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Intelligent Purchasing: How artificial intelligence can redefine the purchasing function

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Abstract

Artificial intelligence (AI) can affect all of a company's functions, not least the purchasing department. In addition to automating and optimizing existing processes, AI opens up new opportunities for purchasers to undertake new, strategic, collaborative, enduring missions. AI enables complex, strategic decision-making in an unpredictable, hostile environment. This article analyzes to what extent AI can improve the performance of the purchasing department. First, a review is undertaken of how AI is used in purchasing. Thereafter, the research follows an exploratory, inductive, and qualitative approach based on a multiple case study of the following technologies: (1) the Synertrade automated international purchasing system; (2) the Silex matching system; (3) SAP Ariba decision support; (4) Jaggaer supplier relations management; and (5) the Ideapoke collaborative ideation and innovative project management platform. The present study's contributions lie in its redefinition of the purchasing function, of the purchaser's role, of supplier relationship management policy, and of interdepartmental collaboration, involving, for example, Marketing and R&D.

Keywords: Artificial intelligence; Purchasing function; Machine learning; Matching systems; Decision-making; Collaborative project management.

1. Introduction: the advent of AI in purchasing

Although still much less digitalized than other business functions, purchasing is turning towards artificial intelligence (AI) (Bienhaus & Haddud, 2018). The intelligent information systems used by purchasers increasingly include decision support, strategic monitoring, prediction, and collaboration technologies. Some large groups, considered as pioneers in the field, already use AI widely. Their high level of purchasing maturity (Potage, 2017) enables them to design and adopt AI-based systems to undertake various tasks in parallel with, or instead of, their buyers, and to accomplish missions that could not be undertaken without these emergent digital technologies.

Organizations' purchasing departments, suppliers and partners produce massive quantities of data. Even more are produced in the organization's ecosystem. This huge volume of data provides substantial potential for added value, but this potential is seldom, if ever, fully exploited. Moreover, in general, the data produced, internally and externally, are not analytically processed in depth, due to a lack of specific skills (Mikalef, Pappas, Krogstie, & Giannakos, 2018) and/or appropriate tools. Resistance to change is another major obstacle to digital transformation and to the adoption of AI by purchasing departments. Yet competition is increasing in every sector: firms face a hostile environment in which the slightest mistake can be very damaging, particularly in manufacturing. Markets have become gigantic, highly competitive, extremely complex, faster moving, unpredictable, and more responsive. In this environment, the ability to do more than just survive and submit to circumstances is crucial for corporate performance, and the purchasing department plays a decisive role. Due to AI, purchasers can provide firms with the means to anticipate and adapt to market trends, or even to take control and guide the market to create disruption and gain critical, lasting competitive advantage (Borges, Hoppen, & Luce, 2009). AI is linked

to knowledge management and absorptive capacity through the increase in organizations' ability to learn (Van Der Heiden, Pohl, Mansor, Genderen, 2015; Liebowitz, 2001). Thus, the relationship between AI systems and organizational management has become a crucial issue for researchers and business leaders. The previous literature has examined various applications of artificial intelligence, from social signal processing that helps entrepreneurs make decisions (Gieure, Benavides-Espinosa, & Roig-Dobon, 2019; Liebrechts, Darnihamedani, Postma, & Atzmueller, 2020), through commercial banking and behavioral finance (Königstorfer & Thalmann, 2020), and business value creation in terms of strategic performance using machine learning (Ruivo, Oliveira, & Faroleiro, 2020), to the management of sustainable supply chains (Dauvergne, 2020). However, little research has been carried out into the use of artificial intelligence in purchasing departments.

This article explores the potential applications of AI in purchasing, and its effect on the performance of purchasing departments. The literature review presents the various areas in which AI can be used by purchasers, from the highly operational to the highly strategic. The present study explores the impact of AI tools on the purchasing function and their limitations. To achieve this a multiple case study based on documentary data explores the technologies associated with each of these missions. For this research, five different machine-learning technologies, designed to help the purchasing department make decisions, are examined.

The main contribution of this study is its analysis of the applications of AI in the fulfillment of the purchasing department's missions and its impact on the department's performance. This approach will allow us to better understand the role, contribution, functioning, challenges, and development prospects of AI in the purchasing function.

The present study therefore provides a complete overview of all available AI-based purchasing management technologies, a critical analysis of their advantages and limitations, perspectives on their evolution, and managerial recommendations as to how they might be used. The second part of the study proposes a theoretical framework for the different applications of AI, its associated practices, and its impact on company performance. The third part discusses the research methodology. The fourth explores five typical, emblematic cases. The fifth discusses the results and perspectives of these cases. The study concludes with a summary of the main findings of the research and provides managerial recommendations.

2. Current and potential uses of AI in the purchasing function

Although it has been adopted only recently by purchasers, AI is already well established in a variety of forms, both quantitative, to optimize performance indicators, and qualitative, in relation to decision-making and personal interactions. The next subsections discuss the different missions that AI can undertake for the purchasing department. Understanding the possible applications of AI helps to identify how they can be improved and the gaps that they do not yet bridge.

2.1. Automation and optimization of purchasing processes

The most common ways that purchasing departments use AI are to automate and optimize processes. These techniques include: analyzing expenditure by purchaser, supplier, internal client, segment, geographical area, project, and industrial program; optimizing stages of the purchasing process, from the identification of the need to source a product or service, negotiation, contracting, and finally to reception; contract management and monitoring, particularly with framework contracts; analyzing key performance indicators; quality

control and reducing nonconformities; and answering the questions most frequently asked by internal and external contacts.

Automation optimizes purchasing processes, for example, by making them easier to control and to monitor in real time, by ensuring they are respected, by avoiding delays and mistakes, and obtains better results (Allal-Chérif & Maira, 2011). AI is capable of processing incomparably greater quantities of data than can humans, with unparalleled reliability and at lower cost (Salminen, Ruohomaa & Kantola, 2017). In addition to immediate savings of money and time, digitalizing purchases and implementing intelligent technologies is likely to create long-term qualitative value.

Process optimization is not limited to automation and control. Developing good relationships with the different partners involved in these processes is crucial. To achieve this, buyers might use chatbots, that is, intelligent, autonomous virtual agents capable of conversing or negotiating with humans and/or other chatbots (Chung, Ko, Joung, & Kim, 2020). Chatbots are configured to analyze the needs and responses of their real or virtual contacts, and to provide them with information and/or services (Garimella & Paruchuri, 2015). A chatbot can contact a selected supplier, provide information about its parent company and its activities, collect basic information, and test the potential for a commercial relationship or partnership. Chatbots can take responsibility for the Request for Information (RFI) stage of supplier sourcing, and have the advantages of being able to contact many more firms, to follow up on 100% of the requirements and to maintain positive relations even with firms that are not selected.

2.2. Supplier selection using matching systems

Even small firms now source globally, and purchasers cannot consider and compare all the offers made by the thousands of available suppliers without using IT. Many suppliers can

answer calls for tender and comparing them all is a colossal task. Moreover, to avoid missing out on exceptional suppliers, purchasers must broaden their selection criteria to assess tenders that may, at first sight, appear inappropriate, but which may just be atypical, and have unique features. Time constraints and strict deadlines prevent buyers from examining all the detail of their suppliers' offers. Yet value creation lies in the subtle differences in the minor components of suppliers' proposals. This is where buyers can find most new ideas (Legenvre & Gualandris, 2018).

Matching systems developed to manage calls for tender are based on algorithms that consider thousands of weighted parameters to find the most suitable supplier for an internal need (Asthana & Gupta, 2015). Inspired by dating websites, these systems attempt to find the most suitable and satisfactory match for each of the two parties, the buyer and the supplier. If they "fall in love at first sight" they can develop a lasting, balanced, cooperative, and less opportunistic relationship, as it will be based on a multitude of objective criteria. These systems can analyze many types of proposal, including the unexpected, the original and the quirky (Lu & Hong, 2019).

AI allows purchasers to more efficiently source items, for example, by placing orders for families of items, by program and even by series of programs, to avoid the impossible task of managing a multitude of suppliers. The aim is to group purchases as much as possible, using a limited number of suppliers, but without losing innovative capacity, by compromising on certain non-strategic criteria. This process simplifies logistics, contracting and financial management, while reducing risk. Supplier selection is based not only on internal needs, but also on inter-supplier compatibility, their complementarity, and their affinities.

2.3. Predictive buying and decision aids

Purchasing departments produce a large amount of data that previously was often incomplete, inaccessible, unreliable, or simply unused. Technological progress is gradually making it possible to overcome these difficulties and to analyze big data using powerful algorithms. In addition to internal data, purchasers constantly analyze external data, simultaneously scanning thousands of information sources to identify weak signals showing opportunities and threats. AI can recommend measures to benefit from opportunities and to avoid threats. Comparing internal and external data can reveal inconsistencies in suppliers' practices in terms of innovation, ethics, sustainable development, prices, product ranges, flows and trends.

Purchasers need to employ immense multidimensional data sources and knowledge in a wide variety of fields, and combine them to ensure optimal decision-making (Baryannis, Validi, Dani, & Antoniou, 2019). Thus, they need simultaneous access to commercial, technological, logistical, legal, financial, environmental, ethical, and strategic information. In addition to information produced by purchasing activities, organizational ecosystems yield enormous amounts of data. It is simply impossible for buyers to examine all this data and to select the most important or useful without using intelligent information systems. Intelligent content extraction tools can read many types of documents, in a wide range of formats, including handwritten, and extract relevant information based on algorithmic configurations defined in line with the buyers' objectives. AI can identify current and future malfunctions that are difficult for humans to identify. AI is even more useful when it anticipates problems before they arise. This allows buyers to implement preventive solutions proactively (Bienhaus & Haddud, 2018).

2.4. Supplier relationship management

Supplier portfolios are becoming increasingly complex and difficult to manage, due to the simultaneous increase in their numbers and variety in terms of size, location, organizational, and corporate cultures (Choi & Krause, 2006). By analyzing big data, buyers can monitor supplier performance and help them to improve with regard to certain criteria. These criteria are no longer limited to costs, quality, and deadlines. Sustainable development, relationship quality, and innovation now have an important place.

Maintaining good relations with strategic suppliers and becoming privileged clients is a priority and a major competitive advantage for many firms, particularly innovators. In addition to assessing suppliers and checking that their performance is always satisfactory, buyers also want to ensure that a strategic supplier is satisfied with them, and that their relations with the supplier are good.

Buyers have to be able to assess supplier satisfaction and know how to improve it. Thus, they regularly ask their most important suppliers for their opinion on the quality of their interactions. In some manufacturing industries firms can now even discover how their suppliers rate them, thanks to dedicated software/applications that use algorithms to calculate company rankings. Electronic supplier relationship management, or e-SRM, guarantees rigorous, accurate monitoring of the different indicators used to assess this satisfaction (Batra, Erben, Schulz, & Sperl, 2017).

Thanks to AI, these indicators can be measured using many more data, and not just after the event, but also in real time. AI no longer manages indicators only separately, but in combination. Being one of a supplier's best clients, not only in volume terms, but, above all, in terms of relationship quality, provides certain privileges, such as having priority in cases of emergency and/or for innovative projects.

2.5. Collaborative project management and open innovation

In the current context firms are finding it increasingly difficult to remain competitive on their own, and to overcome global competition using their own resources. To achieve success, they must join other organizations and share resources, and thereby innovate and outdo other market players. Collaboration between players in a single value chain has become crucial, and to integrate suppliers as extensions of the firm is a strategic priority. The aim is to combine expertise and go further, faster, and more efficiently at less cost. Global clusters compete to attract the best partners and develop the most profitable, disruptive technologies (Bleda & Chicot, 2020).

However, the task of coordinating the decisions and actions of multiple, diverse actors contributing to innovative projects is particularly complex. Orchestrating the actors' initiatives to form shared objectives requires AI to communicate with the tools specific to each member of an alliance, and consistent, dynamic connections between its component parts, based on agreed master plans. Supplier integration is based on the implementation of collaborative ecosystems in which data are managed collectively and disseminated in a fluid, optimal manner between the actors in the system (Yang, Zhang, & Xie, 2017).

AI can recreate proximity between distant actors and promote involvement and trust between a company and its suppliers and strategic partners. AI makes it possible not only to federate the expertise of different suppliers and encourage them to work together, but also to take account of the recommendations of reference clients and other organizations whose skills and knowledge can contribute to project accomplishment (Aragon-Mendoza, Pardo del Val, & Roig-Dobon, 2016). AI enables buyers to orchestrate widely diverse multifunctional teams made up of internal and external actors from different departments, firms, cultures, and generations, using different technologies, and can help them to work together harmoniously to achieve ambitious objectives.

4. Methodology

Taking into account the uses that purchasing functions can make of AI, two research questions seem obvious: How can AI help make purchasing decisions? And what improvements can be made to make AI systems more efficient and effective?

The learning processes that organizations implement to improve their capabilities to compete with other organizations have been extensively examined in management research (Kotnour, 1999). Thus, studying these learning processes is crucial. In the case of AI, these processes are controlled in part by machine-learning technologies (MLTs), due to the feedback they receive from their interactions with other MLTs and humans.

Our qualitative exploratory methodology consists of a multiple case study of five information systems that use AI and MLTs. The case study method is particularly suitable for examining emerging technologies, such as AI, whose impact on managerial practice are difficult to assess due to their recent, rapid development (Yin, 1993). To ensure that the conclusions reached by case studies are valid the information they collect must be triangulated by comparing data, testimonies, and theories from several independent sources. While using a wide range of cases enables researchers to adopt a more comprehensive approach and provide more nuanced insights, valid conclusions can be drawn from a limited number of cases.

We selected the systems examined in this study because they corresponded closely to the missions described in the literature review and because of their reputation with professionals. (1) Synertrade is a purchasing management software package that develops automated processes. (2) Silex is a matching system that automatically links purchasing requests to the most appropriate suppliers. (3) SAP Ariba is data analysis and decision support software that proposes the best choices to purchasers. (4) Jaggaer promotes

collaborative, lasting supplier relations. (5) Ideapoke facilitates technology capture and the implementation of innovative projects.

The use of a range of diverse sources enabled us to enrich and triangulate the information (Denzin & Lincoln, 2005). For each case we based the data collection on: a documentary analysis of websites, brochures and presentation videos; non-participant observation of the platform's operations; and the testimony of a buyer who uses the software regularly. Companies that have adopted AI in their purchasing departments provide opportunities for observation, analysis, and interpretation (Miles & Huberman, 1994).

Exploration techniques are preferable to experimentation for the observation of natural, everyday behaviors, and the collection of authentic data about actual practice. From an inductive perspective, the technologies analyzed lead to a discussion about AI's influence on companies' performances, missions, buyer relations, and about its limitations.

5. Case studies

Developers have created software incorporating big data and AI that carry out tasks that buyers could not undertake as effectively using their previous systems. The cases chosen cover the five purchasing areas where AI can be deployed; they were chosen based on quality and prestige criteria. The cases are emblematic and typical, which facilitates understanding of how the AI technologies function. These digital purchasing management technologies have been acknowledged as the best in their fields by independent analysts and professional associations. The studied platforms have renowned customers and are considered as pioneers in their fields. They have won awards for their innovation and the quality of the services they offer.

5.1. The Synertrade automated purchasing processes system

Synertrade Accelerate is a modular software that manages and optimizes purchasing processes. A leader in digital procurement solutions, Synertrade has recently been recognized by Qlik (a US-based data analytics platform) as “EMEA OEM Partner of the Year” for 2019. Awarded annually, these awards recognize excellence in Qlik's partner community, in various categories, both globally and in key regions. Synertrade was recognized, among the international network of Qlik partners, for its expertise in strategic purchasing, combined with the ever-increasing involvement of its technical experts. It assists buyers at every stage in sourcing, procurement, supplier integration and evaluation, performance monitoring, and joint project management.

Synertrade Accelerate encompasses a portfolio of 35 applications divided into five essentially operational and tactical sub-sets. (1) Source to Contract (S2C) replaces desktop software and online forms with dedicated ergonomic software that go much further than simply responding to internal needs. S2C helps buyers: develop local and global sourcing strategies; design calls to tender in line with predefined models and to process them in parallel, rather than separately; refine selection criteria and establish allocation scenarios; and negotiate transparently, rapidly and automatically using nine types of reverse auction. Synertrade Accelerate provides savings and increased conformity, and accelerates the sourcing process by, on average, 20%.

(2) Procure to Pay (P2P) is a digital toolbox for managing procurement. It facilitates imports, homogenizes and updates supplier catalogues, monitors flows of purchasing order approvals, controls expenses in line with budgets, and reduces non-standard purchases. It makes an e-business portal available for internal clients to place orders that respect framework contracts. The P2P module accelerates and homogenizes procurement while reducing costs and non-standard operations.

(3) Supplier relationship management (SRM) enables firms to develop lasting collaborative relations with their suppliers and to include them in processes to increase transparency and reduce risk. SRM uses applications that continuously improve quality and increase supplier loyalty by taking medium- and long-term approaches to supplier relations. This module enables the firm to retain its best-performing suppliers, to approve or certify promising new suppliers and stop working with those who have reached their limits.

(4) The Purchasing Intelligence module uses applications for purchasing management accounting, documentary analysis, and dashboard design. The system produces statistics on AI adoption and user behavior, and enables firms to implement risk management policies.

(5) Idea to Product is a project management module that, through managing internal and external collaborations, helps firms select and introduce innovations. It uses applications for communication, planning, resource management, and process optimization. It provides better traceability, reduces project duration, increases project success rates, and standardizes processes.

The Synertrade Accelerate platform now incorporates CommodityBots, virtual intelligent robots that supervise purchasing processes and the data collected by its different applications and notifies buyers of opportunities or any relevant issues. An intelligent agent, named Marvin, is available to serve buyers, answer their questions, and find information. Using natural language processing (NLP) Marvin can speak on behalf of buyers to colleagues, internal clients, and suppliers via messaging systems such as Skype. Marvin learns by machine learning technologies and observes buyer behavior to improve his contribution to the purchasing process.

5.2. The Silex matching system

Silex is a SaaS cognitive sourcing platform that manages the whole purchasing process: centralized expressions of needs, approval procedure, contract visualization, panel development, suggested solutions, negotiation, performance monitoring, and relationship management. AI takes charge of repetitive tasks and assists buyers throughout the process of selecting a supplier from a pool of more than 180,000.

Due to its recommendation engine, which is similar to those used by dating and e-commerce websites, Silex can suggest the best procurement sources for a need expressed in natural language. Prequalified suppliers are ranked in order of suitability, with priority being given to those who already have a contract in progress or have previously worked with the firm and given satisfaction. The AI system makes recommendations based on past purchasing requests, using a semantic analysis tool and MLTs. The most suitable matches are established by automatically matching needs to available offers.

Silex combines the information provided by suppliers with data from multiple outside sources to provide industrial, technological, financial, and legal knowledge about the whole supplier base. This enables the buyer to triangulate the data provided by the supplier with more robust, diverse information when making decisions. Buyers can easily reference, recommend, assess, and document suppliers; thus they can contribute to the dynamic real-time mapping of all the available suppliers for the stakeholders at the firm's different sites. Silex enables purchase requests to be monitored progressively as they move through successive stages: entering, approval, planning, allocation to purchasers, identification of potential suppliers from the pool, cataloguing, selection, and contracting. The Silex platform centralizes various catalogues of standard products, thus removing the need to go through other systems, which saves time for the more basic requests. Silex has enabled some of its clients to reduce their sourcing time by up to 90% for simple purchases,

particularly for equipment and services; and the suppliers chosen provide at least as much satisfaction as prior to the introduction of Silex.

The Silex interface is intuitive and ergonomic, unlike many sourcing tools, which can be complex to navigate around and require user training and support. The criteria considered are not limited to quality, cost, and lead times, but include innovation capacity, CSR, relational quality, and performance history. Silex users come from a wide variety of sectors: the oil industry, with Total, the airline industry, with Air France, the banking sector, with Societe Generale, the HR sector, with Randstad, and the insurance sector, with Covea.

5.3. The SAP Ariba decision support system

SAP Ariba, the world's leading e-purchasing platform, enables buyers to act proactively and anticipate problems before they occur, both to avoid them and to prepare for them. SAP's vision is that, in the coming years, purchasing departments will play increasingly strategic roles and make substantial impacts on their firms' and their ecosystems' innovation, reputations and overall performances.

SAP Ariba provides buyers with an overall view of their partnerships and their impact on the satisfaction of internal and external clients based on predictive analysis technologies that rely on multidimensional data and algorithms to develop knowledge and increase quality. The technologies become increasingly effective as they learn more about the activities of the stakeholders and analyze the repetitively reproduced data.

SAP Ariba offers its users new tools that combine AI and MLTs to monitor hundreds of thousands of public and private information sources and, thus, reduce risk. The SAP modules "Procurement", "Supplier Risk", "Supplier Lifecycle and Performance", and "Network" help firms make safer procurement decisions by comprehensively assessing

their exposure to financial, operational, reputational, societal, and environmental risks. A system of permanent supplier monitoring and assessment warns buyers of potential failures or excessive risk exposure.

SAP Leonardo Ariba and IBM Watson technologies have formed an association to offer buyers intelligent tools to assist, and eliminate any bias, in their decision-making. Together they can now more quickly detect opportunities and threats crucial to the firm's activities and deal with them more effectively by acting earlier and more transparently. Buyers' traditional competences are being replaced by risk analysis, data science, and innovative project management. Suppliers are integrated as extensions of the organization, and decisions are taken to create collective value. Intelligent information systems contribute to enlightened decision-making by multiple players in unstable, unpredictable environments in which agility and coordination are the key success factors.

SAP Ariba has developed a chatbot, which they have named "Procurement", capable of adapting to organizational, departmental, and individual characteristics to answer questions and provide the right actors with the right information at the right time. This conversational robot assists buyers and suppliers throughout the sourcing process, proposes different scenarios, warns them when they, or other stakeholders, make mistakes, and helps them achieve better results more quickly.

5.4. The Jaggaer SRM system

Jaggaer, the world leader in cost management, offers firms innovative supplier relations' solutions, that is, Total Supplier Manager and Direct SRM. With the ability to analyze and predict costs, Jaggaer contributes to the development of appropriate strategies that are shared with other stakeholders. Jaggaer combines intelligent, machine-learning technologies, to help buyers identify key elements, share their vision, establish

partnerships, and mobilize different players to work on joint projects. In 2016, Jaggaer received the Use of Technology Award for E-Commerce from the North Carolina Technology Association in recognition of the excellence and innovation of their e-purchasing platform.

Although it has focused on better cost management, this system is evolving to become more collaborative and helpful in managing the whole supplier relationship. Suppliers are no longer considered only as occasional cost-incurring procurement sources, but also as potential strategic partners who can be essential parts of the company's innovation and long-term value creation processes. Suppliers no longer feel dominated, or even bullied, by buyers; relations between them are peaceful and based on trust. Buyers now have better knowledge of the strengths and weaknesses of their suppliers, and undertake regular discussions about their outlooks, concerns and opinions about market trends, and can, thus, support them better, benefit from their expertise, and develop innovations with them, while making substantial savings as the suppliers come to see purchasing entities as important partners.

Jaggaer's SRM solutions manage the collection and compilation of information about suppliers, select and qualify them, monitor their performance, and manage risks and incidents. The applications organize and supervise all supplier-related documentation and can alert buyers when suppliers do not respect a commitment, or their contracts expire. Using these tools buyers can organize supplier certification and continuous improvement campaigns by monitoring performance indicators and setting objectives to achieve within fixed timelines.

The system operates using multidimensional data collected from internal and external sources, updated in real time. The objectives are to have the most transparent possible

supplier relations, to have a 360° view of supplier performance and capacities, and to take a comprehensive, long-term, overall approach to costs and value created. Buyers use Total Supplier Manager to make better use of data which, in complex structures, is characterized by its volume, complexity, volatility, and interconnectivity. The intention of companies which use Total Supplier Manager is to implement AI modules gradually to identify critical weak signals early, and to incorporate them into supplier management policy.

5.5. The Ideapoke innovative project management system

Ideapoke is a platform that brings together players who might be able to work together on research and development projects. Using AI, the system suggests technologies and partner firms that correspond to the specifications provided. The system is designed to assist organizations in creating innovative ecosystems in which start-ups, research laboratories, non-profit organizations and local authorities can work on joint projects.

The main competitive advantage of the application is its powerful algorithms that find niche solutions that no other systems can find, and which connect technologies in ways that create value for the actors. Using MLTs, Ideapoke's algorithms suggest trends, matches, potential trajectories, and even business models and competitive strategies. The platform also claims that it can anticipate digital disruptions and their impact on consumer behavior and industrial competitors.

Ideapoke is based on a matching system that does not focus on sourcing and procurement, but on ideas, vision, projects, and innovation. Buyers can, thus, use it to introduce novel technologies, co-develop innovations, diversify, and conquer new markets. The system enables companies to make sense of the confusing, overabundant information that makes it difficult to identify relevant data and appropriate partners. Moreover, all the accurate, usable information about technologies cannot be accessed using traditional research tools,

given that it exists in a wide range of forms and throughout countless networks and spaces. It is exceedingly difficult to distinguish between technologies with real commercial potential and experimental technologies that have no practical uses. On Ideapoke suppliers sell their technologies and promote their R&D projects to find investors and co-developers. Ideapoke is mainly used by high-tech businesses such as Honda, Philips, Fujifilm, Panasonic, Electrolux, Murata, Bosch, and NEC to find partners with whom to develop new innovative projects. Coca-Cola, Unilever, and L'Oréal are also among its clients. The main contributions of Ideapoke are in reducing projects' time to market and improving their success rates.

6. Results

This analysis of five intelligent purchasing systems generated the following conclusions: AI makes purchasing missions more strategic and less operational; AI gives purchasers new capabilities, and enhances the purchasing function; AI strengthens the cross-functional role of purchasing, and its role as an interface with outside players; and the adoption of AI is subject to certain limitations, and its power must not be overestimated.

6.1. New missions for buyers

AI represents a different approach to purchasing and a new direction for the profession. The purchasing department has become forward-looking, or predictive: it makes hypotheses in line with probabilities, conducts simulations, and suggests practical solutions. Companies are introducing AI not only to move from reactivity to proactivity, and/or to anticipate events to prepare for them more effectively, but to become faster and more agile than their competitors. Although predictive purchasing is often reduced to the forecasting of demand and expenditure, AI provides visionary capacities that go much further (Mikalef, Pappas, Krogstie, & Giannakos, 2018). Its most important contributions lie in anticipating socio-

economic upheavals, optimizing CSR policies, and managing partner suppliers. The combination of technologies developed by Synertrade, Silex, SAP Ariba, Jaggaer, and Ideapoke enable buyers to: make better choices of partners and suitable projects, optimize relations, limit risk, and take the right decisions at the right time. For example, Jean-Baptiste Allemand, Head of Tools & Procurement Processes at Bouygues Telecom points out that: “SAP Ariba is a turnkey solution that covers the whole negotiation process. What I like about Ariba is having the whole supplier relationship recorded and I can have a 360° view of my supplier.”

Obviously, before they install technologies that will provide knowledge of the future, buyers must have access to technologies that can analyze the past and manage the present (Aragon-Mendoza, Pardo del Val, & Roig-Dobon, 2016). Internal data is compared with data obtained from outside entities such as suppliers, institutional partners, other market players, and thousands of other relevant sources. This exploration is conducted using datamining algorithms which make correlations, draw up statistics, determine trends, identify anomalies, and produce associated knowledge. This approach, which is still rarely used, goes well beyond the responsibilities of the purchasing department, and requires cross-functional vision and consistent information systems’ management. Predictive purchasing can anticipate supplier failures and implement preventive measures to avoid the consequences of failure. AI-based purchasing helps buyers manage all the dimensions of supplier risk in real time: ethical, ecological, climatic, geopolitical, logistical, financial, and qualitative (Yang, Zhang, & Xie, 2017).

6.2. Toward augmented buyers

AI favors the emergence of intelligent, augmented, predictive 4.0 purchasing. Buyers who employ AI can become faster, more reactive, and more efficient. Selecting a supplier and

signing a contract becomes an affair of weeks, rather than months. The augmented buyer no longer sees suppliers for what they are, but for what they can become. (S)he sees suppliers for the value that they can create not just by working for his/her firm but, above all, for the value they can create by working together. Buyers can use AI to attract suppliers that do not need, or wish, to work with their companies, for example, because the volumes involved are too small, because they see too many constraints, or because they disagree with the company's values (Batran, Erben, Schulz, & Sperl, 2017). Understanding these obstacles encourages buyers to promote their organizations upstream with marketing actions and to create the conditions necessary to reach agreements. Thus, buyers must "hunt" suppliers to make them new business partners that can help them realize the firm's ambitions, provide it with new expertise, and improve its reputation.

Some buyers deplore the fact that operational tasks and emergencies take up too much time in their daily work and that they are unable to spend enough time on strategic and tactical issues. Andrea Murani, Chief Procurement Officer at Mondadori Group, provides the following comments about Synertrade: "Nowadays, we must be quick to analyze, to understand what is happening, and to react. Synertrade is easy to adopt, it is simple, and it is more flexible than other solutions. Synertrade reduced waste of time, provides spend figures to the top management, and improves process compliance."

AI provides a solution to this problem because, while it manages the company's operational activities, the buyers can deal with other issues. The intelligent agents used in the different technologies we have studied replace dozens of buyers and accomplish tasks that buyers cannot undertake, such as analyzing tens of thousands of contracts, invoices, outgoings, and deliveries. They can answer most questions asked by colleagues, suppliers, and others. The agents learn by observing and reproducing buyers' practices. As the technology progresses,

these agents are becoming increasingly intelligent: they speak every language; they understand different natural language registers, including specific jargon, vocabularies, and codes; they contextualize discussions to provide appropriate responses; and they are learning to manage more and more exceptions.

6.3. Interdependence with other departments

Some advantages of AI are that it provides an overall approach to every department and stakeholder, considers an enormous number of parameters, and can then simulate new business models that take into account different types of organization, available resources, and potential profits. While the purchasing department is at the heart of this process, since it is cross-functional, open to the environment and proactive, AI-based initiatives will quickly become limited if they are led only by purchasers. Ideapoke, for example, highlights its coordination capacity in the following statement taken from its website: “[Ideapoke] redefines the way organizations innovate by providing software tools and a business platform to access the world’s technology information easily, connect with technology experts, and collaborate with technology partners. Our customers appreciate Ideapoke’s primary strength which is our in-house developed discovery engine where we use best-in-class big data and analytics to make sense of the technology data lying across various sources.”

Substantial information flows go through the purchasing department due to its: (1) multifunctional role, connected to all the firm’s departments and (2) its role as an interface between internal and external stakeholders. Given its position in the firm, the purchasing department cannot implement AI-based solutions without coordinating with other departments. It is, thus, essential to integrate the information system used in purchasing with those used elsewhere in the firm. As purchasing functions seem to be lagging behind

other departments, such as marketing, sales, finance, and human resources, with regard to AI adoption, they must adapt to, and choose tools that can connect with, existing systems.

As the purchasing function matures in large multinational groups, it becomes less centralized, with different subsidiaries and sites becoming more independent; the coordination between these elements can be ensured by intelligent systems capable of preventing nonconformity, making recommendations and, where needed, warning the appropriate purchaser. AI helps senior purchasers demonstrate the value of their role and their contribution to the firm's overall performance. AI puts purchasing at the heart of innovation. The buyer proposes ideas to the R&D department, which can incorporate them in its projects, and to the marketing department, which is permanently looking for new ways to satisfy client demands (Bleda & Chicot, 2020).

6.4. Significant limitations

Most firms are not, as yet, ready to adopt AI in their purchasing because they lack relevant experience. The relevant processes do have to be complete, consolidated, automated and shared by all actors. In such cases, AI can take charge of certain steps, enhance them, monitor their performance and predict the results (Bienhaus & Haddud, 2018). In this way, data analysis can be reliable, systematic, and significant. AI cannot resolve all purchasing problems and can even generate more problems than it solves if the organization, the department, and the buyers are not individually prepared. Algorithms sometimes suggest overly obvious, overly predictable solutions that lack daring and uniqueness. Such solutions keep organizations in their comfort zone by reducing risk to a minimum, and by maximizing short-term value creation. AI proposes safe choices and well-established paths that leave no room for imagination and innovation. Yet the greatest entrepreneurial and

industrial successes are born out of unexpectedness (Gieure, Benavides-Espinosa, & Roig-Dobon, 2019).

AI might deprive purchasers from providing the flashes of genius and intuition that only humans are capable of, but which are often decisive. This trend is strengthened by the phenomenon of concentration and mimetic behavior apparent in the service providers that have developed the AI used in businesses. Technology giants such as Google, Microsoft, and IBM make other firms dependent on them, with the aim of increasing their domination and ensuring their systems become standards.

AI raises suspicions and can deter partners that mistrust its associated technologies. Indeed, AI could easily be used for industrial espionage and other illegal activities. AI systems can be targeted by cyberattacks, making them weak links in the IT-security system. They can be used both as entry points that might provide access to sensitive data and be fed fake data to put them out of action. AI can dehumanize relations, making them less spontaneous and natural.

7. Conclusions

The organizational literature has thrown up an issue that has become the cornerstone of knowledge management, that is, absorptive capacity; this is due to the positive effect of absorptive capacity on the learning capacity of companies (Allal-Chérif & Makhoul, 2016; Van Der Heiden, Pohl, Mansor, Genderen, 2015; Liebowitz, 2001). Studying AI can help organizations to develop the necessary systems to learn and to incorporate new knowledge into business management.

AI helps buyers solve complex problems that were previously unsolvable, or to which they had hitherto found less effective responses. Intelligent information systems use algorithms to analyze the environment and provide information that helps buyers' decision-making,

and which then analyzes their proposed solutions, establishes scenarios, and suggests which will provide the best performance and the least risk. Clearly, AI pushes the limits of what is possible for buyers in terms of new missions. AI is useful to buyers in three areas. First, at the strategic level, it assists in decision-making, intelligence gathering, supplier integration, and prediction. Second, at the tactical level, it helps companies monitor performance and manage resources and risk. Finally, at the operational level, it helps with sourcing, process automation, payment control, contracting, and administration.

One of the major uses of AI is to help integrate the digital technologies used by buyers; this helps to simplify the buyers' needs and facilitates the adoption of the technologies. In addition, companies need to anticipate and adapt to market trends to build lasting competitive advantage (Borges, Hoppen & Luce, 2009). AI can improve businesses' capacity to achieve this. Furthermore, the purchasing department literature shows a clear correlation between companies' supply chain management and their competitive advantage (Büyüközkan, 2012), which this study corroborates.

AI can be intuitive and mask its structural complexity behind its user friendliness. A huge gap exists between the fashionable image of, and fascination for, AI; there is a fantastic view that accredits AI with powers which go far beyond what it is capable of, and reality, which is, today, much less extraordinary. Whilst AI's potential is enormous, access to these emerging technologies remains for the moment reserved for large groups capable of investing massively in the research needed to develop it. In any case, AI is not a miracle solution for every problem faced by purchasing departments.

Although this study provides a better understanding of how AI can improve the purchasing function, achieve higher performance, and handle new missions, it has some weaknesses. The first relates to the data. Interviews and documentary data can be good sources of

information. However, other types of data source and collection techniques may help to complement the methodology employed. Future studies should address this by introducing other methods of data compilation such as, for example, ethnographic techniques.

Furthermore, as previously explained, the cases were chosen based on reputation criteria and, thus, represent the best in their categories. This is appropriate for a first step. However, future studies should examine less sophisticated AI systems with less elevated reputations. This might help in the understanding of other needs or gaps that AI can address. Finally, although in the early stages of research qualitative measures are commonly used, future studies should quantitatively analyze the impact of AI on performance, for example, by employing financial indicators.

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