Process improvement in an industrial procurement department
Tabaqueira EIT, SA | Philip Morris International

Inês Rey Guimarães Nascimento

Master's Dissertation

FEUP supervisor: Eduardo Gil da Costa

Tabaqueira supervisor: Patrícia Pinto

Faculdade de Engenharia da Universidade do Porto

Mestrado Integrado em Engenharia Industrial e Gestão

2013-06-28

Às minhas avós

Abstract

The following dissertation analyses the application of process improvement in a procurement department. Considering the interaction between this department and all other functional departments in the organisation, successful changes lead to overall organisational improvement.

The addressed problems refer to the lack of standards for managing negotiation processes, the extensive workflow needed for processing purchase orders, and the implementation of alternative inventory management systems. For each problem, solutions are presented, focusing on simplicity and on the systematisation of processes.

From the development of the presented solutions it was possible to conclude that process improvement is of essence in organisations nowadays, and can always be achieved, even in an international organisation with mapped out processes and extensive configuration of workflows and system configuration.

Although the financial impacts of the proposed solutions are not apparent as of the writing of this dissertation, as the implementation is not yet completed, qualitative impacts, namely considering the reduction of workload in the procurement department were attained.

Melhoria de processos num departamento de compras industrial

Resumo

A presente dissertação analisa a aplicação de melhoria de processos num departamento de compras. Tendo em conta a interação entre este departamento e os restantes departamentos funcionais na organização, a implementação com sucesso de mudanças leva também a uma melhoria organizacional.

Os problemas analisados referem-se à falta de estandardização para a gestão de processos de negociação, ao extenso fluxo de trabalho necessário para o processamento de ordens de compra, e à implementação de soluções alternativas para a gestão de inventários. Para cada problema são apresentadas soluções, com foco na simplicidade e na sistematização de processos.

Com base no desenvolvimento das soluções apresentadas foi possível concluir que a aplicação de melhoria de processos em organizações é essencial nos dias de hoje, e pode sempre ser atingida, mesmo numa empresa de dimensão internacional, com processos mapeados e uma configuração extensa dos seus processos e sistemas.

Embora os impactos financeiros das soluções propostas não sejam aparentes à data da escrita desta dissertação, uma vez que a sua implementação não está concluída, impactos qualitativos, nomeadamente no que diz respeito à redução de carga de trabalho no departamento de compras, foram atingidos.

Acknowledgments

First of all, I would like to thank my supervisor at FEUP, prof. Eduardo Gil da Costa, for his constant help and availability, and for accommodating all my last minute changes and doubts.

I also would like to express my gratitude to my supervisor at Tabaqueira, Patrícia Pinto, for her constant support during this project and for welcoming me to her team. A team that I also want to thank: My thank you to Cláudio Castanheira, José Rato, and Sandra Santos for accommodating an extra table in their office, and for putting up with me and always making me feel as part of the team.

Still at Tabaqueira, I have to thank Manuel Gameiro and Daniel Faustino in the technical materials department for receiving me so well and always being there for my constant questions. And finally I have to thank everyone that I crossed at Tabaqueira, for making me feel welcome from the first day.

Last but not least, I thank my family and friends whose support is a constant in my life.

Contents

Acronyms

BOM – Bill of Materials

CI – Consignment Inventory

EDI – Electronic Data Interchange

ERP – Enterprise Resource Planning

GR – Goods Receipt

IM&S – Indirect Materials & Services

IR – Info Record

LU – Link-Up

MRP – Material Requirements Planning

MRP II – Manufacturing Resource Planning

PDCA – Plan Do Check Act

PMI – Philip Morris International

PO – Purchase Order

PR – Purchase Requisition

RFI – Request for Information

RFID – Radio-Frequency Identification

RFP – Request for Proposal

RFQ – Request for Quotation

ROP – Reorder Point

SKU – Stock Keeping Unit

SL – Source List

SME – Small and Medium Enterprises

SOW – Statement of Work

SRM – Supplier Relationship Management

TMW – Technical Materials Warehouse

TPS – Toyota Production System

VMI – Vendor Managed Inventory

Figure Index

1 Introduction

The present dissertation explores the implementation of process improvement methods in the Procurement Department at Tabaqueira EIT, SA, a Portuguese tobacco company. This results from the need for a company, in the current economic context, to focus on achieving improvements and savings, in order to keep being competitive. But before explaining the project related to this dissertation, it is important to introduce the company and the department on which it is based.

1.1 Philip Morris International

Philip Morris International (PMI) is an enterprise integrated in the tobacco industry. Its core business is the production of cigarettes, and it is the world leader on sales of this product since 1972. Even so, it also commercializes other tobacco products, such as rolling tobacco and snubs.

PMI's history begins in 1847, when Philip Morris opened a tobacco and cigarettes store in Bond Street, London. The business was kept in the family until 1894, although the company was open to public capital since 1881. At the beginning of the 20th century the company expanded to New York, and half of its capital was acquired by American partners. In 1919, Philip Morris Company, as it was then called, was totally bought by its American shareholders. Its production facilities were transferred to Virginia, and, in 1924, one of the best known tobacco brands was created: Marlboro. In the 1950's, with a firm presence in Northern America, the company created PMI so as to distribute its products across the globe. (PMI, 2013)

Since the creation of the first American affiliate in 1953, PMI has been expanding both geographically and in terms of productive capacity. Currently, PMI has factories positioned across the different continents and manufactures its products in over 180 countries. Of the top 15 brands sold worldwide, seven of them are PMI products, as is the case of Marlboro, L&M, and Chesterfield. In 2008, in a spin-off process, PMI separated from Altria Group, to which it belonged, achieving a market share of over 15% at that time. It is still currently the biggest tobacco company in the world. (PMI, 2013)

1.2 Tabaqueira EIT – A Philip Morris International Affiliate

Tabaqueira was established in 1927 by Alfredo da Silva, who was granted the concession to operate the tobacco business in Portugal. In 1962, the factory of Albarraque was inaugurated. It is still in this same spot that the productive facilities of Tabaqueira can be found today. In 1975 Tabaqueira was nationalized, and it became an S.A. company, in Portugal designated as Anonymous Society, in 1991. However, it was only privatised again by the end of the year 2000. Currently, Philip Morris International holds 99% of Tabaqueira's social capital.

Since 2008, Tabaqueira is organised into two sister companies: Tabaqueira – Empresa Industrial de Tabacos, S.A., which is responsible for the productive aspect of the company, and Tabaqueira II, S.A., which is responsible for the commercialisation of cigarettes and other tobacco products in the Portuguese market (PMI, 2013).

With the implementation of this new structure, the purchasing of raw materials and the commercialisation of the finished goods in international markets are conducted by the mother-company, PMI. It is also PMI that is in charge of decisions related to long term production

plans, acquisition of new productive equipment, product specifications and quality standards, and client relationship management. Tabaqueira EIT is accountable for, amongst others, procuring all indirect materials and services necessary for the functioning of the factory, establishing short-term production plans, and for performing the entire productive process, from the arrival of packages of tobacco leaf to the exit of pallets of finished goods, ready for distribution.

1.3 The Procurement Department at Tabaqueira

The Indirect Material & Services (IM&S) Procurement Department of Tabaqueira is directly responsible for the procurement of all the materials and services that are necessary for the adequate fulfilling of any of Tabaqueira's functions, from administrative processes to the manufacturing of products itself. This dissertation focuses particularly on this department, and the processes related to its daily business.

The procurement department belongs to the Operations department, more specifically to the Supply Chain department, as explained on Figure 1. This organisational positioning helps understanding the role of procurement in Tabaqueira, since all acquisition and management of goods and services that are accessory, but indispensable, to the functioning of Tabaqueira, namely of the manufacturing process, are managed by the IM&S Procurement Department. Therefore processes such as leading negotiations, contract management, acquisition of spare parts, amongst others, are all within the scope of this particular department.

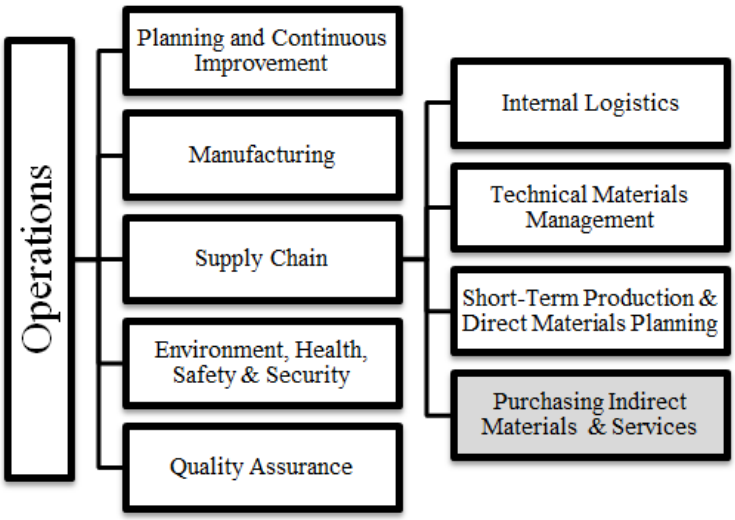

Figure 1 - Organisation Diagram
Source: PMI intranet

The main goal of the IM&S department is to "fully satisfy the internal customer, through the procurement of materials, goods, and services indispensable to the global functioning of the company, at the best price, respecting the required quality, and within the necessary deadlines, always following the Practices and Principles of the company" (PMI, 2013).

1.4 The Project: Process Improvement in the Procurement Department

As it can be inferred from the description of the IM&S procurement department scope, the daily business of this department implies directly dealing with Tabaqueira departments,

and often with PMI global departments. Every project or action that requires any kind of expenditure will have to involve the procurement department, no matter its origin or purpose. Therefore, it is only natural that improving procurement processes will bring about benefits not only to one particular department, but to the entire organisation. This dissertation addresses different issues that present themselves as open for improvements. These different problems are not related between them when it comes to key concepts. Nevertheless, what they have in common is that they all exist in procurement processes, and have implications in the day-to-day functioning of this department.

The first addressed problem is the lack of standards in the procurement department. There was no documentation to support negotiation processes, which led to unavoidable workloads to track the status and development of any processes, as well as all the files and documents related to those processes. To solve this particular problem, two different documents were created, so as to back any negotiation process from the beginning.

The second problem is the deficiency in ERP processes in the purchase order creation process. The involved process implicates a complex workflow, and the lack of automatic procedures leads to the need for workload to execute non-value-added activities. This problem was exacerbated to deficient inputs in the system over time, which kept propagating, leading to incorrect parameterisations for outputs.

The final problem concerns the spare parts warehouse, and its inventory management system. Considering the amount of different materials kept in stock, the workload needed to process and store low value materials is often disproportionate to the obtained benefits. There was a need for studying new inventory management systems that could solve this disparity. New methods for Supplier Relationship Management are also considered in order to achieve reductions in the workload for material procurement.

1.5 Methodology

Tabaqueira, as part of the bigger multinational that is Philip Morris International, is an organisation of considerable age and size. As such, all processes have at one time or another been addressed and studied. This brings about a multitude of positive aspects. Its Enterprise Resource Planning (ERP) software is extensive and in use in all departments. Its configuration is specific to the company's needs, allowing for an effective transfer of information not only across departmental boundaries, but also across affiliates. The successful implementation of ERP is one of the main strengths of Tabaqueira and PMI. Also, every single process is deeply rooted in PMI's Practices & Principles, which are developed and applied in all their affiliates. This means that every affiliate runs on the same objectives and principles. Therefore, the exchange of information between affiliates becomes a more fluid process. Consequently, if an affiliate undergoes a transformation of a process that is successful, this change is transmitted to the other affiliates. Change and improvement are often based on best practices which can be found in any affiliate around the world.

However, these positive aspects can also present some constraints to the implementation of change and process improvement. Every process is extensively systematised, based on software that has undergone substantial studies and configurations that apply to every PMI production site. Thus, substantial changes, such as the implementation of new software or algorithms are unthinkable. Considering these constraints, the main methodology used for implementing new solutions is the accurate studying of each process. This implies analysing each step of the process and their underlying Practices & Principles.

Communicating with other affiliates and exchanging information on best practices is another way of developing new solutions for Tabaqueira's processes with room for process improvement.

Data Gathering and Analysis

The methodologies followed for this dissertation are mainly qualitative, although quantitative aspects are also taken into account to understand the impact of achieved results. But as the implementation of the proposed solutions is still underway, it is not always possible to gather the necessary results to analyse the degree of financial success.

In approaching the challenge of improving processes in the procurement department, the first step was to list the existing processes and establish the ones that were most prone to undergo changes so as to achieve perceptible improvements. Taking into consideration that some improvements have direct impact in the procurement department's objectives for the year, and with the help and input of other departments involved in the different processes, it was possible to define the problems to be addressed.

Once the problems were identified, it was necessary to map out accurately the current state, as well as the desired future state. To do so, the adopted methodology was to start by collecting data. This was done firstly by consulting existing documentation on the subjects, found in PMI's files and databases. This provided an overview of the existing processes, as well as of related best practices, and also guidelines and principles that must be followed. Secondly, members of the different involved departments were consulted, so as to gather information from different points of view, as well as to establish eventual user requirements from the different users. Maintaining contact with staff from the different departments was a constant during all the improvement process, as assembling expertise from different fields is clearly a distinct advantage. In addition to contacting with internal departments, the exchange of information with other affiliates, particularly with affiliates that had addressed, or were addressing, similar problems, was another significant source of data.

Another important step was researching and analysing existing scientific papers on the addressed subjects. The understanding of key concepts in the different theories was fundamental in order to correctly apply them in the development of possible solutions. Also, the studying of case studies and success stories from scientific papers, as well as from other affiliates, provided an essential analysis of expected and possible results, as well as obstacles and hindrances which could be expected to be found during the implementation of the possible solutions.

During the development of the proposed solutions, the analysis of results – or expected results – was mainly based on input and feedback from the procurement department team, as well as members from the involved departments. Members from other affiliates addressing similar problems and implementing similar solutions were also consulted not only for feedback but also for benchmarking. When, during the development of the proposed solutions, new data or new obstacles arose, the previous steps of data gathering were revisited.

Finally, the results to be expected from the proposed solutions were shared by consulting with all involved members, as well as with Tabaqueira's management team. The comparison of expected results from the suggested solution with the expected results from the annual objectives for the procurement department provided a logical tool for establishing the success of the presented solutions. The financial impact of the improvements to be applied

can only be identified when the implementation is completed. However, qualitative results, such as successful elimination of unnecessary tasks and diminishment of workload can be observed, if not quantified.

1.6 Structure of the Dissertation

This dissertation begins with an introduction, presenting the company and the department which were the source of analysis. It also states the existing problems, as well as the used methodology.

The second chapter reviews existing literature on the underlying concepts of the addressed problems. As the nature of the problems is diverse, so is the nature of the analysed subjects. Therefore, they are addressed in the same order as the problems that they relate to.

The third chapter is a continuation of the state of the art. It describes the productive process at Tabaqueira. It also describes the technical materials department, as it is directly related to the productive areas and has a significant impact on the problems addressed by this dissertation.

The fourth chapter is a concatenation of what is normally described in two chapters. As it was mentioned earlier, three different problems are addressed, therefore three solutions are presented. To maintain a logical stream of information, in this fourth chapter each problem is described and then followed by a description of the proposed solution, and a brief conclusion.

The fifth and final chapter refers to the conclusions drawn from the addressed problems and offered solutions. It also presents opportunities for future work related to the studied issues.

2 State of the Art

This chapter presents a literature review of concepts relevant to the problems addressed in this dissertation. Firstly a definition of "procurement" is presented, and its role in the organisation is explained, as well as its positioning in Porter's value chain. Secondly, the concept of "process improvement" is studied, alongside with some of its relevant methodologies, considering the subject of this dissertation. The importance of process improvement in a procurement department is also considered. Since all procurement processes at PMI are, to different degrees, rooted on the utilisation of the ERP system, the third part of this chapter addresses this concept of ERP.

The implementation of Electronic Data Interchange (EDI) through the ERP is also reported, as it is of particular relevance to procurement processes, namely in the creation of purchase orders. This section is followed by a study on "inventory management" concepts, such as Vendor Managed Inventory (VMI) and Vendor Owned Inventory. These are protocols that can be employed for managing stocks, and which significantly alter the role of the procurement department in the creation and management of purchase orders. Finally, the continuous improvement concept of Kanban is analysed, as it is relevant in the implementation of new inventory management systems.

2.1 Procurement

According to van Weele, procurement can be defined as "the management of the company's external resources in such a way that the supply of all goods, services, capabilities and knowledge which are necessary for running, maintaining and managing the company's primary and support activities is secured in the most favourable conditions" (Weele, 2010). For that reason, all companies have a procurement function, with responsibilities that can range from purchasing raw materials to managing contracts for engineering projects. As an indispensable function to any business, it is important to study the role of procurement in the daily activities of a company.

For better understanding the role of procurement in a company, it is adequate to analyse its position in Porter's value chain (Figure 2). According to Porter, all activities that are performed in a company in order to produce the final product can be represented using a value chain. Furthermore, these "value activities can be divided in two broad types, primary activities and support activities". (Porter, 1985) Primary activities are directly and physically associated with the production of the end product. These activities are inbound and outbound logistics, operations, marketing and sales, and service. Support activities exist, as the name indicates, to support primary activities and each other. Firm infrastructure, human resource management, technology and procurement embody the support activities category.

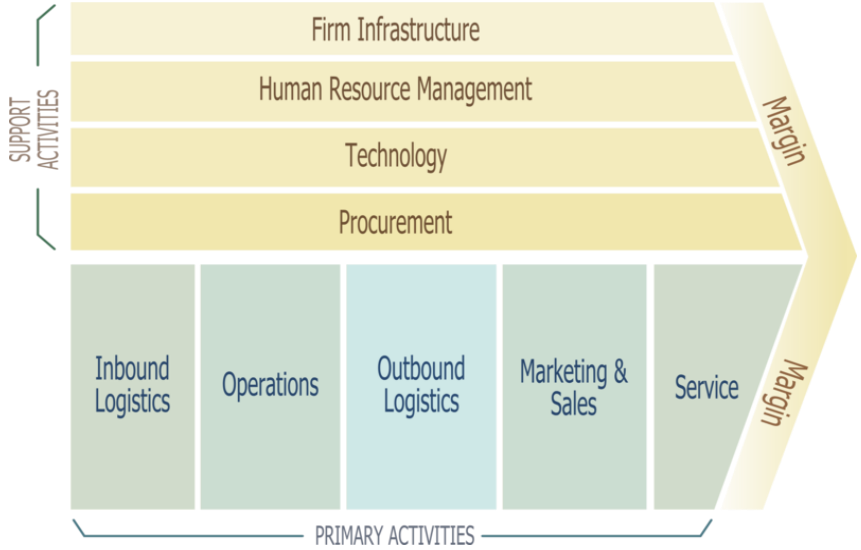

Figure 2 - Porter's Value Chain
Source: Singh, D.P. 2009, http://en.wikipedia.org/wiki/File:Porter_Value_Chain.png

As a support value activity, procurement is, as stated by Porter, "the function of purchasing inputs used in the firm's value chain, not the purchased inputs themselves". (Porter, 1985) This definition is coherent with Wheele's definition.

Procurement can then be defined as a support activity in a company, which exists to provide assistance to all primary activities, as well as other support activities. The activity of procurement can indeed be demarcated as having a wide degree of variety in its field of action. Every time a company needs to acquire a good or a service, however small, the procurement department must be involved. Therefore, although procurement is a support activity, it is nevertheless an essential one.

2.2 Process Improvement

Merriam-Webster defines *process* as "a series of actions or operations conducting to an end" (Merriam-Webster, 2013) and *to improve* as "to enhance in value or quality: make better" (Merriam-Webster, 2013). Therefore, process improvement can be defined as a way to enhance the value of the actions and operations that are necessary to achieve a specific end.

Any company, no matter the sector where it operates, is continuously evolving, along with its outside environment. It must to do so, in order to avoid becoming obsolete. This evolution is a continuous process of changes and refinements necessary to meet new requirements, and new expectations, as defined by the stakeholders and the markets. Process improvement then must be the focus of any company. And this focus must be implemented in its culture. Often the problem with the implementation of process improvement methods is related to the misalignment between an organisation's business goals and its goals on an operational level. For successfully implementing changes, the company must promote a positive attitude towards it. Processes must be analysed, in order to define the current state, assess critical process problems, and determine a desired future state. The main objective is the establishment of more efficient and effective activities. However, companies are composed of different functional departments, each with different processes, which, nevertheless, tend not to be independent between them. Therefore, when considering the

application of process improvement methods to a single process, it is necessary to analyse the system of processes in which the specific process is integrated. Often improving one process may reveal to be counterproductive when considering the entire system. Therefore, goals for success should be established considering a system as a whole (Lepmets, et al., 2012).

The successful implementation of improvement efforts also depends on the education of the involved individuals, i.e. the individuals with the right knowledge and the right skills should address the right processes. To ensure that this is the case, Rohleder, et al. propose a conceptual framework for implementing process improvement in a systematic and flexible manner. The starting point is ensuring the involvement of senior management, along with the adequate organisational support. The second and third steps encompass the decision on which processes to tackle and the definition of the appropriate team to address the issues. Next, the analysis and understanding of the process is of essence. The fifth step then proceeds to the removal of evident wastes and non-value-added activities. Further steps are related to the acquisition of data to accurately monitor the process, and defining whether it has stabilised or not. If the process is not stable, there are still issues to be addressed. When the process is finally stable, it is necessary to assess whether the improved process meets the established target (Rohleder, et al., 1997).

Related to this proposed framework is the concept of Plan-Do-Check-Act (PDCA), which goes hand in hand with the concept of process improvement. PDCA, also known as Deming cycle (Figure 3), is a management tool consisting of four iterative steps, for controlling the success of continuous process improvement. It can be applied in any activity without any immediate financial implication. However, it relies on one crucial factor: acting upon feedback (Charantimath, 2011) .

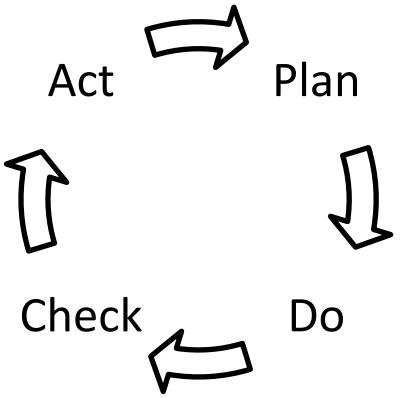

Figure 3 - PDCA Cycle

The first step of the PDCA cycle is Plan. Planning implies the definition of the desired improvement. To do so, the process must be mapped and studied, so as to determine the causes for the problem and suggest possible solutions. In this step a plan for implementing the selected solutions should be elaborated. The second step, Do, represents the execution of the plan. It is important during this step to keep track of the development of the actions put in practice. The third step, Check, comes next. During this step an analysis of the results obtained from the implemented solutions is made. This step is also frequently called Study. The final step is Act. This implies acting upon the findings of the third step. As progress and outcomes may not have been the desired ones, the fourth step is used to bring the process improvement back on track. (Campbell, et al., 2010)

As with continuous process improvement, the PDCA cycle is iterative. It is constantly being repeated in order to keep improving, while maintaining the achieved results from previous improvement actions.

Process Improvement in a Procurement Department

Considering once more Porter's value activities, it is noticeable that the cost of running procurement activities is negligible when compared to the cost of the goods and services. However, these activities can have a significant impact on other activities, especially considering that procurement is a support activity which interacts with all the other activities, both primary and support. Therefore, improving purchasing practices can affect the cost and quality not only of the products themselves, but also of the outputs of all the areas that directly or indirectly interact with these products. (Porter, 1985)

Furthermore, considering the current state of the world economy, savings are increasingly becoming the focus of all activities. By directly dealing with the contracting of both goods and services, procurement activities are becoming an evident target for process improvement. By standardising and mapping accurately all procedures undertaken by procurers, and eliminating non value-added activities in a procurement process, significant savings can be achieved.

Finally, the procurement department is particularly attractive to implement process improvement. Considering once more Porter's value chain, the procurement department is a support activity. This means that it develops connections with every other activity. This originates a myriad of different processes, with different workflows, different objectives, and even different internal customers. This variety of processes directly implies a variety of activities available for analysis, and therefore, for process improvement.

2.3 Enterprise Resource Planning (ERP)

Enterprise Resource Planning (ERP) systems are software packages which include diverse modules to integrate data across the different business units of an organisation, such as finance, manufacturing, sales or human resources (Esteves, et al., 2001). Each module can be considered as a single application, specific to a business process, accessing a core or shared database (Poston, et al., 2001). ERP encompasses "techniques and concepts for integrated management of businesses as a whole" (Leon, 2008). By doing so, ERP implementation facilitates the information flow between the different functions, in order to achieve the "effective use of management resources to improve the efficiency of enterprise management" (Leon, 2008).

ERP is commonly used nowadays in the most diverse companies, especially in the industry related ones. According to a recent Aberdeen Group study, 92% of manufacturing companies have implemented ERP. This implementation led consequently to reductions in inventory levels, better inventory accuracy and increased compliance of manufacturing and transportation schedules (Castellina, et al., 2012). The success of ERP systems in the manufacturing world is correlated with the origins of ERP: Material Requirement Planning (MRP) and Manufacturing Resource Planning (MRP II). Both concepts, MRP and MRP II, are fundamental for production management and control (Leon, 2008).

MRP, which was introduced in the 1970's, helps managing the factory's needs for materials, both for the final product as well as for the productive equipment (e.g. spare parts).

To do so, MRP requires inputs such as the production schedule (based on demand), the current inventory status, and open and planned orders from the shop floor and from suppliers (Langenwalter, 2000). Another important input for the MRP is the Bill of Materials (BOM), which lists all the necessary materials to manufacture an end product. The benefits of an accurate portrayal of materials needs are twofold: On the one hand it allows for a more effective planning of manufacturing activities, thus facilitating the establishment and compliance of delivery dates. On the other hand it also results in a reduction of inventory levels, as materials are ordered only for when needed, and just strictly necessary or critical materials are kept in stock. In short, MRP aims to enable planning in order to "have the right items, in the right quantities, at the right time" (Langenwalter, 2000).

MRP II appeared a decade after its predecessor. It is a broader system, which not only coordinates production and manufacturing processes, but also human relations and financial aspects. It also introduces simulation capabilities for better decision making. Outputs from MRP II, such as business plans, shipping budgets, and inventory projections, integrate information from different departments (Leon, 2008). Although MRP II encompasses some of MRP's functionalities, they are complementary systems.

The expansion of MRP and MRP II, associated with their apparent advantages, led to the development and implementation of ERP systems in the early 90's. According to the Aberdeen study, the main reasons companies presented for making the decision to implement an ERP system are achieving cost reductions and managing growth, as shown on the graph below (Figure 4). These two reasons are correlated, as the addition of new departments, human resources and processes is an inevitable result of the expansion of an organisation. These new additions will inexorably lead to further expenses, which need to be controlled so as to achieve cost reduction. (Castellina, et al., 2012)

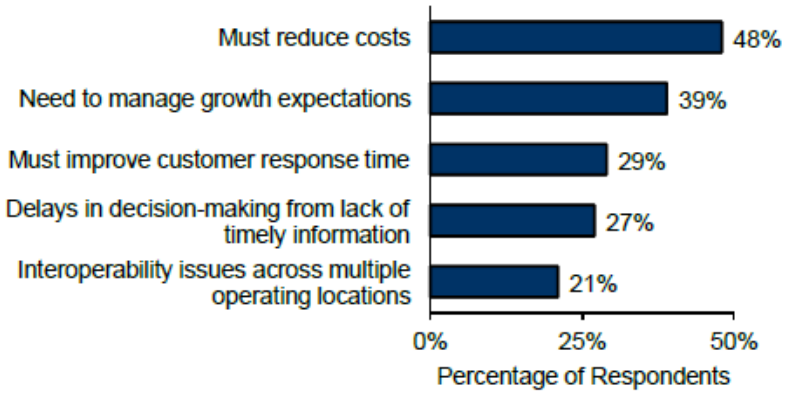

Figure 4 - Stated Reasons to Implement ERP
Source: Aberdeen Group, June 2012

Although the benefits of ERP systems are apparent, its implementation is a complex process. Pastor and Esteves proposed a framework for an ERP system life-cycle (Figure 5). This life-cycle is composed of different stages from the decision to implement the system, to its maturity and then its retirement. The first phase in the life-cycle is the adoption decision. During this stage the organisation managers study the possibility of implementing an ERP system, and what configurations best apply to their business. This is a phase of definitions: system requirements, goals, benefits and impacts should be established during this period.

This decision is followed by the acquisition process. It is necessary that the company studies the available offers in the market in order to choose the software that best fits the organisation's requirements, so as to require minimum customisation efforts. Other factors such as price, training, and maintenance should also be taken into account. The implementation phase is self-explanatory. During this stage the system should be customized and adapted to the needs of the organisation. This can be accomplished with the help of ERP consultants. The fourth phase, use and maintenance, is the longest. It consists on using the systems in order to benefit from the advantages of implementing the ERP software. As with any other software, corrections and improvements are bound to occur. This leads to the next phase: evolution. When the use of the ERP system is well established in the company, new capabilities and modules can be installed, so as to further improve the expected benefits. The final phase is retirement. This only happens when the development of new technologies renders the installed ERP system obsolete or when the evolution of the business needs of the organisation leads to incompatibility issues with the existing system.

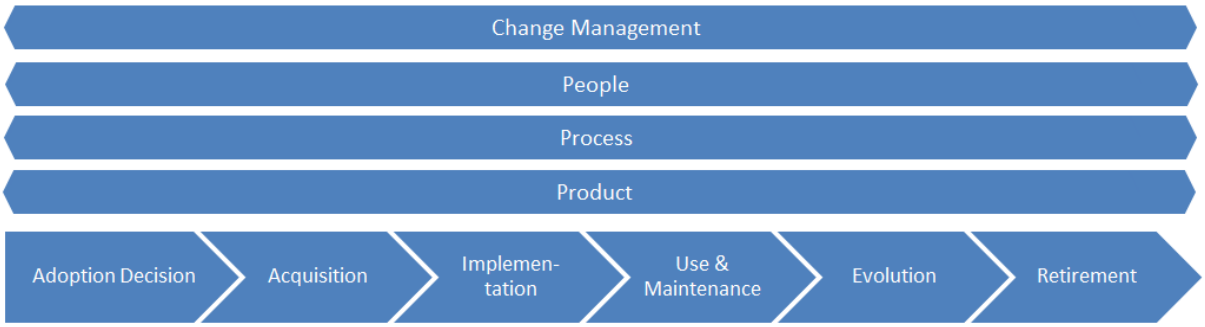

Figure 5 - ERP Life-Cycle
Source: Esteves, et al., 1999

However, during the whole process, there are four dimensions that are always relevant: Product, Process, People and Change Management. For a successful implementation of ERP, awareness of software requirements and capabilities, knowledge of the business processes and their adaptability to an ERP system are essential. People should also always be involved, as they will be the users of the system, and this will imply a complex change in their daily routines. For the ERP implementation to be successful, it is necessary to ensure acceptance and willingness to learn about the new system. (Esteves, et al., 1999)

Inherent to the complexity of ERP systems and their life-cycle is the possibility of failure. The time and resources necessary for application do not always bring about the desired benefits. The lack of commitment from the different business divisions, the inclusion of outside consultants whose area of expertise is not ERP, providing inadequate training during and after the implementation, or simply not fitting the corporate culture to the dynamic and interdependent environment needed for the successful implementation of ERP, are common mistakes that can lead to dissatisfactory results. (Barton, 2001) Therefore, careful planning is crucial when studying the implementation of ERP systems, so as to avoid cost overruns and lack of positive results (Poston, et al., 2001).

Furthermore, the evolution of information technology over the last few decades implies that the organisation is also always expanding to new markets and new technologies. By doing so, the requirements and uses of ERP system are constantly being pushed forward. An example of this is the integration of B2B e-commerce modules into ERP systems. The aim of these modules is to facilitate inter-organisational communication. And basing B2B e-

commerce in an ERP system provides stable groundwork, with already well defined and parameterised databases and information exchange systems. Therefore, the implementation of B2B e-commerce through ERP allows for the creation of synergies between systems, thus achieving better processing capacity, and less involved costs in future technology enhancements. This continuous enhancement of ERP capabilities, along with the implementation of complimentary systems leads us to one other relevant concept, that of Electronic Data Interchange (EDI).

ERP to EDI

Electronic Data Interchange (EDI) is "a form of inter-organisational electronic commerce where one trading partner (a buyer or a seller) establishes individual links with one or more trading partners through a computer-to-computer electronic communication method" (Lee, et al., 2003). The use of EDI allows for the all procurement process to be established through the ERP system, as explained in Figure 6. All relevant documentation and information can be exchanged via EDI, thus reducing the utilisation of physical supports for information, improving the efficiency and effectiveness of the exchanged information, and improving the quality of the stored data.

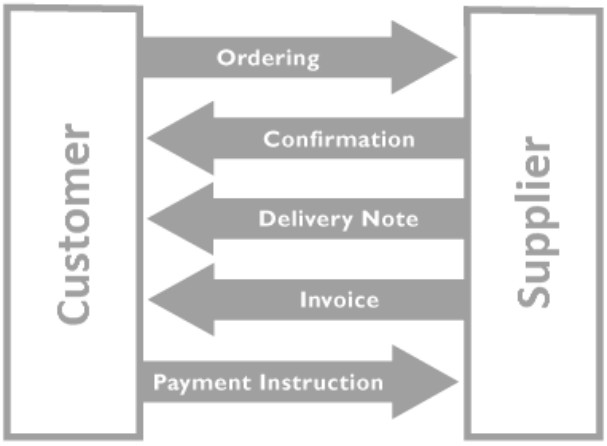

Figure 6 - Example of EDI use

Source: http://www.phoenixcontact.com/local_content_images/edi_geschaeftsdokumente_en_xxl.gif

As stated above, the utilisation of EDI for exchanging business documents brings several benefits, such as up-to-date storage of accurate information, reduction of processing costs, and shorter lead times. However, deployment costs and lack of interoperability among information systems are two significant obstacles to the wide spread of this technology (Lu, et al., 2000). Nevertheless, it is important to consider that, with the evolution and propagation of information technology and the internet, the cost of utilising EDI has significantly decreased, therefore currently presenting a smaller obstacle to its application (Agi, et al., 2005).

The implementation of EDI can bring about multiple savings to an industry. An efficient data transmission system reduces the need for data processing, thus diminishing the workload for data transcription, controls, and error investigation and correction. It also reduces the delay in communicating information between buyer and purchaser, thus obtaining shorter lead times, which leads to more effective inventory management (less products in stock, smaller risk of obsolete material). (Ratnasingham, 1998)

As EDI is a system of transferring data, it is only rational to integrate it with the existing ERP. With the development of global standards for EDI, the percentage of companies incorporating EDI applications into the existing ERP system is elevated, already ranging values of 80% in a 1997 study by Themistocleous, et al. (Themistocleous, et al., 1997). Therefore, with the level of ERP implementation achieved in the manufacturing industry, as stated above, the development of EDI for exchanging information between companies, particularly between buyers and suppliers, is a logical outcome of the technological development experienced in recent years.

2.4 Inventory Management

In any manufacturing industry there is need for keeping in stock raw materials for production, final products for shipment, and indirect materials and spare parts needed for the productive process equipment. This implies a concern on managing and tracking inventory costs. Holding inventory brings about a myriad of costs, such as warehousing space, inventory management labour, insurances, and depreciation. Also, inventoried goods represent an opportunity cost; they are tied up capital, which is not being invested elsewhere. As such, inventory management strategies are studied and implemented so as to minimize the impact of these expenditures.

Vendor Managed Inventory

Vendor Managed Inventory (VMI) is a cooperative inventory management system, where the supplier, not the buyer, is responsible for running the inventory, and keeping the material stock level. This means that the supplier has access to the buyer's inventory information and is accountable for the replenishment decisions, including order quantities, shipping and timing. By adopting this strategy, both supplier and buyer acquire certain benefits. The supplier can better control its production planning and/or stock levels, as he has more information available for establishing more accurate forecasts for demand. The buyer improves its fill rates, and since the supplier is responsible for keeping stock level, also avoids stock-outs without incurring the risks of overstocking (Almehdawe, et al., 2010). By establishing this type of partnership with the supplier, the buyer relinquishes control of important decisions, which have not only a strong financial component, but may also have a direct impact on the production schedule. Due to these implications, it is important when establishing a VMI system to establish specific targets and expectations for the quality of the service provided by the supplier (Waller, et al., 2001).

Although the underlining risks of implementing a VMI system are tangible, the benefits are also considerable. On the one hand, VMI implies a reduced inventory cost, as the supplier in a VMI relationship tends to increase the frequency of replenishments. This implies a reduced stock value at any given time. Also, as the supplier has a better knowledge of demand, he can coordinate deliveries so as to achieve better route planning and to avoid less than truckload shipments, i.e. using trucks which are not at full capacity. By doing so, the transportation costs can be improved, if not optimized. On the other hand, VMI provides the supplier with information that allows him to prioritize orders. And by managing orders, the supplier can coordinate different orders and deliveries from different clients so as to assure product availability, and therefore improved customer levels. (Waller, et al., 2001)

Consignment - Vendor Owned Inventory

To take VMI a step further, both supplier and buyer can establish a consignment contract. Under this contract, the supplier's goods are stored at the customer's facilities, but are still owned by the supplier until the moment of their consumption. This presents a significant benefit for the buyer as he has the material available at any given time, without incurring in tied up working capital in inventory. Consignment Inventory (CI) also mitigates the risk of inaccurate consumption forecasts. The advantages for the vendor are less evident, but reside mainly in securing its position as a supplier of specific goods, often of materials that the buyer would hesitate to acquire. (Gümüs, et al., 2008)

As under CI the supplier assumes both inventory holding costs and deterioration costs, his expectations and objectives must be taken into account when deciding which materials should be provided under this agreement. It must be a joint decision. Preferably the items which are kept under a consignment inventory are items that the buyer would be hesitant to acquire, either because of their cost or because they represent a new technology. Under this protocol the buyer has the item in stock, available to be consumed, which increases the likelihood of consumption, when compared with the item not being in stock and having to be ordered on purpose. However, the supplier can also opt to implement a consignment protocol either to show good-willingness, and strengthen its position as a supplier, or simply because the power gap between buyer and supplier is too large, forcing the supplier to accept the buyer's terms in order not to lose sales.

2.5 Kanban

For inventory management, there are several systems that are designed to provide a visual control of the logistical chain, and identify the need for production. One of the most simply and widely applied pull mechanisms is the kanban system, based on the utilisation of authorisation cards also called kanbans. A kanban system is aligned with the implementation of lean and just in time concepts. (Tardif, et al., 2001). A kanban, in its card form, is a piece of paper with information related to pick up, transfer, and production activities. It signals the need for reposition of materials, and is therefore used to control inventory levels. It is one of the fundamental tools in the lean Toyota Production System (TPS).

To explain the concept of kanban, one can refer to the commonly used supermarket analogy: Upon a sale of products to a given customer, a card carrying information on purchased commodities would be forwarded to the purchasing department. Using the information presented in this card, considering product types and quantities, a correct reposition of products can be promptly set in place. This card, in a productive system, would represent the removal of a kanban from a specific inventory. The figure below, Figure 7, demonstrates a possible illustration of a kanban card, with information related to the item number, shop area, storing location, etc. (Ohno, 1988)

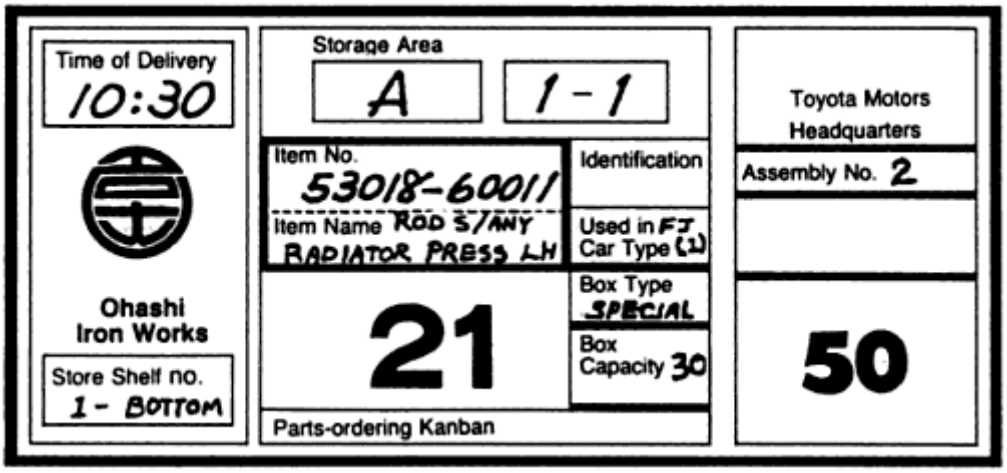

Figure 7 - Kanban Card
Source: Ohno, 1988

The main advantages of a kanban reside in minimising inventory costs and improving productive effectiveness, avoiding the accumulation of raw materials, work in progress, and finished goods at the start or end of any productive stage (Sarker, et al., 1997). However, a kanban system only works effectively under specific conditions, mainly in a linear and well defined production flow. In situations of unstable demands and processing times, great variety of items, long setup times, amongst others, the use of a kanban system would not bring about the desired benefits (Junior, et al., 2010).

Although a kanban system is usually associated with a productive process, considering its origins on the TPS, it can be used as a control mechanism for inventory levels in other environments. Together with the implementation of Radio Frequency Identification (RFID) technology, which facilitates the reading of kanban cards, kanban systems have been set in place in other activity sectors, such as the health care sector. This reviewing of processes, consistent with the application of lean concepts, allows for an effective replenishment of inventory, eliminating waste related to overstock, expired products, and unnecessary workload. Therefore, the range of fields on which kanban systems are being applied is constantly rising, as lean thinking is becoming a tendency across business sectors. (Bendavid, et al., 2011)

3 The Tobacco Productive Process

After the literature review, this chapter presents an introduction to the tobacco industry, as well as its associated productive process. Although the procurement department is not directly involved in this process, the larger share of its activities exists to provide support to the production departments: Primary and Secondary. Therefore, what follows is a description of the manufacturing process of a volume of cigarettes, from the arrival of the raw materials to the stocking of finished products. The Technical Materials department is also introduced, as it provides all necessary equipment and spare parts for the functioning of the productive process, as well as for all required maintenance.

3.1 Primary

The Primary department is responsible for the processing of tobacco leaves, and the mixing of those leaves to create the different tobacco blends. These blends are specific for each brand of tobacco, as they determine the flavour of the cigarette when it is smoked. Therefore, the primary department has to maintain a constant monitoring of variables such as humidity and temperature during the whole process. Slight variations in these parameters implicate noticeable alterations in the tobacco flavour, hence the placement of control systems along the equipment used for this production stage.

Tobacco leaves arrive at Tabaqueira from the leaf warehouse, after having already undergone a process of aging and drying. They are separated according to their nature. There are four main types of tobacco leaves: oriental, burley, dark, and virginia. The latter is presented in Figure 8 as an example of the utilised raw materials for the production of cigarettes.

Figure 8 - Virginia Tobacco Leaf

Source: http://www.hrvatskiduhani.hr/eng/grafike/slike/srednja-galerija/list-duhana-virginia.jpg

After the sorting upon arrival, the leaves undergo a humidification process. They are stored in silos, where the different types of tobacco are pre-blended. The heavier particles are separated from the tobacco mixture, so as only the desired ingredients are kept. Before the end of the process, the tobacco undertakes a final process to improve its flavour and humidity, so as to allow for a smoother cutting process. The tobacco then undergoes a final blending, and is cut to its final form. Thus is created the finished product of the Primary production cycle: the cut filler. The cut filler is the tobacco on its final form, ready to fill the cigarettes. Part of the cut filler produced at Tabaqueira is exported to other tobacco factories. The other part is sent via vacuum tubes to the Secondary department for cigarette production.

3.2 Secondary

The Secondary department is responsible for receiving the cut filler and produce the cigarettes, packaging them appropriately for distribution. For this, the Secondary uses what are called link-ups (LU). Link-ups are two productive sets, one designed for producing cigarettes, and one for packaging them, which function as a whole, forming a single LU unit. The production of cigarette filters is also encompassed in the secondary activities.

When the cut filler from the Primary arrives to the Secondary, it is received in a LU. There the cut filler is disposed on a continuous stream of smoking paper, forming a tube of smoking paper with cut filler. During this process an electronic system controls the input of tobacco, thus guaranteeing that the cigarette extremities are the areas with the bigger amount of cut filler. The continuous cigarette tube is then cut in pieces, with the size of two cigarettes. These pieces are cut once more in half, and a filter is inserted at the end of each cigarette.

The filters arrive to the Secondary automatically via a pneumatic system, directly linked to the filter production facility. The filters are added to the cigarettes with the help of tipping paper, which makes the cigarette mouthpiece. The process of adding the filter and the tipping paper joins two cigarette pieces, so they must again be cut in half. The finalised cigarettes are then rotated to assure that all cigarettes have the mouthpiece facing the same direction for packaging.

The finalised cigarettes are then sent to packaging or put on hold in a buffer. At the packaging area, the cigarettes are wrapped in an aluminium paper called the inner-liner. If they are being packaged in hard packs, an inner-frame is also added. They are then automatically stored in packs, which are wrapped in a polypropylene film. The packs are then packaged in volumes, and these volumes are sent to the case packer to be stored in cardboard boxes and sent to the Finished Product Warehouse to await distribution.

A cigarette pack can be soft (made out of paper) or hard (made out of cardboard), and it can hold different quantities of cigarettes. Not all LU are set up to process every type of packs. Therefore, a careful planning of production, taking into account the different brands and quantities to be manufactured over the week, is essential to avoid unplanned stops or stocked product shortages.

3.3 Technical Materials Department

The technical material department is in charge of running Tabaqueira's warehouse. This means managing over 8.000 Stock Keeping Units (SKU), and 4.000 additional materials that are not kept in stock, but may be ordered for supplying the productive and maintenance departments with the necessary spare parts.

This department is in constant dialog with the procurement department, as all spare parts purchases are communicated to the technical material department, but must be processed by the procurers. Moreover, establishing new inventory management systems or implementing new protocols with suppliers are processes that involve both departments. This happens as inventory management and technical aspects must be taken into consideration, as well as financial and quality issues.

And as Tabaqueira is constantly growing and expanding, often obsolete productive equipment are discontinued, and new machines are installed in the productive areas. These processes involve the introduction or removal of materials from the system. When new

materials need to be acquired, suppliers must be consulted, lead times, and prices established. This is a cooperative process between the two departments.

Therefore, considering that this dissertation is based on the procurement department, which cannot be disassociated from the technical materials department, this brief introduction of the latter was considered relevant.

4 Presentation of Problems and Solutions

The subject of this dissertation is the application of process improvement in the procurement department of Tabaqueira. As it was mentioned earlier, Tabaqueira has a very well defined structure, rooted in a fully parameterised ERP system. Therefore, it is not feasible to implement any radical change. However, this does not contradict the purpose of process improvement, or even more so, continuous process improvement, where the achieved improvements are not originated in a big successful change, but in achieving small improvements over time. These small improvements, when put together, will lead to an overall improvement with significant impact in the organisation. Considering the incremental nature of these changes and improvements, three problems were selected to be studied and potentially improved.

The first selected problem is the lack of standards in the procurement department. This was a concern that had already been expressed upon the auditing of the procurement department processes by Tabaqueira. In a department that is constantly working with other departments, exchanging information amongst people from the most diverse areas, the existence of standards is essential. This happens not only from a record-keeping point of view, where all existent records should be kept in an ordered manner, but also from the point-of-view of exchanging information in a simple and effective way with people that may not be aware of the full extent of the process. Moreover, the procurement department continuously interacts with external entities. This implies the following of specific PMI rules, based on its Practices & Principles. Legal and security issues must be taken into consideration at all times. As such, a standard that allows mapping out a process, providing its status at any given point, and notifying the user about the necessary considerations for further steps brings about an obvious benefit.

The second problem is the systemisation of the process of creating purchase orders. As it can be inferred from their name, purchase orders are part of the daily business of the procurement department, particularly the ones for spare parts. These orders are requested from every productive department in the company, and have the most varied configurations. A purchase order can be routine, i.e. an order for a material which is frequently bought, or it can present the need for a new material. It can also have different degrees of urgency. As the process of creating a purchase order is extremely complex and time-consuming, it makes sense to try to improve the process for those orders that are more ordinary, so as to free up more time to manage the unusual and/or urgent requests. This problem can mainly be addressed by taking advantage of the advanced and highly customised ERP system implemented at all PMI affiliates, either via the implementation of EDI protocols or by simply automatising the process further.

The third considered problem is related to inventory management, and the reduction of workload necessary for the purchasing of materials, particularly those which are consumed frequently but are low-value. Every purchased material must undergo the same procurement workflow, independently of cost. This often means that the workload necessary to process orders for minor materials, such as screws or bearings, presents a higher cost to the company than that of the materials. The implementation of new inventory management systems, such as a consignment protocol, where the supplier is responsible for the processing workload is an apparent solution to this problem. Associated with this protocol is the increasing focus of Tabaqueira on using consolidators, i.e., suppliers IR that offer a wider range of materials.

Also, the employment of a kanban system presents a solution for a quick visual management of stocked materials, diminishing the need for constant controls, which imply more workload.

Considering the differences between the three projects, a problem/solution description, for each project, has been adopted, as it has been considered to be clearer than an all-problems description followed by the all-solutions description. This will provide the reader with a straightforwardly comprehensible flow of information, so as to better grasp the proposed solutions to the addressed problems.

4.1 Lack of Standards in the Procurement Department

4.1.1 Problem Description

As stated earlier, this first problem addresses the lack of standards in the procurement department. Although standard documentation is necessary for every process, the process which is considered in this dissertation is the negotiation process for the providing of a new service by an external entity. This is a process that occurs often, as it can be required by any department in Tabaqueira. The services provided can be simple, such as auditing the electrical installations of a warehouse, or more complex, such as redesigning and reconstructing a set of offices. However, no matter their complexity, negotiation processes are all based on the same workflow, allowing, naturally, for several variations, namely in the required documentation.

When a need for services provided by an external entity arises in any of Tabaqueira's departments, it is the responsibility of the procurement department to lead the negotiation process. During every stage of this procedure the procurement department must follow PMI's practices and principles. Keeping accurate records and following the existing guidelines becomes of essence.

A process to establish a new contract, as described below (Figure 9), begins when a department states the existence of a need that must be met.

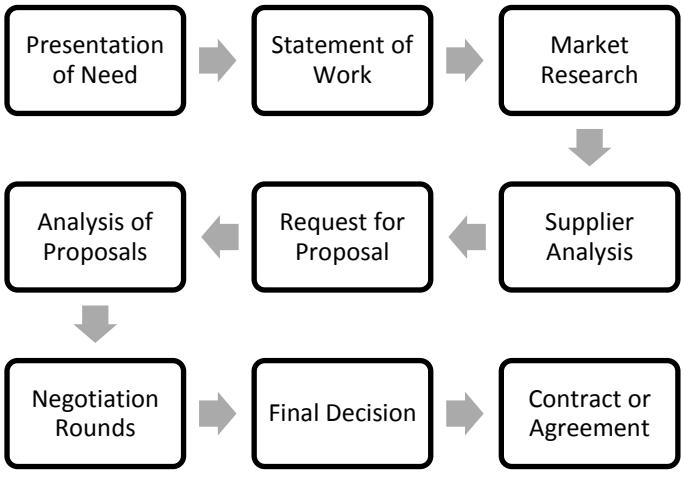

Figure 9 - Negotiation Process Workflow

The nature of these needs is most varied, ranging from consulting, to engineering, human resources or even translation services. Nevertheless, independently of the nature of the desired service, the requesting department must supply the procurement department with all the relevant and necessary information, which must be presented through a unified document, commonly denominated statement of work (SOW). The SOW must clearly specify the

expected deliverables for the project. The accurate description of these deliverables is particularly relevant, not only so the external companies can provide a precise description of their proposed services and budget, but also to guarantee that the comparison between different proposals is viable. Other information, such as the scope of the work, locations, timelines, standards and security issues is also often included in this statement. All presented information is also the base for future analysis of proposed services and their respective quality.

Based on the information provided and with the help of the requesters, the procurement department then begins a market research to establish possible suppliers for the service in question. This market research can be based on different sources: previously consulted or contracted entities, entities that were suggested by other affiliates, or any other companies whose area of business is related to the required service. The market research is complemented by the sending of a Request for Information (RFI). The RFI provides the procurement department with important information to better understand the business scope of the contacted company, as well as its spread nationally and internationally, the dimension and variety of its workforce, and naturally its financial situation. From the information gathered the procurement department, along with the requesting department, elaborate a shortlist of the suppliers to be consulted to provide the service. If deemed necessary, all contacted companies can be added to the shortlist.

The shortlisted suppliers are then required to sign a confidentiality agreement, keeping in line with PMI Principles & Practices for the procurement department. This agreement is of essence, as the information provided to the suppliers is not to be shared, especially considering the existing competition between the three major Tobacco companies. After signing the aforementioned agreement, the suppliers are then provided with the SOW and other relevant material, in order to submit a proposal and a quotation for the specified project. All proposals are then analysed and compared taking into consideration both technical and financial criteria. All internally involved parties are consulted for the comparison and analysis of proposals. The decisions taken during the process always gather the consensus of both the requesting and the procurement departments. After this analysis, further negotiations are undergone, not only for financial aspects, but also for technical aspects of the service. Until an agreement is reached, several rounds of negotiations can be required. Each different round can imply further short-listing of suppliers. At the end of negotiations deliverables and parameters for the evaluation of the quality of the service are clearly established, and mutually agreed upon by Tabaqueira and the selected supplier or suppliers. The process is finalized with the signing of a service contract or agreement.

For every stage of this process, several documents are needed to support each procedure and decision. Even the simpler projects require over a dozen documents, many of them of a legal nature, such as a contract draft, security protocols that must be followed at Tabaqueira, and required certifications. And each type of contracted service requires a different set of documents. A request for an information technology service is different from an engineering or construction service. Both have particular documents that must be filled by or shared with the supplier. Some documents, such as the ones required to open a new vendor for Tabaqueira, are required for internal use. These documents are usually transversal to all negotiation processes.

As it is evident from the description above, the complexity of the information flow becomes a considerable obstacle to a linear and flawless process. The lack of an existing

standard in the procurement department to easily identify each step of the process, along with the needed documentation, implies an unnecessary workload for the purchasers. This means that to understand the status of the process it is necessary to go through the exchanged correspondence with suppliers, and through the employed documentation. This understanding is complicated further when the person consulting the process is not from the procurement department, as access to procurement correspondence and documentation is restricted, and sharing all the existing information is not easily feasible. Hence the need for a single document which summarises all necessary steps and documentation in a negotiation process, presenting the current status of the process as well as further steps.

Another evident flaw in this procedure is the absence of a document that accurately portrays the different steps of the process and the decisions that were made. Such a document would facilitate explaining the process to any person that was not involved in the negotiations. This is particularly useful when presenting a project to senior management. The nonexistence of these standards leads to having the needed information and documentation scattered across different files. As described above, without this document integrating all information, the current development status of a project is assessed based on exchanged correspondence and saved documents, originating the necessity for non-value-added activities, such as going through several files, searching, reading, sorting and summarising. A single unifying document representing major decisions along the development of the process would eliminate the need for such activities, thus freeing work hours for other more relevant undertakings.

In conclusion, the problem of lack of standards in the procurement department leads to several disadvantages, the main one being the use of the scarce work hours for non-value-added activities of searching and sorting. Another obstacle that can be overcome by dealing with this problem is the difficulty in transmitting information to persons outside the procurement department.

4.1.2 Proposed Solution

Considering the shortcomings of not having standards in the procurement department, as described above, it is evident that the creation of documents that provide the necessary clarity and information to the negotiation process must be the focus of the proposed solution. Therefore, to overcome this lack of standard documentation, two main documents were created. The first one addresses the complexity of the negotiation workflow, along with its different steps and documentation needed to support them. This document will allow any person to quickly grasp the status of the process, the next steps, and the needed documents. By doing so, the document will provide a check-up tool, ensuring that the process is linear and flawless in what concerns the utilisation of the correct documentations, as well as the compliance of PMI's and Tabaqueira's Practices & Principles. The second document addresses the multitude of documents and information associated with any process. This document proposes to integrate all information in a single easily readable file. By using this document, all information and important decisions taken during the negotiation process are available to be presented to any person with an interest in the process.

Document One – Checklist

As stated above, the first developed document was created to represent the process workflow, as well as the current state of that same process. With different negotiation

processes, spanned over five different service categories (logistics, professional services, information systems, facilities, and fleet and travel), the developed document had to accommodate this complexity, in an effective but flexible manner. Therefore, a main document was created where all the existing steps and documents, for every single process, were listed. Based on this list, it was possible to identify for each of the different processes which steps and documents were applicable, and which were not. The representation of this information crossover was established through a spreadsheet table, exemplified on Figure 10. This system is easily understandable: Each process type is catalogued under its category, and the application of a step or document to that given process is indicated through the use of an "X". This file is also flexible, as the addition of new steps, documents, categories, or processes is achieved through adding a new line or column, without implying any further change.

	Category 1		Category 2
	Process Type 1	Process Type 2	Process Type 3
Step 1	X	X	X
Document A	X	X	
Document B		X	
Step 2	X		X
Document C	X		X
Step 3	X		

Figure 10 - Process Types Listing

Based on this document, a VBA program was conceived in order to create a checklist for a specific process. Therefore, each time a new process is underway in the procurement department, the responsible person just has to run the program, and select the adequate category and adequate process type. By doing so, a new checklist is created, portraying only the needed steps and documents for that particular process, in a chronological order. This checklist is then used throughout the process, so as to control its progress. The utility of this checklist resides not only on allowing to check the status of any process, but also of ensuring that none of the required steps are skipped or the necessary documents overlooked.

On the checklist, simplistically represented on Figure 11, the visual representation is straightforwardly grasped: For the on-going process, the first step was already completed, and "Document A" was already filled. The next step will be "Step 2", for which "Document C" will be necessary. The process will be finalized once "Step 3" is completed.

CHECKLIST – Category 1 – Process Type 1	
Step 1	X
Document A	X
Step 2	
Document C	
Step 3	

Figure 11 – Representation of Checklist

This simple representation will reduce the necessary workload to keep track of the different on-going processes. It will also contribute to the flawless development of any process. This is of essence, as forgetting a document such as a confidence agreement can have dire legal and financial repercussions. Furthermore, any person, even if not directly involved in a given process, can understand not only the current status, but also the next stages to be undergone.

Document Two – Integrative Document

The second created document, entitled "integrative document", was a document whose existence was already contemplatfied in PMI's Practices & Principles. It is an ordinary spreadsheet file with different fields that must be filled in by the procurement department during a negotiation process. The objective of this document is to ensure that all relevant information and decisions related to a given negotiation process are presented in a single document, which can be readily read and understood by any person inside Tabaqueira, regardless of their involvement in the process.

To develop this document, firstly all existing documentation was analysed, especially the one describing the negotiation process workflow, presented on Figure 9. Secondly, all the members of the procurement department were interviewed, so as to clearly define the user requirements. These requirements were primarily focused on two aspects: clarity and simplicity. On the one hand, this document should clearly state every relevant decision taken during the process. Amongst these decisions are the decision to start the process, and the final supplier selection decision. The reasons stated by the procurement and the requesting department for the different decisions made along the process should also be specified in the document. On the other hand, the document should not be too extensive or use complex terminology. A person from any other department should be able to read the document and fully grasp its content. The main advantage of this aspect is the presentation of a given process to either senior management, or to share information with other affiliates undergoing similar processes. When audits occur, such a document also facilitates the task of confirming that the process was developed according to PMI's Practices & Principles.

Based on the defined requirements and other existing documentation, the negotiation process was divided, for the purpose of creating the document, into the following stages:

Initial Request

The requesting area states an existing need for a particular service. This service must fall into one of the five existing categories: logistics, professional services, information systems, facilities, and fleet and travel. At this stage the procurement department attributes the process to a project owner from the requesting department. An original budget and a target cost are defined, based on the annual budget of the requesting area and the service in question. The criticality of the service to Tabaqueira's daily business must also be established, based on a scale of three values: low, medium, and high. This criticality score, along with the original budget, defines the level of approval needed for the fulfilment of the service. For higher criticality and budget values, higher hierarchical levels of management have to approve the project.

Request for Information (RFI)

After a market research, a list of possible suppliers is created. A Request for Information (RFI) is then sent to these suppliers, so as to acquire relevant information. This information is

used to establish the possible fit between the supplier and the service in question. Criteria such as workforce dimension, company presence nationally and internationally, turnover, financial risk level, and project portfolio are considered. Based on the data gathered from the RFI, a first evaluation of suppliers is conducted, involving the procurement and the requesting departments. From this first analysis, some suppliers might be eliminated, thus establishing a first shortlist of suppliers.

Request for Proposal (RFP)

The suppliers which were selected based on the RFI are supplied with a Request for Proposal (RFP), with all necessary information to submit their bid. These proposals must specifically describe all steps of the process and every detail that is to be accomplished by the offered service. They are then analysed by both the procurement and the requesting departments, so as to evaluate both technical and financial aspects of the proposal. After the initial proposal, several other negotiation rounds may be necessary, leading to new proposals. At any moment, the list of suppliers can be further shortlisted.

Final decision

The final decision is based on the information gathered during the entire process. It is a joint decision, gathering consensus from the procurement and requesting departments, and it must be justified both financially and technically. With this decision, one or more suppliers are selected to execute the project. The process is completed with the signing of a contract or the establishment of an agreement. The cost of the contract is allocated to the cost centre related to the requesting department.

Based on this division of the negotiation process into four clearly defined steps, a first draft of the document was created, summarizing all relevant information for each stage. With final feedback from the procurement team, adjustments were made so as to facilitate reading and ensuring that all relevant information was available in the same document.

The finalised “integrative document” consists of a spreadsheet divided into four main sections: Initial Request, Request for Information, Request for Proposal, and Final Decision. For each section, there are fields that must be filled by the procurement person responsible for the project, stating all relevant information for the process in a clearly visible and defined fashion. The comparison of proposal values from different rounds with the original budget and between each other is calculated automatically, thus facilitating filling the fields and diminishing the possibility of human mistakes. The document final section clearly states the final decision as well as the reasons that fundament it.

This final version of the new “integrative document” was approved and submitted to PMI’s quality system. With the introduction of this document into the quality system and into the procurement practice of Tabaqueira, any negotiation process will now be clearly represented in a single document, thus achieving a higher level of process transparency across departments.

4.1.3 Conclusion

The creation of these documents allows for a more controlled and linear process, diminishing the necessary workload and providing an easier access to information, both to the persons involved in the process, but also to those who are not directly implicated by it. It also elevates the quality standards of the procurement department, and facilitates the flow of information. By doing so, the possibility of flaws is also significantly reduced. Although

quantitative results following the development and integration of these two documents in the procurement department cannot be gathered, as the implementation of these new documents is still recent, qualitative results such as reduced workload and improved information transparency are apparent.

4.2 Purchase Orders Processing

4.2.1 Problem Description

One of the first problems which were identified in the procurement department was the lack of automatic procedures in the ordering process for frequently used technical materials and equipment. This process can be very complex, as it occurs across different departments. To better understand this complexity, the flowchart in Figure 12 explains the different steps from the identification of a given material need to its reception in the warehouse.

The procurement process for spare parts starts on the ERP system, by running the MRP (Material Resource Planning), every day for planned stock (materials which are kept in the warehouse) and twice a week for unplanned stock (materials which are usually not kept in stock). The MRP identifies material needs recorded into the system by the different productive areas and compares them to current stock levels and previous recorded Purchase Orders (PO). It then creates a planned order for the material when the following is true:

$$CS - CN + PO < ROP$$

where CS is the current material stock level, CN is the quantity of current material needs, PO is the quantity of material that was ordered but is not yet in stock, and ROP is the Reorder Point.

As it can be established by the inequation above, the Reorder Point (ROP) is the level of inventory that defines when an order to a supplier should be made. The quantity of material to be ordered is calculated in order to guarantee an established minimum stock level, whilst taking into account delivery lead times.

After running the MRP, the Technical Material Analyst must analyse each planned order (which consists of a material number and an order quantity), and confirm its relevance. After being approved, a planned order becomes a Purchase Requisition (PR). If the material in the PR belongs to an established EDI (Electronic Data Interchange) protocol, the process skips several steps and becomes simpler: The system converts the PR into a PO and sends it to the vendor via the ERP system. However, only 43% of the PO are associated with an EDI protocol. For the remaining materials the process is more time-consuming. In this case, after its creation, the PR is sent to the procurement department.

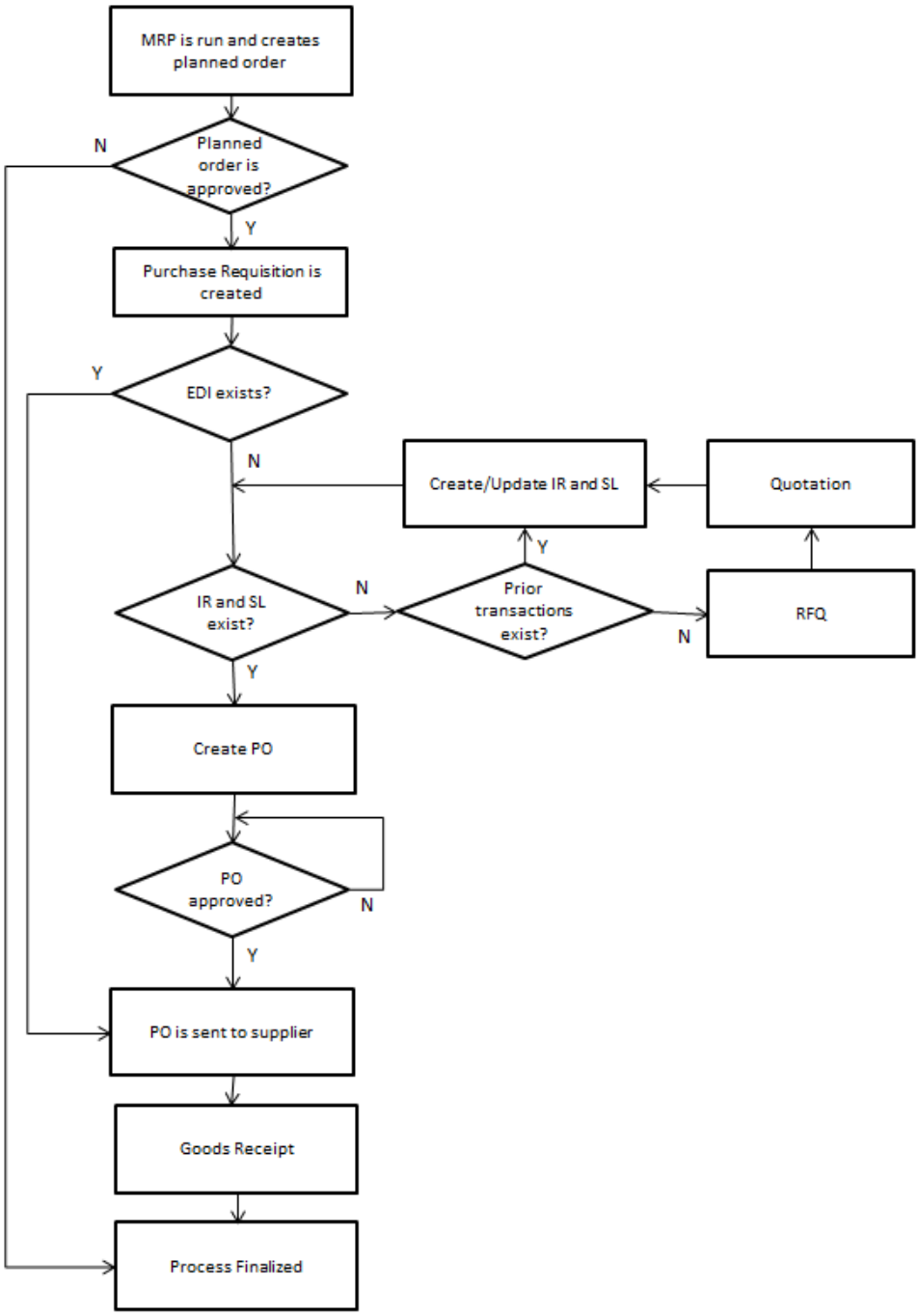

Figure 12 - Purchase Order Workflow

The procurement department is responsible for creating Info Records (IR) and Source Lists (SL) for each material on the ERP system. These are two functionalities of the ERP system used to associate a price, a standard order quantity, a delivery lead time and a vendor to each material. If these IR and SL exist for the material on a given PR, the system fills all the necessary fields when creating a PO, or, if that material is parameterised for automatic creation, the system automatically creates the PO from the PR. The purchaser only needs to check the data and approve the PO.

However, sometimes these records are non-existent, because IR and SL are not updated or because they were never entered on the system (either by human flaw, or because the material was never ordered before). When this happens, the vendor and price of material can often be established based on prior transactions. If this is the case, the material's IR and

SL can be created, and the process resumed. (The system also allows for manual PO creation without IR or SL, but this is a shortcut in the established workflow, and should be avoided, as it propagates errors over time). If the purchaser has no information regarding prices and lead times available for a given material, he has to create a Request for Quotation (RFQ), send it to the supplier(s) and wait for an answer. When the vendor sends the quotation, all data should be entered into the system, so that subsequent PO can be created automatically.

After a PO is created by a member of the procurement department, it has to be approved by the Technical Materials Analyst and, eventually, further approvers, depending on the requesting department and the PO value. After all the approvers have checked and confirmed the PO, it is then considered "released". It is again the responsibility of the procurement department to send the released PO to the vendor. The vendor is then accountable for delivering the material to Tabaqueira's Technical Materials Warehouse (TMW), according to the established delivery time. The delivery is completed when a TMW operator inserts the Goods Receipt (GR) on the ERP system.

By analysing this process, it is evident that the introduction of automatic procedures, such as the implementation of EDI protocols, and the maintenance of up to date information in the system provide useful shortcuts in a complex system. These steps can significantly reduce the necessary workload to order a given material. However, to achieve this higher level of simplicity there are considerable hindrances that need to be overcome.

4.2.2 Proposed Solution

EDI Implementation

As it is clear from the workflow above, establishing an EDI protocol with the supplier reduces the complexity of the process significantly. However, there are certain requirements for achieving this type of protocol. Firstly, the supplier must have a compatible type of ERP system and EDI protocol. This eliminates the possibility of establishing an EDI protocol with most of the local suppliers, as they are Small and Medium Enterprises (SME). This means that often ERP systems are either not being used or do not have the necessary modules implemented. Furthermore, an EDI transaction has an associated cost. Although this cost was significantly reduced with the expansion of the internet, it still exists, making it a non-profitable solution for companies with smaller margins, as is often the case for SME. Secondly, the list of materials, and their prices and lead times, to be purchased via EDI must be mutually agreed by both parties. Moreover, emergencies for materials cannot be dealt with via EDI, as the ERP systems only runs once per day. Often emergencies must be dealt manually, relinquishing the automatisms of EDI. Finally, the necessary system changes and configurations must be entered into the system to accommodate this new trading method.

Taking into consideration the statements above, Tabaqueira focused on implementing EDI protocols with its international suppliers. These companies are multinationals, with their businesses processes designed to accommodate purchases via EDI. The establishment of these protocols with two new suppliers is one of the main objectives for the procurement department in 2013.

This implementation of EDI involves a careful selection of quality parameters required from the supplier. Since the information generated by the system is directly sent to the supplier via EDI, Tabaqueira's technical material department and procurement department relinquish part of their control over the transactions. As such, it is important to make sure that

all materials have well defined lead times that need to be respected by the suppliers. The establishment of a trust partnership between buyer and supplier is therefore of essence when establishing this type of protocol.

Moreover, the process of implementing EDI involves an extensive involvement of the information systems department, not only from Tabaqueira, but also the global department from PMI. Specific parameterisations for the system need to be established by the central department in Poland. This requires a careful and considerate exchange of information between all involved parties, to assure that every required configuration is in place. To make sure that this is the case, the implementation undergoes a phase of trial and error, sending test purchase orders to find possible flaws in certain parameters, both in Tabaqueira's system and in the suppliers system. Only when both systems are fully parameterised and 100% compatible, i.e. the test PO are sent successfully, can the EDI begin.

As several international suppliers have established partnerships with more than one PMI affiliate, exchanging information with departments that have successfully established EDI with a given supplier is often a source of support for Tabaqueira. At the time of writing, the implementation process of EDI was reaching its final stage of testing PO. The deployment of EDI with these two suppliers has an estimated result of increasing automatic orders by 5% to 8%, thus reaching a level of 50% of transactions achieved through an EDI protocol.

As it can be understood from the expected result, implementing EDI protocols can have an important impact on the automatic creation of PO. This represents a sizeable step in diminishing the workload for creating purchase orders, as it skips three to seven steps in the ordinary workflow. However, as mentioned above, it is not currently possible to establish EDI with all suppliers. Therefore, another method that can be applied is to explore the full potential of ERP systems, as explained in the next section.

Automatic Purchase Orders

If material records are accurately kept, the creation of a PO from a PR can be simplified or even become an automatic process. To automatically create a PO from a PR using an existing ERP transaction, three key aspects are necessary: the material must have an up to date Info Record (with information on lead time, standard order quantity, and price), the material must have a valid Source List (indicates which vendor is fixed to a given material), and the material must be parameterised for automatic creation.

The first two aspects, up to date IR and SL are achieved if a constant maintenance of data is implemented in the procurement department. This implies that every time a new quote is received for a given material, the procurer has to create or update its Info Record and its Source List. When the material has the correct information it can then be set to "automatic PO". If this parameterisation is active for a material, a simple transaction on the ERP system automatically converts all PRs for that material into PO, with information on price, supplier and lead time. The only actions then needed to be undertaken by the procurer are the verification and approval of the created PO.

Given the evident benefits of precise record keeping, a process of permanently adding new information into the ERP database is being institutionalised in the procurement department. This is achieved by setting the system to not allowing the manual creation of PO if the IR and SL are not up to date. Maintaining accurate information becomes compulsory. Succeeding the input of new information, when there are new implemented changes, these

must communicated to the technical materials department, in order to parameterise these additional materials for automatic PO creation. By maintaining this process, over 700 materials are, at the time of writing, set for automatic creation. For each material the time required to create a single PO is reduced to 10 seconds, when initially it could take 1 to 10 minutes, depending on the number of lines associated with the purchase order.

4.2.3 Conclusion

By implementing both these processes, EDI implementation and parameterisation of material to automatic PO creation, the workflow required for converting a purchase requisition into a purchase order is considerably simplified. This frees up work hours for the procurement team to spend in more relevant matters, while ensuring that the quality and speed of response for placing PO is kept, if not improved. Maintaining these two processes in place, and further developing them, is an objective of the procurement department that is still on going. But the results are already apparent when comparing the time taken to create a PO manually and the time necessary to do the same operation when the material is set for EDI or automatic creation.

4.3 Inventory Management

4.3.1 Problem Description

At Tabaqueira the number of SKU, Stock Keeping Units, in stock reaches 8.000, plus another 4.000 units that are not usually kept in stock. And this is considering only indirect materials, such as spare parts, as the raw materials needed for production are purchased globally by PMI. The task of managing this inventory is the responsibility of both the technical materials department, which must control and inventory each single material, keeping track of needs and consumption, and the procurement department, which is responsible for every purchase of new materials.

It is possible to categorise these materials by several parameters. But two that are of particular interest are rotation and cost. Many materials of frequent consumption have a negligible cost when considering the total annual purchases. Materials that commonly fall under this category are fasteners, bearings, and retainers. The unit costs for these items do not have a significant impact on the annual budget, independently of how frequently they are needed. And these are materials that are necessary every single day, as they are used in all equipment used in both productive processes of Tabaqueira: Primary and Secondary, as well as in the repairs and preventive actions undergone in the maintenance department.

However, the workflow for purchasing these materials is the same as the one for all the other materials. And the necessary workload for receiving the materials from the suppliers, acknowledge their entry in the warehouse in the ERP system, and placing them in the correct storage compartment, as well as registering every time that a material is consumed by one of the productive areas, is no different either. Therefore, the cost of the workforce necessary for maintaining and managing these materials is often superior to the cost of the materials themselves. And giving the multitude of tasks that are under the responsibility of the technical materials and procurement departments, freeing up time of personnel brings about obvious advantages.

Another inventory problem that impacts the procurement department is the complexity of the productive process at Tabaqueira. This complexity is intensified by the specificity of

the Tobacco industry. The productive equipment for the tobacco industry is very complex and industry-specific. And as Tabaqueira is the only tobacco factory in mainland Portugal, acquiring the necessary spare parts for the equipment is often a time consuming challenge. This happens as the number of different SKU that are used in the productive equipment is extremely high, representing the vast majority of the materials kept in stock. And several of these SKU are slow moving, which means that they are only consumed often no more than once per year. But every time there is a need for a given material, all the necessary steps for creating the PO must be followed. And this means finding the correct supplier, which is not always a straightforward task. Moreover, managing different suppliers for different materials – particularly for low-value or slow-moving materials – requires an increased effort from both departments. The procurement department must keep all legal documentation up to date, as well as information of financial and transactional conditions. The technical materials department has a larger number of suppliers to go through when in search for a supplier for a given material. All in all, successful Supplier Relationship Management (SRM) becomes more difficult as the number of suppliers increases.

The problems explained above can be managed through the implementation of different solutions, ranging from the implementation of new inventory management methods, as well as new visualisation systems for consumption, that do not imply inserting every transaction manually into the ERP system. The use of consolidators, suppliers that offer a wide range of materials, also brings about time savings in the processing of orders and search for new materials. This specifically addresses the last stated issue, although indirectly helping the implementation of the new solutions stated at the beginning of the paragraph.

4.3.2 Proposed Solutions

As stated in the previous section, three main solutions are proposed for the inventory management problem. Firstly, the implementation of consignment for certain materials is studied. Secondly, a new visual management method for managing material consumption is analysed. And finally, the use of consolidators to improve SRM and diminishing the workload for the purchasing of commonly used materials is examined.

Consignment

As explained in the literature review, with a consignment system the supplier owns the consigned material, but keeps it in stock at Tabaqueira's facilities, more specifically in the technical materials warehouse. This system brings about multiple advantages for Tabaqueira. Firstly it removes the costs of over stock. This means that more materials can be kept in the warehouse, without Tabaqueira incurring in any of the holding costs. By doing so, a higher margin when calculating security stock is allowed. This reduces the risk of downtime caused by lack of spare parts in the warehouse. Secondly it simplifies the workflow for creating purchase orders. As the consignment system is based on a mutually established agreement, all materials and prices are fixed for the consignment vendor. This means that the creation of purchase order for consignment is automatic. This purchase order does not represent the materials that are needed in the future, but the materials that were consumed over the established period for replenishment.

With the implementation of consignment, it is necessary to establish the restocking frequency and the standard stock. At Tabaqueira the restocking period established for the suppliers with whom a consignment protocol is implemented is one month. This period was

empirically determined, as it is one that occurs frequently enough to ensure that the risk of stockouts is minimised, but also one that does not require a constant monitoring of materials, thus implying extra workload. This means that every month it is necessary to determine which materials were consumed and in which quantities. The supplier is then notified and proceeds to replenish the inventory with the indicated quantities.

Considering that the used material is checked on a monthly basis, the established quantities to keep in stock for each material are fixed at a three month supply. This means that the initial stock of materials is sufficient to ensure the average monthly consumption for three months. Although this may seem an ample security margin, in practice it is not so. When the order for restocking is issued, one month of stock has already been consumed. And between the order for restocking and the actual restocking of materials, the time equivalent to the supplier's lead time for the given materials elapses. In conclusion, when the restocking of materials is effectively finished, more than one month of materials have already been consumed. This can be understood by analysing Figure 13.

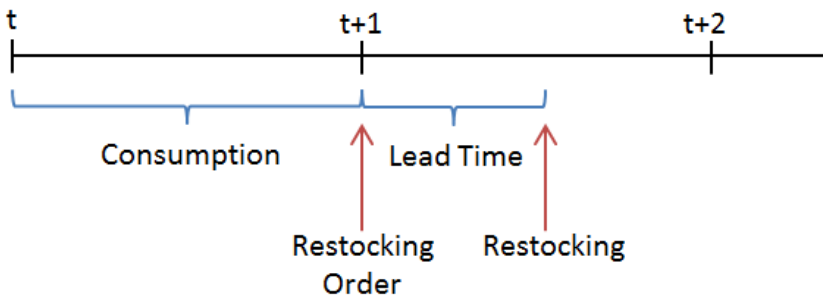

Figure 13 - Consignment Restocking Times

When the restocking occurs, one month plus the lead time have already elapsed, along with their respective consumptions. Therefore, the established quantity of three months of stock represents a conservative but not exaggerated security margin.

The implementation of consignment protocols is indeed a priority at Tabaqueira. However, to do so is not always a straightforward task, as the benefits for the supplier are not always apparent. The main benefit that this system offers for the supplier is the securing of its position as a Tabaqueira supplier. For high rotation items it also presents a method of assuring sales, as Tabaqueira will not look for another supplier, considering it already has the consignment supplier's spare parts in stock.

Therefore, to assure an interesting volume of sales to the supplier, different sets of materials, based on different prices and annual consumption values, were studied for implementing a consignment system attractive for both buyer and supplier. Based on this analysis, the first implemented consignment with local suppliers was based on bearings and seals. Together, these items represent a total of 700 materials, assigned to a single supplier. This volume assures that benefits resulting from the implementation of a consignment protocol are available to both parties.

The current consignment agreements already represent a considerable financial gain for Tabaqueira, and its technical materials department. Furthermore, the implementation of a new consignment for other spare parts, such as electrical or mechanical parts, is currently being considered. This focus on the implementation of consignment not only leads to savings on stock holding costs, but it also reduces the necessary workload for processing purchase

orders, as consignment materials are previously set and agreed upon with the supplier. Therefore, it is expected that with the increase of consignment materials, both the technical materials department and the procurement department will experience a reduction of workload related to the materials that are, or will be, under a consignment agreement.

Kanban – two-bin system

Following the implementation of consignment protocols, another system that presents a satisfactory solution to the inventory management problem is a two-bin system. This system closely follows the concept of kanban.

With a two bin system, each material is kept in stock in two different boxes, containing a predefined quantity of units. The consumption of the material is always made from the first box. When this box is empty, it works as a kanban card. The presence of an empty box signals the need for stock reposition. The second box is then used for consumption, and the empty box is replaced by a new one, with the established quantity of materials.

This system presents a considerable benefit in terms of workload, when it is applied to fast-moving, low-cost materials. When a given material enters or exits the warehouse for consumption, these movements have to be registered on the ERP system. Several materials have such a negligible cost, that the cost of maintaining information on their transactions exceeds that of their acquisition. With a two-bin system, the transactions of the materials are no longer tracked. They are solely based on the consumption of an entire box.

Therefore, to study the implementation of a two-bin system in Tabaqueira's warehouse, the considered materials are the ones that represent a low price, and a high rotation (over 20 units per year). Based on this analysis, screws and fasteners were established as potential candidates for this type of inventory. With the implementation of a two-bin consignment system for these materials, the registered movements on the ERP system can be reduced by 6%. This impact is considerable, given that there are over 20.000 materials registered in the system, as screws and fasteners only represent a fraction of them.

The implementation of a two-bin system then appears as an ideal solution for the stated inventory management problem, as it considerably reduces workload. However, although the benefits may exceed the downsides when considering Tabaqueira's viewpoint on a two-bin system, it does not mean that these are inexistent. When implementing two-bin, the material consumption is only monitored when a box is empty. And this is a visual monitoring, as the material movements are no longer inserted into the system. This presents two disadvantages: Firstly, the absence of control over material movements may lead to the over-consumption of the two-bin materials. On the one side, the requesting departments have less incentive to attempt to accurately calculate their needs, and on the other side, theft of materials is a possibility, since the materials are made available without control. And secondly, several analyses can be established based on the consumption of materials. Particularly considering that most materials are used on repairs and preventive maintenance, their consumption can be used to determine breakdown patterns, or to understand peaks of needs for repairs. Without monitoring the movements, these analyses can no longer be completed.

In conclusion, this less strict control of materials movements presents the main advantage and the main disadvantage of a two-bin system. However, by carefully choosing

the materials to be kept under this system, the advantages overcome the disadvantages. Therefore, the implementation of two-bin is being considered in different PMI affiliates, and is one of the main objectives of the procurement department at Tabaqueira for 2013. The acquired benefits will undoubtedly impact the daily business of the technical materials department and the procurement department, freeing up time for more relevant activities, than tracking low-value materials that do not have an impact on the overall inventory costs.

Consolidators

A final solution presented for the inventory management problem is the use of consolidators. Consolidators are suppliers that provide a wide range of materials. By using consolidators, the main objective is to diminish the number of Tabaqueira's suppliers. This reduces the workload needed for maintaining a vendor database, along with offered materials, prices, and lead times.

Consolidators also present another advantage when searching the market for new materials, as they offer a privileged position in the market to find the necessary products with an attractive lead time. Moreover, by providing a wider range of materials, consolidators automatically achieve a higher turnover from sales to Tabaqueira. This increases their interest in successfully maintaining a working relationship with Tabaqueira. To do so, consolidators often offer better or extra services, such as availability 24/7, or maintenance for the supplied materials.

On the other side, consolidators rarely provide the best available prices in the market for a given material. But the availability of a consolidator, along with level of service provided can justify the increased cost. Especially in an industrial company as Tabaqueira, where the Primary department is working 24 hours a day, seven days a week. Having a supplier available on short notice to provide necessary materials can easily compensate the higher costs, when the alternative can be a machine breakdown, leading to loss of production.

Although the use of consolidators does not directly address the stated inventory management problems, it indirectly affects the proposed solutions of consignment and two-bin. With a consolidator that expects a given volume of sales, negotiating the implementation of consignment or two-bin systems for a particular number of materials is easier, as both parties are committed to maintaining a fully working business relationship: Hence the willingness, from both buyer and supplier, to be more flexible when studying new partnerships or new ways of doing business. Finally, as stated earlier, the wider range of offered materials also diminishes the workload necessary for the procurement department when procuring new or rare materials, for which no supplier was previously established.

4.3.3 Conclusion

The use of consolidators, along with the successful implementation of consignment protocols, and two-bin systems, are powerful solutions to address the inventory management problems. In Tabaqueira all three solutions are currently undergoing implementation, and the results are already noticeable: The workload when processing new purchase orders is significantly diminished, and the positive response of consolidators to daily matters such as new materials or urgent requests is also freeing up time for procurers to focus on other subjects.

5 Conclusions and Future Work

The first conclusions to be gathered from this dissertation arise from the literature review. By studying the underlining concepts to the addressed issues, it was possible to determine that, no matter the viewpoint, an organisation is constantly in motion. This evolution, resulting from the appearance of new technologies, new financial challenges, or simple a need to keep improving, is what motivates the application of continuous improvement concepts.

By studying the role of procurement in an enterprise, or in an industry, the apparent need for constant changes is obvious from an organisational standpoint. As a support activity, procurement must evolve along with all the others, both primary and support. And being involved in the daily business of other departments, improvements achieved in the procurement department will doubtlessly lead to overall improvements. This is what was defined as addressing the whole system of processes, not one single isolated process, when implementing changes and process improvement.

Analysing the story of ERP implementation also provides a glimpse to the dynamic nature of an enterprise. ERP systems have been around for decades, and are still evolving. The introduction of new technologies brings about the implementation of new ERP modules and functionalities. Thus ERP becomes an important foundation for a company's expansion: it provides a solid basis from which new technologies and new capabilities can spawn, while maintaining stable the core business and functions of the company.

The final consideration on inventory management systems, once again, describes an evolutionary perspective. New systems, with the aid of new information technology, are still being developed and implemented. Often not the models themselves, but the reasons behind them change. In the current financial climate where achieving cost savings is key, inventory systems that before were regarded as liabilities, now are being considered advantages. This is the case of consignment protocols, where buyers are relinquishing on direct sales, in order to guarantee their position as a supplier.

The final study on the use of kanban cards for controlling stock provides a different view on process improvement: it shows that simplicity can bring about considerable savings. A simple methodology, with a low or inexistent inherent cost, can provide a visual and effective solution to a complex problem. And although it was created thinking on a productive environment, with work in progress and finished goods, kanban systems can be applied in other areas, as is the case in this dissertation.

This focus on evolution and simplicity, intrinsic to the application of process improvement, was the basis of this dissertation, along with the addressed problems and proposed solutions. Therefore, after analysing the theoretical background, it is necessary to draw conclusions from the practical issues as well.

By analysing the existing processes in the procurement department and selecting three of them for further analysis, it was possible to understand that process improvement is always possible. Even in a company with well-defined processes, established boundaries between departments, and an intensively and accurately configured ERP system, there is always room for small improvements. And it is the sum of all small improvements that leads to the maintenance of a constant state of continuous improvement.

In this dissertation three main problems were addressed. For all of them the current state was mapped out, and solutions were suggested in order to achieve a desired future state.

The first addressed problem was the lack of standards in the procurement department. This existing flaw led to overwork and a dispersion of relevant information across different files and locations. By addressing this issue with the implementation of two simple documents, providing standards for the development of negotiation process, it is possible to significantly simplify the tracking of process status. The possibility for human flaws, often ones leading to legal considerations, is reduced with the application of the designed documents. This problematic serves to illustrate that simple solutions can have a considerable impact on an existing problem. It also exemplifies the importance of standards in maintaining linear processes and accurate information.

The second addressed problem was the time-consuming process of creating purchase orders. Taking into consideration that systems were available to systematise the process, the presented solution is based on analysing possible configurations of the system, and apply them to the broadest number of cases. This is another good example of small progressive changes that have an impact in the overall result, in this case, in the overall degree of process automatisation. Successfully solving this problem leads to a diminution of unnecessary workload, used for developing non-value-added activities.

The third problem was the application of inventory management solutions for the storing of spare parts in the warehouse. The first considered system is a consignment protocol with suppliers. Through the establishment of a consignment partnership the material is kept in stock at the buyers facilities, but is owned by the supplier until the moment of consumption. This brings about significant financial advantages as Tabaqueira has the material available at any time without incurring in any of the holding costs. The second solution is the implementation of a two-bin system, where the replenishment orders are based on the existence of two boxes of materials. When one of them is empty, a replenishment order is issued. This system has a disadvantage of not allowing the control of material transactions. But this is also its main advantage as it diminishes workload. The main issue that is presented with this solution is achieving a win-win solution with the supplier. For solving this, the use of consolidators presents itself as an answer to be considered. However, as implementation of consignment and two-bin at Tabaqueira is still underway, the final results can only be analysed in the future.

In conclusion, all three problems addressed the implementation of process improvement, through the dialog with other involved departments. The involvement of the right persons is essential when establishing an improvement plan. Considering the Plan-Do-Check-Act cycle, the proposed solutions are still at the early phases of Plan and Do. However, with the process improvement culture at Tabaqueira and the involvement of different people, the future results will surely support the expected improvements from the proposed solutions.

For future works, it is important that the Check and Act parts of the cycle are not forgotten. New problems and unexpected results are bound to arise. It is necessary to evaluate them, study new plans and implement new actions. This is the core of process improvement. And these small improvements over time, and across departments, will undoubtedly lead to significant organisational level improvements and positive results in the long run.

6 References

Agi, Maher, Ballot, Eric and Molet, Hugues. 2005. *"100% EDI-Connected Suppliers" Projects: An Empirical Investigation of Success Factores.* s.l. : Journal of Purchasing & Supply Management, 2005.

Almehdawe, Eman and Mantin, Benny. 2010. *Vendor Managed Inventory with a Capacitated Manufacturer and Multiple Retailers: Retailer versus Manufacturer Leadership.* s.l. : International Journal of Production Economics, 2010.

Barton, Patricia. 2001. *Enterprise Resource Planning - Factors Affecting Success and Failure.* 2001.

Bendavid, Ygal and Boeck, Harold. 2011. *Using RFID to Improve Hospital Chain Management for High Value and Consignment Items.* s.l. : Procedia Computer Science, 2011.

Campbell, Clark A. and Collins, Mike. 2010. *The One-Page Project Manager for Execution.* s.l. : Wiley, 2010.

Castellina, Nick and Prouty, Kevin. 2012. *ERP in Manufacturing 2012 - The Evolving ERP Strategy.* s.l. : Aberdeen Group, 2012.

Charantimath, Poornima M. 2011. *Total Quality Management.* s.l. : Dorling Kindersley, 2011.

Esteves, José and Pastor, Joan. 2001. Enterprise Resource Planning Systems Research: An Annotated Bibliography. *Communications of AIS.* 2001, Vol. 7, 8.

Esteves, José M. and Pastor, Joan A. 1999. An ERP Life-cycle-based Research Agenda. *First International workshop in Enterprise Management and Resource Planning: Methods, Tools and Architectures.* 1999.

Gümüs, Mehmet, Jewkes, Elizabeth M. and Bookbinder, James H. 2008. *Impact of Consignment Inventory and Vendor-Managed Inventory for a Two-Party Supply Chain.* s.l. : International Journal of Production Economics, 2008.

Junior, Muris Lage and Filho, Moacir Godinho. 2010. *Variations of the Kanban System: Literature Review and Classification.* s.l. : International Journal of Production Economics, 2010.

Langenwalter, Gary A. 2000. *Enterprise Resources Planning and Beyond: Integrating Your Entire Organization.* s.l. : Taylor & Francis Group, LLC, 2000.

Lee, Sangjae and Lim, Gyoo Gun. 2003. *The Impact of Partnership Attributes on EDI Implementation Success.* s.l. : Information & Management, 2003.

Leon, Alexis. 2008. *Enterprise Resource Planning.* s.l. : Tata McGraw Hill, 2008.

Lepmets, Marion, McBride, Tom and Ras, Eric. 2012. Goal Alignment in Process Improvement. *The Journal of Systems and Software.* 2012.

Lu, Eric Jui-Lin and Hwang, Rong-Ji. 2000. *A Distributed EDI Model.* s.l. : The Journal of Systems and Software, 2000.

Merriam-Webster. 2013. Improve. *Merriam-Webster.* [Online] 2013. [Cited: 05 06 2013.] http://www.merriam-webster.com/dictionary/improve.

—. 2013. Process. *Merriam-Webster.* [Online] 2013. [Cited: 05 06 2013.] http://www.merriam-webster.com/dictionary/process.

Ohno, Taiichi. 1988. *Toyota Production System: Beyond Large-Scale Production.* s.l. : Productivity Press, 1988.

PMI. 2013. Company Overview. *Philip Morris International.* [Online] 2013. [Cited: 05 03 2013.]
http://www.pmi.com/eng/about_us/company_overview/pages/company_overview.aspx.

—. 2013. Internal Source - Intranet. [Online] 2013. [Cited: 03 05 2013.]

—. 2013. Philip Morris International. *Historial da Tabaqueira.* [Online] 2013. [Cited: 03 05 2013.]
http://www.pmi.com/pt_pt/about_us/tabaqueira_overview/pages/tabaqueira_history.aspx.

—. 2013. Phillip Morris International. *Our History.* [Online] 2013. [Cited: 05 03 2013.] http://www.pmi.com/eng/about_us/pages/our_history.aspx.

Porter, Michael E. 1985. *Competitive Advantage: Creating and Sustaining Superior Performance.* s.l. : The Free Press, 1985.

Poston, Robin and Grabski, Severin. 2001. *Financial Impacts of Enterprise Resource Planning Implementations.* s.l. : International Journal of Accounting Information Systems, 2001.

Ratnasingham, Pauline. 1998. *EDI Security: The Influences of Trust on EDI Risks.* s.l. : Computers & Security, 1998.

Rohleder, Thomas R. and Silver, Edward A. 1997. A Tutorial on Business Process Improvement. *Journal of Operations Management.* 1997.

Sarker, Bhaba R. and Balan, Chidambaram V. 1997. *Operations Planning for a Multi-Stage Kanban System.* s.l. : European Journal of Operational Research, 1997.

Tardif, Valerie and Maaseidvaag, Lars. 2001. An Adaptive Approach to Controlling Kanban Systems. *European Journal of Operational Research.* 2001.

Themistocleous, Marinos, Irani, Zahir and O'Keefe, Robert M. 1997. ERP and Application Integration - Exploratory Survey. *Business Process Management Journal.* 1997.

Waller, Matt, Johnson, M. Eric and Davis, Tom. 2001. *Vendor-Managed Inventory in the Retail Supply Chain.* s.l. : Journal of Business Logistics, 2001.

Weele, Arjan J. Van. 2010. *Purchasing and Supply Chain Management: Analysis, Strategy, Planning and Practice.* s.l. : Cengage Learning EMEA, 2010.