utility in the Annual SNS Hospitals Bill, in 2014**

*Source: ACSS (2016)*

### 5.3. Expenses

During the last years, the Portuguese economy has been facing periods of imbalances and adjustments. Table 14 shows three macroeconomic indicators of Portugal: GDP, GDP variation rate and the inflation rate between 2011 and 2016. From 2011 to 2013, it is possible to observe a decreasing GDP. The variation rate of GDP reaches even 4.03 negative percentage points in 2012. However, from 2013 to 2016, the GDP has been improving, with positive variation rates. Regarding the Consumer Price Index (CPI) of health in Portugal, it had positive variation rates between 2011 and 2015, which means that the prices for the healthcare sector have increased. However, there was a decrease between 2015 and 2016 with a negative inflation rate in the sector. These macroeconomic indicators suggest a recover regarding Portuguese production and prices for consumer in the healthcare sector, in the last year.

| Indicator/Year | 2011 | 2012 | 2013 | 2014 | 2015 (P) | 2016 (P) |
|---|---|---|---|---|---|---|
| **GDP (1)** | 176,166.6 | 169,070.1 | 167,159.4 | 168,652.3 | 171,309.3 | 173,698.9 |
| **GDP variation rate - % (2)** | -1.83 | -4.03 | -1.13 | 0.89 | 1.58 | 1.39 |
| **Inflation rate of health - %(3)** | 4.5 | 0.4 | 1.5 | 0.7 | 0.4 | -0.6 |

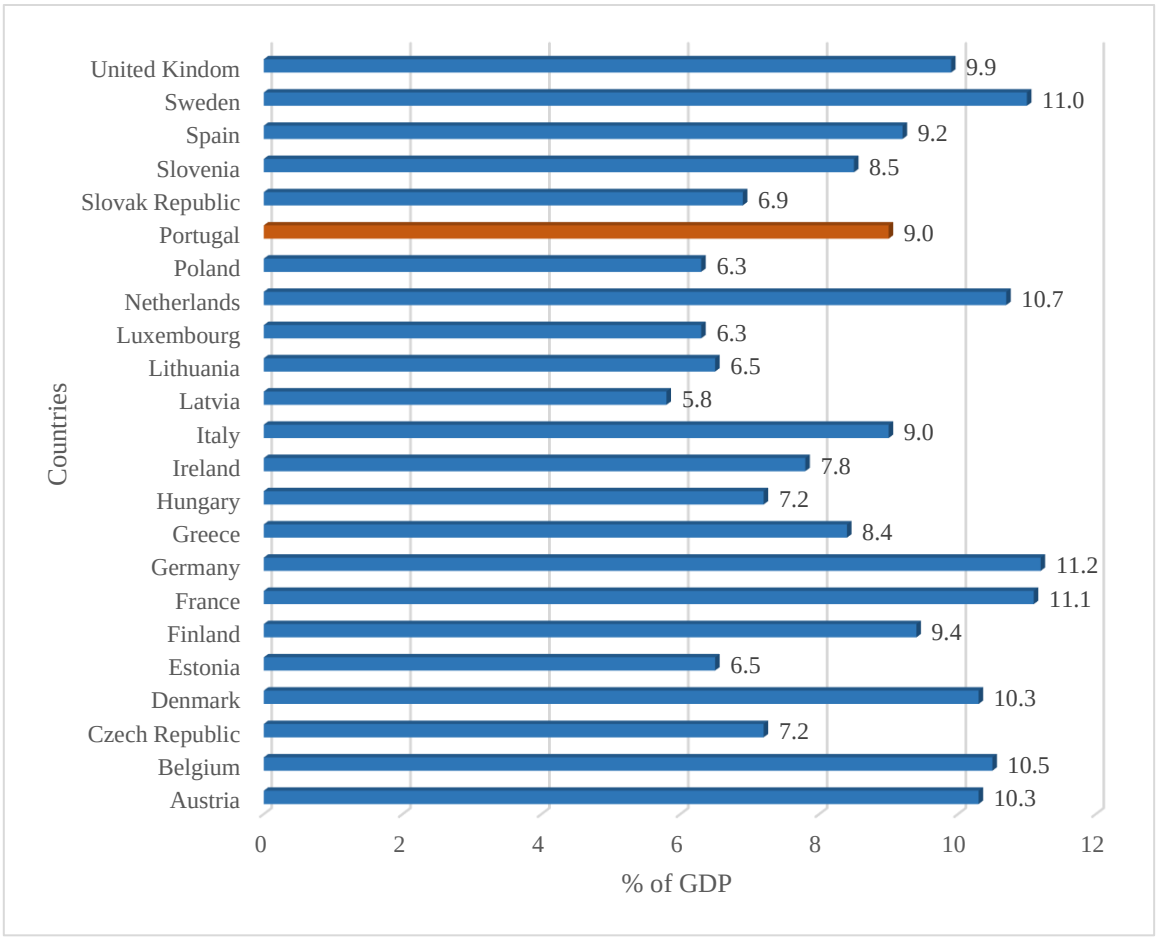
**Table 14 - Macroeconomic Indicators**

*Source: INE, PORDATA (2017)*

Gross Domestic Product at constant prices in millions euros (base=2011); Gross Domestic Product variation rate (real growth rate, annual); Consumer Price Index variation (inflation rate)

In order to contextualize Portugal regarding its economic position in the healthcare sector, the following indicators are analysed: total, private and public health spending in percentage of GDP in Portugal and other EU countries, and the evolution of Portuguese health spending in percentage of GDP. Data was collected by OECD and it refers to 2015. The 22 countries used for comparison are part of EU (28) according to the data available by OECD. This source considers the health spending indicator as the measure of final consumption of health care goods and services, including personal health care and collective services. The spending on investments is excluded. The indicator is presented by three types of financing: public, private and out-of-pocket (OECD, 2017).

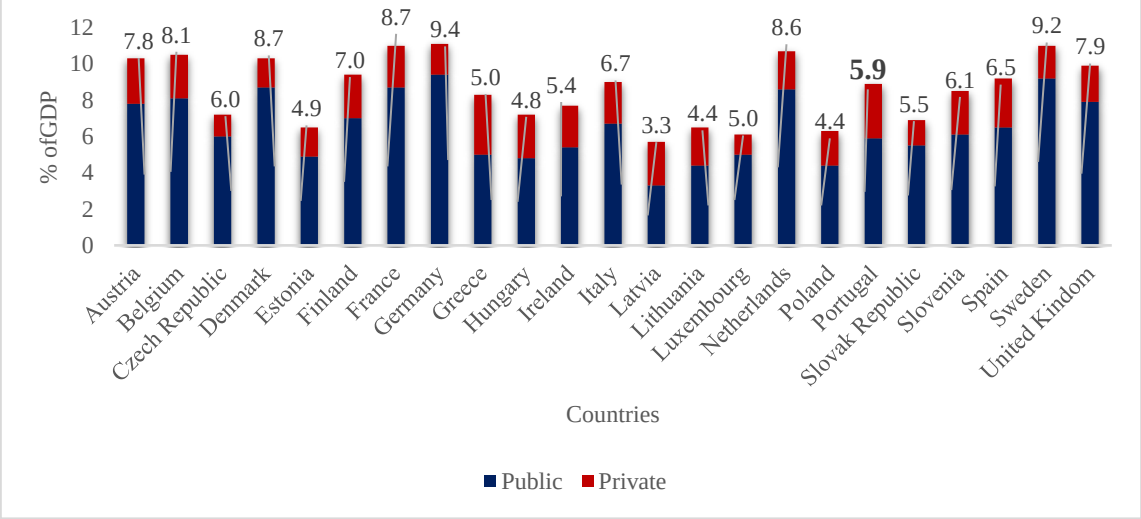
Graph 2 shows the total health spending in percentage of GDP, per country, in 2015. Portugal spent 9% of GDP on healthcare goods and services, which is above the average comparing with the other 22 countries. Germany and France are the countries with higher health spending in percentage of GDP while Latvia is the one with lower percentage.




**Graph 2 - Health Spending in Percentage of GDP in 2015**

*Source: OECD (2017)*

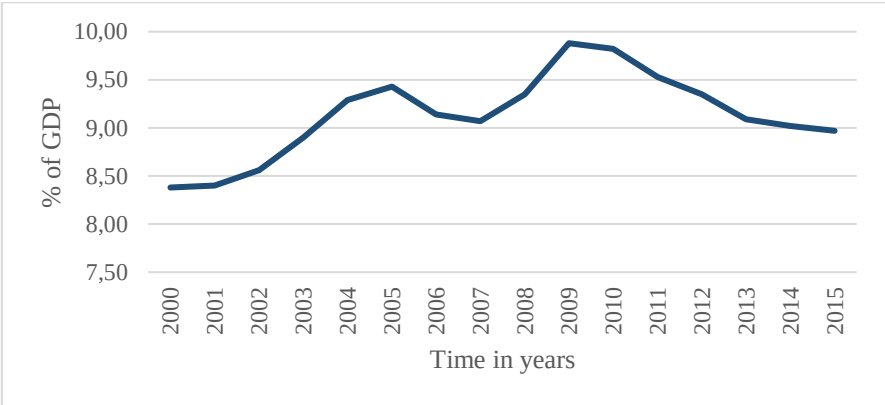
Graph 3 shows the health spending in percentage of GDP in 2015, in the same 23 countries, specifying the percentage of public and private financing arrangements. The values of percentages appearing in the graph correspond to the public financing. In Portugal, the public expenditure in healthcare is 5.9% of the national GDP. Sweden and Latvia are the countries with the highest and the lowest public health spending in percentage of GDP, respectively.




**Graph 3 - Public and Private Healthcare Spending in Percentage of GDP in 2015**

*Source: OECD (2017)*

Graph 4 shows the evolution of the total Portuguese health spending in percentage of GDP from 2000 to 2015. It is possible to observe a higher peak in 2009 when this indicator reaches 9.88%. Although there was a decrease on health spending in the last years, the indicator is still high comparing with the begging of the decade. In addition, in 2011 Portugal was under the Economic and Financial Adjustment Program, in which had to cut health expenses.

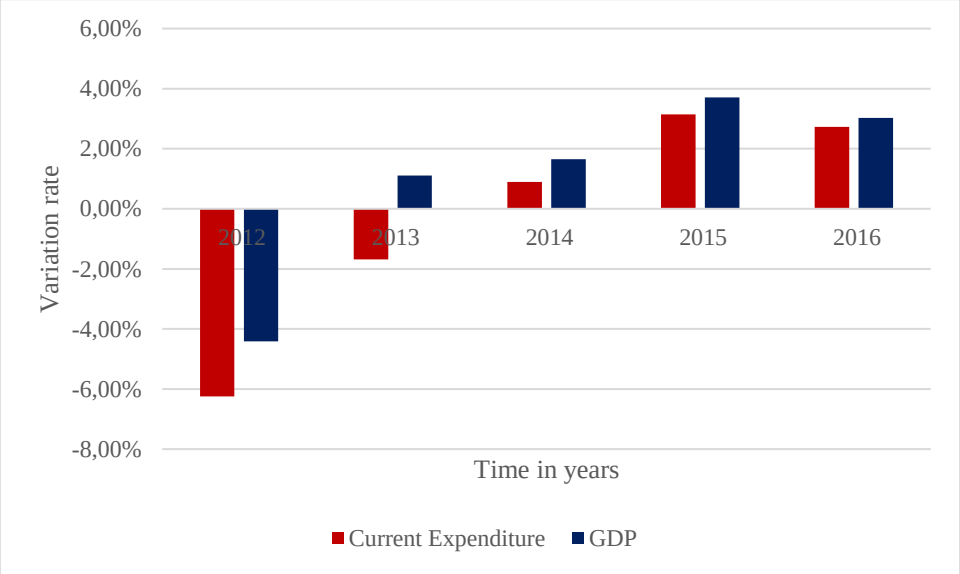



**Graph 4 - Evolution of Total Health Spending in Percentage of GDP in Portugal**

*Source: OECD (2017)*

Although there was a decreasing on health spending in percentage of GDP in the period from 2013 to 2015, it was accompanied by a positive GDP variation rate. Graph 5 shows the variation

rate of both GDP and current expenditures, in Portugal. For calculations, there were taken the healthcare current expenditures and the nominal GDP provided by INE and PORDATA (2017). During the timeline analysed, the growth rate of GDP is higher than the healthcare current expenditure growth rate. This means that the decreasing of the health spending in percentage of GDP (graph 4) can result from a rise of GDP and not from a decreasing on expenses.




**Graph 5 - Variation Rates of GDP and Healthcare Current Expenditure**

*Source: INE, PORTADA (2017)*

In addition, in 2015, the current expenses in health financed by Public Administration was 66.2% of the total healthcare expenses. During the years, the proportion financed by families increased (INE, 2017).

### 5.4. Closure of Chapter 5

The National Health Service is composed by various bodies with different responsibilities and statutes. The main body is the Ministry of Health to whom the other institutions are subject to. The entities being part of the SNS are organized geographically, amongst five ARSs, including hospitals, CHs, ULSs, ACES and IPOs. The status of these entities varies between an IP, EPE, PPP and SPA. This chapter also cover the definition of main suppliers: medicines, medical devices, utilities and supplies and external services. In Portugal, the health spending in percentage of GDP decreased, however, the current healthcare expenses increased in the last years. The State finances around 66.2% of total healthcare expenses.

# 6. Data Collection

## 6.1. Object of Study

### 6.1.1. Healthcare Entities

Due to the high amount of entities belonging to SNS, seven entities were selected for the purpose of this work: CH de Lisboa Central, CH de Lisboa Norte, CH de Lisboa Ocidental, CH do Porto, CH de São João, H. Professor Doutor Fernando Fonseca and CH. Trás-os-Montes e Alto Douro. Although the seven entities contribute for estimating the potential savings of migrating from manual to electronic invoicing in accounts payable, only the first five are deeply analysed regarding the exchanging documents process. This happens due to the different source of information (for these entities, the data was collected from a service provider). Despite of the seven entities chosen, other three were initially considered for the study, however, due to the lack of feedback, they are not analysed (IPO do Porto, IPO de Lisboa, and CH da Universidade de Coimbra). All of these entities are EPEs and are financed by the Portuguese government.

**Centro Hospitalar de Lisboa Central (CHLC)**

**Figure 11 - CHLC's Logo**

*Source: SNS (2017)*

CHLC is an EPE hospital centre created in 2007. It is formed by six units: H. Curry Cabral, H. Dona Estefânia, H. Santa Marta, H. Santo António dos Capuchos, H. São José and Maternidade Doutor Alfredo da Costa. It covers the population of 38 different areas in Lisbon County and other seven in Loures County (SNS, 2017). The covered population by CHLC is around 379,000 inhabitants. However, it has capacity to receive more people. Its total costs of purchases in 2014 was 135 million (Saphety, 2016).

**Centro Hospitalar de Lisboa Norte (CHLN)**

CHLN was created in 2007 and it combines two hospital units: Pulido Valente and Santa Maria. It operates under an EPE statute. CHLN's influence area includes: Alvalade, Avenidas Novas, Benfica, Campolide, Carnide, Lumiar, Santa Clara and São Domingos de Benfica (SNS, 2017). It is responsible for 373,000 of city residents and it also receive patients from the entire country and abroad. Its purchases, in 2014, amounted €152,159,401 (Saphety, 2016).


**Figure 12 - CHLN's Logo**

*Source: SNS (2017)*

**Centro Hospitalar de Lisboa Ocidental (CHLO)**


**Figure 13 - CHLO's Logo**

*Source: SNS (2017)*

CHLO is a hospital centre created in 2005 and it integrates three hospital units: S. Francisco Xavier, Santa Cruz and Egas Moniz. It is managed with an EPE statute. CHLO is located in Lisbon and it serves the following areas: São Francisco Xavier, Santa Maria de Belém, Ajuda, Alcântara, Santo Condestável and Oeiras, Cascais, Amadora and Sintra Counties (SNS, 2017). This area includes around 993,000 city residents. Its transaction volume represented €103,782,202 in 2015 (Saphety, 2016).

**Centro Hospitalar do Porto (CHP)**

CHP was created in 2007 and it results from the fusion of four units: H. de Santo António, Centro Materno-Infantil do Norte Dr. Albino Aroso, Centro Integrado de Cirurgia de Ambulatório and Centro de Genética Médica Doutor Jacinto de Magalhães. It is an EPE hospital centre. The influence area of CHP covers all areas of Porto city (except Bonfim, Paranhos, Campanhã) and Gondomar. It is also considered a reference for Bragança, Vila Real, Amarante, Baião, Marco de Canavesses and other Counties located in Aveiro and Viseu (SNS,


**Figure 14 - CHP's Logo**

*Source: SNS (2017)*

2017). CHP is the most populous CH in the North Region, serving around 37% of the resident population of the Portuguese continent. In 2014, it purchased €102,690,613 (Saphety, 2016).

**Centro Hospitalar de São João (CHSJ)**

**Figure 15 - CHSJ's Logo**

*Source: SNS (2017)*

CHSJ is a hospital centre endowed with an EPE statute and it is composed by two units: H. Nossa Senhora da Conceição de Valongo and H- São João. CHSJ is located in Porto and it serves the areas of Bonfim, Paranhos, Campanhã and Maria and Valongo Counties. It is also a reference for Porto district (except Baião, Amarante and Marco de Canaveses), Braga and Viana do Castelo (SNS, 2017). This is the largest unit hospital in the Northern region of Portugal and it provides assistance to 7.2% of population at a national level. In 2014, its purchases were €132,901,121 (Saphety, 2016).

**Centro Hospitalar de Trás-os-Montes e Alto Douro (CHTMAD)**

CHTMAD is an EPE hospital centre which results from the merger of five units: H. de Chaves, H. de Lamego, H. Dom Luiz I – Peso da Régua, H. São Pedro de Vila Real and Unidade de Cuidados Paliativos Vila Pouca de Aguiar. Its influence area is Tarouca, Tabuaço, São João da Pesqueira, Montalegre, Lamego, Chaves, Boticas, Armamar, Vila Real, Vila Pouca de Aguiar, Santa Marta de Penaguião, Sabrosa, Ribeira de Pena, Peso da Régua, Murça, Mondim de Basto, Mesão Frio e Alijó. It serves around 300,000 inhabitants (CHTMAD, 2017).

**Figure 16 - CHTMAD's Logo**

*Source: SNS (2017)*

**Hospital Professor Doutor Fernando Fonseca (HFF)**

**Figure 17 - HFF's Logo**

*Source: SNS (2017)*

HFF is a hospital created in 2008. It operates as an EPE. HFF serves around 600,000 inhabitants of Amadora and Sintra's municipalities. Its costs of purchases were €62,345,782 in 2015 (Saphety, 2016).

Figure 18 shows the approximated location of the five entities in the map of Portugal.


**Figure 18 - Hospital Centres' Location**

### 6.1.2. Service Providers

In order to calculate the costs for the adoption of electronic invoicing by healthcare entities, two service providers are taking into account: Indra and Saphety. Indra is a Spanish multinational company of consulting and technology with a strong presence in Spain and Latin America. It offers a range of solutions including consulting and outsourcing of information systems and business processes. It operates in different sectors such as public administration and health (Indra, 2017). According to Gonçalves (2017), the strategic positioning in areas of EDI and electronic invoicing for the healthcare sector is to be a leader in services provision. Saphety is a Portuguese company which offers solutions for exchanging electronic documents, e-invoices, electronic contracting, and data synchronization (Saphety, 2017). Zegre (2017) argues that Saphety intends to be leader in EDI and electronic invoicing solutions in the healthcare sector, investing in a global approach regarding information exchange between hospitals and their suppliers. Despite of the two service providers chosen, other two were initially considered for the study, however, due to the lack of feedback, they are not analysed (the identity of these companies is kept as anonymous due to the choice of do not collaborate).

## 6.2. Methodology

### 6.2.1. Data Collection

In order to collect data from the healthcare entities, a qualitative approach was chosen, through questionnaires. Two questionnaires are implemented: one directed to the ten selected entities, and the other one to four service providers.

- **Healthcare entities' questionnaire**

The questionnaire for healthcare entities (appendix 1) is composed by two parts: (1) the first part aims to characterize the problems emerged during the invoicing process; (2) the remaining part of the questionnaire is more concerned with the invoicing process. The latter part requires information about the reception of invoices, transport guides, and send of purchase orders. It is asked about the process used in each entity (paper or EDI) and the amount of documents exchanged with three suppliers: medicines and medical devices, utilities and services.

Copies of the questionnaires were sent by e-mail for the financial departments of each entity. Besides the questionnaire about the invoicing process, two documents were attached: a presentation letter (appendix 2), and a declaration form for permission for data publication (appendix 3). All the documents are in Portuguese since it is the native language of the receptors, facilitating the communication between both parties.

- **Service providers' questionnaire**

The questionnaire for service providers (appendix 4) is formed by eleven questions and it explores the services provided to healthcare entities, the documents that are exchanged by them and the methods for the trading. The remaining questions are referred to the costs of these entities, according to the prices charged by each service provider.

For data collecting, four service providers operating in Portugal were chosen initially: Saphety, Indra, and other two companies[16]. However, it was only possible to collect data from Saphety and Indra.

Copies of the questionnaires were sent by e-mail for responsible persons of each company. Attached to this e-mail two other documents were sent: a presentation letter (appendix 2), and a declaration form for permission for data publication (appendix 3). For the same reason, all the documents are in Portuguese.

[16] Due to the impossibility of answering by the chosen companies, the anonymity of them remains

# 7. Data Analysis

## 7.1. Results

- **Current process for receiving invoices**

Table 15 shows that all entities use paper invoices in their accounts payable. This means that all the invoices received from their suppliers are printed and physically archived. Data is manually inserted in the ERP since there is no automation or integration of information. This procedures correspond to the manual process described in chapter 4. Although in CHLN the adoption of EDI for processing invoices is in a pilot phase, paper invoices are still used currently.

| Entity | Paper | EDI |
|---|---|---|
| CHLC | X | |
| CHLN | X | X |
| CHLO | X | |
| CHSJ | X | |
| CHP | X | |

**Table 15 - Current Invoicing Process (Recipient Perspective)**

- **Type of inefficiencies with the current process**

As the literature suggests, there are some inefficiencies during manual invoicing process. It was asked for the problems and inefficiencies occurred during the current invoicing process. Since this question is open, the answers are different in terms of detail. CHLC identifies as main inefficiencies the incompatibility between informatics applications since there is no files integration. This lack of integration generates a constant repetition of tasks and wasting of resources. CHLN argues that the problems are associated with invoices' conference circuit. According to CHLO, the manual process is inefficient due to the loss of paper invoices, being also processed belatedly. In addition, the lack of systems integration is also pointed out, similarly to CHLC. CHSJ mentions that the problems identified during the invoicing process are related with invoices production registers quality. CHP indicates that the main problems are related with the high volume of received invoices and the large number of invoicing typologies which results in different validation circuits.

- **Number of invoices and credit notes**

Table 16 shows the total number of received invoices and credit notes exchanged with suppliers of each entity, in 2016. Since a credit note is a rectification of an invoice and the data regarding

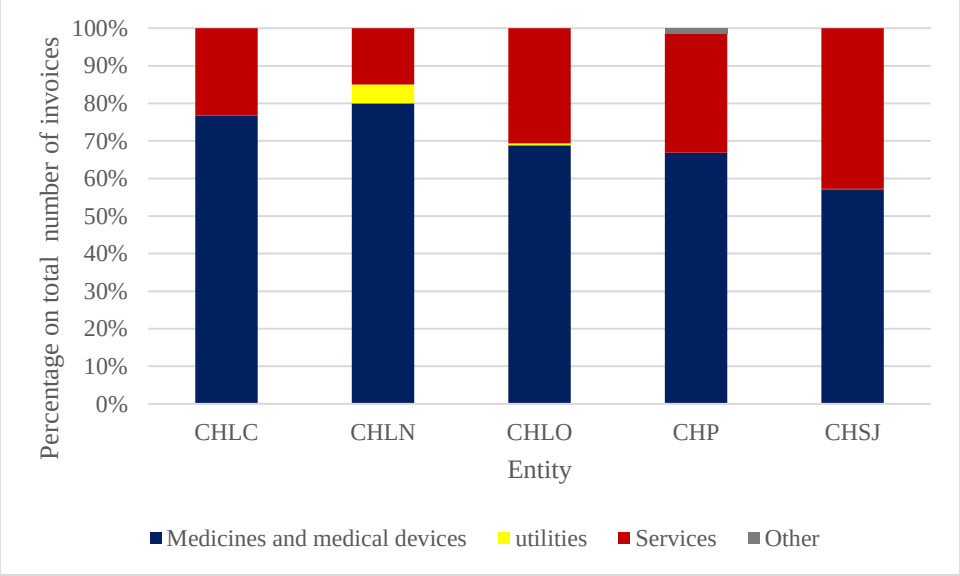
the number of those documents is provided together, credit notes are treated as invoices. CHSJ presents the highest number of invoices. This number has a huge difference comparing with the other entities, being 4 to 6 times higher. CHP follows the CHSJ in terms of highest number of invoices with a total amount of 83,713. CHLN has the lowest number (57,456).

| Entity | Total |
|---|---|
| CHLC | 72,954 |
| CHLN | 57,456 |
| CHLO | 68,231 |
| CHP | 83,713 |
| CHSJ | 350,000 |

**Table 16 - Number of Total Invoices in 2016**

Graph 6 shows the percentage of invoices per type of supplier: medicines and medical devices, utilities and services. The type "other" was created for CHP, and represents immobilized assets, due to its inclusion in the total amount of invoices (1% of the total amount) provided in the questionnaire. In the cases of CHLC and CHP, utilities and services are jointly treated since the data was not distinguished in the answer.

Medicines and medical devices represent more than half of the total received invoices for all entities. For CHSJ it represents 57.14% while for CHLN it represents 80% of the total amount. The opposite situation occurs regarding services where CHLN has the lowest percentage (15%) and CHSJ the highest (42.74%). There is a proximity in the percentage of invoices related with each type of supplier (exception for utilities). In all cases, the majority of these documents are exchanged with medicines and medical suppliers.



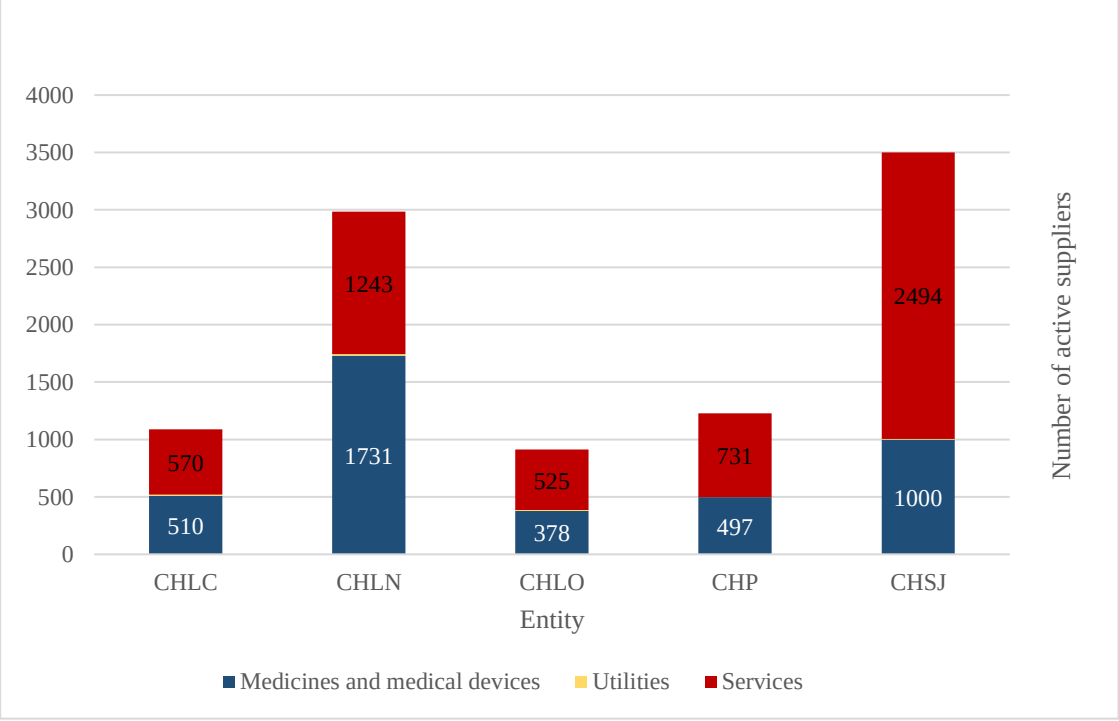

**Graph 6 - Invoices per Supplier in 2016**

- **Active suppliers**

Suppliers play an important role during the invoicing process since they are one of the most important parties involved. Graph 7 shows that the number of active suppliers varies among the entities involved. CHSJ has 3,500 active suppliers which is the highest number comparing with the other entities. CHLO totalizes 912 of active suppliers. The total amount of suppliers are divided in three types: medicines and medical devices, utilities and services. In the case of CHP, utilities are treated jointly with services since it was the way data was presented.

The number of active utilities suppliers varies between 6 (CHSJ) and 12 (CHLN). According to the list provided by CHLO, the list of utilities suupliers is as follows: EDP COMERCIAL - COMERCIALIZAÇÃO DE ENERGIA, EDP SERVIÇO UNIVERSAL, S.A.; EPAL - EMPRESA PORTUGUESA ÁGUAS LIVRES; GALP POWER SA; MEO - SERVIÇOS COMUNICAÇÕES E MULTIMÉDIA S.A; NOS - COMUNICAÇÕES, S.A; PETROGAL, SA; GALP ENERGIA; SIMAS; and SUCH - VEOLIA, SERVIÇOS HOSPITALARES ACE.

CHLN is the entity with highest number of active suppliers of medicines and medical devices and it is the unique case where this number exceeds services' suppliers. CHLO has the less number of both types of suppliers (which is notable in the total number). In the case of CHSJ, around 71% of active suppliers are from services.




**Graph 7 - Number of Active Suppliers in 2016**

Table 17 shows the suppliers, per type, with highest number of invoices over the total. This data is summarized by the list of active suppliers provided by CHLO and CHP. The other entities did not answer to this question. In CHLO, 3.76% of the total invoices are sent by BAXTER – MEDICO FARMACÊUTICA, LDA (medicines and medical devices) and 9.48% by ASSOCIAÇÃO BOMBEIROS VOLUNTÁRIOS DAFUNDO (services). In CHP, 9.61% of total invoices received, are issued by GAER - INSTITUTO MÉDICO DE RADIOLOGIA CLÍNICA, LDA (utilities and services) while 3.05% came from JOHNSON & JOHNSON MEDICAL, LDA.

| Entity | Type of supplier | Supplier name | Number of invoices | Percentage of total invoices |
|---|---|---|---|---|
| **CHLO** | Medicines and medical devices | BAXTER - MEDICO FARMACÊUTICA, LDA | 2,561 | 3.76% |
| | | MEDTRONIC PORTUGAL - COM. E DIST. DE APA | 2,173 | 3.19% |
| | | B. BRAUN MEDICAL, LDA. | 1,523 | 2.24% |
| | Utilities | MEO - SERVICOS COMUNICACOES E MULTIMEDIA S.A (EX PT) | 153 | 0.22% |
| | | EDP COMERCIAL - COMERCIALIZACAO DE ENERGIA | 3 | 0.00% |
| | Services | ASSOCIAÇÃO BOMBEIROS, VOLUNTÁRIOS DAFUNDO | 6,455 | 9.48% |
| | | HOSPITAL ORTOPÉDICO DE SANTANA | 5,791 | 8.51% |
| | | CLÍNICA CUF BELÉM, SA | 755 | 1.11% |
| **CHP** | Medicines and medical devices | JOHNSON & JOHNSON MEDICAL, LDA | 2,554 | 3.05% |
| | | B. BRAUN MEDICAL, LDA | 2,266 | 2.71% |
| | | MEDTRONIC PORTUGAL, LDA | 1,408 | 1.68% |
| | Utilities + Services | GAER - INSTITUTO MÉDICO DE RADIOLOGIA CLÍNICA, LDA | 8,046 | 9.61% |
| | | SMIC - SERVIÇO MÉDICO DE IMAGEM COMPUTORIZADA, S.A. | 1,230 | 1.47% |
| | | INSTITUTO PORTUGUES DO SANGUE | 929 | 1.11% |

**Table 17 - Suppliers of CHLO and CHP**

- **Costs of current invoicing process**

In order to find out the approximated costs during the reception of an invoice, it was asked to each entity to complete table 6 of chapter 4 with the hours and costs spent per task. Table 18 shows the answers per each entity, in a year. CHSJ did not answered to this question and CHP only provided the total hours and costs. Regarding total costs, CHLC and CHP (€51,900 and €52,836) are similar but significantly far from CHLN and CHLO (€330,000 and €275,910). The number of hours assigned to each task also depends on the entity and the numbers vary considerably among entities. CHLN argues that time consumed for receiving invoices per year is 440 hours while in CHLO is 55,128 hours.

| | **CHLC** | | **CHLN** | | **CHLO** | | **CHP** | |
|---|---|---|---|---|---|---|---|---|
| **Recipient Process** | **Hours per year** | **Costs per year (€)** | **Hours per year** | **Costs per year (€)** | **Hours per year** | **Costs per year (€)** | **Hours per year** | **Costs per year (€)** |
| 1. Receive | 540 | 2,700 | 80 | 50,000 | 5,760 | 28,800 | | |
| 2. Entering Codification | 480 | 2,400 | 80 | 50,000 | 792 | 3,960 | | |
| 3. Validation and Matching | 5,760 | 28,800 | 120 | 80,000 | 12,672 | 63,360 | | |
| 4. Dispute Management | 240 | 1,200 | 80 | 70,000 | 14,784 | 73,920 | | |
| 5. Payment and Cash Management | 1,680 | 8,400 | 80 | 70,000 | 8,448 | 42,240 | | |
| 6. Archiving | 1,680 | 8,400 | 0 | 10,000 | 12,672 | 63,630 | | |
| **Total** | **10,380** | **51,900** | **440** | **330,000** | **55,128** | **275,910** | **1,440** | **52,836** |

**Table 18 - Costs of Receiving Invoices with Manual Process**

Table 19 shows the average total hours and average costs per task during the process of receiving an invoice. The most expensive task is the validation and matching which totalizes, on average, €57,387. Dispute management is the second most expensive task, followed by payment and cash management. The archive and the reception of invoices cost around €27,000 each one. The less costly task is entering codification.

| *Recipient Process* | Average of total hours | Average of total costs (euros) |
|---|---|---|
| *1. Receive* | 2,127 | €27,167 |
| *2. Entering Codification* | 451 | €18,787 |
| *3. Validation and Matching* | 6,184 | €57,387 |
| *4. Dispute Management* | 5,035 | €48,373 |
| *5. Payment and Cash Management* | 3,403 | €40,213 |
| *6. Archiving* | 4,784 | €27,343 |
| ***Total*** | **21,983** | **€219,270** |

**Table 19 - Average Costs of Receiving, a Paper Invoice per Task**

- **Intention of adopting EDI**

As it can be seen in table 15, all entities receive their invoices in paper. However, it was asked if they intend to implement EDI with direct integration in the ERP and, in case of positive answer, in what time frame. CHLC answered that there is no forecast for implementation. All the other entities answered yes to the question. CHLN is implementing EDI during this year and predict that the adoption process will extend for the next year. CHLO will implement this process in the second semester of 2017 for a 100% functioning in the begging of 2018. CHP intends to implement the EDI technology within a period not exceeding 12 months. CHSJ argues that the project for the implementation already exists but it has being difficult to implement by suppliers. Table 20 shows the intentions of implementing EDI technology.

| Entity | Yes | No |
|---|---|---|
| CHLC | | X |
| CHLN | X | |
| CHLO | X | |
| CHP | X | |
| CHSJ | X | |

**Table 20- Intention of Implementing EDI with Direct Integration in the ERP**

- **Process of sending and receiving other documents (POs and transport guides)**

Besides invoices and credit notes, there are other documents exchanged during the process, including the purchase orders and the transport guides. Table 21 shows the current process used for each entity to send a purchase order to suppliers. It was added the option “e-mail” since three entities referred that exchange the document by this via: CHLC, CHLO and CHP. This document is sent in a PDF format. CHSJ is the only entity using EDI for this procedure. CHLN mentioned that paper is used, however, it also can use e-mail for exchanging information and, after, printing the document and archive it.

| Entity | Paper | EDI | E-mail |
|---|---|---|---|
| CHLC | | | X |
| CHLN | X | | |
| CHLO | | | X |
| CHP | | | X |
| CHSJ | | X | |

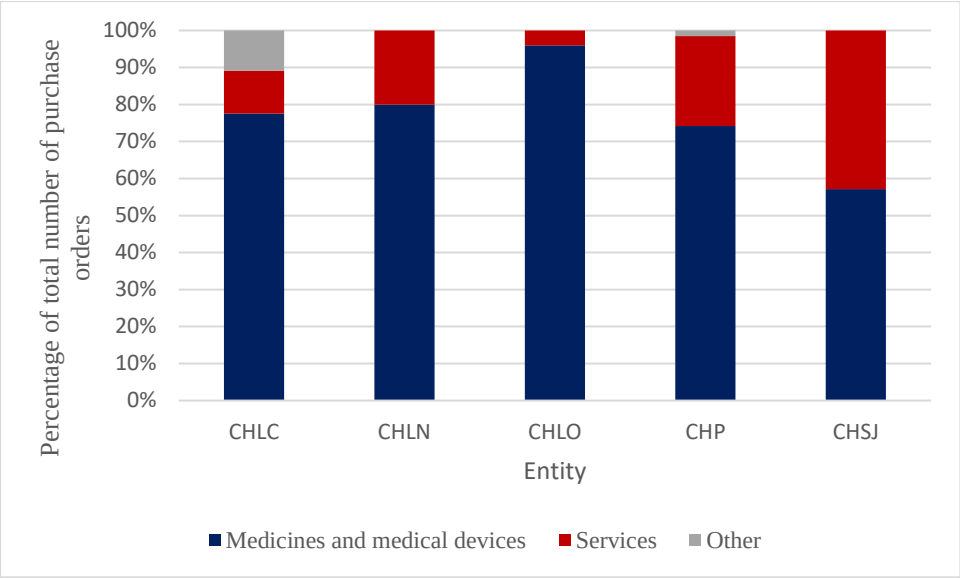
**Table 21 - Current Process for Sending POs**

Table 22 exhibits the number of purchase orders sent by each entity in 2016. CHSJ is the entity with the highest number of POs sent while CHLC is the one with lowest number (29,963). In terms of number of POs, CHLO and CHP are closed (65,689 and 66,941, respectively).

| Entity | Total |
|---|---|
| CHLC | 29,963 |
| CHLN | 39,876 |
| CHLO | 65,689 |
| CHP | 66,941 |
| CHSJ | 350,000 |

**Table 22 - Number of POs Sent in 2016**

Graph 8 shows the total number of POs per type of supplier: medicines and medical devices and services. The type “other” was created for CHP and represents immobilized assets because this number is included in the total amount of POs (2% of the total amount) provided in the questionnaire. Regarding CHLC, the type “other” is unknown since it was not revealed in the answer. For utilities, there is not POs since it is paid at the end of consumption as there is a pre agreement between the two parties. In all entities, the percentage of POs sent to medicines and medical devices’ suppliers constitutes the majority of total number of POs. In case of CHLO, medicines and medical devices constitute 96% of POs. The entity with lowest percentage of PO for medicines and medical devices is the CHSJ. It is also the one with higher percentage of services.




**Graph 8 - Purchase Orders per Supplier in 2016**

Table 23 shows that all the entities receive transport guides in paper. Regarding the number of transport guides exchanged, there is lack of information. CHLN argues that the total amount is 147,897 (98% for medicines and medical devices and 2% for services). CHSJ argues that the total amount of transport guides is 200,000 (only medicines and medical devices).

| Entity | Paper | EDI |
|---|---|---|
| CHLC | X | |
| CHLN | X | |
| CHLO | X | |
| CHP | X | |
| CHSJ | X | |

**Table 23 - Current Process for Receiving Transport Guides**

- **Electronic documents exchange**

Indra and Saphety have projects of EDI and electronic invoicing awarded to healthcare entities of SNS. Indra works with two hospital centres in phase of project implementation. However, the identity of both CH is anonymous. Saphety identifies six entities in different stages of implementation. CHP is awarded but the project did not initiate yet. CHLC, CHLN, CHLO CHSJ are in phase of needs assessment and CH Trás-os-Montes e Alto Douro is in phase of implementation.

Considering the accounts payable process, there are different documents exchanged between suppliers and healthcare entities which can be dematerialized. Indra refers the following documents: purchase orders, delivery notes, invoices, and credit and debit notes. Saphety, with

a global approach, provides a cycle of 4+1 documents: purchase order, delivery notes, receiving notice, invoice (and credit and debit notes) and payment notice (+1).

According to these two technology companies, the methods used for connecting the suppliers are the integrated EDI, web portal and OCR. Saphety also refers "other" method, however, it does not specify which method is.

Table 24 shows the costs of adopting an electronic process for exchanging documents. It is important to say that there are two different types of costs: the archive of electronic invoices, supported by the healthcare entities, and the messages costs exchanged between healthcare entities and suppliers. There are some differences in the data presented by both companies. While the average cost per electronic archive of an invoice is more expensive than the cost per exchanged document in Indra, the opposite happens with Saphety's costs. The average costs of ERP integration also differ between the two companies.

| Entity | Average costs of ERP integration (euros) | Average cost per electronic archive of an invoice (euros) | Average cost per exchanged document (euros) |
|---|---|---|---|
| Indra | €15,000 (outsourcing) | €0.08 | €0.06 |
| Saphety | from €10,000 to €45,000 | €0.12 | €0.20 |

**Table 24 - Average Costs of Electronic Documents**

Saphety provides data about two other entities: HFF and CHTMAD. Since it was not possible to obtain an answer directly from both entities, the information about the number of documents exchanged by them are analysed together. Table 25 shows the number of exchanged documents, per method, of HFF and CHTMAD together. There are part of these documents: PO, ASN, received invoice, credit note and reception notice.

| Type of documents | Number of documents | Number of documents per method | | | |
|---|---|---|---|---|---|
| (CHTMAD + HFF) | | Integrated EDI | Portal | OCR | Other |
| PO | 100,000 | 30,000 | 70,000 | | |
| ASNs | 110,000 | 25,000 | | | 85,000 |
| Received invoices | 128,000 | 64,000 | | 64,000 | |
| Credit notes | 1,300 | 650 | | 650 | |
| Invoices + Credit notes | 129,300 | 64,650 | | 64,650 | |
| Other: Reception notice | 110,000 | 35,000 | 75,000 | | |

**Table 25 - Number of Documents Exchanged, per Method in HFF and CHTMAD in 2016**

According to Saphety, CHTMAD is in phase of implementation of the EDI/e-invoicing project, however, regarding HFF, the current phase of the project is not mentioned. The total number of received invoices and credit notes is 129,300, in which 50% is exchanged by integrated EDI and the other half by OCR. POs are mostly sent via portal to suppliers and only 30% is send by EDI. Regarding ASNs, these documents are exchanged by "other" method that is not specified by Saphety, however, 23% of them are received from suppliers via EDI. Saphety also provides the document "reception notice" which is exchanged, in its majority, via portal.

### 7.2. Cost- Benefit Analysis

- **Costs of manual process**

In order to calculate the unit cost of receiving invoices, it is taken into account two hospital centres: CHLN and CHLO. The decision of taking into account the costs of these two entities was made based on the literature presented in chapter 2 which is also considered an international reference for invoicing studies. According to Koch (2016) the unit cost of a received paper invoice is €17.60. According to data provided by CHLC and CHP, a paper invoice would cost €0.71 and €0.63, values that are considered too low. Although the costs of CHLN and CHLO are much lower than in the literature, they are used to calculate potential savings for changing from paper to electronic invoicing process. Table 26 shows the total costs for receiving invoices in a year, the number of invoices in 2016 and the unit cost per invoice received. The unit cost used is the result of the average of the unit costs of both entities: €4.89.

| Entity | Total costs (euros) | Number of invoices | Unit cost per invoice received (euros) |
|---|---|---|---|
| CHLN | €330,000 | 57,456 | €5.74 |
| CHLO | €275,910 | 68,231 | €4.04 |
| Average (CHLN and CHLO) | | | **€4.89** |

**Table 26 - Costs of a Paper Invoice**

Table 27 shows the costs of manual invoicing process (as a recipient) for each entity. The total costs are obtained by the multiplication of the number of invoices and the average unit cost (€4.89). In the totality of entities, the invoicing process in accounts payable costs €3,724,488.

| Entity | Total number of invoices | Unit cost paper invoice (euros) | Total costs paper invoice (euros) |
|---|---|---|---|
| CHLC | 72,954 | €4.89 | €356,745 |
| CHLN | 57,456 | €4.89 | €280,960 |
| CHLO | 68,231 | €4.89 | €333,650 |
| CHP | 83,713 | €4.89 | €409,357 |
| CHSJ | 350,000 | €4.89 | €1,711,500 |
| HFF and CHTMAD | 129,300 | €4.89 | €632,277 |
| **Total** | 761,654 | €4.89 | **€3,724,488** |

**Table 27 - Average Costs of Manual Invoicing Process**

- **Costs of electronic process**

The prices given by the EDI service providers, serve as the reference for the costs that healthcare entities incur when adopting electronic invoicing process (in accounts payable). Table 28 presents the costs of acquiring the EDI integration with the ERP, the costs of the electronic archive, and the costs of electronic documents exchanged between healthcare entities and suppliers. It is calculated the average of all these costs based on the answers given by both companies (Indra and Saphety). Since Saphety mentions that the average costs of the integration with ERP depends on the hospital and the degree of integration, and it can vary between €10,000 and €45,000, an average value is used: €27,500. The cost of the electronic archive is the cost for maintaining the electronic document in archive during ten years. The cost of the electronic document is the cost for exchanging each document. The average cost for the integration with the ERP is €21.250 and it is charged in the first year of implementation. The cost per document (archive for ten years included) is €0.23.

| Company | EDI with ERP integration (euros) | Electronic archive (euros) | Electronic document (euros) | Average cost per invoice (euros) |
|---|---|---|---|---|
| Indra | €15,000 | €0.08 | €0.06 | €0.14 |
| Saphety | €27,500 | €0.12 | €0.20 | €0.32 |
| Average (Indra and Saphety) | €**21,250** | €0.10 | €0.13 | €**0.23** |

**Table 28 - Costs of an Electronic Invoice (Service Provider)**

Besides the costs of having a service provider company, there are also other human resources costs that remain in the electronic process when receiving an invoice. For calculating the difference of human resources costs between manual and electronic processes, it is considered the calculations done by Koch (2016). For the human costs on electronic invoicing it is considered the costs remained per each task when migration from manual to electronic process.

Table 29 shows the data presented in figure 2. The last column shows the percentage of human resources' costs that remains in the electronic process when an entity migrate from the manual process. The costs of the first two tasks decrease to €0 since the tasks are done automatically. The cost for validation and matching reduces 70%, for dispute management 20%, and 58% for payment and cash management tasks. Although, in the literature, the electronic archive costs 36% of manual costs, in calculations it is assumed the price of €0.10 because this value is known by service providers.

| Tasks | Manual cost (euros) | Electronic cost (euros) | % of human resources' costs with electronic process |
|---|---|---|---|
| Receive | €1.10 | € - | 0% |
| Entering codification | €3.00 | € - | 0% |
| Validation and matching | €4.00 | €1.20 | 30% |
| Dispute management | €2.50 | €2.00 | 80% |
| Payment and Cash management | €4.80 | €2.00 | 42% |
| Archiving | €2.20 | €0.80 | 36% |

**Table 29 - Human Resources' Costs in both Manual and Electronic Processes**

Table 30 shows the average costs per task during the invoicing reception process. The receiving and entering codification is fully automated. The decreasing is justified due to the reduction of errors and inefficiencies during the process. The average of human recourses' costs in electronic process, per entity is €115,843 (38% of total manual costs). For calculations, there are considered the costs per task of CHLO and CHLN, since these values are closer to reality.

| Recipient Process | Average total costs in manual process (euros) | Average HR electronic process (euros) |
|---|---|---|
| Receive | €39,400 | €0 |
| Entering Codification | €26,980 | €0 |
| Validation and Matching | €71,680 | €21,504 |
| Dispute Management | €71,960 | €57,568 |
| Payment and Cash Management | €56,120 | €23,383 |
| Archiving | €36,815 | €13,387 |
| **Total** | €302,955 | **€115,843** |

**Table 30 - Average Human Resources' Costs in Electronic Process**

Among the existing business models, there are different forms of payment. Indra argues that all models are possible for all documents. Saphety says that both entities and suppliers can pay all

types of documents. In order to cover the different models of payment, three scenarios are created:

Scenario 1: the healthcare entity pays the integration and the electronic archive; the supplier pays the remaining documents: invoice, PO and ASN.

Scenario 2: the healthcare entity pays the integration and the electronic archive; the electronic documents are paid by who send the document: hospital pays the PO, supplier pays the invoice and the ASN.

Scenario 3: the healthcare entity pays the integration and all documents.

**Scenario 1:** In this case, the healthcare entity pays the integration via EDI with its ERP and the electronic archive of invoice, which is saved during ten years. Table 31 presents the calculations used for determining total costs in the first year of implementation (includes the integration costs). The costs of integration with ERP are assumed as equal for all entities, according to average costs referred in table 28. The unit cost used of electronic archive is €0.10. The entity with higher total costs is CHSJ due to the highest number of invoices, followed by HFF and CHTMAD. Since CHLN is the entity with the lowest number of invoices, it also has lower total costs. Considering all the seven entities, the total costs are €898,723. If considering the costs for the years next the implementation, the integration costs are not taking into account. This means that the total average costs for 7 entities, for year 1+X (X>0) in this scenario is €771,223. X means the number of years after the implementation.

| Entity | Total number of invoices | Integration with ERP costs (euros) | Total costs of electronic archive (euros) | Human resources cost of electronic process (euros) | Total costs (year 1) (euros) | Total costs (year 1+X) (euros) |
|---|---|---|---|---|---|---|
| CHLC | 72,954 | €21,250 | €7,295 | €115,843 | €144,388 | €123,138 |
| CHLN | 57,456 | €21,250 | €5,746 | €115,843 | €142,839 | €121,589 |
| CHLO | 68,231 | €21,250 | €6,823 | €115,843 | €143,916 | €122,666 |
| CHP | 83,713 | €21,250 | €8,371 | €115,843 | €145,464 | €124,214 |
| CHSJ | 350,000 | €21,250 | €35,000 | €115,843 | €172,093 | €150,843 |
| HFF and CHTMAD | 129,300 | €21,250 | €12,930 | €115,843 | €150,023 | €128,773 |
| Total | 761,654 | €127,500 | €76,165 | €695 058 | €**898,723** | €771,223 |

**Table 31 - Total Costs of Electronic Invoicing Process in Scenario 1**

**Scenario 2:** In this scenario, the healthcare entity pays the EDI integration with ERP, the electronic archive (which is saved during ten years) and the purchase order. The supplier is responsible for paying the invoice and the ASN. Table 32 shows the total costs for healthcare

entities in this scenario, in the first year. The unit cost for archiving the invoice that will be received by the supplier is €0.10 and for sending POs is €0.13. Since the entity pays one more document, the total costs are higher than in scenario 1. In the previous case, CHLO has lower total costs than CHLC, however, in this case, CHLC has less total costs. This happens due to the higher number of CHLO's POs. Considering all entities together, the total costs are €983,544, higher than scenario 1. If considering the costs for the years following the implementation, the integration costs are not taking into account. The total average costs for 7 entities, for year 1+X, X>0, in this scenario is €856,044. X means the number of years after the implementation.

| Entity | Total number of invoices | Total number of POs (euros) | Integration with ERP costs (euros) | Human resources cost of electronic process (euros) | Total costs for integration, HR and electronic archive (euros) | Costs of POs (euros) | Total costs (year 1) (euros) | Total costs (year 1+X) (euros) |
|---|---|---|---|---|---|---|---|---|
| CHLC | 72,954 | 29,963 | €21,250 | €115,843 | €144,388 | €3,895 | €148,284 | €127,034 |
| CHLN | 57,456 | 39,876 | €21,250 | €115,843 | €142,839 | €5,184 | €148,022 | €126,772 |
| CHLO | 68,231 | 65,689 | €21,250 | €115,843 | €143,916 | €8,540 | €152,456 | €131,206 |
| CHP | 83,713 | 66,941 | €21,250 | €115,843 | €145,464 | €8,702 | €154,167 | €132,917 |
| CHSJ | 350,000 | 350,000 | €21,250 | €115,843 | €172,093 | €45,500 | €217,593 | €196,343 |
| HFF and CHTMAD | 129,300 | 100,000 | €21,250 | €115,843 | €150,023 | €13,000 | €163,023 | €141,773 |
| Total | 761,654 | 652,469 | €127,500 | €695,058 | €898,723 | €84,821 | €**983,544** | €856,044 |

**Table 32 - Total Costs of Electronic Invoicing Process in Scenario 2**

**Scenario 3**: In this scenario, the healthcare entity incurs in all costs. This case is not common, however, it corresponds to the "worst" scenario in terms of costs for healthcare entities. Table 33 shows the calculations for this scenario. These consider the costs for the EDI integration with the ERP (for the first year), the invoice (and its archive during ten years), the PO and the ASN. The unit cost for invoice archive is €0.10 and the unit cost for invoice, PO and ANS is €0.13. The integration costs are €21,250 for all entities. The human resources 'costs are considered the same used for receiving invoices (together): €115,843. The majority of the entities did not answered about the number of transport guides, so the following assumption is made: the number of ASNs is equal to the number of PO of medicines and medical devices. This decision is taken based on the fact that the products need to be delivered (the same does not happen with utilities and services). This scenario is the one with the highest total costs: €1,144,684 for the seven entities. Similar to scenario 2, the ascending order, regarding the total costs among entities is the following: CHLN, CHLC, CHLO, CHP, HFF and CHTMAD, and CHSJ. If considering the costs for the years following the implementation, the integration costs

are not taking into account. The total average costs for 7 entities, for year 1+X, X>0, in this scenario is €1,017,184. X means the number of years after the implementation.

| Entity | Total number of invoices | Total number of POs | Total number of ASN | Integration with ERP and HR of electronic process costs (euros) | Total costs of invoices (euros) | Costs of POs and ASNs (euros) | Total costs (year 1) (euros) | Total costs (year 1+X) (euros) |
|---|---|---|---|---|---|---|---|---|
| CHLC | 72,954 | 29,963 | 23,239 | €137,093 | €16,779 | 6,916 | €160,789 | €139,539 |
| CHLN | 57,456 | 39,876 | 31,900 | €137,093 | €13,215 | 9,331 | €159,639 | €138,389 |
| CHLO | 68,231 | 65,689 | 63,075 | €137,093 | €15,693 | 16,739 | €169,525 | €148,275 |
| CHP | 83,713 | 66,941 | 49,665 | €137,093 | €19,254 | 15,159 | €171,506 | €150,256 |
| CHSJ | 350,000 | 350,000 | 200,000 | €137,093 | €80,500 | 71,500 | €289,093 | €267,843 |
| HFF and CHTMAD | 129,300 | 100,000 | 110,000 | €137,093 | €29,739 | 27,300 | €194,132 | €172,882 |
| Total | 761,654 | 652,469 | 477,879 | €822,558 | €175,180 | 146,945 | €**1,144,684** | €1,017,184 |

**Table 33 - Total Costs of Electronic Invoicing Process in Scenario 3**

- **Potential savings**

The potential savings of migrating from manual to electronic invoicing process in accounts payable is the result from the difference between the manual costs and electronic costs. Since the estimated average costs collected is considering only for invoices, the potential savings only take into account a fourth scenario: the healthcare entity pays the EDI integration with ERP, the electronic archive, human resources and the invoice document. Table 34 shows the total costs of electronic invoicing process and the total costs of manual invoicing process. The potential savings are also calculated based on these costs. For electronic costs, it is considered €21.250 for integration costs for each entity and €0.23 per invoice (including the archive and the document exchange). The costs of human resources are €115,843. The costs of manual process, similarly to table 28, are based on the estimated cost of a paper invoice: €4.89.

The total potential savings, from the seven entities is €2,726,750, considering the year of implementation. The entity with the highest potential savings is CHSJ (€1,493,907) while the CHLN has the lowest potential savings (€130,652). The average unit cost of an electronic invoice is €1.31. This cost varies according to each entity.

| Entity | Total number of invoices | Total electronic costs (euros) | Unit cost paper invoice (euros) | Total costs paper invoice (euros) | Potential savings (euros) | Unit cost of an electronic invoice (euros) |
|---|---|---|---|---|---|---|
| CHLC | 72,954 | €153,872 | €4.89 | €356,745 | €202,873 | €2.11 |
| CHLN | 57,456 | €150,308 | €4.89 | €280,960 | €130,652 | €2.62 |
| CHLO | 68,231 | €152,786 | €4.89 | €333,650 | €180,863 | €2.24 |
| CHP | 83,713 | €156,347 | €4.89 | €409,357 | €253,010 | €1.87 |
| CHSJ | 350,000 | €217,593 | €4.89 | €1,711,500 | €1,493,907 | €0.62 |
| HFF and CHTMAD | 129,300 | €166,832 | €4,89 | €632,277 | €465,445 | €1,29 |
| Total | 761,654 | €997,738 | €4,89 | €3,724,488 | **€2,726,750** | €1,31 |

**Table 34 - Potential Savings of Migrating from the Manual to Electronic Invoicing Process**

Since previous calculations are subject to the need for integration of EDI with the ERP, in which the entities incur in the first year, table 35 shows the total potential savings in a horizon of 3 years. During years 2 and 3, entities still pay for the electronic archive, the electronic message exchanged and for human resources. For calculations, the total number of invoices is the same for the three years (based on 2016). The total potential savings is €8,435,246. The average unit cost of an electronic invoice is €1.20.

| Entity | Total number of invoices | Total costs paper invoice | Potential savings (year 1) | Total electronic costs (years 2 and 3) | Potential savings (years 2 and 3) | Potential savings for 3 years | Unit cost of an electronic invoice |
|---|---|---|---|---|---|---|---|
| CHLC | 72,954 | €356,745 | €202,873 | €265,245 | €448,245 | €651,118 | €1.91 |
| CHLN | 57,456 | €280,960 | €130,652 | €258,116 | €303,804 | €434,456 | €2.37 |
| CHLO | 68,231 | €333,650 | €180,863 | €263,072 | €404,227 | €585,090 | €2.03 |
| CHP | 83,713 | €409,357 | €253,010 | €270,194 | €548,519 | €801,529 | €1.70 |
| CHSJ | 350,000 | €1,711,500 | €1,493,907 | €392,686 | €3,030,314 | €4,524,221 | €0.58 |
| HFF and CHTMAD | 129,300 | €632,277 | €465,445 | €291,164 | €973,390 | €1,438,835 | €1.18 |
| Total | 761,654 | €3,724,488 | €2,726,750 | €1,740,477 | €5,708,499 | €**8,435,249** | €1.20 |

**Table 35 - Potential Savings of Migrating from the Manual to Electronic Invoicing Process (3 Years)**

### 7.3. Discussion of Results

The process of receiving invoices in the five analysed entities (CHLC, CHLN, CHLO, CHSJ and CHP) is still based on manual procedures, exchanging invoices in paper format. This process brings different inefficiencies for each hospital centre. The more common inefficiency is the lack of integration between systems, causing repetition of tasks and wasting time of human resources. The manual process also turns invoices' management more confused due to the high volume received and the different invoices typology. There are situations where some

invoices are lost and other are paid belatedly. Besides the negative impacts on the AP department's efficiency, these problems can also affect the relation with suppliers. For example, in case of lately payments, the entity can lose the opportunity to access special discounts from the supplier. In addition, the loss of invoices or errors in validating can mean a huge loss for the entity.

The number of received invoices in 2016 varies between 57,456 and 72,954 considering four of the five entities. CHSJ totalizes 350,000 invoices, which is five times more than the average of the remaining entities. A possible reason for this may be the incapacity of CHSJ to buy together and the need for purchasing goods and services separately. Amongst the three types of suppliers (medicines and medical devices, utilities and services), the majority of invoices are from medicines and medical devices, for all entities. However, the same does not happen with the number of active suppliers (except for CHLN). This fact suggests that suppliers of medicines and medical devices represent higher percentage of total invoices, individually. Hence, these companies have great influence in terms of the model of invoicing adopting by the healthcare entity. The main suppliers of medicines and medical devices are the following companies (see table 17): BAXTER (3.76% of CHLO's total invoices), MEDTRONIC (3.19% of CHLO's total invoices and 1.68% of CHP's total invoices), BRAUN MEDICAL (2.24% of CHLO's total invoices and 2.71 % of CHP's total invoices), and JOHNSON & JOHNSON MEDICAL (3.05% of CHP's total invoices). These four suppliers are multinational companies, spread around the world, with high technology incorporated in their internal processes, using already EDI with healthcare entities in other countries. This fact works as a facilitator for the adoption of electronic invoicing processes by healthcare entities since their main suppliers have already the capacity of receiving electronic methods for exchanging documents. Regarding utilities, although few number of suppliers, they are represented by important enterprises in Portugal in the sector, with developed solutions. Although the main three services' suppliers are not the same for both entities (CHLO and CHP), they are similar to all healthcare entities due to the fact that these entities need the same type of services. In this way, if all healthcare entities adhere to electronic exchange processes, suppliers will have pressure to adapt and adopt an electronic model easier and faster.

The total costs of receiving paper invoices revel discrepancy on data provided by entities. In terms of hours spent on this process, there is no pattern. In terms of total costs, data provided by CHLC is similar to data from CHP. The same happens with CHLN and CHLO. However, CHLN and CHLO have approximately four times higher total costs than CHLC and CHP. Since

these entities are similar in terms of size (measured by the number of collaborators), no reason was found for these results. In order to choose the right estimation, literature of chapter 2 is taken into account. According to Koch (2016), the unit cost of a paper invoice received is €17.60. The total costs of CHLC and CHP indicate that their unit cost per invoice is €0.71 and €0.63. These numbers are considered too low for a paper invoice and it is why the costs provided by CHLN and CHLO are used to calculate the unit cost of a paper invoice received: €4.89. However, this value is still too low when compared with the literature (only 27% of the cost given by literature). It is also important to notice that this unit cost does not consider differences of efficiency among entities. Regarding the total average costs per task in receiving an invoice by the manual process, the results are also different from the literature. The results of CHLN and CHLO suggest that dispute management is the most expensive task, followed by the validation and matching (low difference). The third most expensive task is the payment and cash management. Archiving is the fourth and the reception the fifth most expensive. The entering codification is the cheapest task. The high costs can happen due to dispute resolutions with suppliers that are usually done by phone and unstructured e-mails, which can be time-consuming. High discrepancies with Value- Added Tax (VAT) compliant, orders, and contract terms can also emerge during the validation and matching of invoices, increasing the costs.

Purchase orders are mainly sent via e-mail. On one hand, this method is faster than sending in paper format. On the other hand, this process is still depending on human resources by the suppliers, being subject to inefficiencies. According to data provided by the five entities, the number of POs varies between 29,963 and 350,000 and the total number of active suppliers ranges between 912 and 3500. The main issue of sending PO by email is the lack of knowledge by the healthcare entities if the supplier received the PO and who received. Many times the PO is lost. This can bring serious problems in urgent deliveries, out of stock products, adding potential conflicts between stakeholders. This problem exists mainly in POs sent to medicine and medical devices suppliers, as the products to be delivered are more critical to the patients, but also happen with services suppliers. For utilities suppliers there are not PO issued (usually those services are pre-stablished and agreed with the suppliers). Even if the PO is well received by the supplier, there is the need to manually insert the data in the ERP, what brings potential errors (e.g. wrong codes, wrong product quantities). As a consequence, product deliveries will not be according PO, bringing the same type of problems already described. Although the studied healthcare entities are currently using email processes for sending PO, they (excluding CHLC that was not clarified in its answer) intend to adopt an electronic solution using EDI with

direct integration in the ERP. Besides EDI, a PO can be send through a portal. In this case, suppliers will get PO in the portal. This is not a method as efficient as EDI because suppliers also have to introduce manually the data in the ERP. However both stakeholders have access to the same information, as PO is registered in the service provider platform, reducing the potential conflicts between both parts. According to data provided by Saphety about HFF and CHTMAD, the web portal is more used to send POs and reception notes while OCR is more used for receiving invoices. The ASN (considered as an electronic transport guide) is also other document exchanged between entities, regarding transport conditions that is automatically processed.

The total costs of the overall 7 entities (5 + HFF and CHTMAD) for receiving an invoice by the manual process is €3,724,488. Since the unit cost is considered the same for all entities, the total costs raises according to the number of invoices received. In average, CHSJ achieves €1,711,500 while CHLN reaches €280,960 in receiving the totality of invoices.

The prices given by Indra and Saphety differ significantly. In Indra, the price of the electronic archive of an invoice is more expensive than the price of the electronic document, and it differs in €0.02. The opposite situation occurs in Saphety where the electronic archive's price is cheaper than the electronic document's price (and the difference between both is €0.08). The fixed costs of EDI integration are dependent on the project. For estimating electronic costs the prices of both entities and the average of it are both considered. The fixed price is €21.250 which means that the entity pays this value for the implementation of the system that will allow the automation and integration of the process (charged in the first year of adoption). In this case, where is not possible to predict the conditions of the projects, this value is taken as fixed which means that it does not depend on the number of invoices. The variable cost is €0.23 and it includes the electronic document and the electronic archive of an invoice during 10 years. The costs for human resources are considered the remaining costs of migrating from manual to electronic process, based on the literature. For calculating the average values, the costs given by CHLN and CHLO are considered. The impact of the costs per task are different in manual and electronic process. The most expensive electronic cost is related with dispute management, followed by the payment and cash management. Validation and matching is the third most expensive task, and the archiving is the cheapest one.

In terms of payment models (who pays which document), service provider companies are not specific, since it depends on the conditions stablished in pre agreements between entities and their suppliers. However, three scenarios usually happen regarding the division of costs.

Besides invoices, other documents are incorporated in the hypothesis: PO and ASN. The scenario with less total electronic costs for healthcare entities is the one in which these entities only pay for the integration and the electronic archive: €898,723 in the first year, and €771,223 in the following years (2 and 3). In this case, suppliers pay for each document exchanged. In scenario 2, the total costs of the seven entities raise 9% comparing with scenario 1. However, CHSJ has a huge impact on this average. Taking into account each entity individually, the total electronic costs from scenario 1 to 2 increases 3% for CHLC, 4% for CHLN, 6% for CHLO, 6% for CHP and 9% for HFF and CHTMAD. The seven entities, in scenario 2 totalizes €983,544 in the first year. In years 2 and 3, the total electronic costs are €856,044. The third scenario is considered the worst situation since the healthcare entity incurs in all costs of the exchanging process: €1,144,684 for the first year, and €1,017,184 in years 2 and 3.

Considering only the process of receiving an invoice, the potential savings of migrating from manual to electronic process is €2,726,750 in the implementation year. In a 3 years horizon, the 7 entities are able to save €8,435,249. However, only CHSJ represents 54% of total saving potential due to the high number of invoices. The results show that saving potential varies in the same direction as the number of invoices: entities that exchange a higher number of invoices are able to save more money in a year. In the literature, the unit saving potential per invoice is 64%. The results suggest that CHLC is able to save 57%, CHLN 47%, CHLO 54%, CHP 62%, HFF and CHTMAD 87%, and CHSJ 74% of costs per invoice, in the first year. In the years following implementation, the unit saving potential per invoice increases since the cost per invoice decreases: CHLC saves 61%, CHLN 52%, CHLO 58%, CHP 65%, HFF and CHTMAD 88%, and CHSJ 76%. The price of each electronic invoice corresponds to 35% of the cost of a paper invoice (in a period of 3 years).

Data shows that the four out of the five healthcare entities analysed intend to adopt EDI integration with ERP in the near future, which means that potential savings can be actually reached. The results suggest that electronic invoicing and automated processes causes a positive impact in healthcare entities, reducing the costs in accounts payable operations.

# 8. Business Intelligence (BI)

## 8.1. Concept

"Business Intelligence is a collection of decision support technologies for the enterprise aimed at enabling knowledge workers such as executives, managers, and analysts to make better and faster decisions" (Chaudhuri et al., 2011). This technology has the capacity to transform the data collected into actionable information, which is easily readable. A BI software prepares the information from the data, analysing it and develop and run queries. From the analytical results, reports, dashboards and data visualizations are created.

This technology is used in several sectors nowadays, affecting the management of enterprises and allowing them to be closer to success (Chaudhuri et al.,2011) .The decision making process becomes better and faster since the time lag between the data collection and the decision making is shortened. The BI technology also optimizes internal processes and increases the operational efficiency. In addition, the data collection and storage costs decrease significantly.

## 8.2. BI and Ministry of Health

The BI technology has several benefits for both business and government entities and the Ministry of Health is not an exception. It is a useful tool, able to bring advantages for the global management of the services provided to the general population.

In case of using electronic invoicing and an EDI software, all the data inserted in AP, including the documents exchanged, are registered in the system. Moreover, if applied to the whole SNS, i.e. all hospitals, hospital centres, health local units, health centres and other health institutions, the Ministry of Health can access to all the information. This data contains information about the orders and delivery of goods by the health entities, according to their consumption needs, including medicines and medical devices. The data from invoices can also be consulted as well as the transportation documentation, and the credit and debit notes. In this way, the MS is actualized regarding what is happening in each health public institution.

The right data processing that comes from these systems is decisive to be able to interpret the huge amount of information exchanged between health entities and their suppliers. The insertion of a BI competent integrated with the systems leads to a better organization and an easy reading of information for the whole SNS. The Ministry of Health, as the major health entity in the Portuguese health system, can have access to these information. A BI software

allows to organize it in reports, dashboards, and data visualizations, being easier to analyse the all data.

Implementing this concept to the accounts payable processes, it is possible to coordinate the essential documents for trade operations with suppliers, allowing the MS to control the consumption of medicines and medical devices at a local, reginal and national levels in real time. Through a BI tool, which reports the electronic information about transactions, it is easier to define standards of consumption across the country and to make comparisons of data in time, detecting irregularities.

This technology allows the MS to act more effectively in different ways. It has more control of the whole SNS, tracking all the movements happening in AP in real time. In this way, there is higher information transparency, which also leads to a decrease on the risk of mistakes or even fraud. The access to the historical of orders and invoices allows to create a tendency for consumption per a certain period, resulting in a better management of stocks and avoiding to break it in peaks' seasons (overconsumption periods). The MS has the capacity to better allocate the resources, being able to easily identify the unnecessary or under-utilized goods and services.

Through the whole picture of the SNS, the MS is able to act with more efficacy when detects irregularities, and to develop and execute health policies that are more adequate to each health entity and region. In general terms, this technology contributes to the improvement of the global management of the SNS.

A big challenge by Ministry of Health is the control of the purchases done by each entity, by region and at a national level in a centralized way. The commercial documents flow between SNS entities and business stakeholders – orders, ASN and financial documents, are performed as a decentralized process (although SPMS has a centralized pricing negotiation power with medicine and medical devices suppliers, each entity is responsible to manage the relation with their own suppliers, according to a budget defined by the corresponding ARS). The question is how the Ministry of Health can have a centralized control in a decentralized operation? How Ministry of Health can have a real time control of the associated expenses?

As it was previously seen, the connection of each entity to their suppliers using an intermediate EDI service provider to exchange commercial documents (figure 19) will grant higher efficiency and very important reduction of costs. If each of SNS entities implements this process, the Ministry of Health can achieve costs reduction.

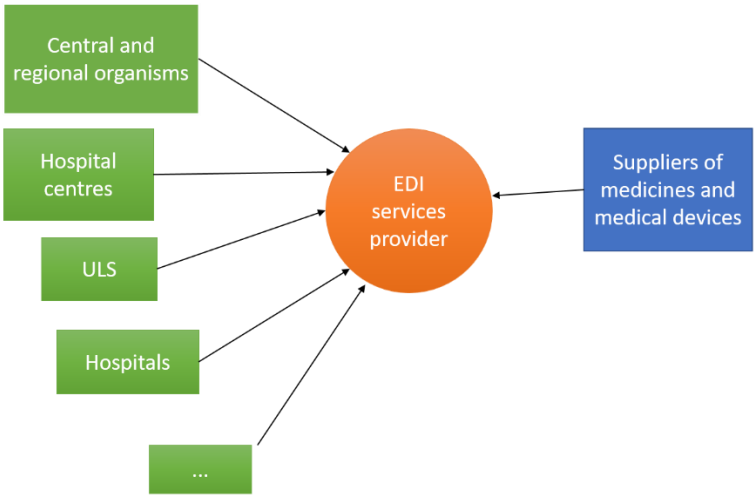



**Figure 19 - Connection of Entities to Suppliers with an Intermediate EDI Service Provider**

*Source: Saphety (2017)*

Taking into consideration that each medicine and medical device has a code that identifies the product, it is possible to match quantities and prices per each product ordered, delivered and invoiced. In a decentralized process, only each entity is able to manage this information. If all the entities or the main ones implements EDI operation, the Ministry of Health can have an umbrella vision of all flow of documents by being connected to the EDI service provider (figure 20).

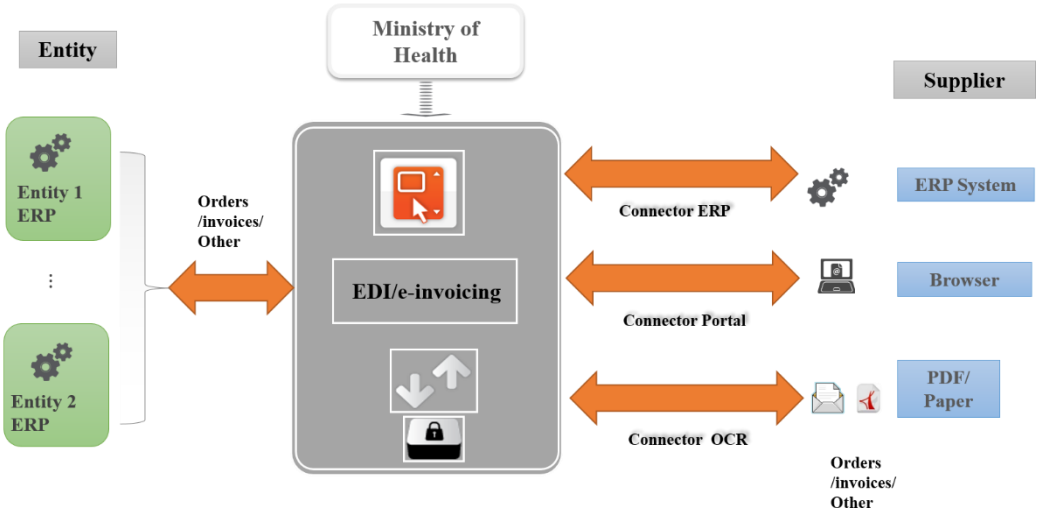



**Figure 20 - Vision of All Flow Documents Using EDI Service Provider by The MS**

*Source: Saphety (2017)*

In this way, the Ministry of Health can have access to data exchanged between each entity and suppliers, per region, defined by each ARS and in an integrated way, at a national level. For example, the Ministry of Health can have information about the consumption of a specific medicine by each of the levels (local, regional, national), the consumption per supplier or per

other analytical vector defined. All this in real time. The definition of the analytical flows and information can be target using BI technology.

The access to real time information as described can be a strategic direction that the Ministry of Health shall follow. Presently, this information is known only after some time (months) and with lack of content. The implementation of a global SNS EDI strategy, taking on top a real time analytical vision supervised by the Ministry of Health bring important economic impacts. In a political perspective, the capacity to go deep in this analytics give important tools to Portuguese government to have more accurate reports for take in EU discussions.

# 9. Conclusions, Limitations and Future Work

## 9.1. Conclusions

Electronic processes allow companies to save resources, increasing its efficiency and minimizing the errors with manual processes. There is a consensus in the literature that dematerialization and automation of processes brings several advantages for managing accounts payable. The European Union and the Portuguese State have already taken several initiatives, thought directives and laws, regarding the adoption of electronic invoicing, encouraging companies to adopt it. The directive 2014/55/EU turns mandatory to receive invoices in electronic format, for contracting authorities and entities. As part of public administration, healthcare entities of SNS are subject to this rule and need to adapt their systems do its implementation.

Besides invoices, there are other commercial documents that need to be exchanged between healthcare entities and suppliers such as purchase orders, transport guides, credit and debit notes. The manual process of exchanging those documents is time consuming and raise the costs of each entity due to its inefficiencies. The automation of this process removes the human intervention, decreasing the change of errors and maximizing the time spent on tasks related.

Five of the seven entities analysed are, currently, using a manual process for receiving an invoice, which reveals to be costly due to the problems occurring during the process. According to the results, a paper invoice costs about €4.89 and the total costs of MS for these seven healthcare entities is €3,724,388, considering the manual process. However, in the electronic process, the average cost of an invoice and its archive is €1.31, in the first year, and €1.20 in the following years. The results suggest that the MS is able to save €2,726,750 in the year of implementation. In a 3 years horizon, with the EDI integration with the ERP included, the MS may save €8,435,249, taking into account the seven healthcare entities.

The extension of dematerialization to the other type of documents, when exchanging them with the suppliers also reduces costs. Purchase orders are sent by e-mail and transport guides are exchanged in paper. The problems that can emerge during this process can affect the relationship between healthcare entities and their suppliers. The adoption of electronic methods for exchanging documents improves this relation and decrease costs.

In addition, the usage of EDI allows the MS to use a BI technology, having access to real time information, increasing the space to act and the accuracy of the policies developed.

After all, the potential savings calculated only takes into account seven entities belonging to the SNS. Although the remaining entities varies in size, if the calculation is extended for all healthcare entities, the potential savings of MS is much higher.

### 9.2. Limitations

One limitation of the study is the whole size of the SNS. Due to the high number of healthcare entities, it was not possible to collect data and estimate costs for all healthcare entities belonging to the SNS. Another limitation identified is to get the availability from the responsible persons for answering to the questionnaires and the control of quality of those answers. The information asked in the questionnaires needs time and it is complex, being subject to high discrepancies among entities. In this way, some values can affect significantly the estimated averages. Another limitation is the calculation of the potential savings only with the invoices number, without the remaining documents.

### 9.3. Future Work

The existent literature on the subject developed in this work is poor. In Portugal, the studies of electronic invoicing in the healthcare sector are scarce. It would be interesting, in future studies, to include all the healthcare entities of SNS, calculating the total savings potential for the MS. Also, since the entities analysed intend to adopt an electronic process in the future, a comparison of costs before and after the implementation of the process can give an accurate idea about the efficiency caused by migrating from manual to electronic process, in each specific entity. In addition, in order to have the full electronic process savings, the accounts receivable and the relations with buyers, should be analysed. In order to overcome the limitations that can emerge in future works, I recommend a creation of a project in collaboration with the MS, facilitating the access to uniformed information of the overall healthcare system.

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# Appendixes

## Appendix 1 – Questionnaire for Healthcare Entities

### Appendix 1.1 – English Version

## Survey about invoicing process

#### 1 – PROBLEM IDENTIFICATION

**1.1.** Which are the problems/inefficiencies identified in the invoicing process?

**1.2.** How many departments and people are involved in the invoicing process?

**1.3.** How many employees has the entity?

#### 2- ACCOUNTS PAYABLE – RELATION WITH THE SUPPLIERS

**A – Process of invoices reception**

**A.1**. How many active suppliers?

**A.1.1.** TOTAL

**A.1.2.** of medicines and medical devices

**A.1.3**. of utilities

**A.1.4.** of services

**A.2.** How many invoices and credit notes are exchanged with suppliers, annually (referring to 2015 and 2016 if available)

**A.2.1**. TOTAL

**A.2.2.** of medicines and medical devices

**A.2.3.** of utilities (telecommunications, electricity, water and gas)

**A.2.4.** of services

**A.3.** Which is the actual process in the reception of invoices? (Please, choose one of the two options).

**A.3.1**. Paper

**A.3.2**. EDI (*Electronic Data Interchange*) with the integration in the ERP

**A.3.3** If you selected the process 3.1., it is intended to implement 3.2.? If yes, how long it will take?

If you selected the process 3.2., when was it implemented? How many suppliers are integrated? Which is the percentage of the total invoicing?

**A.4.** During the reception of paper invoices, there is a set of direct and indirect tasks that contribute for the costs item. In the following table are presented, in the 1st column, the different tasks that are usually executed in the process and, in the 2nd column, some examples of these tasks. It is asked the filling of the 3rd and 4th columns with the information regarding the number of human resources and hours allocated to each task, and respective costs (correspondent to 1 year).

| Tasks | Manual work and problems with paper based processes | Number of HR and hours | Costs |
|---|---|---|---|
| **1. Receive** | • Opening mail<br>• Check and remove undesired attachments<br>• Entrance stamp<br>• Forward to AP department | | |
| **2. Entering Codification** | • Entering to AP system<br>• Delayed entering during peak season or permanently<br>• Entering of data in the ERP (10% of entered data statistically viewed with errors) | | |
| **3. Validation and Matching** | • Discrepancy in VAT compliance is detected at the late stage<br>• Line items in an invoice quite often contain a discrepancy with the order or contract terms.<br>• Manual matching is time-consuming and expensive | | |
| **4. Dispute Management** | • The dispute resolution with the supplier is often done by phone, unstructured email or fax<br>• Dispute resolution can be very time consuming<br>• A percentage of these disputes require a treatment by direction and even administration, increasing the costs of the process<br>• A percentage even implies the involvement of lawyers, increasing the costs involved | | |
| **5. Payment and Cash Management** | • Time consuming and costly circulation within the company for payment release; discounts are typically missed<br>• Manual work for payment order and risk of errors<br>• Cash Manager without the full transparency for all pending invoices | | |
| **6. Archiving** | • Hundreds or thousands of folders with paper invoices with high demand for storage capacity<br>• High costs for manual search | | |

**A.5.** List of suppliers

**A.5.1.** List of suppliers of medicines and medical devices, with the respective annual number of invoices and credit notes received per supplier.

**A.5.2**. List of suppliers of utilities, with the respective annual number of invoices and credit notes received per supplier.

**A.5.3**. List of suppliers of services, with the respective annual number of invoices and credit notes received per supplier.

**B – Process of sending purchase orders**

**B.1.** What is the current process for sending purchase orders?

**B.1.1.** by paper

**B.1.2.** by EDI

**B.2.** How many purchase orders are sent to suppliers annually?

**B.2.1.** TOTAL

**B.2.2.** of medicines and medical devices

**B.2.3.** of services

**C – Process of reception transport guides**

**C.1.** What is the current process for receiving transport guides?

**C.1.1**. by paper

**C.1.2**. Electronically without the integration with the ERP

**C.1.3.** by EDI with the integration with the ERP

**C.2.** How many transport guides are received annually?

**C.2.1.** TOTAL

**C.2.2.** of medicines and medical devices

**C.2.3.** of services

## Appendix 1.2. – Portuguese Version

# Inquérito sobre o processo de faturação

### 1 – IDENTIFICAÇÃO DA PROBLEMÁTICA

**1.1.** Quais os problemas/ineficiências identificados no processo de faturação?

**1.2**. Quais os departamentos e pessoas envolvidos no processo de faturação?

**1.3.** Qual o número de empregados da entidade?

### 2- CONTAS A PAGAR – RELAÇÃO COM OS FORNECEDORES

**A – Processo de Receção de faturas**

**A.1.** Qual o número de fornecedores ativos?

**A.1.1.** TOTAL

**A.1.2.** de medicamentos e dispositivos médicos

**A.1.3.** de *utilities* (telecomunicações, eletricidade, água e gás)

**A.1.4.** de serviços

**A.2.** Qual o número anual de faturas e notas de crédito trocadas com os fornecedores? (referentes a 2015 e 2016 se disponível)

**A.2.1**. TOTAL

**A.2.2.** de medicamentos e dispositivos médicos

**A.2.3.** de *utilities* (telecomunicações, eletricidade, água e gás)

**A.2.4.** de serviços

**A.3.** Qual o processo atual na receção de faturas? (escolher uma das duas opções, realçando-a)

**A.3.1**. em papel

**A.3.2**. por EDI (*Electronic Data Interchange*) com integração direta no ERP

**A.3.3** Se selecionou o processo for 3.1., pretende-se implementar 3.2? Se sim, em que espaço de tempo?

Se o selecionou o processo dor 3.2, quando foi implementado? Qual o número de fornecedores integrados? Qual a percentagem da faturação total?

**A.4.** Nos processos de receção de faturas em papel existe um conjunto de tarefas diretas e indiretas que contribuem para a rúbrica de custos.

Na tabela seguinte apresentam-se, na 1ª coluna, as diferentes tarefas que normalmente são executadas no processo e, na 2ª coluna, alguns exemplares destas tarefas. Agradece-se o preenchimento da 3ª e 4ª coluna com a informação relativa ao número de recursos humanos e horas alocadas a cada tarefa, e respetivos custos (correspondente a um ano).

| Tarefas | Trabalho manual e problemas com os processos baseados em papel | Nº de RH e horas | Custos |
|---|---|---|---|
| **1. Receção** | • Abertura do correio<br>• Verificação e remoção de anexos indesejáveis<br>• Selo de entrada<br>• Envio para o departamento de contas a pagar | | |
| **2. Entrada e codificação** | • Entrada no departamento de contas a pagar<br>• Atrasos ocorridos em alturas de pico<br>• Entrada dos dados no ERP (10% dos dados processados manualmente apresentam estatisticamente erros | | |
| **3. Validação e aceitação** | • Discrepâncias nos valores do IVA são detetadas posteriormente<br>• Muitas vezes as linhas dos itens na fatura contêm discrepâncias relativamente a encomenda ou aos termos do contrato. A validação manual é consumidora de tempo e cara | | |
| **4. Gestão de disputas** | • A resolução de disputas com o fornecedor é muitas vezes realizada por telefone, *e-mail* ou fax, de uma forma não estruturada<br>• A resolução de disputas poderá levar muito tempo e apresentar custos elevados<br>• Uma percentagem destas disputas obrigam a tratamento por parte da direção e mesmo da administração, aumentando o custo do processo<br>• Uma percentagem implica mesmo o envolvimento de advogados, aumentando ainda mais os custos envolvidos | | |
| **5. Pagamento e Gestão de Tesouraria** | • A circulação de faturas no interior da empresa para aprovação do pagamento é demorada e cara<br>• O processo manual apresenta um elevado risco de existência de erros<br>• Possível falta de transparência na gestão de faturas pendentes | | |
| **6. Arquivo** | • Elevado número de pastas com faturas em papel, o que implica espaço para o seu armazenamento e respetivos custos<br>• Custos de pesquisa elevados | | |

**A.5.** Listagem de fornecedores

**A.5.1.** Listagem de fornecedores de medicamentos e dispositivos médicos, com o respetivo número anual de faturas e notas de crédito recebidas por cada fornecedor.

**A.5.2**. Listagem de fornecedores de *utilities*, com o respetivo número anual de faturas recebidas por cada fornecedor.

**A.5.3**. Listagem de fornecedores de serviços, com o respetivo número anual de faturas recebidas por cada fornecedor.

**B – Processo de envio de notas de encomenda**

**B.1.** Qual o processo atual de envio de notas de encomenda?

**B.1.1.** Em papel

**B.1.2.** Por EDI

**B.2.** Qual o número anual de notas de encomenda efetuadas a fornecedores?

**B.2.1.** TOTAL

**B.2.2.** de medicamentos e dispositivos médicos

**B.2.3.** de serviços

**C – Processo de receção de guias de transporte (logística)**

**C.1.** Qual o processo atual de receção de guias de transporte?

**C.1.1**. Em papel

**C.1.2**. Eletronicamente sem integração com o ERP

**C.1.3.** Por EDI com integração com o ERP

**C.2.** Qual o número anual de guias de transporte?

**C.2.1.** TOTAL

**C.2.2.** de medicamentos e dispositivos médicos

**C.2.3.** de serviços

## Appendix 2 – Presentation Letter

### Appendix 2.1 – English Version

Lisbon, 21st June 2017

Dear Doctor,

I would like to ask your attention to the subject that I will explain. For the moment, I am writing a master's dissertation on Management, by ISCTE-IUL, on the theme "Financial and Economic Impacts with an implementation of the electronic invoicing in the SNS".

This study aims to analyse the current processes related to the relationship between Hospital Centres, ULS, Hospitals and ARS with their suppliers of medicines and medical devices and services. The study focuses on receipt of invoice, also addressing the processes of sending the order and receiving a transport guide.

Attached I send a small questionnaire whose answers are fundamental for the study and development of my dissertation, appreciating, quite, your availability to answer.

I am sure that the result of the study will allow, to one each of the NHS units, deepen the knowledge on the impact of the dematerialization of business documents can get.

Thank you in advance for your attention and your availability.

Best regards,

Filipa Gomes Pereira

### Appendix 2.2 – Portuguese Version

Lisboa, 21 de Junho de 2017

Exmo. Doutor,

Gostaria de solicitar a sua atenção para o assunto que passo a expor. De momento, encontro-me a escrever a dissertação de mestrado em Gestão, pelo ISCTE-IUL, sobre o tema “Impactos Financeiros e Económicos com a implementação da faturação eletrónica no SNS”.

Este estudo tem como objetivo analisar os processos atuais relativos à relação entre Centros Hospitalares, ULS, Hospitais e ARS com os seus fornecedores de medicamentos, dispositivos médicos e serviços. O estudo foca-se na receção de fatura, abordando também os processos de envio de encomenda e receção de guia de transporte.

Junto envio um pequeno questionário cujas respostas são fundamentais para o estudo e desenvolvimento da minha dissertação, apreciando, bastante, a sua disponibilidade de resposta.

Estou certa de que o resultado deste estudo permitirá, a cada uma das unidades do SNS, aprofundar os conhecimentos sobre o impacto que a desmaterialização dos documentos comerciais no processo de contas a pagar poderá alcançar.

Agradeço antecipadamente a sua atenção e a sua disponibilidade.

Com os melhores cumprimentos,

Filipa Gomes Pereira

## Appendix 3 - Declaration of Authorization for Data Publication

### Appendix 3.1 – English Version

**DECLARATION OF AUTHORIZATION / CONSENT**

I, _____, bearer of the Identity Card / Citizen's Card no. _____, hereby authorize the publication of the responses to the inquiry on the billing process in the entity _____, for the purpose of conducting the master's dissertation on Management of the student Filipa Gomes Pereira , In the ISCTE-IUL.

Date: _____

Assignation: _____

### Appendix 3.2 – Portuguese version

**DECLARAÇÃO DE AUTORIZAÇÃO/CONSENTIMENTO**

Eu, _____, portador do Bilhete de Identidade/Cartão do Cidadão nº _____, declaro que autorizo a publicação das respostas ao inquérito sobre o processo de faturação na entidade _____, para o efeito da realização da dissertação de mestrado em Gestão da aluna Filipa Gomes Pereira, no ISCTE-IUL.

Data: _____

Assinatura: _____

**Appendix 4 – Questionnaire for Service Providers**

**Appendix 4.1. – English Version**

# Questionnaire about electronic invoicing process in the public healthcare sector in Portugal - SNS

1- What is the strategic positioning of your company in the areas of EDI/electronic invoicing in the healthcare sector?

2- Does your company have EDI / electronic billing projects awarded by hospitals / public health entities?

3- If so, is it possible to list a contracting entity according to its project **implementation phase?**

3.1. Awarded but not initiated

3.2. Awarded but in phase of survey

3.3. Awarded but in phase of implementation

3.4. Awarded and operating

4- Given the accounts payable process, **which documents** are exchanged or are expected to be exchanged between each of the hospitals awarded and their suppliers? (Ex: order notes, transport guides, invoices, credit and debit notes)

5- In the process of receiving documents, from the hospital perspective, **which methods** are used to link providers? (Eg EDI - integrated with your ERP, portal, OCR, others)

6- For each hospital / public health entity, and referring to question 4, **what number of electronic documents are expected** to be exchanged, after the project is fully operational, for each of the methods (referring to question number 5)? Please, fill out the following table:

HOSPITAL A

| Type of documents | Number of documents | Number of documets per method used | | | |
|---|---|---|---|---|---|
| | | Integrated EDI | Portal | OCR | Others |
| PO to suppliers | | | | | |
| Transport guides received | | | | | |
| Invoices received | | | | | |
| Credit notes | | | | | |
| Debit notes | | | | | |
| Others:_____ | | | | | |

HOSPITAL B…Z

…idem

7- What are the **average costs of integrating a hospital's ERP** with your platform for all documents exchanged between the hospital and its suppliers? (if possible, include the hospital's average internal costs with your ERP provider)

8- What is the **average cost of the electronic file** of each **invoice** received by the hospital?

9- In your business model **which entity pays** the documents exchanged? The Hospital, the provider, both? What documents?

10- What is the **average cost per document** exchanged?

11- If there are relevant data not mentioned in the questions, I would be grateful if they would send them.

**Appendix 4.2. – Portuguese Version**

# Inquérito sobre o processo de faturação eletrónica no setor da saúde pública em Portugal – SNS

1. Qual é posicionamento estratégico da vossa empresa nas áreas do EDI/Faturação eletrónica no setor da saúde?

2. A vossa empresa tem projetos de EDI/faturação eletrónica adjudicados por hospitais/entidades de saúde pública? (Sim / Não)

3. Se sim, é possível listar a entidade adjudicante de acordo com a **fase de implementação** do projeto?

   3.1 Adjudicado mas não iniciado
   3.2 Adjudicado em fase de levantamento das necessidades
   3.3 Adjudicado em fase de implementação
   3.4 Adjudicado e em produção

4. Tendo em consideração o processo de contas a pagar, **quais os documentos** trocados ou previstos serem trocados entre cada um dos hospitais adjudicatários e os seus fornecedores? (Ex: notas de encomenda, guias de transporte, faturas, notas de crédito e débito)

5. No processo de receção de documentos por parte do hospital, **quais os métodos** utilizados para a ligação dos fornecedores? (Ex.: EDI – integrado com o seu ERP, portal, OCR, outros)

6. Por cada hospital/entidade pública de saúde, e referenciando a pergunta 4, qual o **número de documentos eletrónicos previstos** a serem trocados, depois do projeto estar totalmente em operação, por cada um dos métodos (referente à pergunta número 5)? Agradecia o preenchimento da tabela seguinte:

HOSPITAL A

| Tipo de documentos | Número de documentos | Número de documentos por método utilizado | | | |
|---|---|---|---|---|---|
| | | EDI Integrado | Portal | OCR | Outros |
| Encomendas a fornecedores | | | | | |
| Guias de transporte recebidos | | | | | |
| Faturas recebidas | | | | | |
| Notas de crédito | | | | | |
| Notas de débito | | | | | |
| Outros:_____ | | | | | |

HOSPITAL B...Z

…idem

7. Quais os **custos médios de integração do ERP** de um hospital com a vossa plataforma para todos os documentos trocados entre o hospital e os seus fornecedores (se possível incluir os custos médios internos do hospital com o seu fornecedor de ERP

8. Qual o **custo médio do arquivo eletrónico** de cada **fatura** recebida pelo hospital?

9. No vosso modelo de negócio **qual das entidades paga** os documentos trocados? O Hospital, o fornecedor, ambos? Quais os documentos?

10. Qual o **custo médio por documento** trocado?

11. Se existirem dados relevantes não descriminados nas questões colocadas, agradecia muito que mos enviassem.