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Navigating the Socio-Technical Impacts of Purchasing Digitalization: A Multiple-Case Study

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Abstract

The wave of digitalisation is impacting companies at multiple levels. Beside the most researched impacts on manufacturing, also other business functions are subjected to the change. Among them, purchasing is expected to greatly benefit from digitalisation, if properly managed. This research analyses the digitalisation of the purchasing process, in terms of how and why it happens, and the co-evolution which is triggered on the social dimension. A multiple-case study approach is adopted, analysing eight companies from industries characterized by different digital intensity levels but all at a relatively advanced stage of digitalisation of the purchasing department. The results show how different technological innovation approaches (i.e., automation and/or augmentation) impact the evolution of the purchasing department's social dimension in terms of autonomy, job enlargement, competences, internal and external collaboration. A new framework describing how automation and augmentation impact on purchasing social dimension, as well as purchasing efficiency and effectiveness, is proposed as main theoretical contribution. The study combines the socio-technical systems perspective with the automation-augmentation paradox and describe the strong relationship between purchasing departments' social and technical dimensions, offering managers insights on handling a purchasing digitalisation process, simultaneously managing the technical and social dimensions impacted along the process.

Keywords: Purchasing, Socio-technical system, Automation, Augmentation, Digitalisation

1. Introduction

As part of the studies on the impact of digitalisation on organisations, the evolution of the purchasing department has received increased attention (Bals et al., 2019; Hallikas et al., 2021; Srai and Lorentz, 2019; Wehrle et al., 2022). Scholars are highlighting the changing role of purchasing from a cost centre to a business leader in response to the digitalisation opportunities (Seyedghorban et al., 2020), and how to approach the digitalisation process of purchasing and supply management functions from an intervention point of view (Srai and Lorentz, 2019). With a promise of reaching a 40 percent increase in annual savings and 30 to 50 percent less time spent on transactional sourcing (De la Boulaye et al., 2017), making purchasing digitalisation work efficiently and effectively is challenging. In particular, further studies are necessary to expand our understanding of the effects of digitalisation on the purchasing department, particularly to comprehend whether this phenomenon will empower the function and its employees or whether they will be weakened and replaced (Van Hoek et al., 2020; Wehrle et al., 2022). Specifically, digitalisation's impact on the purchasing department's social dimension is still to be unveiled (Gottge et al., 2020). In this regard, Bals et al. (2019) provide evidence the increasing digitalisation is challenging previous assumptions on the necessary competencies for modern purchasing and supply management. Moreover, digital innovation may create the fear of loosing the job caused by the evolution of the required competences. The latter has also been identified by Seyedghorban et al. (2020) among the main challenges in the path towards business leadership of the purchasing department.

Research on digitalisation has highlighted two complementary approaches to the implementation of digital technologies into organizations, i.e., automation and augmentation (Weyer et al., 2015; Raisch and Krakowski, 2021). While automation aims at taking humans out of the loop and replacing them with technology (Bailey and Barley, 2020), with augmentation, humans collaborate with machines to perform tasks, creating a complementary relationship with technology (Markoff, 2016). In this paper, we use the automation-augmentation paradox to understand the impact of digitalisation on purchasing department and the possible coevolution of technical and social systems coherently with the socio-technical systems theory. In particular, the following research question is addressed:

> *RQ - How the purchasing department social system evolves in relation to purchasing automation and augmentation?*

We adopted a multiple-case study approach, selecting eight companies with a high level of digitalisation of the purchasing process. Our results show how digitalisation could support the evolution of the social dimension of purchasing in terms of organisation and human resources. We see an effect of professional empowerment consisting of job enlargement and increasing decision-making autonomy. Then, this research shows how digitalisation supports internal collaboration, i.e., between the purchasing department and other business areas, and external collaboration, i.e., with suppliers. The research contributes to the operations management literature that studies the relationship between the technical and social dimensions, using a socio-technical perspective and contextualising it within the purchasing department. The novelty of the theoretical contribution lies in having identified a specific relationship between digitization and social impacts, showing the potential implications on organization and human resources for each adopted technological approach (automation and augmentation) and for each level of the purchasing process (strategic, tactical, operational). The implementation in purchasing of technologies with different purposes, such as automation and

augmentation, is an already known topic; however, the novelty of the practical contribution of our study is that it does not limit itself to defining cuts in approaches. Specifically, it brings specificity with respect to the different tools that characterize the two approaches, and, more importantly, it identifies and links approaches and tools to the different levels of the purchasing process. Finally, while maintaining the same specificity by level, the study makes it possible to identify the relationship between the different technological approaches and the impacts on the social system. All this evidence provides practical support for purchasing managers facing a path of digital innovation.

The paper is organized as follows. First, the theoretical background is presented, including an overview of the existing literature on purchasing digitalisation and the main theoretical perspectives used in the article. Second, the research method is detailed and described. Next, the main and most relevant findings are reported, followed by a discussion of the same. Finally, the conclusions close the article.

2. Theoretical background

2.1. Purchasing process and its digitalisation as automation or augmentation

Purchasing is a formal entity within the organisational chart, and a process characterised by many activities that ensure that maximum value is delivered to the organisation. This value can be summarised with the "five rights": getting the right quality, in the right quantity, at the right time, for the right price, from the right source (Monczka et al., 2015). The purchasing process is characterised by different sub-processes (Bals et al., 2019) organized within a general model, where activities are divided along three levels, namely strategical, tactical and operational (Van Raaij, 2016). In all these stages, data are generated and exchanged. Consequently, the purchasing department is a business function that has already been benefited from technological innovation in the past, such as the application of corporate ERPs and the advent of e-procurement (Dong et al., 2009). However, the new wave of digitalisation known as Industry 4.0 has the potential to affect purchasing in a deeper way, transforming this function from tactical and administrative to a strategic unit inside the organisation (Seyedghorban et al., 2020). From a technological point of view, the digitalisation of the purchasing department is characterised by enabling technologies that fit different technological groups (Klünder et al., 2019) such as connectivity and communication, data analytics, Human-Machine & Machine-Machine interaction and advanced procurement systems. Among these technologies, artificial intelligence is described as a mean to support supply market analysis and cooperation with suppliers (Hofmann et al., 2017). In addition, the use of big data can help select suppliers, formulate sourcing strategies and predict supply chain disruption (Moretto et al. 2017). Then, multi-agent technology can support the identification and selection of suppliers (Ghadimi et al., 2019) or cyber-physical systems can be used to automate demand generation (Zunk et al., 2014). With these applications digitalisation can have a dual purpose: it can automate procurement activities by replacing purchasing agents by machines or it can support humans who make decision. This is consistent with research on the digitalisation of management activities where two fundamental concepts have been identified: automation and augmentation (Weyer et al, 2015; Raisch and Krakowski, 2021). While automation means that machines take control of a human task, augmentation implies that humans collaborate closely with machines/digital applications to take decisions.

2.2. Socio-technical systems theory and purchasing digitalisation

Current organisations are intricate and require a comprehensive examination. The socio-technical systems theory (STS) starts from this assumption by emphasizing the need to understand the systems through the connections and interactions between its components, such as the interactions between people, process, and technologies (Trist and Murray, 1993). STS and digitalisation are related, as digitalisation is a process that affects both social and technical elements within an organisation (Beier et al., 2020). The application of the STS theory to digitalisation, has resulted in distinguishing the human, technology, and organisation (HTO) dimensions (Dregger et al., 2018) where the social system encompasses both the human and organisation dimensions. Building on the HTO concept, this study examines the relationship between technology, organisation and human resources, specifically considering the different digital applications introduced in purchasing and the purchasing department itself. Relative to previous digital introductions, STS theory has identified coevolution of these dimensions, highlighting impacts at the human level (Leonard-Barton, 1988) and the organisational level (Mintzberg, 1989). The literature shows different possible evolutions and how different technologies and applications influence the human dimension. Makarius et al. (2020), examining artificial intelligence (AI) showed how various technological approaches can have different effects on human resources. The first effect is substitution due to the most straightforward applications related to task automation. In this perspective, we observe a reduction in the employees' autonomy of decision and breadth of tasks (Cagliano et al., 2019). The operative work becomes constrained to procedures and reduced to limited and repetitive tasks. The second effect is complementarity in which advanced technologies and humans complement each other. This perspective sees technologies as enablers of a professional evolution characterised by greater autonomy and less standardisation of activities for employees (Venkatesh et al., 2010). In this perspective, technologies provide knowledge and support to the worker, facilitating decision making that remains at the human level. The evolution also involves job enlargement with more interdisciplinary, interactive and team-based activities, mainly thanks to the information exchange enabled by technology (Basaglia et al., 2010). In summary, in the literature we have evidence of different technological orientation and professional evolutions: complementarity of digitalisation with human resources maintaining an active role at the operational and decision-making level or digital substitution replacing the human role in favour of technology (Leyer and Schneider, 2021). The literature discusses these developments on a general level, thus it is possible to expect these concepts to also apply to procurement personnel (Klünder et al., 2019) even if purchasing personnel will need to be prepared remains an open question (Schiele & Torn, 2020).

According to STS, we can expect impacts even on organisational dimension. The literature provides some insights into how digitalisation can improve collaboration, but often from a supply-chain perspective, with a lack of specificity on purchasing (Srai and Lorentz, 2019). Digitalisation can influence the horizontal and vertical integration of the company, opening the possibility for new collaborative dynamics both internally and externally, especially in the interaction with suppliers (Oesterreich and Teuteberg, 2016; Oztemel and Gursev, 2018). The most common collaboration mechanisms concern information sharing, joint planning and decision making, thanks to the application of technologies such as Internet of Things, Blockchain and Cloud Systems (Glas and Kleemann, 2016). Digitalisation can also potentially reduce the complexity and uncertainty of coordination, ensuring better visibility and reducing the risks of demand and information interruption (Ivanov et al. 2019).

3. Research framework

Literature designs possible paths of evolution for organization that approach digitalisation, still procurement lacks a clear theoretical model that foresees the possible organizational impacts and the conditions affecting these effects.

This study examines the digitalisation of purchasing, from drivers of implementation to impacts on organisation and human resources. The conceptual framework that guided the research is based on the socio-technical theory and the automation-augmentation paradox, thus considering the relationship between the technical and social dimensions and studying their coevolution (Trist and Emery, 2005). At top level we consider the drivers that can led to digitalization in purchasing. The technical component is represented by digitalisation in terms of automation and augmentation applications. The organization and human resources represent the social component. Cimini et al (2020), starting from the five organisational dimensions (strategy, people, rewards, process, and structure) proposed by Galbraith (2002), introduced a new classification composed of three constructs: competences, job and structure. This study, starting from this classification, at first evaluates within the purchasing personnel the impact at human level in terms of tasks breadth and autonomy (for the job dimension), and in terms of competences. Then, at the organizational level the study considers the evolution of the purchasing department in terms of relations with other functions (internal collaboration) and with other stakeholders in the supply chain (external collaboration). Given the coevolution of the two dimensions, this research hypothesizes a reciprocal relationship between the social and technological dimensions. This reciprocity means that we simultaneously consider the social structure influencing technological choices and being impacted by digitalisation. Table 1 summarizes the elements that characterize the framework of the study.

Table 1 - Dimensions, components and items of the study

Dimension	**Component**	**Item investigated**
Social	Human resources	Autonomy, Tasks breadth, competences
	Organisation	Internal collaboration, external collaboration
Technical	Digitalisation	Automation
		Augmentation

4. Research method

We adopted a multiple-case study approach to answer our research questions. The case study approach is aligned with the study's exploratory nature (Voss, 2016). According to Yin (2009), case study is *"an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident"*, as such it adopts an interpretivist view on the phenomenon under study. Given the novelty of the topic covered and the limited knowledge available on the new technical-social dimensions relationship in the context of purchasing, rather than conducting statistical analysis on a large sample, we opted for this method, which allows us better exploration and in-depth detail.

4.1. Cases selection

The case selection was developed in three phases. First, representatives from ADACI, the Italian association of purchasing and supply management, and EIPM, the European Institute of Purchasing Management, recommended a starting sample of potential interesting cases with respect to the digitalisation of the purchasing department. Second, in a pilot phase an activity model was established based on a literature review and refined through discussions with the 20 purchasing managers suggested. At the end of the preliminary interviews, conducted in English, all the 20 companies were questioned about their digitalisation level, examining the types of applications adopted, their diffusion in the process and degree of use. Third, we used the results of the pilot phase to assess the digitalisation level of the purchasing department and we applied our selection criteria. We selected companies from industries characterized by different digital intensity levels (Calvino et al., 2018), but at a relatively advanced stage of digitalisation of the purchasing department. Also, we selected organisations that had at least five years of experience with the use of digital technologies in purchasing. This allowed us to access cases that had implemented multiple projects at strategic, tactical and operational levels. Finally, we selected organisation that centralized their purchasing activities to ensure that we could gain insight on company-wide and not local implementation of digital technologies in purchasing. This process led to the selection of eight companies. Since the purchasing process can differ significantly between sectors (Wynstra et al., 2018), we decided to consider companies from different industries, at different digital intensity levels, so the eliminate industry bias and to understand whether there were similarities and differences. The selection of informants for each case was performed as follow. First, we interviewed one individual with a managerial role who has a complete visibility on the use of digital technologies for the organisation. This was typically a member the purchasing management team or someone in charge of purchasing process improvements or purchasing transformation. Then, we targeted individuals who are category buyers or equivalent so we could understand from them how digital technologies impact on strategic, tactical and operational tasks. Table 2 shows the case studies considered for this research. For each case, two interviews were conducted with purchasing department managers. All the interviews were conducted in English.

Table 2 - Summary of analysed cases

ID	Industry sector	Digital intensity of sector	Business	Employees	Interviews	Interview duration (minutes)
A	Aerospace	High	Manufacturing	80.000	2	131
B	Automotive	Medium -low	Manufacturing	127.000	2	139
C	Electrical/ electronic	Medium -high	Manufacturing	136.000	2	103
D	Telecommunication	High	Service	17.000	2	131
E	Information Technologies	High	Service	350.000	2	105
F	Telecommunication	High	Service	100.000	2	157
G	Agri-food	Low	Manufacturing	8.500	2	109

H	Plastic and rubber products	Medium -low	Manufacturing	400	2	145

4.2. Data collection and analysis

A specific interview protocol was developed (see Appendix), and the data was collected through semi-structured online interviews conducted between the second half of 2020 and early 2021. Then, we evaluated the technological implementation at different process levels and finally analysed the impacts on the organisation. The interview protocol was developed to give the interviewees a logical path to follow, avoid going off-topic, and make the reasoning easier and more immediate, allowing the gathering of useful information in the shortest possible time. In this regard, the protocol also includes the general model of the purchasing process drawn from the literature. Thanks to this inclusion, besides giving a logical path in the responses, we were also able to verify that the model of the purchasing process (see Appendix) was aligned with the one implemented by the organisation analysed. This allowed us to ensure homogeneity in the case studies and results related to technology implementation. Finally, at least two researchers always participated in each interview. In addition, all the interviews were recorded and transcribed verbatim.

A within-case and cross-case analysis were performed (Eisenhardt, 1989). In the within-case analysis for each company, we have developed multiple tables to structure data. In the cross-case analysis, we have combined the data into summary tables, coding the data according to our conceptual framework, to spot any differences and commonalities among the studied cases. Three researchers independently coded all the cases following the research framework presented in Table 1, but also inductively identifying new codes. To ensure consistency, the research team discussed potential discrepancies till consensus was reached. The final data structure is reported in Tables from 3 to 7.

4.3. Methodological rigour

Data collection and analysis were designed to guarantee construct validity, internal and external validity and reliability. To ensure construct validity, we triangulated different sources, that are data from cases with internal documents provided by the company and information found from the website. To ensure internal validity, we defined a specific protocol, conducting more than one interview for each case and having the interviewees verify the correctness of the information to reach saturation. Concerning external validity, being the analysis exploratory and based on case studies, it does not aim to completely generalise results. However, the sample was purposely designed to include companies at an advanced level of digital maturity, so the impacts identified may be valid for companies with these characteristics and provide best practices to be followed by companies at lower levels. We also reasoned about commonalities and emerging differences in the cases analysed. Finally, multiple researchers were involved in coding and analysing the data to ensure reliability.

5. Results

This section describes the findings of the study on the main dimensions presented in the research framework. In particular, the drivers that drove the digitalisation of the purchasing department are initially described. Then for each level of the purchasing process we detail the main technologies implemented and their applications,

differentiating in terms of automation and augmentation, and their effects on human resources (in terms of autonomy and tasks breadth) and on the organisation (in terms of internal and external collaboration). Each section provides the table containing the main quotes for each of the covered items. The number of quotes for each item is proportional to its presence.

5.1. Digitalisation implementation: drivers

To understand the digitalisation process of purchasing departments, first we investigated why they invested in technologies by identifying the main drivers. The results delineate three main drivers, namely data aggregation, efficiency and effectiveness. Table 3 reports the main quotes collected from our informants for each of the three drivers.

Table 3 - Drivers to digitalisation and evidence from cases

Drivers	Main evidence from the cases
Data aggregation	Q1: *"In terms of data, the focus was to completely restructure, orchestrate and harmonize them"* Q2: *"We need digitalisation to improve in the field of compliance, to avoid what is happening right now, involving exchanges of certifications and information between multiple stakeholders"* Q3: *"The company is overwhelmed by data, the information extracted is not at a satisfactory level, especially when compared with the amount of data collected"* *Q4: "Ultimately data quality is key: after a diagnosis phase now investments in poka-yoke techniques to move away from Garbage-in-Garbage-out phenomena;"* Q5: *"There is the need to start asking the question about what is the data that is needed and wanted, instead of what is the data that can be collected"* Q6: *"Through automation a lot of information can be obtained, but it can generate an overflow, and this is where intelligence becomes fundamental, either through augmentation or human intervention to separate what matters from what doesn't and to devise a strategic intent out of it"*
Efficiency	Q7: *"Transactions are being automated and made quicker; issues are automatically corrected this led to an improvement in operational efficiency"* Q8: *"We realized that procurement activities took too long or cost too much, due to the complexity and size of the company, with many handoffs and multiple approvals"* Q9: *"We realized that our purchasing was not fast enough, and we needed to really do something and transform"* Q10: *"Digitalisation allows to collect data faster and more efficiently from different fields"* Q11: *"Digitalisation leads to more proactiveness, quicker results, fewer escalations and crisis to manage, due to better anticipation"*
Effectiveness	Q12: *"We have a significant push for automation but still some areas exist in which human decision is kept and technology is there to augment and support decision making"* Q13: *"Anything that is not highly collaborative, or complex should be prone to automation, leaving for augmentation things that have a collaborative complexity"* Q14: *"Digitalisation is helping to accelerate decisional processes and providing more information for them"* Q15: *"The effort is in really structuring the procurement to be working in an agile way, not just conventionally, like category managers and supplier managers"*

> Q16: *"Digitalisation allows a broader vision on the market, implying wiser and more accurate decisions, by being able to monitor bigger ranges of data"*
> Q17: *"Digitalisation was mainly driven by the need of ensuring supply chain resilience, commitment to the market in terms of compliance and, ultimately the need of providing means to devote more time to strategy rather than operational level activities"*
> Q18: *"We invest in digital tools to improve the visibility of the purchasing organisation"*

According to the interviewees, the shift towards digitalisation in purchasing was driven by the need for data aggregation. One of the goals highlighted by all our informants is the pursuit of the development of their data aggregation capability to harmonize and orchestrate data (Q1). Data harmonization consists in creating data repository or data warehouse out of the many systems and tools used by the different departments and legal entities across a company (Q2 & 3). The quality of data is a concern in digitalisation initiatives as manual entries, manual transfers or mistakes in a spreadsheet can results in poor data quality (Q3 & 4). Because of the abundance of data that can create an information overload, our informants highlighted the importance of carefully selecting and harmonising data that contribute to improve decision-making (Q5 & 6). Digitalisation plays a crucial role in helping purchasing departments sift through the noise and focus on the data that is most relevant to decision making.

Efficiency is the second driver of digitalisation highlighted by our informants. Through automation, purchasing departments reduce their operational costs, streamline their process, reduce unnecessary information transfers, and eliminate unnecessary approvals to make the process more efficient (Q7 & 8). All our informants highlighted the need to collect data faster and to reduce the time and effort required to complete purchasing tasks (Q9 & 10). This causes quicker results, less escalations and better anticipation as issues can be identified before they become problems (Q11).

Effectiveness is the third key driver of digitalisation in purchasing. This driver is supported by augmentation, through which humans and machines work together. With access to a larger range of data, companies can better handle complex and collaborative tasks and come up with faster, more reliable and accurate decisions (Q12, 13 & 14). Digitalisation also allows companies to be more agile and flexible. Thanks to digitalisation and the accessibility of a wide range of data, it becomes easier for buyers to perform projects in across different segments of purchase. Three of the organisations in our sample were exploiting to a different extent this increase in flexibility (Q15). Digitalisation improves effectiveness by providing more accurate understanding of the market and producing detailed information on suppliers that improve decision-making (Q16). Two of our informants provided examples of significant cost savings ranging from 10% to 15%; they were generated by costs analysis using data collected from multiple sources. Moreover, digitalisation improves effectiveness by ensuring supply chain resilience and reducing risks. The ability to monitor and track the performance of suppliers and supply chains helps companies to identify issues before the problems occur. Some of our informants said that risks that were not anticipated before are now becoming predictable and easier to address (Q17). Finally, digitalisation allow companies to improve the image of the purchasing organisation (Q18). As digitalisation allows rapidly reaching data-driven consensus, purchasing departments are perceived as valuable contributors to effective decision-making.

5.2. Automation and augmentation in the purchasing context

Following the description of the main drivers for the digitalisation of purchasing departments, in this section we summarize the main types of technological applications, how they impact on the performance of purchasing departments and their scope of application. Pushed by the three identified drivers, the analysed companies have adopted two main technological orientations: automation and augmentation. Automation addresses the need for greater efficiency by reducing lower-value activities, simplifying and speeding up the process and providing faster access to data. Augmentation addresses the need for increased effectiveness by improving the quality of decisions and the ability to sense and respond to risks and opportunities rapidly. Automation applies to simple, repetitive tasks, while augmentation enables more complex and collaborative tasks where human knowledge is necessary to complement available data. Table 4 provides a characterisation of automation and augmentation in terms of definition, as well as impact and scope of application deriving from our observations in the case companies.

Table 4 - Automation and Augmentation in purchasing

	Automation	**Augmentation**
Definition	Automation implies that machines take over a human task (Raisch and Krakowski, 2021; Makarius et al., 2020)	Augmentation means that humans collaborate closely with machines to perform a task (Raisch and Krakowski, 2021; Makarius et al., 2020)
Impact	Increased efficiency through a reduction of human resources, faster processes and access to more data (Q6, 7)	Effectiveness through improved quality of decision and the ability to sense risks and opportunities earlier (Q12, 13 & 14)
Scope of application	Simple tasks that can be performed autonomously through automation (Q6 & 13)	Complex and collaborative tasks where complementary knowledge is required to take specific decisions (Q6 & 13)

5.3. Automation, augmentation and the impacts on the social dimension of purchasing

For each level of the purchasing process (strategic, tactical and operational) we provide some examples of the collected data. This includes the implemented technologies and applications covering both automation and augmentation. To understand the relationship between the technical and social dimensions of purchasing, we include the effect of technological application at the human level, in terms of autonomy, task breadth and competence, and at organisational level, in terms of internal and external collaboration.

5.3.1. *Applications and impacts at the strategic level*

Digitalisation of purchasing at the strategic level is mainly characterized by the implementation of technologies with augmentation orientation. Table 5 shows the technological applications and the impacts on the social dimension of purchasing at the strategic level.

Table 5 - Digitalisation and impacts on social dimension at strategic level of purchasing

Strategic level applications and impacts	Main evidence from the cases
Technologies	E-procurement system Business Intelligence Artificial Intelligence Spend management tool Market intelligence Predictive pricing and costing tools
Applications Automation	Q19: *"For specifications and clarifications, there is an automated tool to define in detail specifications"*
Applications Augmentation	Q20*: "The business intelligence solutions employed takes data from the e-procurement tool and generates analysis on financial performances for different segments, geographies or business units"* Q21*: "Time was wasted in market assessment done inefficiently. Last year, to solve this, we implemented a project with a market intelligence provider"* Q22*: "We have lots of specific applications, like those enabled by artificial intelligence, used for example for contract intelligence or supplier intelligence or pricing intelligence"* Q23: *"For commodities it may be possible to automate, but for technical categories, augmentation is more likely, since humans cannot be replaced"* Q24: *"For forecasts, plans and requirements, there's a dedicated portal for Supply Chain Management, which is linked to a platform for Supplier Relationship Management"*
Autonomy of decision in existing tasks	None
Tasks breadth	Q25*: "Our personnel are now able to concentrate on more important tasks of their job, consisting in category strategy, high level negotiation and contracting"* Q26: *"Digitalisation allows to spend more time in high added value activities, moving the focus to strategical discussions rather than tactical or operational"*
Competences	Q27: *"People will need to switch from the role of doers to the role of thinkers to support this"* Q28: *"The process of making decision requires certain skills in terms of identifying whether the data are making sense or not"* Q29: *"It's important to make sure people in purchasing have the competences needed and, if that is not the case, to accompany them and to develop the competences that they are missing in order to do their new job well"* Q30: *"A lot of focus is on procurement skills transformation, moving from being a generalist to having special skills, whether they are on technology, data or any aspect of that"* Q31: *"The management realized that tough decisions were needed, and they replaced those employees with new ones, less experienced but more energetic"*
Internal collaboration	Q32: *"Digitalisation brings improvements in cross-functional collaboration, mainly with shared KPIs, which are made easily available in dashboards"* Q33: *"Better ability to react quickly and take better decisions internally, due to those being shared by all the relevant people of various department, in a limited amount of time"*

	Q34*: "Ultimately, more internal interconnection is present, with procurement having more of a pro-active role, instead of a reactive one"*
External collaboration	Q35*: "We are creating more relevant interfaces with suppliers, through dedicated portals to bring more strategical interactions with the suppliers"* Q36: *"There are capabilities to capture strategic innovation through proposals, for example value engineering proposals from suppliers are captured in a new centralized database"*

The managers we interviewed described several augmentation applications. For instance, business intelligence solutions take data from the e-procurement tool and other sources to generate analysis for different segments, geographies, business units or groups of suppliers (Q20). One of the interviewed managers explained that before implementing augmentation technologies the market analysis was performed inefficiently and wasted time but with the implementation of a market intelligence tool this problem was solved (Q21). Then, our results show that artificial intelligence is used for specific applications such as contract management, costing and supplier management (Q22). Augmentation also supports the development of forecasts and the management of supplier production capacity thanks to dedicated portal for supply chain management, linked to a platform used for managing suppliers (Q24). Our informants also suggested that specifications and related clarifications can be supported by tools that ensure that all suppliers have access to the same level of information. The automation orientation is very limited at strategic level, which is reduced to tools to simplify specification and clarification activities (Q19), since the activities at this level tend to require complementary knowledge and human interventions that cannot be replaced by machines (Q23). However, augmentation is facilitated by the continuous automation that has occurred before and facilitated the aggregation of multiple data sources.

Concerning the impact on the social dimension, at the individual level our results show an enlargement of tasks due to augmentation. Automation and augmentation allow personnel to concentrate on important tasks in their job, including developing category strategies, high-level negotiation, and contracting activities (Q25). They spend more time in high added-value activities, moving the focus towards more strategic discussions and collaborative decision-making activities with other functions rather than tactical or operational tasks (Q26). In contrast, no effects of technologies on decision-making and operational autonomy at the strategic level were identified.

Digitalisation at the strategic level enables a shift in the role of purchasing professionals from "doers" to "thinkers" (Q27). This shift requires a different set of skills and competences to support the new activities brought about by digitalisation effectively. The decision-making process becomes more complex as it requires data analysis and interpretation skills to ensure that the data being used is accurate and meaningful (Q 28). To mitigate these challenges, organisations need to focus on the development of the necessary competences and skills within their purchasing teams. This includes providing training and support to help professionals acquire the necessary skills in technology, data analysis, and other key areas (Q29). The need to move from being a generalist to having specialized skills is also essential to stay competitive in the digital age (Q30) and management gave more weight to the energy of new resources than to experience, thus introducing in new staff.

Considering the impact on the organisational dimension, we identified an increase in terms of internal collaboration thanks to augmentation. Automation and augmentation facilitate internal communication and the sharing of strategic information, including KPIs

and supplier information (Q32). By providing purchasing professionals with advanced tools and technologies, such as artificial intelligence (AI), predictive pricing and advanced costing tools, augmentation leads to improved decision-making and increased effectiveness. In turn, an improved internal collaboration is experienced as purchasing professionals can share their insights and collaborate more effectively to make strategic decisions (Q33). Augmentation technologies can also be used to support and enhance category management, which is a key element of the purchasing department's internal collaboration. With the support of these technologies, the purchasing department can improve the performance of the internal team. Augmentation technologies can also be used to improve the internal collaboration by facilitating the use of collaborative platforms, where stakeholders can capture both initiatives and data and document decisions at the strategic level. This allows for better alignment of the purchasing department with the rest of the organisation and leads procurement to work closely with other organisational units in a proactive manner (Q34).

In terms of external collaboration at the strategic level, especially with suppliers, we identified potential improvement due to augmentation applications. First, augmentation technologies allow purchasing professionals to access and analyse vast data and share their insights to collaborate with suppliers to negotiate better prices, terms, and conditions. The dedicated interfaces and portals support this strategical interaction (Q35). Then, augmentation can help to establish and strengthen the relationship between the purchasing department and the suppliers by providing a more transparent and efficient communication and negotiation process. This allows for a better alignment of the objectives, leading to a mutual understanding and cooperation between the parties. Finally, augmentation facilitates the analysis of supplier performance, the identification of risks and opportunities and the strategic decisions. This leads to improved external collaboration as purchasing professionals can collaborate with suppliers to ensure continuity of supply, mitigate risks, and identify new opportunities in the market thanks to the new digital capabilities to capture strategic innovation through proposals (Q36).

5.3.2. Applications and impacts at the tactical level

At the tactical level, various technologies have been implemented to increase efficiency and improve decision-making. These technologies are used combining both augmentation and automation, to optimize and support the processes and tasks of the purchasing department. Table 6 shows the technological applications and the impacts on the social dimension at the tactical level.

Table 6 - Digitalisation and impacts on social dimension at tactical level of purchasing

Tactical applications and impacts	Main evidence from the cases
Technologies	E-procurement tool Digital application for supplier management Contract life cycle management tool External database E-signature RPA (robot process automation) for RFQ (request for quotation) and RFI (request for information) Enhanced compliance systems

Applications Automation	Q37: *"In terms of negotiation and contracts, the managing of contracts now implements e-signatures, which are much more efficient than the previous method, which were wasting time"* Q38: *"For contract management there is an AI-based application to automatically read all contracts and create a contract hierarchy, identifying which contracts needed to be updated and where, leading to savings of hundreds of manhours"* Q39: *"Cost breakdown and analysis are part of the e-procurement tool"* Q40: *"The process of capturing suppliers' risk is automated and digitalized, through the integration in the system of dataflows from external providers, especially in terms of financial risk and ratings"* Q41: "*Thanks to digitalisation you can now know much more about suppliers in terms of compliance or other information useful for screening"*
Applications Augmentation	Q42: *"Work is being done on product costing by quickly providing buyers with a price target for negotiation and by making sure that the supplier is offering the right cost"* Q43: *"In source to contract subprocess, many phases are supported by technologies: man and machine can then work together to create a greater impact"* Q44: *"The purchasing department is equipped with a tool is tool for supplier evaluation, with matrixes and grids, which are shared with internal partners during business reviews, with the additional objective to improve their performance"* Q45: *"Process of supplier identification, selection, qualification evaluation is digitalized with an application for supplier management, so that everyone involved can access data and comments that are then shared, with visual aspects included, with the suppliers"*
Autonomy of decision in existing tasks	Q46: *"There are programs to automate several aspects of tactical activities, such as providing category managers automatic alerts for risks, not to waste time to receive data from others"* Q47: *"Digitalisation is improving decision making autonomy by giving more confidence to employees, who can take better decisions thanks to the better availability of data"* Q48: *"Thanks to digitalisation the increase in delegation was made possible, without putting the company in danger"* Q49: *"People in purchasing have experienced an increased autonomy in negotiation, due to a higher delegation threshold, made possible by digitalisation"* Q50*: "The degree of digitalisation has a positive impact on decision making, but you can hurt yourself by taking the level of implementation to extremes"*
Tasks breadth	Q51*: "Digitalisation helped to redistribute tasks, releasing buyer from the most tactical moving to the most strategical"* Q52: *"We observed a higher number of tasks related to analysis, while other operational activities were eliminated"* Q53: *"The support offered by digitalisation leads to a wider breadth of tasks horizontally speaking, in terms of having to coordinate their work with other departments (finance, legal, business, tax)"* Q54: *"Digitalisation allows for enlargement of tasks, but that can ultimately be overwhelming"*
Competencies	Q55: *"Need to perform training to improve digital skills in certain employees who are lacking in that department, as people must reach the competences needed to use tools autonomously"*

	Q56*: "Sometimes data literacy is severely lacking among employees"* Q57: *"Employees must have skills to access the data and generate the necessary reports independently"*
Internal collaboration	Q58: *"Digitalisation leads to an easier and better communication by having factual information at disposal"* Q59: *"The dashboards had a big impact on internal collaboration, allowing real time monitoring of performance and, moreover, the better tracking of the process"* Q60: *"Internal collaboration was definitely improved, even considering that now the collaboration is more formalized, and this makes it possible to immediately notify problems"* Q61*: "The legal teams, purchasing and other departments are supported through this improved service, which now takes roughly 16 days to work on one contract, instead of 25-30 days"*
External collaboration	Q62: *"Digitalisation plays a role in most of the interfaces between procurement and other external stakeholders"* *Q63: "Digitalisation is viewed as a mean to filter out noises that don't add value in the collaboration with suppliers, thus allowing more efficient processes"*

Automation at the tactical level is mainly aimed at reducing wasted time in performing certain operations, especially in negotiation and contract management activities (Q37 & 38), but also at speeding up the collection of internal information (Q39) and especially supplier information (Q40 & 41). Augmentation at the tactical level ensures rapid access to information needed in negotiation and contracting activities (Q42 & 43), but more importantly it supports employees in managing suppliers in the identification, selection, qualification and evaluation phases (Q44 & 45).

Both automation and augmentation at tactical level can have significant impacts on autonomy of the purchasing department personnel in conducting existing activities. Automation technologies, such as RPA and e-signatures, can streamline processes and reduce the need for manual collecting data and input from other departments, increasing employees' autonomy (Q46). This can lead to increased efficiency and free time for employees. Augmentation technologies, such as digital applications for supplier management, contract life cycle management tools, and enhanced compliance systems, can also increase autonomy by providing employees with access to more information and resources. Thanks to this, digitalisation gave employees more confidence, leading to improved decision-making (Q47). Because of the control (over the process, not the people) offered by digitalisation, even managers were able to increase the confidence in their personnel, making it possible to delegate more without endangering the organisation (Q48). One of the managers interviewed stated that procurement people have experienced greater autonomy in negotiation due to a higher threshold for delegation, made possible by digitalisation (Q49). In addition, another interviewed manager, confirming the growing possibilities of greater autonomy for employees, reminds that too extreme level of decentralization of decision-making could be harmful and could congest the organisation (Q50).

Digitalisation of the purchasing department at the tactical level can have a significant impact on tasks breadth. Adopting both automation and augmentation technologies can lead to job enlargement of purchasing department employees with new tasks. On the one

hand, automation technologies can automate repetitive and time-consuming tasks, such as contract management, supplier evaluation, and cost analysis. This can free up time for purchasing employees to focus on more strategic and value-added activities (Q51), such as supplier relationship management and cost negotiations. On the other hand, augmentation technologies, such as e-procurement tools, digital applications for supplier management, and contract life cycle management tools, can provide purchasing employees with access to real-time data, analytics, and other information, increasing the number of tasks related to analysis (Q52). These tools can also increase the collaboration with other departments and external partners, such as suppliers and legal teams, which can lead to an expansion of the tasks related to the coordination of their work with other stakeholders (Q53). To ensure the feasibility of the job enlargement effect, it is necessary that automation also accompanies augmentation. Without freeing resources from low-value activities, the new tasks would overallocate employees, making their work overwhelming (Q54).

Furthermore, it is important to note that while digitalisation can lead to job enlargement, it is not always the case, as it can also lead to job displacement or job loss, especially in the case of automation technologies. Therefore, it is important for organisations to consider the potential impacts of digitalisation on employment and implement measures to mitigate any negative effects, such as upskilling and reskilling programs for employees (Q55). Data literacy is a key skill that is often lacking among employees (Q56). The integration of man and machine is also a key consideration in the tactical level of purchasing, with the need for employees to have technical skills to use tools autonomously, to access data and generate reports independently (Q57). These skills are also essential for employees to be able to handle new activities related to internal and external collaboration. Without them, employees may struggle to perform their duties and the implementation of digitalisation may not be as successful as intended.

Digitalisation can have a significant impact on internal and external collaboration at the tactical level. Augmentation technologies can improve internal collaboration by providing a centralized platform for communication and data sharing among different departments and teams within the organisation. This provides everyone with shared and update information. (Q58) and automation ensures that data are collected automatically and quickly. For instance, digitalisation allowed the real time monitoring and tracking of the process and of performances (Q59) and made possible immediate notification of problems (Q60). Increased internal collaboration between different departments also supports activities involving suppliers, with improvement in supplier management and more effective supplier selection processes. Similarly, contract life cycle management tools can allow legal teams and procurement teams to collaborate more effectively, resulting in improved contract management processes (Q61). Considering the external collaboration, digitalisation (Q62) is a key interface to collaborate with external entities, with the use of e-procurement tools and external databases. For instance, an e-procurement tool can facilitate the communication with suppliers and make the process of purchasing more streamlined, while an external database can provide access to external market and compliance data, which can be used to make better purchasing decisions. Automation helps to filter out noises that don’t add value in the collaboration with suppliers, thus allowing more efficient processes (Q63). For instance, without the help of digital tools, reviewing contracts with suppliers could be extremely problematic, with huge time losses in useless tasks such as verifying that everyone was on the same version of a contract.

5.3.3. Applications and impacts at the operational level

At the operational level, digitalisation is characterised by the implementation of automation technologies to gain efficiency (Q64 & 65). These technologies are primarily focused on streamlining and automating routine tasks such as purchasing order preparation and approval (Q66), as well as automating invoices settlement and payments to make the transaction with supplier more efficient (Q67). Additionally, the implementation of automation tools for data collection and automated tracking of purchase orders (Q68) also contribute to the digitalisation of the operational level. Table 7 shows the technological applications and the impacts on the social dimension at the operational level.

Table 7 - Digitalisation and impacts on social dimension at operational level of purchasing

Operational applications and impacts	**Main evidence from the cases**
Technologies	ERP RPA E-procurement Automation of purchasing order preparation, approval and contract Automation of invoices settlement and payments PI and metrics automated Automatic data consolidation
Application Automation	Q64: *"There is a lot of process efficiency due to automating and simplifying processes: the gain is easily 40-60 or even 70% for invoice processing or order processing"* Q65: *"We use RPA at operational level, which makes any process faster, cheaper and reproduceable"* Q66: *"Our focus was on the implementation of tools related to purchasing orders treatment, in particular aimed at automating preparation and approval of the orders"* Q67: *"Efficiency has improved especially at this level, due to smoother processes, in terms of transactions with suppliers becoming more efficient"* Q68: *"We developed a new tool to send purchase orders capable of sending orders and receiving confirmation receipts, but also tracking the performances and delivery dates"*
Applications Augmentation	None
Autonomy of decision in existing tasks	Q69: *"Digitalisation is providing tools that give relevant data and contribute to reach a higher level of autonomy"* Q70: *"Buyers now need to seek less approval from managers"*

	Q71*: "Buyers are benefitting from the digital information provided by the implementation of automatic catalogues, where pricing and latest prices from vendors are presented"*
Tasks breadth	None
Competencies	Q72: *"We faced problems with the qualification of the procurement personnel, which wasn't prepared nor trained, in terms of competences, to use digitalized tools"* Q73: *"After the implementation, the main issue is how people will react to the new tools"* Q74: *"Digitalisation didn't happen in a top-down way, with centralized decisions, but rather happened with interactions with final users, to understand their needs, collect their inputs about the general direction and understand which of their issues could be solved with digitalized tools"*
Internal collaboration	None
External collaboration	None

One of the main impacts of digitalisation at the operational level is an increased level of autonomy for buyers, as digital tools provide relevant data and enable them to make decisions with less approval from managers (Q69 & 70). For instance, the implementation of automatic catalogues provides buyers with updated pricing and vendor information which allows them to make more informed decisions (Q71). In other terms, employees at operational level can access data and make decisions with less supervision.

However, in terms of tasks enlargement, we did not find any significant impacts due to digitalisation at the operational level. The automation of routine tasks may lead to job simplification, but it does not appear to lead to a significant change in the breadth or depth of tasks performed by the buyers.

Digitalisation at the operational level of purchasing can lead to issues with the qualification and training of procurement personnel in terms of their competences to use digitalized tools (Q72). After implementation, there may be challenges in how employees adapt to the new tools and their ability to use them effectively (Q73). Some tools may be user-friendly, but others may not be as intuitive. To address these issues, it is important to understand the needs of the final users, collect their inputs about the general direction, and understand which of their issues can be solved with digitalized tools (Q74). This can be achieved through a hand-in-hand integration between man and machine, where the focus is on training and qualification of procurement personnel to use digitalized tools effectively.

Considering the organisational dimension, in terms of internal and external collaboration, the use of digital tools and automation technologies did not appear to have a significant impact at the operational level. While digital tools may facilitate communication and data sharing, they do not appear to fundamentally change the nature of internal or external collaboration within the purchasing department.

5.4. Variations across cases

Our results show general trends where automation results into smaller, more effective purchasing departments with more autonomy in decision-making for operational and tactical tasks and where augmentation results in increased effectiveness with an enlargement of tactical and strategic tasks for better qualified purchasing professionals. However, the careful analysis of the cases also highlights that different paths can exist. Compared to other cases, the interviews performed for cases D and F tend to exhibit the characteristics of purchasing departments that are mainly focused on performing operational and tactical tasks in a very efficient way. Our informants for case D highlighted that strategic decisions are taken by directors outside of the purchasing department. They are given access to all data provided by purchasing and they use voting systems provided by the purchasing digital system. Also, our informant for case F was mainly providing examples where the purchasing department was sourcing commodities and standard goods or services. One hypothesis we can formulate at this stage is that purchasing department that only need to source commodities and standard goods mainly benefit from automation. While purchasing departments that purchase more complex goods and services benefit from augmentation. This was suggested by one of our informants who told us that for commodities, it is possible to automate, but for complex technical categories, augmentation is more likely as humans cannot be replaced (Q23). However, the process of requalification should also be considered to understand this dynamic. Indeed, our case D informant mentioned that senior employees were not able to adapt to their new technical environment and were replaced with less seasoned ones but more capable of doing the expected work (Q31). Instead, for cases A and F we were told that the move towards more strategic tasks was facilitated by the level of qualification that existed in the purchasing department. For case F it was suggested that no problems in term of competence or change management were experienced as the company employs many people with advanced technical education.

6. Discussion

Based on our findings, we propose a framework on how digitalisation, by enabling both automation and augmentation, impacts the purchasing social dimension (see Figure 1).

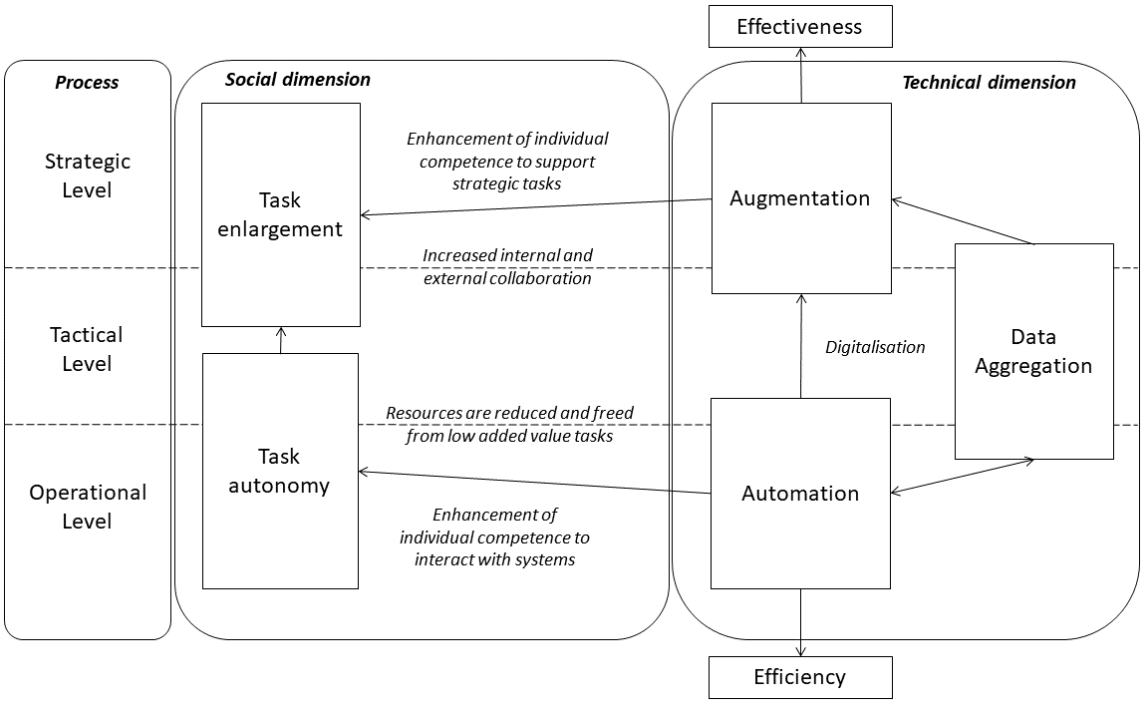

Figure 1 – The socio-technical impacts of digitalization: the case of purchasing

The framework describes how automation creates efficiency gains and increases autonomy in decision making while preparing the ground for augmentation that enlarges strategic activities performed by purchasing professionals and increases the effectiveness of the purchasing organisation. This framework suggests a dynamic and evolutive system where cumulative changes can result in better performance and significant organisational and human modifications. However, our results also show that digitalisation can lead to different outcomes. The purchasing department can rely extensively on automation and ends up as a highly efficient department that performs operational and tactical tasks. However, the purchasing department can evolve into a more strategic function increasingly capable of performing strategic tasks and contributing to collaborative decision-making.

Purchasing investment in digital technologies is motivated by three drivers that support investment in new technologies: data aggregation, efficiency, and effectiveness. First, data aggregation consists in collecting and bringing into a single repository data from different internal and external sources. Second, efficiency is linked to investments in automation technologies to replace humans by with machines to perform operational and tactical tasks. Automation also allows to access and collect new sources of information. Third, effectiveness is linked to augmentation technologies, so humans and machines work together to perform tactical and strategic tasks. Augmentation helps take more informed decisions and earlier decisions. Data aggregation and automation are mutually supportive. In fact, data is aggregated from multiples sources through automation. This is a complex and cumulative process as data needs to be reliable, timely and relevant. Augmentation is made possible as the automation of tasks and data aggregation progresses. Indeed, digital technologies augment the ability of humans to take decisions by turning data into valuable and well-presented information. This is achieved through extensive combination and treatment of data from very diverse sources. Through

augmentation, data is transformed into information that improves decision making. Summarizing, to answer the part of the first RQ related to the "why" purchasing organisations implement digitalisation, we can state that:

- *RP1a: Digitalisation of purchasing is driven by the search for the push of data aggregation, efficiency and effectiveness.*
- *RP1b: Efficiency is mainly achieved through automation applications, while effectiveness is achieved through augmentation applications.*
- *RP1c: Data aggregation and automation are mutually supportive, together they facilitate augmentation.*

Technical dimension

Coherently with the literature previously presented, our findings show that digitalisation can be introduced to automate purchasing process activities and support the process by increasing its capabilities. Automation and augmentation, i.e., the two types of digitalization discussed, constitute the technical dimension of the framework. The introduction of automation technologies is driven by the strategic choice for savings and efficiency, leading to shortened cycle times, efficient use of resources and error reduction (Lorentz et al., 2021). On the other hand, other augmentation-oriented technologies may improve coordination and control mechanisms and support process activities (Lorentz et al., 2021). Both the literature and this research make clear that digitalisation in purchasing department can serve two purposes: automating tasks and augmenting capabilities. The results of this study contribute to current knowledge by identifying how purchasing organisations have implemented digitalisation at each level of the process, thus defining for each level the specific technologies and applications. Summarizing, we can state that:

- *RP2a: Augmentation prevails at the strategic level of the purchasing process, particularly in complex and collaborative tasks with higher value-added activities.*
- *RP2b: A mixed approach combining automation to augmentation prevails at the tactical level.*
- *RP2c: Automation prevails at the operational level of the purchasing process, especially for simple and lower value-added activities.*

Social dimension

Impacts on the social dimension affect the entire purchasing, with different implications in the three levels, i.e., strategic, tactical, and operational. From a social perspective, automation results in productivity gains and the reduction of the number of people employed for purchasing operational and tactical tasks as machines increasingly perform these tasks. Employees who are involved in operational and tactical tasks experience an increase in their decision-making autonomy. Indeed, through the sharing of data they depend less on other departments, and they can take decisions at a tactical and operational level in more complete autonomy. From a performance standpoint, automation results in an increased efficiency for purchasing operational and tactical tasks. Augmentation results in task enlargement for purchasing professionals, especially at tactical and strategic levels. Indeed, as some purchasing professionals are freed from some tactical and operational tasks, they can become more engaged in internal and external collaboration. The purchasing professionals who enhance their competence and have access to complementary knowledge on suppliers and supply market can support strategic

tasks as part of cross-functional teams, hence the enlargement of tasks that we observed in our findings. From a performance standpoint, augmentation results in an increase of effectiveness.

Hence, our results show that the professional evolution depends on automation and augmentation technologies. If a beneficial effect could be expected for augmentation technologies, it was not so for automation. The automation introduced by digitalisation has been investigated in relation to employment risks and job elimination (Gregory et al., 2016). Instead, this study reveals that automation is necessary for professional development and may not affect the entire role but the lower value-added activities. This study does not seek to assert that automation of entire jobs does not exist. Still, it does seek to show how opportunities related to its implementation can benefit both the firm and the people employed. Summarizing, to partially answer the second RQ on how the purchasing department social system evolves in relation to purchasing automation and augmentation, we can state that:

- *RP3a: The combination of automation and augmentation technologies in purchasing enables operators to evolve professionally through increased decision-making autonomy and job enlargement.*
- *RP3b: Automation substitute humans with machines and increases the autonomy of decisions of professionals who continue to perform operational and tactical tasks.*
- *RP3c: As automation expands, purchasing professionals who become more involved in external and internal collaboration need to enhance their capabilities and knowledge to support strategic activities.*
- *RP3d The combined use of automation and augmentation enlarges the strategic tasks performed by purchasing professionals.*

This evolution is not systematic as some of our informants suggested that they recruited new people who were better fitted for the more strategic tasks. Moreover, the technological effect is not deterministic, and even if the technological choices are similar, the professional evolution can have a different magnitude. To make a digital innovation project successful, purchasing managers need to be aware that implementation must be managed; often, digitalisation is carried out without careful consideration of the employees who will have to use it (Makarius et al. 2020). The manager must facilitate and support professional development to have adequately trained personnel. In addition, our results show that the operator's evolution will require new skills and capabilities. Hence, managers will be required to maximise the social potential of digitalisation for human resources. These results are consistent with Leyer and Schneider (2021), who show that managers are not only involved in choosing technologies and their applications, but also in making the technology available and usable for the department. The technological choices made in implementation can influence professional development possibilities. Unbalanced investments in favour of automation could hurt the job content, but in the same way, investing only in augmentation technologies could not guarantee sufficient free time for employees to take advantage of the new support possibilities. Second, human barriers such as a lack of skills, resistance to change, or a lack of a development plan can slow or even block opportunities for evolution. These considerations extend the findings of Flechsig et al. (2022), who, by considering the implementation of RPA, identify barriers of different nature, namely technical, organizational and environmental. While Flechsig et al. (2022) defines barriers with

respect only to technology implementation, our article also shows potential difficulties in using and enabling professional development. The barriers addressed in this study, therefore, are not limited to the technical dimension, but also affect the social one.
Finally, in terms of social dimension the research has explored possible changes in the organisational collaborative dynamics in which the department is involved. The results show how digitalisation can have a positive effect on internal collaboration. Simplification and standardisation, and improved visibility into processes, make it easier for departments to relate to each other. Besides, to manage the complexity of digitalisation projects, companies will experience an increased need for cross-functional teams in which personnel from the purchasing department is also involved. This tendency may be accentuated in companies where purchasing department is directly involved in implementing digitalisation for the entire company. It is possible to define distinct roles of the purchasing department concerning digitalisation: a simple "user" of the technology or involved in scouting and buying technologies of interest for the entire company (Legenvre et al., 2020). In the second case, our results are in line with Sjödin et al. (2021), in which the purchasing department is indicated as an orchestrator who guides internal processes that clarify the roles and activities of each function during the procurement of digital solutions. This means that the purchasing department does not have an administrative role but has an active role in coordinating activities with other organizational units. Thus, internal collaboration becomes not only an effect of digitalisation, but also a requirement for the procurement and implementation of digitization to be successful. Furthermore, the results show that digitalisation can support the external collaboration with suppliers and stimulate the integration of the supply chain. Integration involves the flow of information and data not only at an operational level such as transactions and material movements but also at a more strategic level, such as the sharing of sales plans. The integration can also cover purchasing activities, even coordinating decision-making processes. This duality finds confirmation in the literature in the field of Supply Chain Management that suggests two interrelated forms of integration, i.e., information exchange and operational integration (Kulp et al., 2004; Leuschner et al., 2013). The increasing possibilities for internal and external collaboration is mainly due to augmentation technologies, especially for their ability to provide visibility, traceability and exchange information in real-time. However, automation plays its role here as well. By freeing the process from non-value-added activities, it allows the firm to focus on reasoning of a more strategic nature internally, while it makes collaboration more agile and efficient externally. These considerations lead to the formulation of the following research proposition.

- *RP3g: Digitalisation enhances internal collaboration with other departments and external collaboration with suppliers; augmentation contributes primarily, but even automation has a positive effect.*

7. Conclusion

Our research findings describe an evolutive socio-technical system characterised by cumulative changes where automation and augmentation impact on the purchasing department social system and on purchasing efficiency and effectiveness. We show how automation, by replacing humans with machines, supports data aggregation and generates efficiency gains. Automation increases the autonomy in decision making for purchasing professionals working at tactical and operational level. Then, automation and data aggregation enable augmentation that enlarge the tasks performed by purchasing

professionals once they were requalified to perform this expanding set of strategic tasks. Augmentation then results in an increased effectiveness of the purchasing organisation.
This research shows that the adoption of a technical system, here digitalisation, can result in different impacts on the social system. Purchasing department by steering changes towards either more automation or more augmentation as they progress on their digitalisation path can end up either as a highly efficient operational and tactical team or as more strategic function. In the first case, automation creates a smaller purchasing department where individuals experience an increase in decision-making autonomy. In the second case, automation and augmentation result in a more effective purchasing department where the autonomy of decision is complemented by an enlargement of the tasks at strategic level. This finding is important for the STS theory as the adoption of a technical system such as digitalisation can lead to different social impacts. The findings demonstrate the benefit of combining the automation-augmentation lenses with the STS theory. In line with Raisch and Krakowski (2021) we show that automation and augmentation are not either/or options but complementary approaches as automation enables data aggregation and then augmentation turns data aggregation into insights that support collaborative decision making. Our findings enrich the automation-augmentation lenses by suggesting that the boundary between automation and augmentation is not solely related to the ability to aggregate data but also to the need for complementary knowledge for taking effective decisions. Consequently, automation loses its relevance as tasks become complex and collaborative, as more advanced problem-solving heuristics are needed to make sense of information and take relevant decisions. In the case of the selection of suppliers, complex purchase requires, on top of data provided by digital systems, a combination of market and technical knowledge that enables effective decision making.
The main managerial contribution of our research is to offer managers support in implementing digitalisation in purchasing, providing visibility into the main technological choices, and showing which new paths of evolution they should plan and facilitate. The research can provide managers with knowledge on the main drivers of implementation and increase their awareness of possible technological choices and their effects on organisation, human resources and performance. Consistent with the socio-technical perspective, managers should consider the entire social dimension when designing the technological innovation of the procurement department. Hence, purchasing managers must balance effort over time to benefit from both automation and augmentation and have to prepare personnel for the path of professional development.

Limitations and future research
The study is primarily exploratory, and its findings deserve further investigation. Further research could expand our understanding of how human and machines complement each other. While our findings emphasize the need to access multiple sets of quality data, it also suggests that bringing all operational and tactical information into a single platform is not sufficient to take informed decision at strategic level. More data is needed and should be collected from difference sources. Also, some of our informants have highlighted that beyond data aggregation effective decision making depends on the quality of visual representation. We therefore suggest that to progress our understanding of the digitalisation of purchasing department we need to further investigate how data is turned into insights in this context. Future research could focus on the organisational interfaces between the purchasing department and other functions, identifying the data and information exchanged through digital tools. Instead, looking at external

collaboration, future research can explore the types of partnerships that have been established and understand if digitalisation can help remove additional barriers to collaboration. Finally, future research should investigate why and when a purchasing department is likely to remain a highly efficient operational and tactical task performer or become a more strategic function. Our findings suggest that the complexity of the purchased goods and services and the antecedents in terms of profile of purchasing professionals play an important role here. We also believe that the leadership aspiration of chief purchasing officers might impact on this evolution. A last possible development relates to the adopted perspective in the analysis of the socio-technical system. Our work was aimed to analyse how technology influences the social system, and, consequently, of the evolution of the latter influences the former. Moreover, our work provide evidence that the decision to proceed in a certain direction in the development of the socio-technical system is influenced by certain factors (i.e., drivers). As Bailey and Barley (2020) suggest, technology designers often operate from a cultural perspective that privileges the technical over the social. Thus, a gap might exist between their idea of reality and the user's experience of reality. This suggests a move towards user-centred and value-sensitive design approaches, where technology designers have more information about the social context in which the technology is going to be adopted, including the needs of the organization and the social dynamics that it is willing to enhance. Our framework suggests a possible evolutionary path, that companies could take into consideration since the early stages of their digital innovation processes.

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APPENDIX

INTERVIEW PROTOCOL

A. THE COMPANY

(1) Descriptive data
(2) Sector
(3) Core business
(4) Served geographical data
(5) Purchasing office organisation

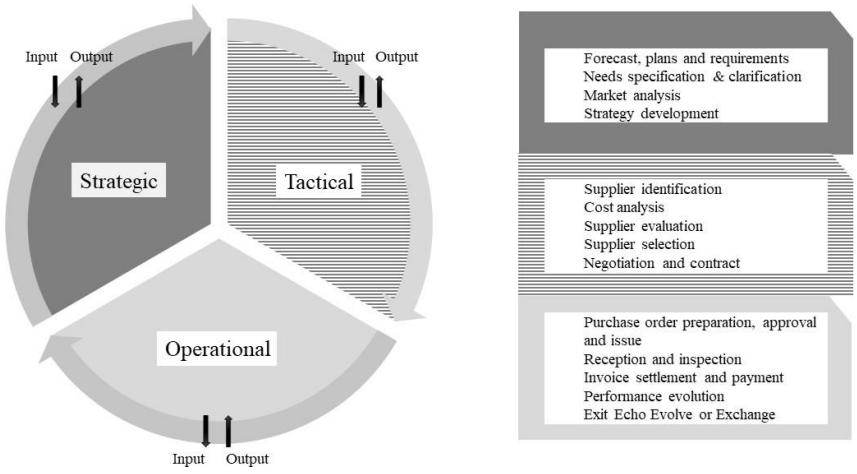
B. IMPLEMENTATION

(1) Reasons/drivers that led to digitalisation
(2) Challenges/barriers faced while implementing digitalisation
(3) Which actions (organisational, managerial, or other) have been taken to support goals and reduce barriers?

C. TECHNOLOGICAL CHOICHES

(1) Does your company's purchasing process reflect the model presented in the Figure below? Where there are differences, please list them.

D.



(2) For each level of the purchasing process (strategic, tactical, operational)and their activities, please identify the technologies* introduced.
(3) Identify the technological orientation** (augmentation or automation)

Phase	Activities	Technologies*	Orientation**
Strategical	• Forecast, plans and requirements • Needs specification & clarification • Market analysis • Strategy development		
Tactical	• Supplier identification • Cost analysis • Supplier evaluation • Supplier selection • Negotiation and contract		
Operational	• Purchase order preparation, approval and issue • Reception and inspection • Invoice settlement and payment • Performance evolution • Exit Echo Evolve or Exchange		

E. IMPACTS: HUMAN

(1) Identify any changes in the number of people employed in the purchasing department. If yes, Is the reduction/increase linked to digitalisation?
(2) Which roles and tasks have been most affected by digitalisation?
(3) Has the job content changed at an operational and managerial level?
(4) Have the impacted roles experienced more or less decision-making autonomy?
(5) Were there any shifts in roles from one level of the purchasing process to another?
(6) How have the competencies of impacted roles changed?

F. IMPACTS: ORGANISATION

(1) Does purchasing digitalisation impact collaboration and integration (with internal department and external suppliers)?
(2) Which are the main data exchanged between purchasing and other department? Which departments has the purchasing interacted with themost?
(3) Which are the main data exchanged between purchasing and suppliers? Doother external stakeholders collaborate closely with purchasing?
(4) How is the data integration (with other departments and suppliers) managed? With which technological applications?
(5) How has communications management changed (modalities, channels,roles) due to digitalisation?