How to improve procurement on a digitalization age?

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Aos meus pais.

How to improve procurement on a digitalization age?

O ambiente desafiante em que as empresas se inserem e a necessidade de expansão para outras geografias fazem com que as organizações tenham como uma das suas maiores prioridades investir em formas de melhorar os processos operacionalmente e estrategicamente. As evoluções tecnológicas têm vindo a abrir portas no âmbito da digitalização da informação e daautomatização de tarefas que eram antes feitas de forma manual e ineficiente.

O presente trabalho pretende providenciar uma visão geral dos principais benefícios e desafios de uma solução digital aplicada aos vários processos do departamento de compras da BA Glass. Após a realização de um estudo de mercado, onde várias plataformas digitais associadas aos processos foram analisadas, foi feito um estudo de *benchmarking* com o objetivo de perceber com maior detalhe o impacto que este *software* teve noutras organizações. Os benefícios e desafios esperados que esta plataforma pode trazer à BA e aos seus processos estão listados e divididos em medidas qualitativas e quantitativas. É também descrito um cenário TO-BE, resultado desta digitalização, e como alternativa a curto prazo é também descrito um cenário de melhorias com as plataformas que já existem na empresa.

Durante esta dissertação são descritos os processos de compras da BA e as maiores oportunidades de melhorias que foram encontradas. Para as concretizar, foram estudadas algumas plataformas através de critérios pré-definidos e ajustados aos requisitos da BA. É mencionada a importância da centralização e visibilidade dos processos de negociação e da falta de organização e análise de dados no processo de tomada de decisão.

Resumindo, o crescimento internacional que a BA tem sofrido tem despoletado a necessidade de digitalização e, consequentemente, a redefinição de processos antiquados tem-se tornado uma prioridade para a empresa. Para que tal aconteça, um investimento significativo é necessário, mas é esperado um retorno positivo como resultado desta iniciativa. Adicionalmente, numa perspetiva de custo-benefício poupanças adicionais poderão ser obtidas através de um melhor controlo da gestão das compras.

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The challenging environment in which companies operate and the need for expansion to other geographies makes it paramount for organizations to invest in ways of improving their processes operationally and strategically. Evolutions in technology have been opening opportunities to digitalize information and automate tasks that were previously done in a manually and inefficient way.

The present work aims to provide a general overview of the benefits and challenges of a digital solution for procurement processes in BA Glass. After a market study has been executed, in which several digital procurement platforms were analysed, a final proposal is made, and a benchmarking study was conducted in order to understand in greater detail the impact that the software had in other organizations. The expected benefits and challenges that the platform can have in BA's processes are listed and divided into qualitative and quantitative measures. An enhanced scenario as a result of digitalization is described, and a short-term improvement process is also presented.

In the course of this dissertation, the procurement processes of BA will be described, and the main opportunities for improvement identified. In order to overcome these issues, some procurement platforms are studied through pre-defined criteria adjusted to BA's requirements. It is mentioned the importance of centralization and visibility in negotiation and the lack of proper data organization and analysis in decision-making processes.

In summary, BA's international growth is driving the need for digitalization, hence redefining outdated processes currently represents a priority for the organization. For this, a significant investment is necessary, although a positive return is an expected outcome of such initiative. Plus, on a cost-efficiency point of view, even more savings could be derived by controlling inappropriate procurement management.

Acknowledgements

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Abbreviations

BA – Barbosa e Almeida

B2B – Business to Business

EDI – Electronic Data Interchange

eInvoice – Electronic Invoice

eProcurement – Electronic Procurement

ERP – Enterprise Resource Planning

ICT – Information and Communication Technology

IS – Individual Section

IT – Information Technology

MRP – Material Resource Planning

OCR- Optical Character Recognition

P2P – Purchase-to-Pay

PO – Purchase Order

RFP – Request for Price

S2C – Source-to-Contract

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1 Introduction

The world is changing expeditiously as a consequence of the technological evolution that is currently taking place in our society. Digital technologies have influenced the daily routines of most individuals in developed countries in different ways. Most of them improved people's quality of life in critical areas like health, education, or communication. Evolutions in medicine and science opened a whole new world of opportunities and brought up new urges. Demanding customers led companies and organizations to adapt and evolve to the digital world to improve their processes and systems. Every day, enterprises around the globe invest heavily in providing more competitive solutions with the help of innovative technologies that streamline and enhance their capability to give customers what they require and even anticipate what will be needed in the future. Digitalization is a big part of process improvement and must be taken into consideration as a top priority in every department of an organization.

1.1 The project in BA Glass

BA Glass, SA is a company with 107 years of existence that produces glass containers for more than 80 countries worldwide, manufacturing 8 billion containers per year in 11 different colors, in 12 facilities equipped with innovative automatic inspection equipment ensuring the quality and conformance to the specification of all bottles.

BA Glass was founded in 1912 by the name of "Barbosa & Almeida" as a bottle commercialization company becoming, 18 years later, "Fábrica de Vidros Barbosa & Almeida" with the inauguration of its first factory in Campanhã, Oporto. This semi-automatic plant was then upgraded with innovative equipment of electronic technology becoming one of the first firms in Portugal with this type of machinery. In 1969, the company introduced the new plant in Avintes, Vila Nova de Gaia, which is until today BA's headquarters. Two years later, in 1971, the first IS automatic machine was installed, drastically increasing the production capacity. Since then, the company has gone through some changes both in terms of equity capital and production capability with the introduction of new methods and technologies and the acquisition or construction of 11 more plants around Europe.

The expansion started in 1993 with the acquisition of CIVE in Marinha Grande which was followed by the construction, in 1998, of a manufacturing unit in Vilafranca de Los Barros and the acquisition of Vilesa - Vidreira Leonesa, SA, in Léon, in the next year. In 2008, BA acquired the Sotancro group initiating its presence in the pharmaceutical business. The expansion in Central Europe begun in 2012 with the acquisition of the polish group Warta Glass, which allowed the company to increase its clients' portfolio on the spirits drinks business, which was complemented, two years later, with the integration of a German Company based in Gardelegen. This allowed BA to expand its market to Central Europe with the commitment to create synergies between operations and improving the service to international clients. The last acquisition made was in 2017 with the Yioula group, in which

BA acquired 4 from their 7 plants in Greece, Bulgari, and Romania, getting the Portuguese company to produce more than 20 million containers and bottles of glass per day.
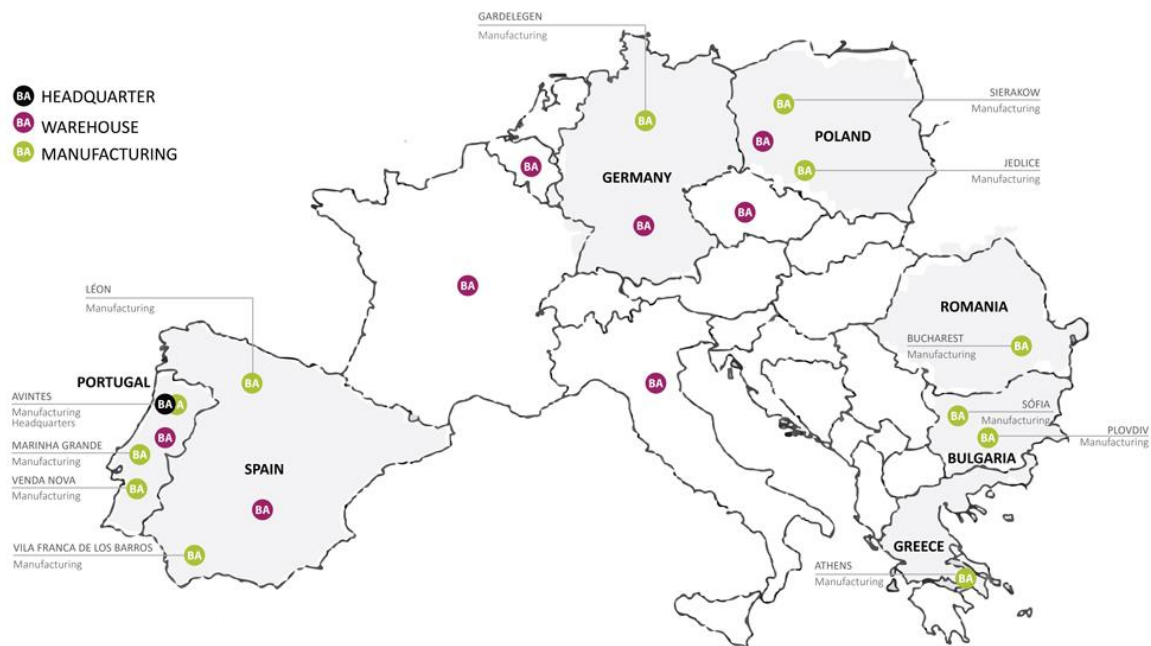
Figure 1 BA's plants and warehouses distribution

1.2 Project's scope and motivation

Unlike what happened in the 2000s, where companies were living in a stable competitive environment, today, large and globalized enterprises are constantly confronted with new challenges. From new competitors to value migration, every business needs to be able to adapt quickly and smoothly to any new income request from the market. It is not easy to forget some examples of the last 10 years of big enterprises who went into bankruptcy because they couldn't keep up with the digital transformation. Adjusting business models to this reality is no longer a matter of choice but a matter of survival.

Digital transformation also covers procurement processes. The main goal is to dematerialize all purchase-to-pay process that includes search, procurement, reception, and payment. The digitalization of the processes enables gains not only in efficiency and time consuming but allows the generation of new data which can be used to perform more accurate analysis that support decision making. Finding new ways of optimizing the procurement process has been a priority in leading companies[5].

BA has experienced exponential growth in the past years, and the main goal is to carry on with this expansion through Europe and the world. This enlargement to other locations, especially considering the ones that represent more instability and uncertainty, will imply new suppliers and partners and will, unavoidably, carry more risks to the company. With evolution comes more competitiveness and for BA to thrive, it needs to be always conscious of its challenges and opportunities. Thereby it becomes evident the importance of investing in innovative digital solutions that enable BA to always stay in a favourable position when compared to its competitors and to grow responsibly and sustainably. This project is the first part of the long journey that is the digital transformation of procurement processes and aims to introduce the solutions that are currently in the market and analyse their benefits for the present and future situations.

1.3 Methodology and structure

This project's main goal was to find an innovative digital solution that could improve the purchasing processes of BA Glass.

It starts with a literature review divided into three segments. The first aims to introduce the digital revolution of the XXI century and the application of these new technologies in procurement processes. After, some notions on the importance of strong and long-lasting relationships between manufacturing enterprises and their suppliers are presented, as well as some techniques to instigate collaboration policies. Finally, the concepts of digital procurement platforms and their essential characteristics are approached with more detail.

To develop the practical work, it was first necessary to get insights on the company and its processes not only in logistics but also in other areas like planning, production, or finance. After the integration phase, a detailed analysis of the purchasing processes was made, separating them in two groups that are described in chapter 3: the first as being the end-to-end process of purchasing materials or services, and the second one as a set of parallel processes that sustain purchasing, like supplier and contract management. The main improvement opportunities related to these processes were identified, and at the end of the third chapter, some final remarks are presented, including the exclusion of the processes that will not be analysed in the rest of the work.

In the fourth chapter, a list of the main features of digital procurement platforms is exposed and a set of possible solutions that were selected based on market studies made by independent 3rd-party organizations is suggested. Then, a comparison of these platforms is established based on customer reviews that were found over several websites, and at the end of the chapter, a solution is proposed.

Chapter 5 begins with a summary of the benchmark study conducted in three companies, followed by an analysis divided into two processes as it was made before. On this analysis, the main qualitative benefits that the proposed solution can bring to BA are presented, as well as the primary expected challenges. A TO-BE scenario was also created for both processes, illustrated by the proper flowcharts and, in the purchasing process case, a quantitative expected savings analysis was accomplished.

This thesis ends with a conclusion and a future work suggestion of the works that should be developed to proceed with the process of digitalization in the company.

2 Literature Review

2.1 Industry 4.0

The world has it is right now is a consequence of several transformations that brought remarkable modifications to the way people do things. Industry's development can be described in four stages of innovation with the four industrial revolutions.

The first industrial revolution was defined by the advancement made in the second half of the seventeenth century, with the withdraw from working with manual tools and animal force toward working with structured industrial production and transportation of goods and people. This revolution was ensured with the introduction of the steam engine by James Watt, in 1782, increasing production capacity by using the energy provided at every location. The second industrial revolution was defined by the introduction of electricity and had a high impact on communication and transportation of goods and people, reducing the price of products substantially. Procurement was also influenced by the expansion of vendors' locations as a result of transport breakthrough, forcing organizations to establish lasting supply partnerships. The third industrial revolution started in 1940 after World War II, with the introduction of the computer. This technological evolution initiated new solutions like numerically controlled machines which facilitated mass production and computer-based applications that helped the organizations' functions. It was also remarkable the introduction of container ships that simplified the transportation of goods in a secure and less labour-intensive way. Several software applications were developed to support procurement management like warehouse management system (WMS) or transportation management system (TMS). This was the beginning of e-procurement systems which allowed an integrated computer application support of procurement. As procurement management became more global, relationships between the organizations and their suppliers turned into shorter partnerships. This software-based systems and platforms were also used to plan inbound procurement, bringing connectivity to the operations, and introducing data analytics to the processes. Inside the plants, internal moves were often made using automatic lines and other robots. This was a significant advance also in transport planning with fleet vehicles scheduled with optimized routes computed by software applications, according to a plan established before the start of production [6].

The fourth industrial revolution, or Industry 4.0, was the main driver of automation and data exchange in manufacturing technologies and includes cyber physical systems, the Internet of Things (IoT) and cloud computing[7]. Industry 4.0 is considered the next stage in digitization, driven by the huge rise of data, developments in computational power, the appearance of data analytics and business intelligence capabilities and the improvements in transferring digital into the physical world. Industry 4.0 takes manufacturing automation to a whole different level by introducing customized and flexible machines that operate independently. To fully exploit the potential of Industry 4.0, manufacturing companies should recognize the importance of information. In order to provide useful insight, data has to be processed using advanced tools that can generate meaningful information[7]. In short, Industry 4.0 describes

several changes driven by information and communication technologies (ICT) and supported by the need of customized sales, the increase of flexibility and high innovation capabilities, decentralization and social awareness of ecological issues[6].

Procurement 4.0 can be defined as the integration of automation and ICTs in support of procurement. This automation requires process re-engineering in order to save labour in terms of handling work, save time and money, and increase flexibility. Therefore, in manufacturing plants, the future is to work smartly, sharing information between all stakeholders in real time, and creating optimized and transparent processes. In addition, digitization and automation of procurement support globalization as they speed up communications between geographies for buyers to be closer to the most competitive supply markets. The productivity benefits of digitalization can be summed up to a transformation from labour-intensive tasks to automatic workflows and ICT-supported processes to satisfy highly customized demands. Another great benefit of this transformation is the enablement of data analytics. These technologies allow the aggregation, processing, and analysis of large volumes of data from many heterogeneous sources. Thus, it becomes possible to understand vendors, markets and customers, predicting trends and driving better and more informed procurement decisions. Data analytic tools enable vendors to take conscious of how they are performing, and predictive information offers the opportunity to optimise maintenance services. The key change of this fourth revolution in procurement is the transformation from "exchanging information" to "free flow of information", which implies a higher degree of exchangeability of data and automation of information [6].

The application of IT in business operations has developed since the 1970s with the MRP (Material Requirements Planning), used to structure production materials demand by connecting internal departments such as production, material management, and production. Later, a robust cross-company integration of IT systems known as ERP (Enterprise Resource Planning) was introduced, intending to provide a common basis for all major functions from sales over finance, production, and procurement. The next stage, eProcurement, is called revolutionary for its ability to connect suppliers with the ordering company using EDI (Electronic Data Interchange), facilitating tasks that previously required heavy manual work. Procurement 4.0 goes further than eProcurement. While eProcurement supports manual work by providing the right channels for exchanging information, technological advances from Industry 4.0 are expected to automate the entire procurement process. The evolution from MRP to Procurement 4.0 (figure 2) makes it possible to acknowledge that evolution happened firstly on the degree of functional and cross-company integration, and secondly on the degree to which systems increase automation. Consequently, these two levels of integration and automation can be used to differentiate eProcurement from Procurement 4.0 [8].

However, the use of cybernetics in procurement can threaten data security, and it is necessary to develop secure systems to ensure data protection [6]. Industry 4.0 will require on-line integration between several entities. This process can give room to data leak and security breaches becoming a dangerous threat that can cause tremendous costs to manufacture companies. Therefore, security is a serious issue that should be dealt with conscience. It is also acceptable to think that employees will need to acquire different sets of skills that are aligned with the company's strategy [7] .
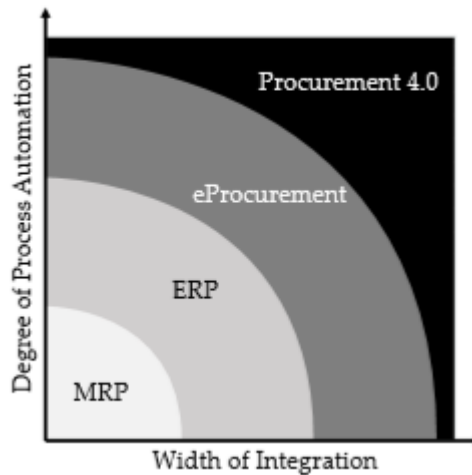
Figure 2 The Evolution of Procurement IT Systems towards Procurement 4.0 [8]

2.2 Digital procurement platforms

As the quantity of data rises exponentially, its granularity and complexity also do. Digital procurement is creating unprecedented opportunities to get new insights over the processes. By comprehending big data, companies have a higher level of visibility and transparency, which empowers negotiation capacity and internally helps to address demand problems. For procurement, the challenges are considerable. First, companies should develop specialized analytical capabilities and promote advances in machine learning analytical models. This would help to uncover insights that are not visible in standard analysis to make reliable predictions [5].

The main idea is to dematerialize all procure-to-pay activities and liberate resources to be reallocated to higher-value tasks like performing a more detailed analysis of procurement practices, consumption models, and supplier transactions. Hence, digitization of procurement processes must aim for a twofold goal: efficiency and effectiveness, by optimizing lead cycle times and maximizing the impact of data analysis. Specialized application suites for procurement tasks have been gradually developed. These kinds of offerings carry limitations that can be resumed into the level of internal and external adoption, expensive deployment, and complexity, especially when it comes to integration with other systems. Process automation will enable industrialized data analytics, supported decision making, and automate repetitive tasks (figure 4) [5].
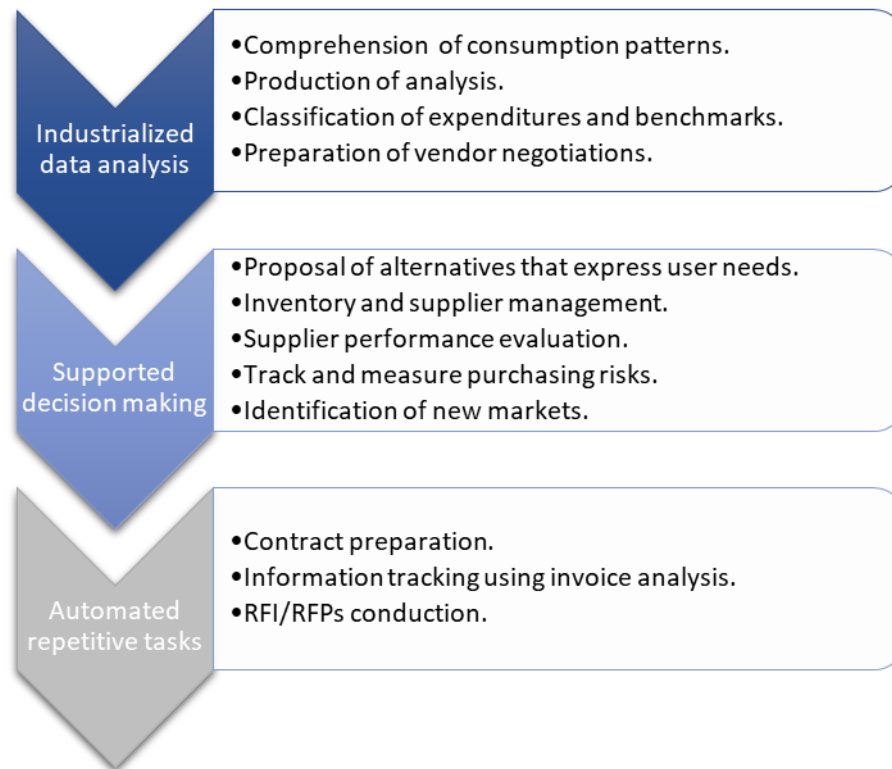
Figure 3 Main benefits from process automation [5]

2.2.1 Procure-to-pay and source-to-contract

Digital procurement platforms are usually divided into two different processes: procure-to-pay and source-to-contract.

Procure-to-Pay, or Purchase-to-Pay, is the cycle of purchasing materials that are needed to do business. The process includes requisitioning, purchasing, receiving, paying and accounting goods and services and has this name from the ordered sequence of procurement and financial processes. The description that follows is the basic P2P process, even though this procedure differs from company to company and holds several exceptions according to the business [9].

The P2P process, as it is often denominated, gathers several stages as it is shown in figure 4. The first step is the internal request of goods and services, following the vendor negotiation and selection processes which include sending a request for proposal (RFP) to the suppliers and analyse their bid, which should consist of price, delivery dates, and related material specifications. Once the negotiations are completed, and the most advantageous deal is identified, a supplier is chosen, and purchase order (PO) issued. The PO is a document with specific amounts, material specifications, and delivery requirements that are sent to the appropriate vendor for fulfilment. When the vendor delivers the goods, and the line items are verified, a receiving document is created to ensure that everything ordered is delivered. After, the supplier submits an invoice for payment that should match the PO and the receipt document in the system, to confirm that the goods were delivered as ordered and billed accordingly. Line items that do not match are flagged and reported for investigation. Once the invoice is approved, the payment is made, and the accounting system is updated [9].
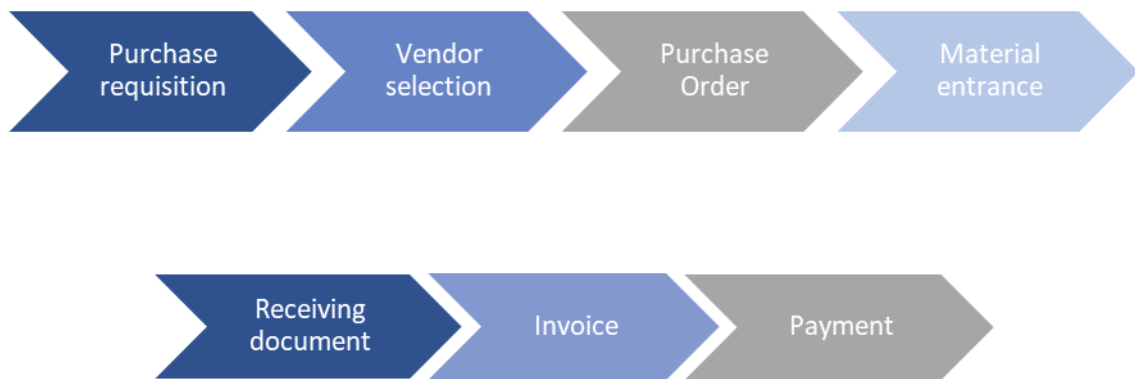
Figure 4 Standard purchase-to-pay process[9]

Source-to-contract (S2C) refers to procurement processes that are adopted during the sourcing stage of products or services. It includes analysing the product or service requirements and develop a sourcing strategy, following the selection of specific suppliers and contracting with them. Parallel to this process, there are supplier and contract management procedures that should be strategically managed, like supplier evaluation and segmentation or contract maintenance [10, 11].
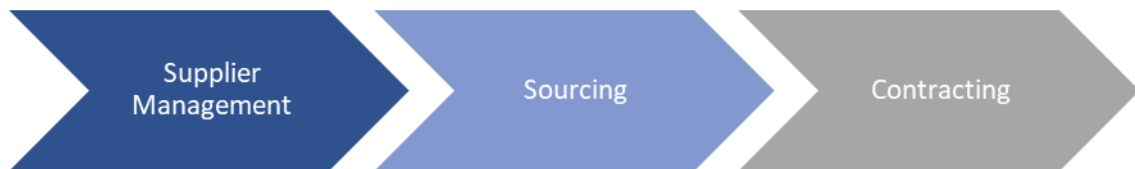
Figure 5 Standard source-to-contract process [11]

2.3 Supplier management in the manufacturing context

Continuous globalization of markets and diversification of customers' needs have made supply chain management a crucial factor in every enterprise's competitiveness. Supply chain management cannot only reduce risk and uncertainty but also improve inventory levels and lead times. Thus, as purchasing costs assume a more significant part of the total costs of manufacturing processes, the importance of purchasing functions follow the same trend. In response to this, companies have been highlighting the importance of a proper supplier relationship management (SRM) system [12].

An SRM system main goal is to instigate collaboration between the buyer and its suppliers in order to stimulate the development of new products competitively and efficiently. There are two types of purchasing strategies. The first is the competitive method, which assumes that competition between suppliers leads to lower prices, which is considered a traditional approach. The new purchasing strategy is the cooperative approach, which suggests that, in order to achieve long-term goals, there must be a total collaboration between the two parts. An efficient supplier selection process is a crucial and complicated stage for any purchasing department. Two paramount issues must be considered: the definition of criteria to be included in the suppliers' assessment, and the application of these techniques in the decision-

making process. Tsai et al. (2012) stay that for lean supply chains, low cost and high quality are the two main factors that should be considered, while for agile supply chains speed, flexibility and quality are indispensable. The most notable collaboration techniques are just in time purchasing (JITP), vendor managed inventory (VMI), where vendors take responsibility on managing the buyer's inventory, and collaborative planning, forecasting and replenishment (CPFR) in which suppliers fully integrate the buyer's supply chain. Other SRM systems include using an integrative case-based supplier selection method or a web-based enterprise collaboration platform. Evaluating suppliers includes rating their value by measuring the supplier's capability and performance to segment and select them. The purpose of supplier segmentation and assessment is first to determine the importance of materials, to establish the attractiveness of the relationship and finally to evaluate the performance. For a buyer-supplier relationship to be long-term and of mutual growth, an integrated approach must be contemplated among many departments besides purchasing. A three-step strategy is presented [12].

Step 1 is the classification of the items based on supplier risk. Suppliers are divided into two groups: the high-risk and the low-risk. Factors like the volume purchased, the percentage of the total purchased amount, and the impact on business growth are used to measure the profit impact of the purchase. On the other side, availability, the number of existing suppliers, competitive demand, or substitution possibilities are factors that allow companies to evaluate the supplier's risk. For high-risk suppliers, the most appropriate approach is the cooperative since this strategy is a relationship-oriented policy, and for low-risk vendors, the competitive approach is more suitable. The second step is the analysis of supplier relationship where the vendor's strength and attractiveness are determined by their financial and economic status, performance, and technological, organizational, cultural, and strategical factors. Step 3 is the development of action plans, which for low-risk materials involve efficient processing, standardization, and consolidation, while the management of leverage items requires exploiting the power and driving profit [12].

For the supplier's selection, the first phase should be to create a supplier pool followed by the proper evolution according to pre-defined criteria. Evaluation methods with incentive-based contracts thrive good performance. In the collaboration stage, it is vital to connect the supplier and manufacturer via shared information [12].
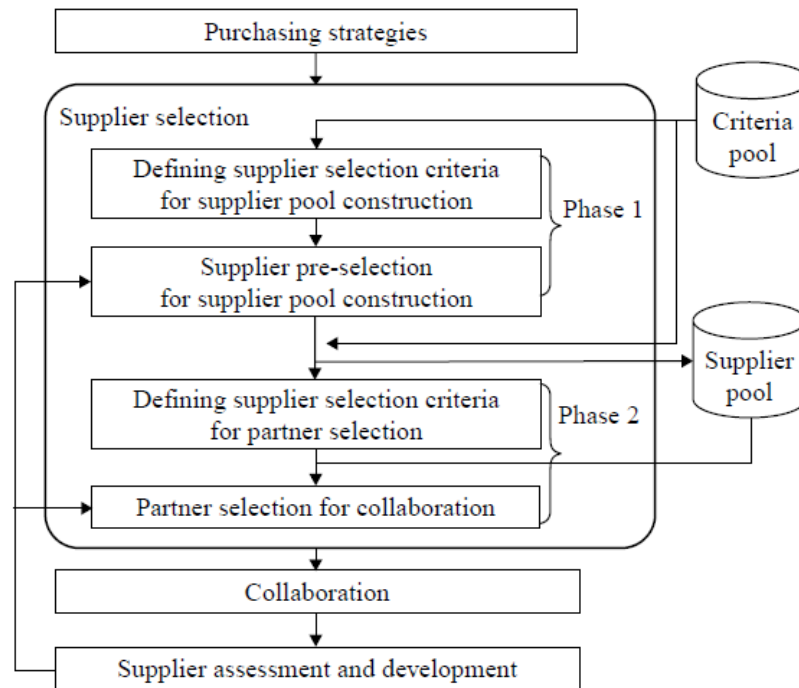
Figure 6 Framework for supplier selection [12]

2.3.1 Mitigating risk on the supplier base

The global economic crisis has been a trial for the relationship between buyers and suppliers since the risks associated with supplier failure have become too great to ignore. Unpredictable demand and rising competition forced the appearance of a new topic: supplier lifecycle risk management. With risk control policies, companies can manage proactively supplier's risk every step of the way with predictive data and technology that provides the insight needed to identify possible weaknesses. This approach delivers both immediate and long-term benefits with the ability to reduce the total cost of supplier management, guarantee the stability of supply, meet corporate social responsibility goals and protect the organization's reputation in the market [13]. According to Zcidisin et al. (2003), supply risk is defined as "the probability of an incident associated with inbound supply from individual supplier failures or the supply market occurring, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to customer life and safety" [14]. Some of these risks may include:

- Reputational risks that compromise the organization's reputation due to a supplier interruption, safety, and quality failure or business practices.

- Resilience risks, when the organization is exposed to risks as a result of an interruption of the supplier's service, for example, an IT failure that could disallow customers from placing orders or interacting with the business system.

- Cybersecurity risk, which reflects the case when sensitive data, like customer data, security is compromised by a breach or failure in the supplier.

- Regulatory risk, which is the risk of non-compliance with regulatory requirements of sourcing or outsourcing arrangements in the jurisdiction the organization operates.

- Commercial risk which represents the financial loss from poorly managed sourcing arrangements or supplier failures and inaccurate billings from outsourcing parties [15].

2.3.2 Cloud vs. on-premise

While Cloud-based systems may have lower upfront costs and shorter implementation times, on-premise software usually provides more flexibility, customization, and easier integration with other software [16].

In cloud-based systems, also known as SaaS – Software as a Service, the connection to the provider's data center is made via the internet which means that the organization stores and accesses data over this channel. The solution provider is responsible for the data center, the security, and the networking functions, while on-premise solutions have their server's operational systems installed within the organization's data center [16].

For cloud-based platforms, costs are significantly lower and are usually charged per number of users. It is easy to predict costs over time, and organizations don't have to invest in additional hardware. The disadvantage is that the organization may end up spending more money over the years. On the other side, with an on-premise solution, the initial investment is higher and riskier, and organizations are required to pay for ongoing maintenance. In terms of security, cloud systems increase risks for data security and can more easily become a threat. The difference between cloud and on-premise is who is in control of security. Cloud-based security depends almost entirely on the vendor while on-premise security is in the hands of the organization. In terms of customization, cloud-based solutions have less flexibility from the vendor, but instead there is greater stability and constant upgrades while on-premise customization features often lead to problems in implementation time and software updates [16].

Choosing between on-premise and cloud-based solutions depends on the specific business requirements of an organization. For procurement, solutions are usually cloud-based and provided either as a single suite or by modules, allowing companies to start small, generate ROI, and then expand. On-premise solutions cannot compete in terms of research and development (R&D), release maps, customer-specific customization, and one-by-one-off focus, at least with a challenging price [17].

3 Procurement in BA Glass

The Procurement process gathers several stages between the necessity of material/service until the payment is made to the supplier, including also the analysis of costs and supplier performance. This chapter aims to describe the current purchase-to-pay and source-to-contract methodologies in BA's group, mainly managed by the corporate department in the headquarters of the company, following an overview of the main improvement opportunities found. It ends with a final remarks section where the processes that are going to be considered in the rest of this thesis are identified.

3.1 Organization

BA's purchasing structure is organized into a central (commonly called corporate department), and several regional departments. The corporate department manages the core segments for the entire BA group, namely energy, raw materials, packaging, moulds, and technical segments. This structure is responsible for the negotiation and strategical approach of its segments. The centralization of the negotiation process, in BA's perspective, is a way of assuring the best commercial conditions. All the other materials and services needs are managed by the regional purchasing structure of each BA division: Iberia, Central Europe, or South East Europe. Materials and services are purchased in a similar way, being the main difference between the delivery and entrance receipt. To simplify this work, materials, and services will from now on be referenced as materials only. A summary outline is represented below.

MATERIAL CATEGORY	NEGOTIATION	PURCHASING
Moulds and Mould Accessories	Corporate	Corporate
Technical Segments	Corporate	Corporate/Regional
Raw materials	Corporate	Regional
Packaging	Corporate	Regional
Consumables	Local	Local
Office supplies	Local	Local
Health&Safety	Regional	Local

Table 1 BA's purchasing structure

3.2 Purchase-to-pay

All materials purchased by BA are managed by an MRP system that divides them into three groups: ND, VB, and PD. Each department has a requisitioner who is responsible for requesting materials in the system, known as the user area.

The materials associated with the ND code need approval every time they are purchased, and the user area creates a requisition in SAP whenever a necessity exists. On the other hand, VB and PD materials are continuously approved since these materials are bought regularly, and the difference between them is that VB materials have stock and the PD do not. VB materials have a reorder point and a minimum order quantity, while PD materials are purchased in the amount requested. At the process level, the user area makes a reservation of the material to the warehouse in SAP, and the system automatically verifies if there is stock in the general warehouse. If it is a VB, the material is delivered to the respective department, and if it is a PD or VB materials get to the reorder point, an automatic purchase order is triggered to pre-negotiated suppliers. All VB and PD materials have a material code and are negotiated annually. For ND materials, the user area creates a purchase requisition in SAP, which is redirected to the buyer that creates the PO and sends it to the supplier. For ND materials, which are negotiated locally, the process is more complicated. When the requisition arrives at the local buyer, sometimes it already has a supplier and price settled by the user area and released by the approver, and the buyer just needs to create the PO and send it to the respective supplier. On the other hand, if the local buyer has to negotiate prices for a particular material, there is another variable that must be considered: the historic price. The historic price is an essential datum in the negotiation stage since it enables the buyer to have a reference or goal to achieve. Historic prices can and should be consulted in SAP for materials that have an associated material code. Many times, buyers do not take advantage of this tool since some requisitions are filled without a material code and, in that case, the negotiation is made with suppliers that were previously considered or that were suggested by the user. This negotiation takes place by e-mail or phone being the final agreement the only thing that is registered in the system. The vendors send their quotations, and the negotiation process takes place until the buyer chooses one supplier to proceed with the order. The buyer issues a PO to the supplier, and this process needs to be carefully done, so the quantity, delivery date, and plant are not mistaken. The supplier then delivers the material in the plant/warehouse together with a delivery note that will be the base to post the goods issued in the system.

The final stage is the payment. The supplier sends an invoice either by e-mail or letter to BA's finance department. The finance department uses an OCR (optical character recognition) tool to record the information coming in digital format into the system. All relevant data like the invoice ID number, price, quantities, tax rates, etc. are extracted from the OCR to another platform that matches the invoice with the PO and the posting of goods issued. This digital platform is used to match and store the information from the three documents and is the midst of communication and approval workflow between finance and procurement departments. If there is any issue regarding this 3-way match related with the non-existence of a purchase order, missed entrance of materials, additional costs or wrong quantities the invoice is sent through the platform to be revised by the buyer. The buyer needs to identify the problem and solve it together with the people involved, whether it is the warehouse or the supplier. After, he should approve the invoice and send it back to the finance department where the final approval is done. After the documents are revised and compliant, data is imported to SAP, and the payment is made.
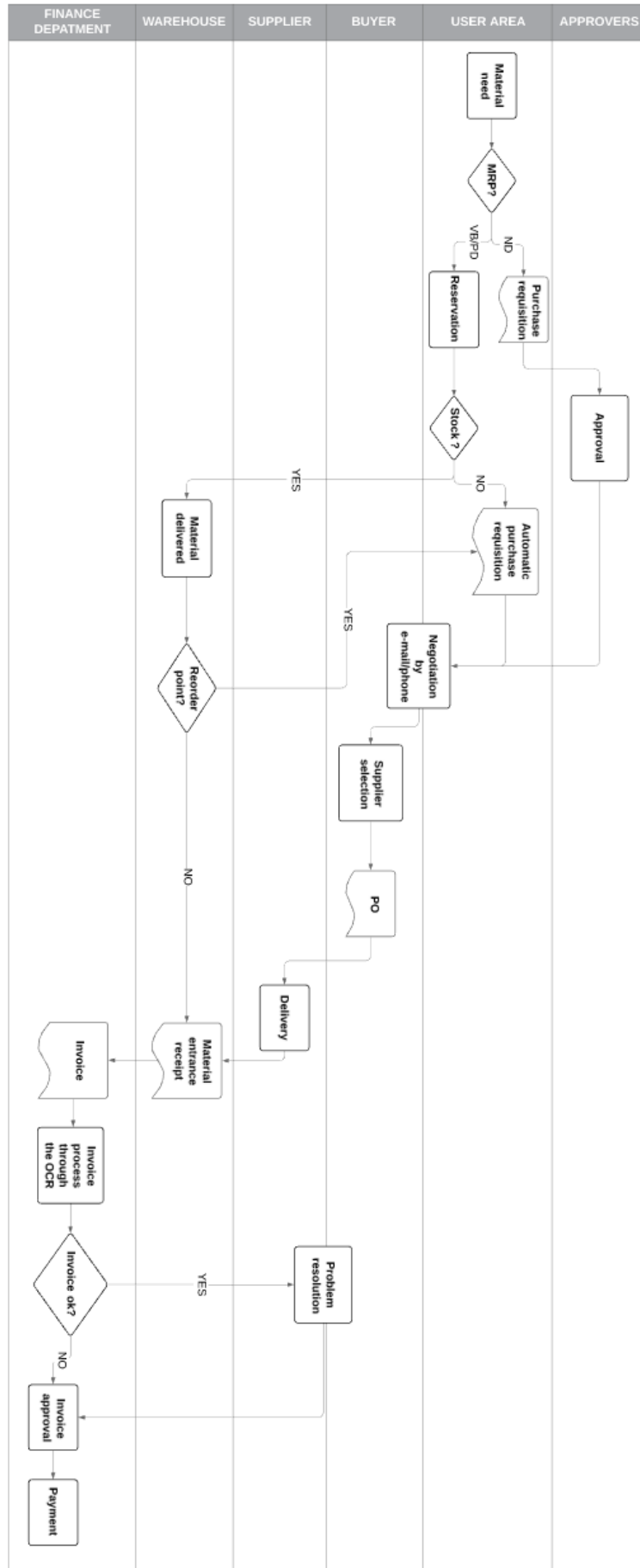
Figure 7 Purchase-to-pay AS-IS process

3.3 Source-to-contract

The source-to-contract process is divided into three main issues that will be approached in the following three sections: suppliers management, sourcing, and contract management.

3.3.1 Suppliers management

BA's Purchasing team has to deal with hundreds of suppliers every year, and it is not always an easy task when it comes to their approval and evaluation. There are some procedures and rules that the team must consider in order to standardize the process. Supplier management is based on four key steps: selection, approval, segmentation, and monitoring.
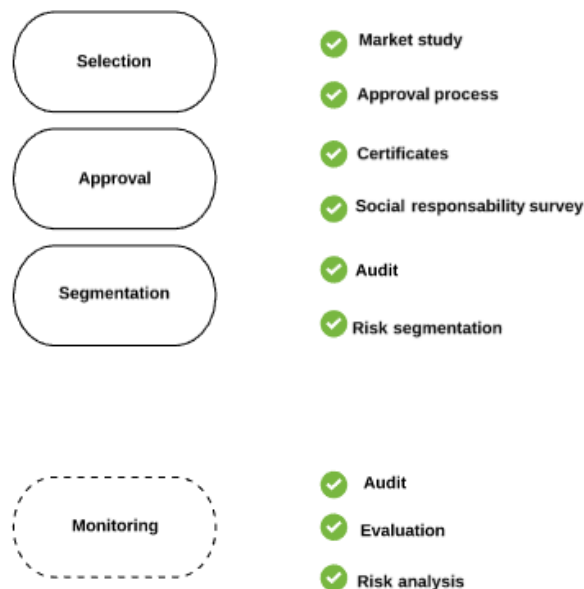
Figure 8 Supplier management stages in BA

For each need, buyers must select a group of suppliers that can fulfil BA's requirements. Core segments usually have their group of leading vendors defined while the other categories have a diversified range of products as also are their suppliers. When making a market study, some buyers find new opportunities to buy products to competitive suppliers, and all of them must go through a process for approval which can be simpler or more complex depending on the type of material in question. The process starts with the standard approval for all the suppliers that fulfil requirements regarding their financial existence, ethics principles, and market competitiveness, before their first delivery. Once approved, the supplier is created in SAP and registered along with all its information.

Some suppliers need a specific approval process according to the materials or services they are providing. The suppliers are classified based on an internal procedure in four levels of risk, according to the risk that the materials they supply represent for BA's final product and customers.

- Very high-risk suppliers: For all the materials that are essential for BA's final products to be safe and compliant with the customer's requirements.

- High-risk suppliers: For all the materials that are directly related to BA's products safety and compliance with the customer's requirements.

- Medium risk suppliers: For all the materials that are indirectly related to BA's products safety and compliance with the customer's requirements.

- Low-risk suppliers: For other materials.

The first three categories have specific requirements regarding their approval, while low-risk suppliers are validated only through the standard rules. When the supplier is registered in SAP, the buyer must ask him to fill a conduct form which is sent by e-mail and has questions regarding ethical and social responsibility regulations such as child work or gender equality. This is also where the supplier should mention all the certificates that he owns and attach them in the e-mail. When the buyer receives the survey back, he must record the survey and the certification on the vendor's SAP page. For very high risk and high-risk suppliers, the requirements usually demand an audit process to evaluate their structure and processes to make sure the vendor does not represent a risk to the company

The evaluation process is conceived with the purpose of continuous monitoring the supplier's performance by checking their fulfilment with the approval requisites, their non-conformities trend, the ability to deal with claims, and their capacity on answering BA's needs in accomplishing the purchasing orders, flexibility, and innovation.

Each one of the categories of suppliers has subgroups of materials and services allocated to either regional or corporate purchasing teams and a minimum evaluation period that must be followed. Everyone must be aware of their last evaluation action, and when will be the next one but, in practice, this does not happen. First there is no alert to warn the person responsible to the evaluation that he has to do it, and secondly, this has no practical impact in the company since this information is not sent to the suppliers and has no significance when deciding about the supplier.

When a rating action takes place, the first step is to ask the people who work directly with the suppliers their opinion regarding the supplier's performance. With this conversation, the purchasing team members have an overall perspective of the work that is being done. Afterwards, the purchasing team must go to SAP get the information about each one of the suppliers they are responsible for and select the company's name.

There are four parameters to take in consideration:

- Organizational system: Classifies the internal organization capabilities taking into account their certifications.

- Price and Purchase Conditions: Evaluates the supplier's position in the market and its availability to respond on volume variations.

- Operational Performance: Measures the supplier's propensity to develop innovative solutions and add value to its products.

- Complaints to suppliers: Measures the frequency of complaints to the supplier divided by the total number of deliveries for a specific period, and the impact of these complaints in BA's business.

The evaluation is made based on scoring the suppliers in several sub-categories inside these four, as it is shown in the next table

PARAMETER	CRITERIA	POINTS	INDEX WEIGHT
Organizational System	Suppliers certificated with 9001:2008	70	5
	Suppliers certificated with 14001:2004	10	
	Suppliers certificated with 22000:2004 (if not applicable, we use 9001:2008)	15	
	Suppliers certificated with SA8000	5	
Prices and Conditions	Competitive price and good payment conditions	91-100	20
	Price and payment conditions undifferentiated	71-90	
	Disadvantageous prices and payment conditions	1-70	
Operational Performance	Accomplishment of purchasing orders	50	40
	Flexibility and good communication	30	
	Initiative and capacity to develop new solutions	10	
	Technical know-how	10	
Supplier Complaints	No complaints	100	35
	1 complaint or <= 5% of the delivered quantities	80-99	
	Complaints between 5% and 25% of the delivered quantities	50-79	
	Complaints in more than 25% of the delivered quantities	0-49	

Table 2 Supplier evaluation criteria

For example, the first criterion is about the certificates that the company owns. If this is an old supplier and has already answered these questions, the evaluator has to go to the supplier's page in SAP and check the attachments to see the form. Then, the expiration date of the certificates must be, verified, and if they are already outside the validity period, an e-mail must be sent to the supplier asking for him to update the information. When the information and the supporting documentation arrives at the purchasing team, it must be updated in SAP.

Regarding the supplier complaints criteria, there is a transaction in SAP where it is possible to check the non-conformities reported by the plants to a particular vendor and then compare this number with the total delivered quantities. All the other criteria are based on the evaluator opinion without a proper data basis.

The supplier risk categorization is a procedure made during the strategic purchasing plan and aims to evaluate the supplier's position towards BA strategically. There are 6 scopes in which the suppliers can be integrated:

- Breakage: Lack of alternative product or volume available.

- Competitiveness: There are less expensive alternatives.

- Bargaining Power: Technical dependence on know-how or patents.

- Flexibility: Synchronization of production methods with the processes.

- Agility: Quality of response by the volume represented.

- Social responsibility.

This analysis is made by the responsible of each segment and allows the company to identify some issues such as total dependency on a specific supplier. In this situation, the purchasing team has to strategically find alternatives to be forearmed in case the supplier fails. It enables the team to have the conscience of its suppliers and internally evaluate and take actions in reaction.

3.3.2 Sourcing

Sourcing in BA is the one that shows the most significant digital advance in all supply chain process. Since July 2018, BA has a module of SAP Ariba digital procurement solution that improves and automates this process. This is a pilot project, and it is not still in its full capabilities, but it has shown great potential when compared to the old methods.

BA's previous sourcing procedure was based on phone calls, meetings and e-mail exchanges between the purchasing team and the suppliers, where the purchasing team would choose several suppliers from past purchases or new suggestions and send them an RFP, by e-mail, with the material specifications, quantities, and delivery. The supplier would reply by e-mail with the quotations, and afterwards, the purchase team member responsible for this negotiation would start the process via e-mail or phone. Then, he would compare the proposals taking into consideration the price and delivery date. In the case of moulds purchasing, there's another platform called PLM that should be taken into account besides SAP Ariba. This platform supports the flow since the need identification, technical validation, attachments, material specifications, delivery dates, and sales needs.

The Sourcing module enables the buyer to create tenders or invitation for bids, which is a procedure that allows the company to generate bids from different suppliers in just one place, with visibilityto get the best possible price. The purpose of Ariba is to automate the sourcing process with a set of intelligent features. The process starts by creating a new Project and an event linked to it specifying the needs requested. After that, the purchasing team member adds suppliers to the list of invitations, and Ariba automatically sends them a notification by e-mail to participate in the event. Suppliers have limited time to answer the RFP, and when that period comes to an end, Ariba shows all the proposals and highlights the one with the lowest cost. To conclude, the purchasing team member must award the supplier and continue the process. One of the greatest improvements regarding this process is the possibility to compare the prices given by the suppliers with the lowest historical prices that BA has in its system. This way, the buyer has a reference price to achieve. After the award, the information is sent to SAP in one of three ways: a purchase order, a contract, or an information record.

Sourcing process in SAP Ariba
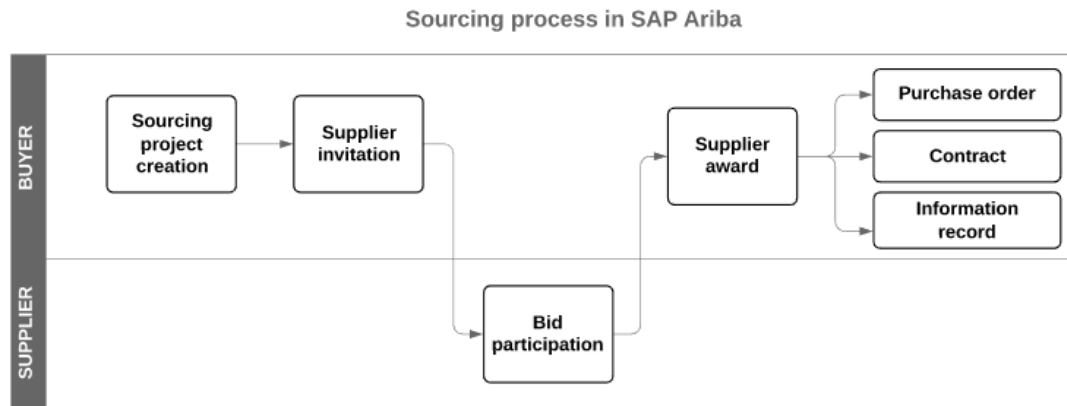
Figure 9 Sourcing process in SAP Ariba

As this study was developed, only moulds and moulds accessories were being sourced through SAP Ariba. In order to have the perception over the savings that are being achieved with SAP Ariba, a sample of 250 RFPs were analysed, taking in consideration their item's historical price and awarded spent to the supplier. The results showed that the amount of money that was saved was 8% of the total amount spent. One must take in consideration that some of the historical prices were obtained more than 5 years ago or through Asian suppliers, which in fact should not be compared with the ones that are made today by European suppliers.

3.3.3 Contract management

BA's purchasing department does not have many contracts with its suppliers, and the ones that exist are mainly done in the paper. Some data from the contracts, like expiry dates, is transferred to an excel file which must be checked by the responsible person from time to time. Each buyer is responsible for the maintenance and renewal of the contract even though no warning sign alerts people when the expiry date gets closer. As this project was being developed, BA acquired a digital platform for contract management. This solution aims to be BA's archive for customer and vendor contracts providing customizable templates and expiry date alerts, smoothing the process. This new platform integrates the outbound of Ariba sourcing, creating an option to finalize the negotiation with a contract.

3.4 Main improvement opportunities

In this section, it will be described the main improvement opportunities found in both processes. As it was done before, they will be divided into two main categories: purchase-to-pay and source-to-pay.

3.4.1 Purchase-to-Pay

Manual processes in purchasing rely laboriously on e-mails and phone calls to create and manage requisitions and purchase orders. This leads to high rates of human errors, lack of process transparency, visibility, spend control, and analysis.

 In BA, the majority of purchases are done centrally, which tends to create a better organizational scenario since the goods are negotiated and managed carefully by the corporate team. On the other hand, indirect goods, which are the ones that are not directly connected to the final product, are bought locally depending on the necessity of each plant. These are the materials that cause greater improvement opportunities in purchasing departments because usually, the person who is requesting is uncareful in the process. People either do not check if

the material is already registered in the system with a material code or they just cannot find even if they look for it. This leads employees to create requisitions with a short text description, making it a hard task for buyers to fully understand what is being requested. Materials that are bought without a material code represent uncontrolled and unmanaged spend because:

a. firstly, it is not possible (or is at least harder) to verify if there is stock in the warehouse that could be exploited, and

b. secondly, if there is no material code, the buyer will have undoubtedly more challenges on finding important historical information about the purchases of this material in the past.

This is a fundamental negotiation tool for any buyer since it gives a reference and mark of the price to reach. Because these indirect goods purchases are made locally and the quantity and value of the requisitioned materials are usually low, buyers do not consider a priority to have the best price or find better vendors. What often happens is that buyers purchase from suppliers with whom they deal for a long time and they consider trustful, instead of effectively checking if this is the best price they could get. Finally, it is important to mention maverick shopping made by employees for these indirect products. When a person buys something without authorization going outside of the accepted buying channels of the organization, it creates issues with invoices, payment activities, supplier management, data management, enforcing terms, and agreements. The failure of structured purchasing measures leads to continuing loss across the bottom line, increasing costs, and risks.

Another improvement opportunity found in this process was the number of materials that are created more than once in the system. These mistakes represent a severe problem to the company and can have many causes. When BA merged or acquired other companies, their information system was also merged with BA's without proper data treatment, and this generates thousands of duplicates. At the moment, it is estimated that ¼ of all materials created in SAP are duplicates that come from mergers and acquisitions. Another cause of duplicates is based on daily purchasing procedures. SAP's searching tool is not efficient and intuitive, and it is hard for users to find materials without having a reference. The number of duplicates caused by daily users is unknown.

Finally, another issue that should be considered is that BA already has an automated invoice processing. The approval workflow is also automated by a platform which allows the input and 3-way match with receipts and purchase orders and full internal collaboration. From the analysis made for the first three months of 2019 on the invoices that arrive in BA, 33% went through the approval workflow, and 15,4% were due to operational issues. These operational flaws can occur as a result of four main causes. The first, and the one that creates more difficulties (52%), is the additional cost or price difference when compared to the agreement made in the purchase order. This can be a result of miss communication or miss information between BA and the supplier. The second largest cause, which represents 43% of all invoices that need to be approved, is missing the entrance notification from the products or services. This happens either because the supplier did not deliver them as it was stipulated, or the warehouse forgot to notify the system about the material entrance. The third cause, representing 4% of the operational complications is the fact that the purchase order is missing from the system, either because it was not correctly identified or because it was not created in the first place. Finally, it can also happen that the invoice, receipt, and purchase order do not match in terms of quantities which represent 1% of the causes. These ratios are depicted in figure 10.

Invoices for approval
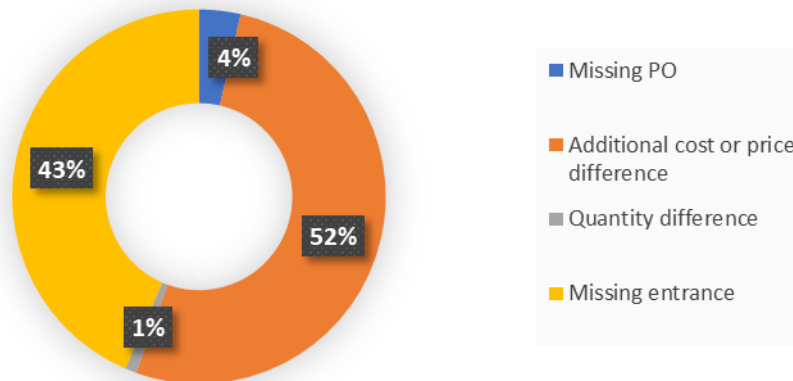
Figure 10 Percentage of invoices sent to approval due to operational mistakes

3.4.2 Source-to-pay

The process of approving, evaluating, and managing suppliers in BA is also very outdated and does not add the proper value to the company. The evaluation made by the purchasing team is not sent to the suppliers and does not have any impact on their performance since they don't have this feedback. This way, this procedure is not taking in significant consideration even for purchasing team members, and it is mainly done for audit purposes. The supplier evaluation is made through a very manual process as it is based on the buyer's "feeling" and own opinion on the supplier and not data based. This leads to errors and inaccurate data that for sure won't be used for taking essential and strategical decisions. The process takes too long, and usually, the information is not updated, and neither are the certificates. Another complication occurs if the buyer leaves the company. In that case, the person that comes to replace has no legitimate information about the supplier and therefore has no negotiation power towards him. This causes insecurity to the new worker and is bad for the company's process.

The process of choosing the supplier after taking into consideration their price proposals does not take into account any aspect regarding the supplier's performance because the buyer does not have instant access to this information. If this is an important and urgent order, the buyer should look not only for the best price but also for the supplier that accomplishes with their delivery dates better. This information should be provided as a tool for negotiation to the buyers.

3.5 Final remarks

Procurement processes in BA are mostly sustained by its ERP SAP. This system is an essential element for information storage and process compliance. Thereby, for all options analysed in the next chapter, it was taken into consideration the impact this system has on the company and the integration potentialities that may or may not exist.
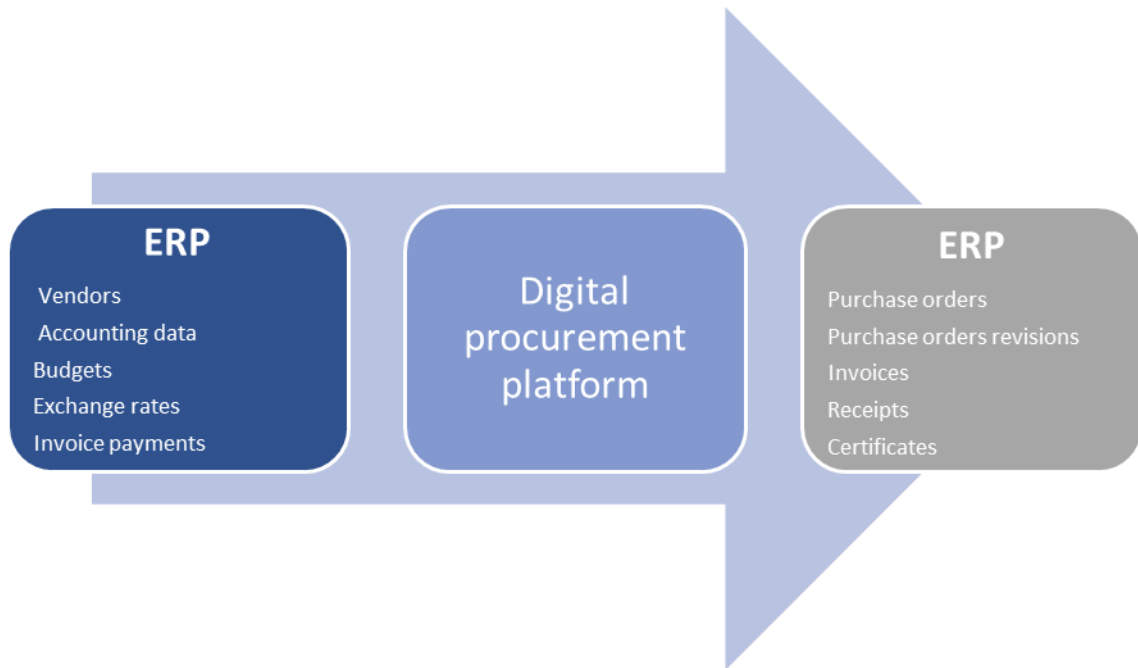
Figure 11 Digital procurement platform integration with ERP flow

In source-to-pay, both sourcing and contract management already have digital platforms to support their processes and, for that reason, they are not considered to be relevant in the next chapter's study. For procure-to-pay, although invoice processing is supported by two digital platforms, the OCR and the 3-way match and approval platform, this work considered relevant to keep this part of the process in analysis, to understand the advantages that a fully integrated suite could bring to the company.

Finally, it is essential to distinguish materials bought by BA and divide them into managed and unmanaged materials. Managed materials like moulds, mould accessories, lubricants, refractories, spare parts, raw materials, and packaging have fewer improvement opportunities, so this study will focus more on other categories (consumables, office supplies, and health&safety), which are the ones that are carelessly purchased and managed.

4 Digital procurement

As it was mentioned in section 2.3, there are currently several platforms that assist the automation of procurement processes. This chapter aims to summarize the study conducted over several weeks regarding the potential options available in the market that can satisfy BA's needs and processes. Firstly, it is presented an overview of the functions provided by these solutions for the processes that are being studied: purchase-to-pay and supplier management. After, seven options were selected and analysed with more detail, based on market studies conducted by renowned benchmark companies that rely on customer experience reviews and technical features. At the end of the chapter, one of the platforms is proposed as a solution.

4.1 Features

4.1.1 Purchase-to-pay

A P2P software typically includes automation for the entire process from requisitioning, purchasing, receiving, paying, and accounting for indirect goods and services. The main features of this solution include requisition creation and workflow, in-house and punch-out catalogues with product specifications and description, purchase order creation and management and invoice processing.

Electronic requisitioning and PO creation

This tool enables organizations to create requisitions and automatically send them to the appropriate purchasing team member for approval through a flexible workflow tool that can be configured to operate across multiple departments, locations, and teams. Purchase-to-pay solutions offer pre-built requisition templates which are customizable according to the application.

Catalogue management, requisition workflow, and approval

Purchase-to-pay solutions have a configurable interface and streamlined catalogue maintenance, providing a shopping experience that helps employees buy goods and services compliant with the company's procedures. The procurement module aims to give an Amazon.com-like experience to the user who is buying, making the process simpler and less susceptible to human error. It has integrated algorithms that set the products by favourites or recently bought creating a faster way for employees to acquire items or services.

There are 2 types of catalogues: internal and punch out. Internal catalogues are the ones that are negotiated with the supplier for a certain period and are uploaded in the system by the buyer, while punchout catalogues (cXML) are basically an easier access to the supplier's website, habitually used for products that are bought occasionally and that don't influence the company's core business directly. Catalogues have a set of adjustable rules that must be executed to upload or update the information and customizable free forms for ad-hoc purchases. Electronic catalogues are not an easy tool to implement because the company has

to count entirely on the supplier to publish the information into their system. From the requisitioner's standpoint, the problem with the actual systems is the lack of intuitiveness of punch out catalogues where he must know what supplier icon to click to go to his website and find what he's looking for. When employees cannot find what they need in the punchout catalogues, they are more tempted to find it through non-approved buying channels which aggravates maverick purchasing and leads to rogue spending.

Another leading catalogue tool is the ability to compare items and integrate it with project-based budget limits, to increase visibility.

Purchase order management

Once the requisition is approved, the system automatically sends an associated PO to suppliers for fulfilment. Most solutions also provide PO receipt acknowledgement and the ability to convert a PO into an invoice. These features give procurement departments real-time visibility and control into the order's status, shipping, and receiving. It also enables communication with the suppliers or internal stakeholders inside the platform. Another essential characteristic of these platforms is the ability to batch multiple orders to a single supplier or multiple POs to several different suppliers from one requisition. The user can send special terms and conditions to the suppliers together with the PO or associate transportation costs.

Goods receipt and reconciliation

P2P solutions allow users to confirm delivery and create a receipt for the shipment. The receipt is created in a 3-way matching with the purchase order and the invoice to ensure reconciliation among the three. Leading platforms support returns or partial shipment orders.

Invoice creation and capture

P2P solutions also offer e-invoicing to exchange and storage electronic format invoices among trading partners. This functionality includes invoice receipt to process the documents, whether through a data capture tool that uses OCR technology to obtain paper invoice data or a mailroom processing service. Invoice's status and remittance details are available for suppliers on a self-service portal. These tools manage exceptions, transportation costs, and other taxes that may not be described on the PO or even quantity differences. They include one or more ways for suppliers to submit invoices including XML and EDI formats. Leaders in the area don't charge suppliers for this feature to ensure maximum supplier adoption and meet eInvoicing technical requirements for most countries.

Invoice management and workflow

Invoice management involves linking invoices to POs and other receiving documents and address them to the appropriate approval workflow based on terms labelled within the invoice. Therefore, invoices are sent through the approval chain to fix errors like a mismatch between the invoice and PO, quantity or price differences or missing entrance of materials. These solutions provide dashboards which expose immediate insights into the productivity of accounts payable and usually include the ability to set reminders for past-due-invoices. Finally, leading solutions can drive workflows for non-PO invoices based on field level identification and allow users to set thresholds to identify errors or fraud.

Integration with SAP is a crucial stage because it allows to connect the master data from the system to the platform and consequently link a particular item and track it through the process. For this reason, important previous work must be done to clean the obsolete master data from the ERP and keep it organized.

4.1.2 Supplier management

The procurement department is a complex network of partners. Supplier management solutions aim to solve supplier management challenges by standardizing processes, enhancing data collection, and the use of this information to improve better decisions. Some of the features include:

Supplier Directory

It provides a single, centralized repository of suppliers where the company can keep all the information and use it wisely to make better and more accurate decisions. Buying organization predetermines the information that is necessary to collect and maintain from the vendors.

Automated supplier registration

Suppliers are qualified, taking into account their market and commodity, relying on a matrix-based process which is complemented with hierarchical questionnaires and logic to aggregate suppliers from different levels. This matrix filters suppliers by category, region, and business unit. These solutions include a self-registration option for new suppliers, enabling them to construct a visual profile or their company's capabilities and product offerings, which is complemented with an approval workflow

Self-service supplier profile maintenance

Suppliers have access to this platform free of charges making it possible for vendors to make sure that the data is always updated including certificates and other key documents. They can also track their performance over time to identify improvement needs. Digital platforms allow companies to stop chasing their suppliers, saving time and resources, and transform this process of exchanging information into a self-service where the suppliers themselves update their information over time. This puts an end to phone calls and e-mails for missing information and instead uses follow-ups that automatically warn the vendors to provide the information.

Mass communication and monitoring

This allows the company to measure, analyse, and manage supplier performance to improve quality, reduce costs, mitigate risk, and drive continuous improvement in the supply base. These solutions provide consistent measurements and resources that identify performance glitches and that can determine the total cost of ownership of supply relationships. For supplier evaluation, the company may schedule recurring tasks or phases for continuous monitoring suppliers, create scorecards by the supplier with interesting KPIs and store them in a library for easy reuse. Surveys filled by employees who work directly with the vendors are used to rate suppliers and automatically pull these results into the scorecards creating an average of all stakeholder's feedback. It also identifies "out of range" scores for each KPI to trigger alerts. This gives users visibility over any issues regarding their suppliers, including high-risk flags and potential duplicates from the supplier master and translates this information in intuitive reports and dashboards. It is supposed to give the company a clear vision of its supplier's performance but also provide vendors with the right feedback on how they are accomplishing their clients' needs, providing metrics and performance evaluations in order to collaborate on solutions.

Risk management

With risk intelligence features, this platform will enable BA to manage the entire supplier lifecycle based on policy, controls, and risk exposure to drive compliance and extensible risk scoring from thousands of public and private sources. There is an ongoing monitoring process for reputational, compliance, financial, sustainability and operational risks and personalized

alerts based on user's risk roles. Suppliers are grouped by risk exposure level and categories which are represented by comprehensive risk dashboards.
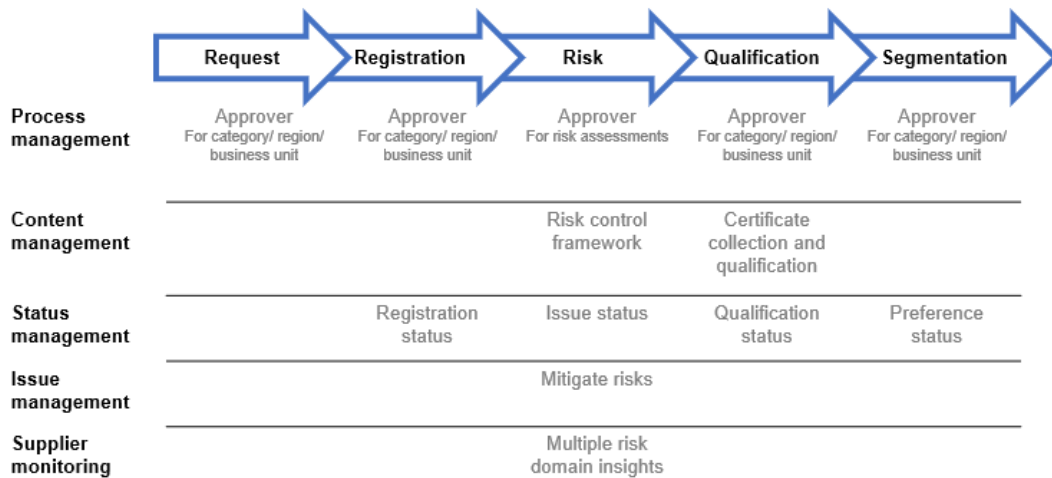
Figure 12 Main features of supplier management platforms

4.2 Selection

To conduct this analysis reports from Forrester, Gartner, and Level Research were analysed in order to identify the potential solutions for BA's processes. From the information gathered, it was made a list of the potential candidates.

Gartner and Forrester are world leaders in research and advisory. These companies classify technological players in a specific market and culminate this information into a graphic: the magic quadrant for Gartner and the wave in Forrester's case. These studies methodology involve several steps and different sources in order to have the most accurate possible results. They gather information from customer references who share their experience with the product, and the vendor response team that provides detailed product and service information. By Gartner and Forrester's side, some analysts define the inclusion and evaluation criteria and score the framework. The results from the studies made by both companies concerning purchase-to-pay and supplier management solutions are depicted in figures 13 and 14, respectively.

Figure 13 Gartner's magic quadrant for procure-to-pay suites 2018 [1] (left) and Forrester's wave for procurement 2017 (right) [3]

Figure 14 Gartner's magic quadrant for strategic sourcing suites 2018 [2] (left) and Forrester's wave for supplier management 2018 (right) [4]

Based in Finland, Basware was founded in 1985 and has 1881 employees with 20 additional offices across North America, Europe, and Asia/Pacific. Its P2P solution provides suppliers paid or free solutions depending on the features and has an active invoice automation feature for global organizations that allows companies to process valid e-invoices in 43 countries and 12 additional countries using 3rd party partners. Basware does not have an S2C solution, which means it cannot address problems like supplier or contract management. Moreover, it is particularly useful to address complications on invoices when a three-way match is not possible. Basware is a leader based on its strong market understanding and customer experience, and it is well suited for multinational organizations that look for better automation on processing invoices.

The reference customer survey showed that for ease of deployment and integration is ranked first, and for an overall product, the offering is ranked second. However, Basware received

low scores for supplier management capabilities, and it is ranked below average for satisfaction with its guided buying experience. Customers did also not show satisfaction on its openness for product enhancement ideas and opportunities to benchmark with other customers [1, 3].

4.2.2 Coupa

Coupa's cloud platform was founded in 2006, in California, U.S., and has 1000 employees in 25 offices around the world. Coupa has 700 customers for its business spend platform on managing indirect spend categories. Suppliers are free of fees, and are capable of processing fully compliant invoices in 38 countries. Coupa does not implement the solution on its own and counts with partners to conclude this process. It is considered a leader for its strong innovation and deep market understanding. This is a good option for companies seeking an innovative P2P solution with strong ease of use functionalities.

In the reference customer survey, Coupa had the highest score for innovation, solution availability, and for offering solutions that meet customers' needs in a creative way. It was also cited the platform's ease of use as a key factor for selecting the vendor. It was the second highest rated solution for its ability to deliver at or below expected implementation and upgrade costs, and it was rated below average for its supplier management capabilities and satisfaction. Coupa also had the lowest rating for the ability to import purchase orders from MRP systems [1, 3].

4.2.3 GEP

GEP is a company founded in 1999 with currently 2800 employees and its headquarters in New Jersey, U.S. With 8 additional offices through Europe, Asia, and Latin America, GEP reports to have 100 customers using its P2P solutions. SMART by GEP is a unified P2P software platform which ensures that all activity is connected across the entire end-to-end process. The solution is mostly used to manage indirect spend categories, although it can also support some direct procurement workflows. It is currently processing fully compliant e-invoices in 23 countries and is a good choice for companies seeking a fully integrated S2C solution. GEP got high rate scores for its ability to improve procurement productivity by delivering spend insight and for its service and support, but it received very low scores on customer satisfaction for the value the product provides when compared to the money spent. It also had below average score on overall implementation experience, ease of integration, ability to change solution configurations, and process non-PO invoices [1, 3].

4.2.4 Ivalua

Ivalua was founded in 2000, in France, and has now over 300 employees in 14 offices around the world. It offers an integrated suite capable of supporting direct and indirect spend and is currently able to process fully compliant e-invoices in 47 countries. Ivalua reports to have over 100 customer organizations using its P2P solution, but it also provides S2C with a strong product strategy. This is a good option for simple and complex organizations looking for a natively integrated S2C solution. Reference customers gave Ivalua above-average score for its requisitioned inventory capabilities and the highest satisfaction rating for its capital expenditure functionality. Most customers use this cloud-based platform as their supplier master record. However, surveyed customers scored this solution below average for its services and support, and it received very low scores for time to value, ability to deliver on time and within budget for implementation and upgrades. It was also low scored for account management and timely communications [1, 3].

4.2.5 SAP Ariba

SAP Ariba is part of SAP, one of the largest software companies in the world. With its headquarters in Palo Alto, California, SAP has over 84000 employees in over 180 countries all over the world. Its P2P cloud solution, named SAP Ariba, counts now with more than 500 customer organizations and is capable of supporting direct and indirect spend, also providing a strong S2C suite with additional modules. The supplier's fee structure can come in three ways: no cost, upgraded account, or customer-paid supplier fees. SAP Ariba has strong sales and above-average customer satisfaction ratings, as well as product innovation, functionality, and configurability. For Gartner's survey, it had the best customer score in overall experience with P2P solution, and it is also referenced for having the largest supplier network and providing opportunities for customers to share best practices with other customers. SAP Ariba's customers rated its tax engine functionality to support tax regulations below the average of all vendors [1, 3].

4.2.6 Jaggaer

Jaggaer was founded in 1995 in North Carolina, U.S. and has 20 additional offices across the world. It offers a full P2P suite and has the capability to process fully compliant e-invoices in 7 countries. It does not charge any supplier fees and also provides a strong S2C solution with additional modules. It is a good choice for companies seeking a P2P solution with powerful analytics functionality that can be expanded into a full S2C solution. Jaggaer received an above-average rating by reference customers for delivering its solution at or below expected implementation and upgrade costs and higher-than-average score for allowing customers to "plug them into" an established community where many of their suppliers were already transacting. Nevertheless, reference customers were mostly from higher education based in North America and gave the lowest reference customer score for its openness to product enhancements [1, 3].

4.2.7 Tradeshift

Tradeshift was founded in 2009 as a business e-commerce company. With its headquarter in California, U.S., it has 650 employees and 13 additional offices around the world. It reports having over 500 organization customers for its purchase-to-pay solution that uses a marketplace approach to enable buyers to run processes with full connection to their suppliers. It conducts fully compliant e-invoices in 50 countries and can handle most of its implementations. According to Gartner's 2018 report, Tradeshift is a good choice for enterprises that are seeking an innovative approach to engaging both internal stakeholders and suppliers. Innovation and price are cited as the main reasons why customers chose this platform and are also referenced for its strength in processing e-invoices. This solution, however, is rated below average for its ability to deliver at or below expected implementation and upgrade costs and for customer's overall implementation experience [1, 3].

4.3   Comparison based on customer reviews

Since Basware was not even considered in S2C studies due to its lack of capabilities to provide such features, it will not either be considered in this analysis. This comparison was based on several websites that allow companies to review their software. As one may understand, this is not where the decision was sustained, but instead, it aimed to provide an overview of the platforms.

Table 3 Software comparison scores from customers' reviews

CRITERIA	Coupa	Ariba	GEP	Jaggaer	Tradeshift	Ivalua
Contracting	4,1	3,7	4,5	4,3	4,2	4,5
Ability to understand the organization's needs.	4,2	3,8	4,5	4,3	4,3	4
Timely and Complete response to product questions	4,2	3,7	4,6	4,4	4,3	5
Pricing and Contract flexibility	4	3,6	4,5	4,2	4	4,5
Integration and Deployment	4,1	3,8	4,2	4,3	4,3	4,1
Length of deployment (months)	6	8	7	6	7	9
Availability of quality 3rd-part resources	4,1	3,8	4,2	4,3	4,5	4,5
Ease of integration using standard APIs	4	4,1	4,2	4,3	4,0	4
Quality and availability of end-use trainning	4	3,7	4,2	4,2	4,3	4,4
Ease of deployment	4,1	3,7	4,1	4,2	4,3	3,7
Service and Support	3,9	3,8	4,3	4,2	4,0	4,0
Timeliness of vendor's response	3,9	3,6	4,6	4,2	4	4
Quality of techinal support	3,9	4,1	4,4	4,2	4,2	4,4
Quality of peer user community	4	3,8	3,9	4,2	3,8	3,6
Region of Deployment						
North America	49%	42%	55%	64%	27%	42%
Europe, Middle East and Africa	24%	20%	17%	13%	48%	58%
Asia/Pacific	17%	23%	19%	17%	15%	no info
Latin America	10%	15%	9%	6%	9%	no info
Ease of use	4	4,6	4,4	4,3	4	4,8
Features and functionality	4,1	4,3	4,4	4,2	4,1	4,5
Advanced features	4,1	4,6	4,5	4,3	3,7	4,8
Performance	4,1	4,6	4,4	4,3	4	4,8
Deployment	cloud hosted	cloud hosted	cloud hosted	cloud hosted	cloud hosted	cloud hosted

All solutions evaluated are cloud-hosted, and from these customers' reviews, it is possible to take the following remarks:

- The platform that gathers the best score in product capabilities criteria (ease of use, features, and functionality, advanced features and performance) is Ivalua followed by SAP Ariba that was rated first by Forrester's report.

- GEP got the best customer review for service and support, which is corroborated by what was mentioned in section 4.2.

- For integration and deployment, Jaggaer got the highest rate and shorter average length of deployment.

- SAP Ariba got the worst mark for pricing and contract flexibility during contracting. It also had bad reviews in customer support.

4.4 Proposed solution

From all options described in section 4.2, the one that makes more sense to work with is SAP Ariba for two main reasons.

First, as mentioned in section 4.4, BA already has a module from SAP Ariba solution and SAP as its central information system, which is an important factor since it is a company with whom BA has experience and contacts. Moreover, as people are already familiarized with Ariba Sourcing, its adoption to other modules would be more comfortable and faster. Regarding the sourcing module, the implementation and integration processes were made internally by BA's procurement and IT teams, which means that the company already has internal resources experts on SAP Ariba and would not need to hire 3rd-party companies for deployment. This represents a brutal diminishing in costs and time for launch. As this is an SAP company, it is expected that the integration with ERP SAP is more straightforward than with any other provider. This is a fundamental requirement for BA since the company uses its ERP to record all additional information and handle processes in all departments and plants.

Full inbound and outbound integration is the only way to ensure that the systems are kept organized and updated and make sure that the process is effectively improved and automated. For the IT department is also easier to manage one single platform instead of multiple.

Secondly, according to the studies mentioned in section 4.2, SAP Ariba is one of the best solutions in the market and fulfils almost all BA's requirements both for Purchase-to-Pay and Supplier Management procedures.

Nonetheless, SAP Ariba cannot process fully compliant e-invoices in Portugal, at the moment and this issue is expected to be fixed in 2 years. Besides that, as it was concluded in section 3.2.2, invoice management is not a priority matter and will not be integrated into the rest of this study.

SAP Ariba is a modular platform that covers all procurement process. The modules that will be considered are *Buying* for purchasing and catalogues, and *Supplier Lifecycle and Performance Management* and *Supplier Risk Management* for supplier management.

5   TO-BE situation

As this project aimed to be an initial approach to the digitalization process of procurement department in BA, and the platform is not yet negotiated or implemented, it was not possible to gather information regarding the actual price and savings that it brought to the company. However, a prevision of the benefits and the overall model was made based on a benchmark study and expected benefits, challenges, and saving analysis.

5.1   Benchmarking

Taking into consideration the findings in chapter 4 regarding SAP Ariba platform, a benchmark study was conducted in order to evaluate the impact that this solution had on other organizations. Three companies from different sectors, packaging, food, and hospitality that use SAP Ariba in their procurement processes were analysed.

SAP Ariba's *Buying* module includes all the process from the purchase request, catalogues, purchase order creation and management, and receiving. Regarding this solution, the organizations highlighted how the solution streamlined their process, improved its structure, and gave them visibility and control over spending that was considered maverick purchasing or fraud. For these organizations, suppliers are expected to improve their performance as soon as they realize that they are being tracked which is expected to reduce the number of complaints.

Catalogues are used for indirect materials that do not represent the core business of the company. In these organizations' opinion, indirect materials are usually the ones that are worse managed and that represent the more substantial part of uncontrolled spend. Therefore these materials can represent more considerable savings for the company. Generally, direct materials like moulds in BA's case, are not appropriate to this kind of solutions because they are purchased centrally and by a restrict and controlled team. It was noticed that internal catalogues that are previously negotiated with the suppliers were used for materials with a material code associated and, for other goods which usually are not bought as frequently, they used punchout catalogues from several suppliers from different categories. There is also a tool named SpotBuy, which connects the company's system to Mercateo Unite, the largest European B2B marketplace. From their point of view, *Buying* is a tool relatively easy to adopt by internal stakeholders since it has clean and user-friendly interfaces that improve the buying experience.

However, there are always people that do not accept these technologies right away and change mentalities should be taken as one of the biggest priorities when committing with a project like this. All companies agreed that in an early stage the main issue should be the organization of the material master, and then create and negotiate catalogues by steps and categories, including travels and hotels. It should be considered that this project demands maintaining and renegotiation of catalogues over time. This is not a homogeneous process since there are some materials that were able to be negotiated for three months or even one year, while others

must be negotiated every month or every week. This will depend on the supplier and material type.

Regarding the supplier management module, only one of the companies approached had this functionality, but they had not started with its utilization due to a lack of time and resources. Thus it was not possible to obtain relevant data and information about this solution.

On the other hand, the sourcing module is used in these companies with ERP integration or independently, for materials and services that represent their core business. It is considered by these organization that supplier and internal adoption is harder, but it is also part of a process that needs to consider an absolute priority to change people's minds which is also a complication that BA has been facing. One of the solutions discussed was that everyone must be aware of the benefits and challenges that will be encountered and provide a demonstration of its practical benefits to all stakeholders with numbers that are being achieved by the ones that are using it.

5.2   Indirect materials purchasing process

In BA the purchase of materials and services is made through SAP/ERP making this a difficult, time consuming and with lack of transparency process, leading to errors and flaws that could be avoided with a streamlined solution. Although a significant part of the segments, as moulds or lubricants, are already being negotiated by the corporate purchasing team, there are three types of indirect materials/services that usually are not: consumables, office ,supplies, and health&safety. These are the segments that this study will focus on since they are the ones that cover most of maverick shopping and uncontrolled spend in BA's processes.

5.2.1 Expected benefits and challenges – a qualitative approach

Purchase-to-pay solutions bring tremendous advantages to organizations. The most obvious benefit is that these solutions can uncover inefficiencies and give BA the ability to control and manage processes. This means that employees can easily buy goods and services form preferred contracts previously approved, ensuring underbudget spend. The main benefits that this solution could bring to BA were separated into three different categories: internal stakeholder centricity, process automation, and digitalization of information.

Internal stakeholder centricity:

- Supporting requisitioners by providing a guided buying experience;

- Streamline policies to increase compliance;

- Self-service enablement for more autonomous purchases;

- Cycle times reduction;

Process automation:

- Improved control and security;

- Process optimization;

- Consolidated invoicing;

- Enhancing process efficiency;

- Cost control over maverick spending;

- Most competitive price;

Digitalization of information

- Driving visibility and transparency across procurement processes with analytics;

- Predicting spending patterns;

- Anticipating requisitioner needs

- Precise and real-time operational models;

- Understand and model risk;

- Providing data-based decision making.

Despite the apparent value and benefits that these solutions can bring to the process, there are barriers to consider on the system adoption:

- Budget concerns: Procurement automation can be expensive, and there are some costs to be considered besides the subscription fee like the implementation and training costs.

- Stakeholder resistance: The failure to gain internal support may result from the lack of education on the purpose and value of the solution as well as the belief that the software will produce on ROI.

- Process adjustment: Even though digital procurement solutions have sterling customization features, people should look at this innovation as an opportunity to review and readjust processes that are not working well.

- Supplier acceptance: One of the biggest advantages of this digital process is the Amazon.com-like experience provided using the catalogues. These elements can only be uploaded and updated with the help of the suppliers. Their support is crucial to achieving the gains.

5.2.2 Expected savings analysis – a quantitative approach

As it was mentioned in section 5.2, three material types can be included in the category of indirect spend: consumables, office supplies, and health&safety.

The analysis was divided by regions: Iberia, Central Europe, and South East Europe, and for each region, the purchase documents from the years 2017 and 2018 were extracted. It would make no sense to make a comparison between all plants because it cannot be expected that a supplier from Poland, for example, could deliver goods in Portugal at the same price. There would be transportation costs involved that would increase the price, and it would not be accurate to assume something like that in this context.

First of all, it is important to define two fields of analysis: the net price and the net value. The net price is the unit value of each material/service, while the net value is the total value of the purchase. To minimize errors associated to the process, two rules were created: calculate the net price dividing the net value by the quantity purchased and exchange the currency of all net values to euros (table 4). Frequently, people set the net price in the wrong way; for example, instead of defining the price for one unit, they do it for 10 or 100 units. This way, the net price is assuredly the unit price.

1 EUR =	0,876 GBP
	1,116 USD
	4,297 PLN
	1,955 BGN
	4,764 RON

Table 4 Currency exchange rates

With the accurate data, two analyses were made. The first one was made for materials that had a material code, by comparing the net price of each material/service with the minimum value from which was purchased in that year and in that region. Hence, it is being assumed that if in that region, there was an annual negotiation for every plant, it would be gotten the best price for all of them. This is still a bleak scenario since a quantity discount could be obtained, and the price for that region and year would be lower. By this reason and because there is not enough data that proves this, the conservative version was preferred. The savings that could have happened if the materials were purchased by region negotiation were calculated and obtained in percentage for each material/service. It was verified that the percentual range of values was extended from 0 to 100%, showing that there are still errors in data that could be related to the fact that the net value was also wrongly inserted. It was analysed with several thresholds to find a disruption point and assume that from there, savings should not be considered. The results of the analysis are presented in figure 15, which contains the percentual values of savings about the total spent on the purchases that are being considered. For example, for a threshold of 30%, only were considered materials with material code and savings below 30%. It was calculated the ratio between the total amount of savings and the total amount spent from this group of values, by year and region. As one may verify, there is no point of discontinuity. Therefore, it is not possible to withdraw any threshold value. In practice, it could be demonstrated through several examples that a minimum acceptable value of threshold would be 35% since under this value there were not found procedural errors and the savings are accurate. Hence, considering the range from 35% to 100% and assembling data from both years, the obtained savings were [2,93; 6,03] % for Iberia; [3,68; 28,21] % for Central Europe; and [2,57;22,15] % for South East Europe. This represents an average of [3,06;18,80] % for BA's group.
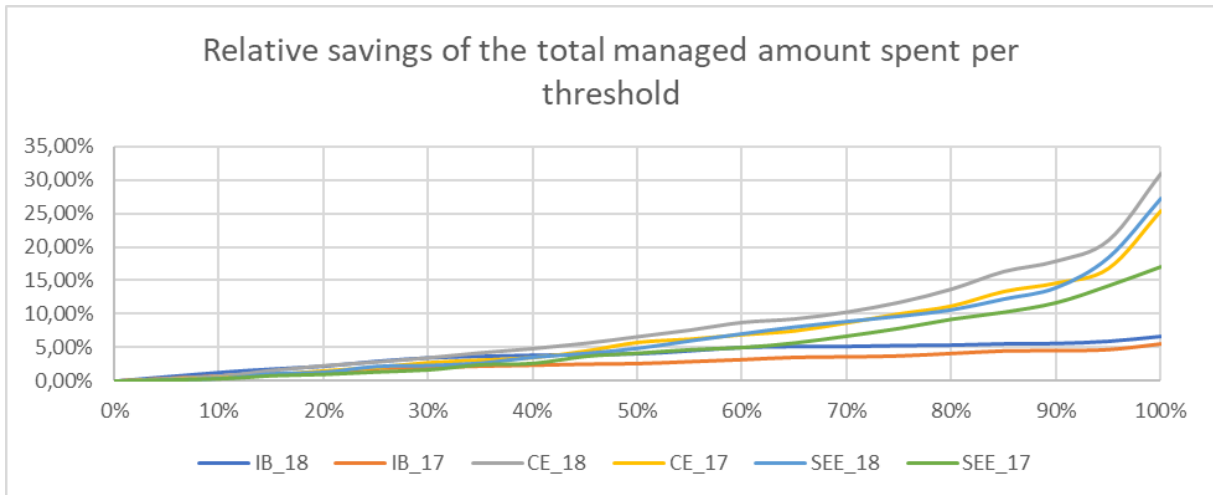
Figure 15 Graphical representation of relative savings (%) of the total

managed amount spent per threshold for each plant in 2017 and 2018

The costs of SAP Ariba's Buying tool could only be determined as a range of expected values. Taking into consideration the highest value, the conservative approach, it was possible to calculate the ratio of costs about the average of the total managed spent per year, for all BA group. A threshold analysis was made again, where the ratio of savings was calculated, dividing the total amount of savings for each threshold by the total managed spent for the same threshold. Analogously, the estimated cost of the platform was divided by the same total managed spent that was considered for the savings, for each threshold. Comparing the ratio of costs to the ratio of savings per threshold in the graphical representation in figure 16, it is possible to conclude that until a 20% threshold, the costs are higher but from then the platform is compensatory on a large scale. As it was mentioned before, a 35% threshold is an accepted minimum value, which leads to the conclusion that from 35% to 100% SAP Ariba will have more benefits than costs.
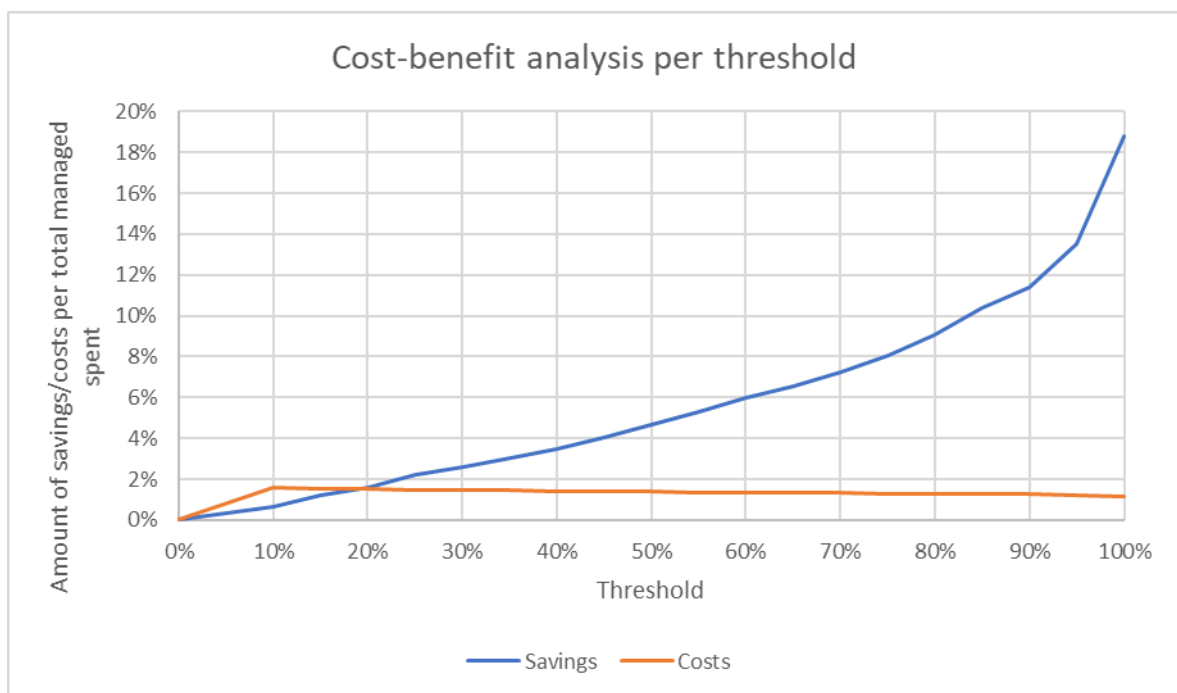

Figure 16 Cost-benefit analysis per threshold for the managed spent for all group

One of the main benefits of digitalization of the procurement process is to control better the money spent. A study was made in order to understand the volume of unmanaged spent in each one of the plants, in 2017 and 2018. It is unmanaged spent, the amount spent on materials and services that were bought without material code. When goods are purchased without material code, buyers do not have visibility over the historical prices and suppliers from whom they were purchased in the past. In figure 17 it is represented the ratio of unmanaged spent divided by the total spent on each plant and year. It is possible to observe that the plant with higher unmanaged spent in 2017 was Venda Nova, with 71,41% and in 2018 Gardelegen with 76,42%. In both years the lower ratio is assigned to Jedlice, with 4,22% in 2017 and 4,38% in 2018. Moreover, the rates of unmanaged spent have, in most cases, increased in 2018 when compared with the previous year.
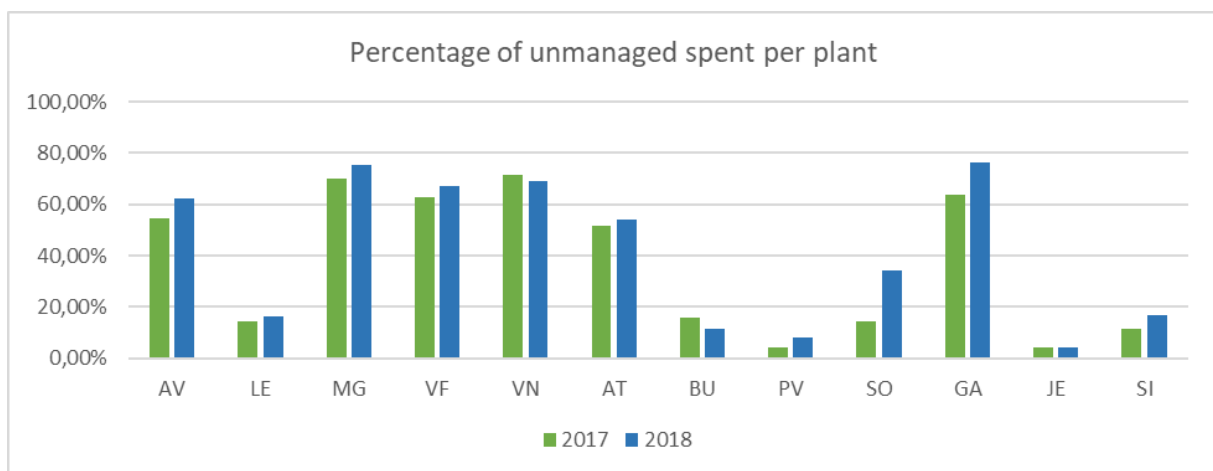

Figure 17 Graphical representation of the unmanaged spent (%) for each plant of BA's group in the years 2017 and 2018

For materials without material code, manual research was made, based on the purchase documents descriptions, to try to find the same material with a material code associated. This process was conducted through a trial-error method until a sample of 23 material types was reached. Then it was made a comparison between the price these materials purchased without a material code, with its minimum historical price in each region. This comparison by region is a conservative version of the study since it was assumed that the lowest price supplier, would make the same price for all the plants inside a region, but outside it could not be proven. It was possible to observe that it could have been saved 17,71% of the total amount spent and the most common values are between 20% and 30%. This corroborates the initial assumption that materials without material code, lead to less controlled purchases and when the buyer has visibility over the material's historical information, will have higher bargaining power and lower prices. For the unmanaged spent the costs of SAP Ariba *Buying* represent between 1,24% and 1,65% for all plants.

5.2.3 TO-BE process

The TO-BE process can be described in 2 stages. The first is the catalogue creation. This will be made by a restrict amount of people who will negotiate products that are currently bought with pre-determined suppliers. For this, buyers must create a sourcing project in SAP Ariba's *Buying* tool, which is a simpler version of Sourcing, and determine the best price. The terms of the negotiation, as well as its validity, should also be clarified. Then, for internal catalogues, suppliers upload their pre-negotiated items into BA's system and should update

them whenever necessary, taking in consideration that every change has to be approved by the buyer. For punch-out catalogues, BA needs to make an integration with the supplier's system and create rules and preference arrangements. As soon as the catalogue is created, the user areas can start to trigger the purchase requisitions through pre-defined templates or free customizable forms where they can specify the product when it is not catalogued. The request goes through the workflow to the buyer, which will have access to that commodity budget with the ERP integration and must decide if the request can be turned into an order. If the answer is positive, a purchase order template is automatically assigned to the purchase with the quantities and prices that were previously defined. Immediately after the purchase order is issued, the supplier is notified and should approve it in the system. When the material is received in the warehouse, SAP Ariba must be noticed in order to make out an entrance receipt. For ND materials that are not catalogued the buyer should make a negotiation process in the tool to identify the best possible arrangement.
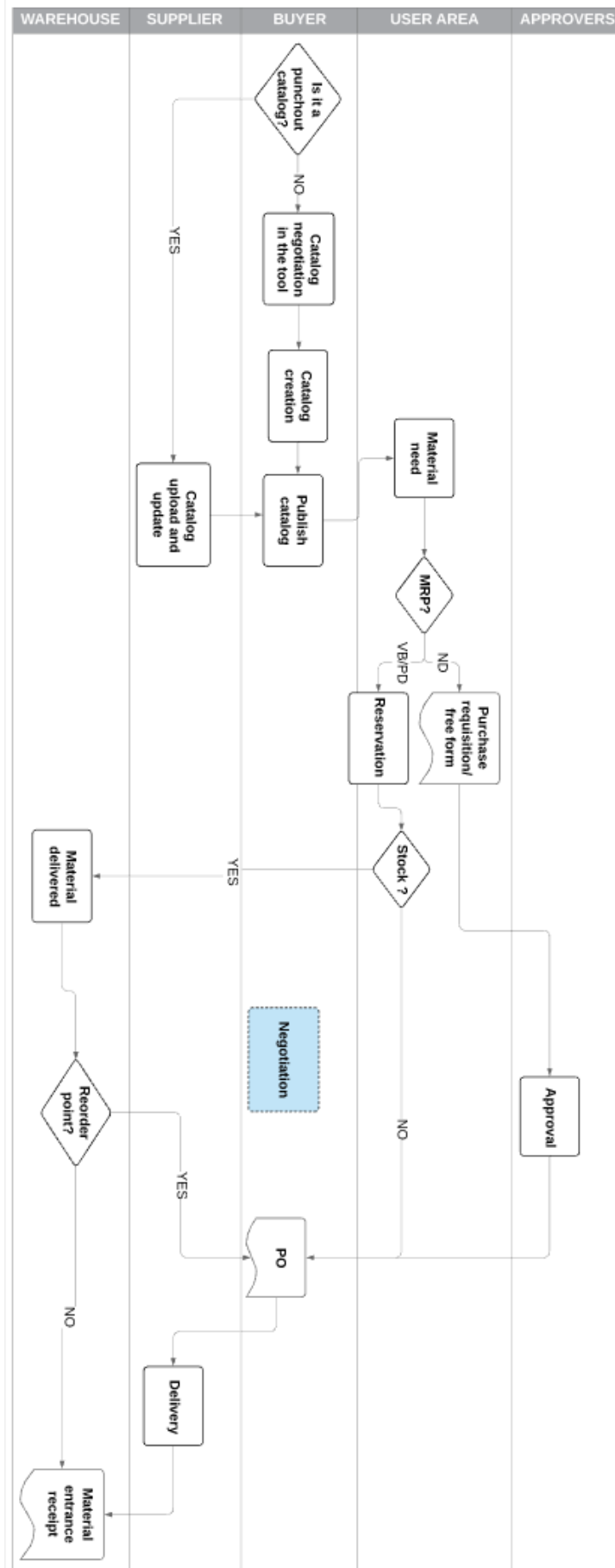
Figure 18 Purchasing TO-BE process

In the short term, the expected improvements can be accomplished with better use of the tool that BA already has at its disposal: SAP Ariba *Sourcing*. Firstly, it is intended to extend its usage to segments besides the core ones, that represent costs above a pre-determined amount. As the negotiation of these items is mostly made locally, it is important to take in consideration some additional challenges and benefits. SAP Ariba will allow the approval process to be made on an easier and more insightful way by the approver after the negotiation process is concluded, unlike what happened before when the approval was made before the negotiation, and the approver did not have any information regarding the price that was being approved, but only a reference price.

Furthermore, the collaborative function of the tool allows the user area to keep up with the process and to give inputs regarding the price or the supplier to award. This feature will increase the acceptance level by the user areas, smoothing the process.

Additionally, as it was mentioned before this tool enables better visibility, organization, and information in the decision making, and registers all the data from the negotiation process, which was not possible when the negotiation tool was the e-mail or the phone. To insert all the materials in SAP Ariba *Sourcing* would be a pilot stage of the process to identify a minimum value from which it is worthwhile using the platform. SAP Ariba *Sourcing* requires specifications and tasks that are important for later analysis and reporting, but it usually requires more time, and for low-value assets, it becomes more disadvantageous than helpful.
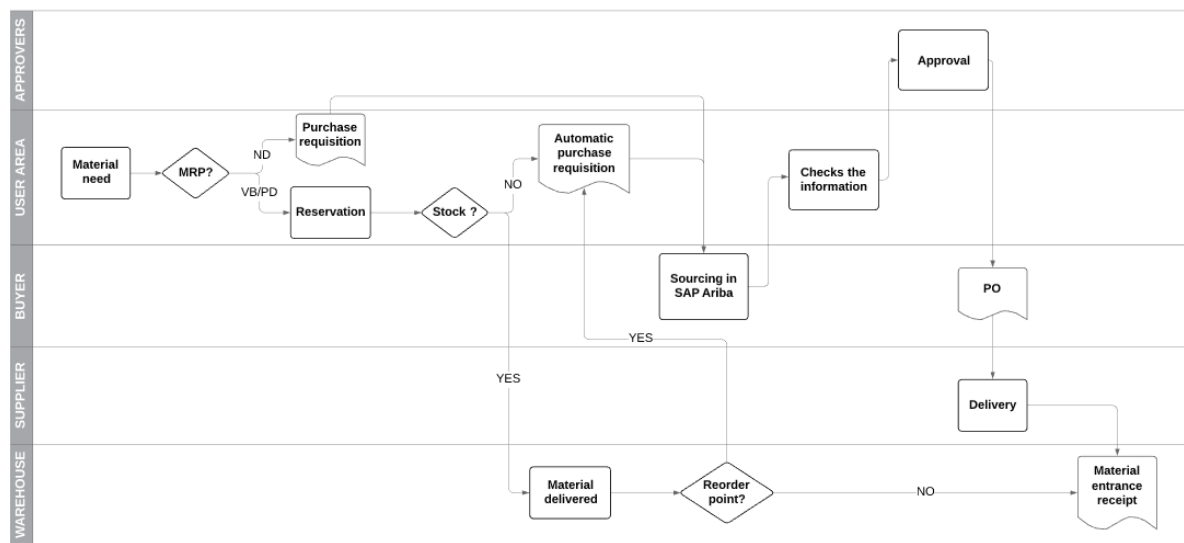

Figure 19 Purchasing TO-BE process for short-term application

5.3 Supplier management

5.3.1 Expected benefits and challenges

Supplier networks allow buyers and suppliers to collaborate through an electronic platform benefiting procurement's visibility towards financial operations and management of spend and catalogue pricing. Both buyers and suppliers can benefit from supplier networks.

Buyer benefits

- Increase process efficiency.

- Get full visibility into all elements of supplier information, including performance, certificates, and contacts.

- Accelerate supplier evaluation and qualification by automating the process of gathering information and approval.

- Protection against supply disruptions and compliance risks.

- Improve supplier on-time delivery and performance.

- More sustainable processes.

- Free staff for higher-value tasks.

Supplier benefits

- Increase sales opportunities since it has access to a large number of buyers in the network.

- Low service costs (some features are even free).

- Improve communication with customers.

- Improve customer satisfaction.

- Reinforce customer's loyalty and relationships.

- Accelerate the order-to-cash cycle.

Regardless of the benefits, the number one challenge for a supplier network is gaining supplier adoption. For BA, being unable to connect some strategical suppliers would leave a tremendous amount of uncaptured value on the table. It is a major aspect to extend focus beyond onboarding top suppliers because, while top suppliers represent a significant part of a buyer's spent in terms of money, they represent a mere fraction of the total transactions.

This lack of adoption by suppliers may be overcome if they are presented with the value proposition the software can provide, which must be done by the buying company and supported by the platform's vendor which should enable a fast, easy and free supplier enrolment as it happens in SAP Ariba's case. Another aspect to take in consideration in supplier adoption is the software's ease of connectivity and use, which can be obtained by cloud-based services. Finally, SAP Ariba has dedicated onboarding teams that provide detailed instructions and presentations, to help BA onboard its suppliers.

Furthermore, this tool will require a process adjustment and the engagement of all stakeholders to participate in tasks that were previously not their concern. For the digitalized supplier management process to bring benefits to the company, it will need all employees to be committed to the project's purpose and goal.

Finally, another aspect to take into consideration is the software's cost. The costs related to this solution are approximately ¼ of the costs associated with the *Buying* module.

5.3.2 TO-BE process

BA's first step is to invite its current suppliers to self-register in SAP Ariba's platform. There the suppliers can create their profile, with their information and certificates which is later approved by the purchasing department. After they must fill category forms where they should specify some aspects regarding their business scope and regions where they operate, which must again be advocated by the purchasing department. Finally, SAP Ariba automatically provides a matrix-based segmentation report and visual dashboard, where suppliers are organized by region, category, and importance for the company. Automatic alerts are sent to all stakeholders who are responsible for supplier evaluation, so they fill the forms, and the scorecards are pulled from Ariba. This information is then placed for

commodity buyers in a strategic dashboard that ranks suppliers based on pre-defined criteria. Suppliers also receive notification warnings to self-update obsolete information like certificates or other key documents. Risk management is a parallel assessment made entirely by SAP Ariba and provides another measure for qualification as well as ongoing monitoring of risk.
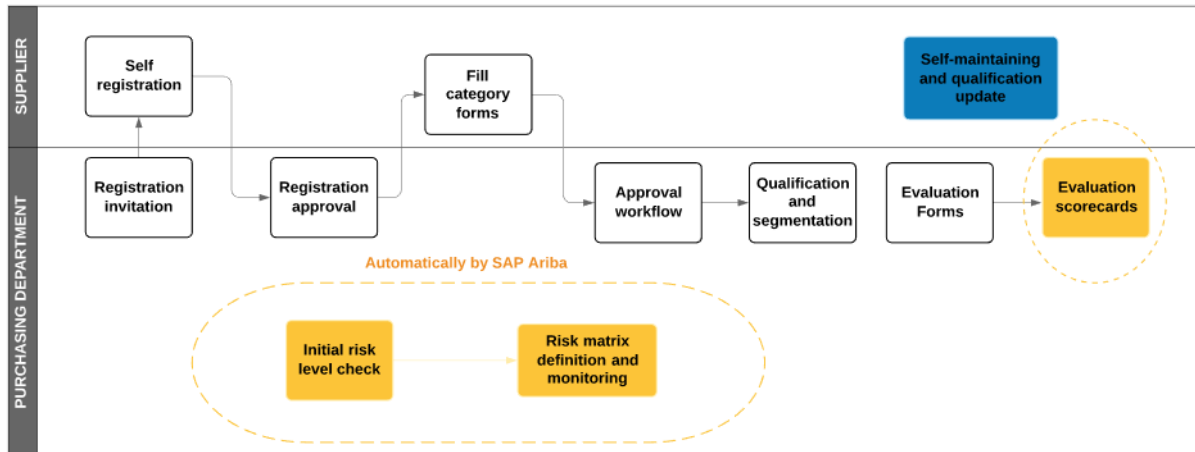

Figure 20 Supplier lifecycle and performance management TO-BE process

6 Conclusions and future work

To conclude, this work recognized the importance that digitalization could have in BA's procurement processes for three main reasons. The first one is the internal and external visibility that the company has over its operations and stakeholders. Better visibility ensures greater control and security of the business. In the second place, it allows streamlining the processes that are usually poorly managed, and control outdated processes that represent inefficiencies to the company. This standardization enables BA to assure that all information is stored in the company's system and control information loss by processes that are, in the present moment, made by e-mail or phone. The third and last major benefit of process digitalization is the possibility of analysing and reporting the processes and follow KPIs that could underly a better decision. Purchasing and supplier management digitalization becomes crucial since it was concluded that these were the most antiquated processes. After several options were analysed, we concluded that on a strategical and operational point of view, SAP Ariba was the best choice to support BA's needs. With this solution, it will be possible to obtain besides qualitative benefits, a cost reduction by controlling unmanaged spend that the company has endured.

This thesis concluded that a broader centralization of purchasing and negotiation could improve buying conditions and reduce costs. These savings can achieve from 3% (conservative approach) until 19% (optimistic approach) of the total spent per year in three specific commodities. Although the investment that will be needed is significative, savings are more substantial, and this platform is considered a good digitalization initiative for BA.

However, before adopting this solution, a master data cleaning must be made, in order to clear up duplicates and obsolete data both for materials and suppliers. It will also be necessary to conceive a detailed plan, setting time goals, and resources to allocate to the project. The procedures will also need a reformulation, and all mentalities must be set to reduce employee's resistance to these changes. Training is a necessary action to achieve the intended results, since the lack of assistance can be one of the main reasons for this possible unwillingness.

To fully enhance the benefits that these actions can bring to BA, performance tests could be arranged to the suppliers, where the leading causes of delivery problems and product defects would be identified. This would help to truly understand the impact that such a problem has on BA's operations and how these digital solutions could help avoiding them. Digital collaboration systems would bring benefits for both parties since this initiative would directly influence the supplier selection, and quality would become a key criterion.

Future works in digitalization are endless since change and evolution are continuously growing, and so are the challenges that BA has to face. The most significant point that this work aims to express is the constant adjustments that organizations must make to give a response to the market's needs, which can be supported by technology developments and process digitalization. This should ultimately be a never-ending action.

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