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Future purchasing roles and skills influenced by Industry 4.0 in the automotive industry: A case study

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Abstract

Due to the rapidly emerging Industry 4.0 technologies, regular operational norms of purchasing are expected to be reshaped, including future roles and skills in the automotive industry. This research aims to investigate the impact of Industry 4.0 on the required roles and skillsets crucial for the future procurement department within this sector. Although different studies underline the significance of these forthcoming roles and skills, they fall short in offering a concrete plan for seamlessly integrating them into the organisational structure of businesses within the automotive sector. To address this research gap, 12 interviews have been conducted with different purchasing and supply chain management (PSM) professionals as part of a focused case study. The insights gathered from these discussions and literature reviews provide valuable guidance on how to strategically integrate future-oriented purchasing roles and skills into the organizational structure of companies operating in the automotive industry. By tackling the perspectives shared during these interviews, organizations can effectively chart a course toward the assimilation of advanced procurement roles and essential skillsets. In essence, this study not only explores the evolving technologies of Industry 4.0 but also intends to lay the foundation for shaping the future procurement organisation within the automotive industry.

Management summary

Background:
In the era of Industry 4.0, rapid technological developments introduced emerging tools, such as Artificial Intelligence (AI), Robotic Process Automation (RPA), and advanced e-sourcing solutions. These technologies facilitate the digital innovation of organisations as they can be integrated into business operations, giving rise to new roles and skills in procurement. The existing organizational structures, either decentralized, centralized, or hybrid play a pivotal role in implementing these evolving technologies. The study focused on evaluating the advantages and drawbacks of various organisational structures to provide an overview about how they influence the integration of Industry 4.0 technologies along with the corresponding future purchasing roles and skills.

Challenges:
The case company operates within a very complex organisational structure, further complicated by the varying procurement structure depending on the geographical location of the department. This diversity makes it challenging to adopt a single structural framework for all purchasing departments and provide one best practice for the various purchasing organisations across the globe.

Proposed Solution:

The research offers tailored guidelines to the case company and similar entities on effectively integrating future procurement roles and skills into their structures. Key emerging roles like data analysts, process automation managers, master data managers, and procurement engineers are pivotal in enhancing efficiency, decision-making and improved accuracy. The study outlines recommendations for adopting digitalization methods that support the adoption of new roles and skills in procurement, utilizing AI, RPA, and advanced e-sourcing solutions. Clearer organizational structures, well-defined roles, and responsibilities promote structural transparency by minimizing misunderstandings, and enhancing collaboration of future roles. By implementing new job profiles and technologies associated with digitalization, purchasing and supply chain management (PSM) professionals are enabled to dedicate their time and efforts towards value-added tasks beyond automation's reach, capturing the strategic nature of purchasing. The study also suggests segregating operational and strategic procurement, entrusting specialized personnel with operational tasks, and empowering commodity buyers for strategic activities.

Impact:
The outcome of the research implies increased purchasing efficiency through the integration of advanced technological developments and roles, leading to improved performance in procurement. The research identifies corresponding skillset by linking them together with emerging roles and suggests educational approaches for acquiring these competences.

Limitations:
Limitations derive from the study's singular focus on one company operating in the automotive industry. While this depth provides insights into the company's specific complexities and challenges, it may hinder the findings' applicability and generalizability across the broader automotive sector.

Recommendations:
Besides the recommendation about how to implement future purchasing roles and skills into the organisational structure of the case company, enhancing organizational transparency for achieving better collaboration is recommended along with the distinct separation of strategic and operational procurement activities.

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1 Introduction: Enabling the implementation of future roles and skills in PSM based on case research

In the past few years, there has been a rapid pace of technological development which has transformed the way we live, work, and interact with each other. Digitalization has become an integral part of modern society, and advancements in areas like artificial intelligence (AI), the Internet of Things (IoT), and cloud computing are changing the world in profound ways (Khanna & Sharma, 2019). As new technologies emerge and evolve, they are shaping the future of industries and paving the way for new opportunities and challenges; digitalization is considered as a driving innovation that enables us to achieve new levels of efficiency, productivity, and connectivity (Mähler & Westergren, 2019). Industry 4.0, also known as the fourth industrial revolution, is a digital transformation that is reshaping various industries, including the automotive area too (Ghosh, 2022). The term 'Industry 4.0' can be defined as follows: "the merging of the physical and digital worlds by means of cyber-physical systems and autonomous machine-to-machine communication" (Schiele et al., 2021, p. 1; Schiele & Torn, 2019, p. 508). Industry 4.0 has a significant impact on the operations of firms across various industries as it enables automation and digitalisation of processes, allowing greater efficiency, accuracy, and speed in operations. It also promotes the integration and exchange of data across various systems by enabling real-time monitoring, control, and optimization of processes. This leads to enhanced visibility, coordination, and decision-making. The diverse technologies of Industry 4.0 can also be implemented in purchasing and supply chain management, because advanced analytics and AI algorithms are able to analyse large volumes of data to forecast demand patterns, optimize inventory levels, and streamline procurement planning (Guida et al., 2023). This helps in reducing costs, minimizing stockouts, and improving overall supply chain efficiency. Additionally, Industry 4.0 facilitates closer collaboration and communication with suppliers through digital platforms and tools because it enables real-time information sharing, joint planning, and supplier performance monitoring.

Implementation of Industry 4.0 technology involves the integration and adoption of various digital technologies and automation into business operations. This implementation typically follows a pre-defined approach, starting with the identification of suitable technologies, assessing their feasibility and impact, and gradually implementing and scaling them within the organization. Integrating these technologies makes the company overall more efficient in its operations, while also helps to be up-to-date with the large amounts of real-time data at hand (Jahani et al., 2021). The adoption of Industry 4.0 technologies, such as artificial intelligence, the Internet of Things and big data analytics have a significant impact on the development of future roles and skills required in the purchasing function of the automotive industry (Ghosh, 2022). The automated network of collaborating systems allows PSM professionals to spend more time on strategic decision-making and less on administrative tasks. Industry 4.0 technologies support a smooth supplier selection process from prequalification through negotiation to contracting, where the main focus is on transparency (Gottge et al., 2020). However, it is important to note that not all organizations fully realize these benefits. Challenges in implementing Industry 4.0 technologies can include high implementation costs, lack of technical expertise and compatibility issues with existing organisational structures, including inadequate roles and skills (Jahani et al., 2021). To fully realize the benefits of Industry 4.0 in purchasing, organizations need the appropriate skill sets and roles within their teams. Although, it is a worthwhile investment into the future, companies have to take preparatory steps before implementing any changes. This might involve reorganizing the structure as new technologies require new skills and talents, which create completely new roles and reformulate old ones.

Adequate training is necessary for long-time employees to catch up with these innovative solutions, and HR professionals have to be debriefed about what exactly to look for when recruiting new applicants. Overall, it has to be understood how different roles are working together to support the implementation of Industry 4.0 technologies.

Delke (2022) has identified the most relevant future roles and skills that are becoming highly important for leading companies in most industries. He discusses current roles and skills, as well as the gap between them and future requirements, but his study does not define how to implement Industry 4.0 technologies and future roles in the organisational structure of an organisation, and his research is not specified to the automotive industry. On the contrary, ADB (2021) and Islam (2022) both researched the automotive industry, extending the list of future roles and skills with relevant additions. However, their studies also lack the definition of how to implement future roles along with Industry 4.0 technologies into the organizational structure of companies in the automotive industry.

This research aims to understand how technology is reshaping the procurement department and practices of a firm; therefore, a single case study is used. The case study addresses different future purchasing roles and competences along with Industry 4.0 technologies, and the aim is to provide a guideline about how to implement them into the organisational structure of different companies in the automotive industry by using the example of a tier 1 supplier and world market leader for steering column modules. This objective will be achieved by answering the following main research question:

How can organisations in the automotive industry integrate future purchasing roles with attached relevant skills into their organisational structure?

To examine this research question in detail, the research addresses a specific set of sub questions:

1. How does technology change the job profiles in future procurement organizations?
2. What is the current organizational structure and job profiles in the purchasing department of the case company?
3. Which future skills and roles are needed in the case's procurement department?
4. How to layout the future organisational structure of the procurement department?
5. How to close the gap for missing talent and skill allocation?

A qualitative research approach was conducted to answer the above-mentioned research questions. First, individual interviews were scheduled with commodity managers and other PSM professionals of the relevant departments to understand how the current processes work and to identify areas for improvement. Second, the data of the interviews were analysed based on different criteria, such as current roles and skills, structure, training opportunities and desired organisational outcomes. Finally, based on the findings, recommendations were provided about how to implement future purchasing roles, skills, and Industry 4.0 technologies in the organisational structure.

The research contributes to the broader field of science by addressing a significant research gap in the existing literature. While previous studies, such as Delke (2022) have identified emerging purchasing roles and skills crucial for various industries, a comprehensive framework is not provided about how to integrate Industry 4.0 technologies and new procurement roles into an organization's structure. Other studies, such as ADB (2021) and Islam (2022) focus on the automotive sector and expand the understanding of future roles and skills, but their studies also lack practical guidance on the implementation of these roles in the context of Industry 4.0 transformations. Therefore, the contribution of this research lies in bridging this gap by providing a strategic framework for the implementation of purchasing roles and skills along with Industry 4.0 technologies into the organizational structure of automotive companies.

The research contributes to practice by providing business-tailored recommendations about how to apply methods of digitalisation which eventually lead to new roles and skills in procurement. The expectation is that other organizations similar to the case company will also benefit from the outcome of this research by gaining insights on the best practices and strategies for integrating Industry 4.0 technologies into their own procurement processes. By leveraging the research findings, these organizations can take proactive steps to optimize their purchasing functions, enhance operational efficiency, and stay competitive in the rapidly evolving automotive industry. The following parts of this study are structured based on the theoretical background, method used for data collection, results of analysis and discussions.

2 Theoretical backgrounds

2.1 Changes in purchasing and supply chain management

The context of this paper is written in the purchasing and supply management domain; therefore, a detailed understanding of purchasing and the implications of technology are required. The term 'purchasing' can be defined in the following way: "the function in a firm responsible for the professional management of a firm's interface with the supply market, to ensure its supply with the necessary goods and services provided by other organisations, i.e., suppliers" (Schiele, 2019, p. 45). Purchasing has a significant impact on business performance, because on average, an industrial company spends around 60% of its turnover on supplies, therefore; it is crucial to have the right purchasing roles and practices in place (Van Weele, 2010). The procurement function is ever-changing due to the growing trend of globalization, improved strategic sourcing solutions and increasing availability of highly advanced technological systems (Tassabehji & Moorhouse, 2008). As time passes by and technology improves, smart changes replace traditional ones in procurement as a result of Industry 4.0 (Chen et al., 2017). The execution of general PSM activities becomes faster, more precise, and more efficient. Data management, supplier audits, order placements, contract creations and numerous other duties are all supported by various Industry 4.0 technologies, helping professionals to do their job more effectively (Jahani et al., 2021). Subsequently, new job roles and skills are expected to emerge which are essential for the future purchasing activities; therefore, an understanding of how technology may change purchasing practices and job profiles is necessary, where technology will lead to new roles and organizational structures.

2.1.1 Industry 4.0 technologies are reshaping the current purchasing function

Over the last few decades, technology has advanced to a level, where it is not only a useful tool that can support businesses to reach a higher potential, but it has become the major driving force behind successful organizations. The fourth Industrial Revolution initiates a fundamental change in business operations, and adoption of related innovations is becoming more accessible for companies. Industry 4.0 refers to the linking of information and communication technologies with each other by creating a "cyber-physical production system" that focuses on the extraction of large amounts of real-time data about all processes with minimal human interaction (Abdelmaijed, 2022). One of the greatest of these new technologies is called the Internet of Things which lays the foundation for best optimizing the processes of any company in any given industry. IoT is basically the underlying technical system that integrates and connects all technologies used by the organization, by creating a network that enables interaction between machines and allows for efficient management by providing essential insights on all of their operations (Gokhale et al., 2018). Linking previously independent devices together ensures the optimal handling of Industry 4.0 technologies, as data exchange between such devices and their users is essentially the bedrock of this revolution. Industry 4.0 relies heavily on IoT, which allows the manufacturing process to be connected digitally from start to finish, where every link in the chain adds to the data set (Georgios et al., 2019). The otherwise time-consuming task of analysing the extensive output can be assigned to the artificial intelligence (AI), which is able to extract data in enormous volume, identify patterns, predict future activity, and enhance progression towards realising the organization's true potential (Singh et al., 2020). By integrating AI in the process, the system can be expanded to an Intelligent IoT, which allows the automation of several operations. A huge advantage of this technology is that it does not require human intervention, as the Machine-to-Machine (M2M) system processes and analyses the collected data collaboratively and is able to make decisions on its own (Khanna & Sharma, 2019). Examples of advanced technologies that emerged from the IoT in the automotive industry include wireless sensors, smart cognitive radio networks, high performance batteries, ultra-low emission internal combustion engines and fuel cell technology (Aris et al., 2015).

The integration of IoT technologies into the organization has a positive effect on PSM performance. A study based on 200 interviews with senior managers, conducted by Legenvre et al. (2019) describes three possible scenarios about the degree of adaptation of IoT technologies with the most added benefits.

1. *The IoT adopter* can benefit from simplified, automated, and improved PSM activities, while gathering a wide range of data that helps to boost future performance. The use of this system also establishes transparency within the supply chain and provides favourable circumstances for those that wish to operate more sustainably. Smart contracts and supplier audits can be handled more efficiently, while reducing possible risks that occur during these activities.
2. *The IoT innovator* takes this technology one step further by collaborating directly with external organizations that make IoT systems to create something new. These partnerships can provide the company with the most innovative systems that are tailored to exact needs. PSM professionals need to cooperate with the R&D team to find areas that need further improvement and to reach out to suppliers that are capable of meeting their demand. A successful project can even yield revenue for the company if they are open to sell the system to other organizations.
3. *The IoT master and strategist* is on the top of the game by continuously innovating brand-new systems and adopting the latest technologies that are being released on the market. This scenario allows for the automation of the most complex PSM actions and regular renewal of the current practices based on the most advanced methods available.

Connecting people, machines and physical objects results in a more transparent management of complex systems. When real-time manufacturing data is available remotely through cloud computing, users have the flexibility to monitor production status, control tools physically with an application or computer software and schedule future activities based on observations and AI suggestions (Zheng et al., 2018). This is called smart manufacturing, which means that the production process becomes more efficient, while lead times are shortened and the organization is able to react to challenges more dynamically than before (Yang et al., 2019). The use of smart systems offers a detailed analytical approach based on Big Data (Torn, 2017). It can contribute to the purchasing and supply chain process in many ways, for example by forecasting future figures, evaluating risk management practices, and optimizing the order of routing (Nguyen et al., 2018). Simply put, Big Data analytics helps to achieve an evidence-based decision making, instead of relying on intuition (Mavidis & Folinas, 2022). Being provided with sufficient proof for determining operational choices, PSM professionals will be able to better define the expected demand for raw materials and other goods in real time. Additionally, big data analytics supports the development of more accurate procurement processes and policies (Biazzin & Castro-Carvalho, 2019).

Besides IoT technologies, there are other innovations that are relevant in the field of procurement and support various PSM tasks. Some of them were available before Industry 4.0, but they surely have a crucial role in making the transition from traditional methods to smart technological solutions. Advanced sourcing systems, or in other words e-sourcing solutions provide some useful advantages by simplifying the analysis of prior requests for quotation (RFQs), and therefore, enabling PSM professionals to better identify future suppliers and improve quotations (Delke, 2022, p. 5). The insight gained from data analysis contributes to the establishment of optimal terms, pricing, quality and so on[1]. The requirements for human intervention are minimized through maturing e-procurement systems, which oversees operational ordering or payments automatically within the system (Hawking

[1] https://planergy.com/blog/big-data-analytics-in-procurement/

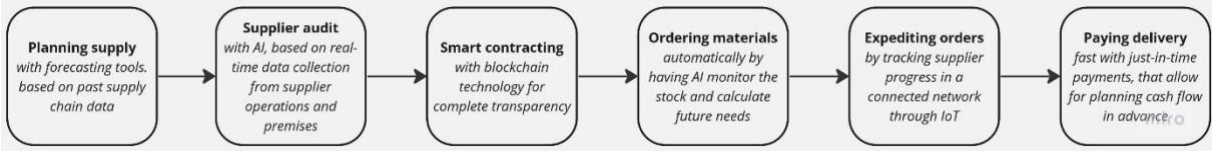
et al., 2004). Consequently, there is no necessity for human involvement in identifying demand requirements (Delke et al., 2022, p. 5). Modern e-procurement sourcing systems usually give access to both Big Data analytics and artificial intelligence tools to make the most of diverse data sources (AlNuaimi et al., 2021). Furthermore, artificial intelligence in e-sourcing software systems helps to increase efficiency by undertaking certain parts of different procurement processes. To name a few, AI can be used to analyse spending patterns and identify possible areas for cost reduction, thus, time and resource savings might be achieved by PSM professionals (Kehayov et al., 2022).

Any structured and repetitive task that was performed manually in the past is now possible to execute via automation. For example, AI is able to scan documents for keywords in a second, extract the useful information and report it to the human auditor. It can also be programmed to detect anomalies, like increased expenses, unexpected order placements or unusually large quantities (Kokina & Davenport, 2017). Moreover, AI supports the supplier selection process through the analysis of supplier performance metrics, which include information regarding quality, price, and delivery time of the ordered items (Guida et al., 2023). Later, when the supplier has already been selected, AI assists in contract management by automatically extracting key contract terms and clauses, and it also notifies the sourcing team about any upcoming contract renewal, so the contracts can be renegotiated for better terms (Talhaoui & Mulder, 2019, p. 15). Last, but not least, artificial intelligence is able to forecast supply demand, identify supply chain risks, and therefore, optimize the purchasing processes. This implies that AI can be utilised in predictive analytics where historic data is used to allow PSM professionals to make more informed purchasing decisions. Real-life cases where AI was implemented successfully in the business process include an AI-based negotiation coach who provides cost models for auctions and supports the consultation with suppliers, and an AI-powered chatbot that screens through inquiries and makes rational suggestions to choose the best candidate (Guida et al, 2023). However, it should be used carefully and with regular control because AI might not always be able to screen out the irrelevant data, which can lead to deceptive patterns, false predictions, and an overall less reliable audit quality (Albawwat & Frijat, 2021).

Another Industry 4.0 technology is robotic process automation (RPA) which has the purpose of automating tasks. Software robots are provided with access to various systems used in the company and execute individual activities or complex processes, practically functioning as a human (Lacity et al., 2017). Repetitive, administrative tasks are usually handed over to software robots, such as creating or editing Excel sheets, generating mass e-mails and periodic reporting (Hofmann et al., 2020). By using RPA technologies, procurement processes can be redesigned and further optimised to achieve an increased operational efficiency and save incurring costs (Viale & Zouari, 2020). RPA can be applied to any activity that has a rule-based structure, hence does not require cognitive thinking and judgemental effort to operate (Aguirre & Rodriguez, 2017). To provide a more thorough overview, RPA can be utilised in purchase order processing, invoice processing, contract management and supplier management. One more advantage associated with RPA is improved accuracy as data entry happens automatically; thus, human error is fully eliminated. Besides accuracy, RPA enhances compliance by ensuring that procurement processes are in line with the organisational policies and regulatory requirements (Flechsig et al., 2022).

Regardless which scenario is realised, any organization will see positive results after the implementation of Industry 4.0 technologies. Complex decision-making processes become less complicated due to the massive amount of data on hand, so PSM professionals can focus more on strategy formulation thanks to artificial intelligence that handles automated tasks. Organizations will be able to spend more time on creating real value to their customers, who in return contribute to the profitability of the business (Bienhaus & Haddud, 2018). When such a monumental, technology

induced change occurs in procurement practices, it might have an impact on the organisational structure as well.



1. Figure: Overview on how technology is changing purchasing (Schiele, 2019, p. 48)

2.2 Organisational structure

The company's ability to react to new technological innovations and its speed of adopting them is highly affected by the organizational structure (DeCanio et al., 2000). When a monumental change in the industry is around the corner, the organization has to adjust its structure and operations to stay competent (Král & Králová, 2016). Adaptation to the new circumstances depends on many factors, such as the leader's personality and expertise in the given field, the nature of the challenge and the possessed skills of employees to tackle changes. According to this information, it was proposed by Fiedler (1958) that the decision-making process should be different with regard to each situation, and the organizational structure has to be flexible for any change. The contingency theory declares that the key for long-term success is that organizations might approach various scenarios and apply the one that fits best per condition. There is no pre-defined best way of organising a business or making decisions, but rather actions should be taken based on the current situation (Lidegaard et al., 2015).

The 4th Industrial Revolution demands leaders to revise the structure of their organization and initiate modifications where it is necessary. With the use of advanced technology, new roles are required to be defined, even forming new departments might be necessary in some cases. The goal of this study is to research these roles relevant to the automotive industry and recommend a practice that can be used for implementing them, while taking into consideration which organisational structure is the most beneficial for procurement. Below, different organisational structures are described that can be used by firms for organising purchasing.

2.2.1 Different organisational structures that support the purchasing function

There are multiple organisational structures which can be used by businesses to organise purchasing. One of them is the centralized organizational structure which implies that a central purchasing department or team makes all purchasing decisions at the top-level management (McCue & Pitzer, 2000). In this structure, purchasing authority is practiced by a single department, thus, all procurement activities of the organisation are handled by a separate office. In a centralized structure, the central purchasing team is responsible for developing policies and procedures, sourcing suppliers, negotiating contracts, and managing supplier relationships (Arizu et al., 2006). This can increase efficiency and consistency in purchasing practices as well as improved negotiation power with suppliers due to the centralized purchasing volume. In this structure, flexibility and responsiveness are more difficult to achieve, because purchasing decisions need to be approved by higher-level managers. Moreover, there may be a lack of visibility and communication across the organization, as individual departments do not have direct access to purchasing information or supplier relationships. Decisions are made at the top-level management; thus, the decision-making power of lower-level employees are limited which leads to little autonomy.

The table below summarises the main advantages and disadvantages associated with a centralized organisational structure

Advantages	Disadvantages
Clear communication and decision-making	Slow response time
Consistent policies and procedures	Lack of flexibility
Streamlined coordination and control	Limited empowerment and autonomy
Efficient resource allocation	Overreliance on top management
Clear accountability and responsibility	Limited local decision-making authority
Cost-effective resource utilization	Limited innovation and adaptability

*1. Table - Advantages and disadvantages of a centralized organisational structure (*McCue & Pitzer, 2000; Arizu et al., 2006)

In a decentralized organisational structure, each business unit has its own purchasing team responsible for sourcing goods and services. This structure enables departments to make purchasing decisions in a quicker and more efficient manner than centralized purchasing organisations, because there is no need for approval from higher-level managers (McCue & Pitzer, 2000). It also allows departments to develop closer relationships with suppliers by leveraging proximity; purchasing teams are usually located closer to suppliers which facilitate face-to-face communication and better interactions. As mentioned earlier, decision-making power is delegated to lower-level employees or teams; thus, more autonomy and control is provided to them over their work (Gianakis & Wang, 2000). On the other hand, more coordination and communication is necessary between different departments of the enterprise which might pose additional challenges. Without a centralized purchasing function, it is more difficult to ensure consistency in procurement practices or to take advantage of economies of scale, because purchasing is not limited to one department. The table below represents the main benefits and disadvantages of a decentralized organisational structure in procurement.

Advantages	Disadvantages
Faster response time	Communication challenges across units
Flexibility and adaptability	Potential for inconsistent policies and actions
Empowerment and autonomy	Potential for lack of coordination
Promotes employee development	Duplication of efforts and resources
Local decision-making authority	Increased complexity and coordination challenges
Innovation and creativity at local levels	Difficulty in maintaining consistent standards

2. Table - Advantages and disadvantages of a decentralized organisational structure (McCue & Pitzer, 2000; Gianakis & Wang, 2000)

A combination of these two structures seems to be an applicable option, and most companies are adopting both centralization and decentralization in some form (Munson & Hu, 2010). A hybrid organizational structure in purchasing refers to a structure that incorporates elements of both centralized and decentralized structures. In this structure, purchasing authority is shared between a central purchasing team and individual departments or business units, depending on the category or type of goods and services being purchased (Trautmann et al., 2009). In a hybrid structure, common goods and services may centrally be purchased by the purchasing department, while specialized or unique goods and services may be purchased by individual departments or business units. This allows for greater flexibility and responsiveness in purchasing decisions, while still providing the benefits of centralized purchasing for common goods and services. Local purchasing teams are empowered to make their own decisions, and more expertise can be gained in their respective areas by understanding the regional market dynamics (Trautmann et al., 2009).

However, a hybrid structure can also be more complex to manage than a centralized or decentralized structure, as it requires coordination between multiple purchasing channels and decision-making

processes. It may also require additional resources and technology to effectively manage and track purchasing activities across the organization (Johnson & Leenders, 2006). The table below visualises the most important advantages and disadvantages of a hybrid organisational structure.

Advantages	Disadvantages
Flexible structure	Complexity in managing dual structures
Efficient decision-making	Communication challenges between units
Balance between coordination and autonomy	Potential for overlapping roles and conflicts
Local empowerment and innovation	Additional managerial oversight and coordination
Effective resource utilization	Potential for power struggles and confusion

3. Table - Advantages and disadvantages of a hybrid organisational structure (Trautmann et al., 2009; Johnson & Leenders, 2006)

When comparing these structures from the standpoint of the purchasing function in an international company, Richter et al. (2019) have concluded that a hybrid structure with relatively stronger centralization is the most efficient approach. Although the positive effect of centralization may depend on the category of products being purchased, the overall consensus is that with durable goods there is no downside of applying a hybrid structure to the organisation (Trautmann et al., 2009; Li & Shi, 2019). The table below provides an overall comparison of the three organisational structures based on different factors, such as communication, hierarchy, decision-making and many more.

Factors	Centralized	Decentralized	Hybrid
Communication	Top-down, formal	Lateral, informal	Combination of formal and informal channels
Hierarchy	Tall hierarchy	Flat hierarchy	Can be flat, tall, or in between
Decision-making	Centralized decision-making	Decentralized decision-making	Combination of centralized and decentralized decision-making
Flexibility	Limited flexibility	High flexibility	Moderate flexibility
Resource allocation	Centrally controlled	Local autonomy	Central control with local autonomy
Standardization	High level of standardization	Limited standardization	Balanced standardization
Strategic alignment	Central strategic direction	Localized strategic focus	Combination of central and localized strategic alignment
Innovation	Slower adoption	Faster adoption	Innovation adopted at local levels
Risk management	Centralized risk management	Distributed risk management	Combination of central and distributed risk management

4. Table - Comparison of centralized, decentralized and hybrid organisational structure (Richter et al. 2019; Trautmann et al., 2009; Li & Shi, 2019)

Comparing decentralized, centralized, and hybrid organizational structures for purchasing matters when integrating future roles and skills because it helps identify the most efficient, adaptable, and communication-effective structure. It also optimizes resource allocation, manages risks, defines decision-making authority, measures flexibility and the degree of innovation adaptation.

2.2.2 Different organisational structures in Purchasing and Supply Chain Management

More specifically for purchasing, there are two different structures which will be described here and can be used by purchasing organisations. One of them is a category-based structure which is designed around categories of similar goods and services provided by the same group of suppliers (Schiele, 2019).

A category-based structure is established in the following way:

The regular purchasing activities can be mapped out in the "purchasing year cycle." This cycle aligns with the firm's strategy and involves planning the supply for materials and services, selecting and contracting suppliers (strategic sourcing), executing the plans (operative procurement), and evaluating performance. While the category sourcing cycle operates at a category level, there is another set of activities conducted at the level of the entire purchasing department, known as the "purchasing department cycle." This cycle involves monitoring the overall success of purchasing activities through controlling activities that contribute to strategic planning. It also involves adapting processes, structural organization, and making personnel choices based on new plans. The fundamental unit of purchasing is the sourcing category, also known as commodity group, product family, or material group. A sourcing category represents a general group of purchased items, including materials or services of a similar type provided by the same group of suppliers in a single supply market. These categories are not based on technical or product characteristics but rather reflect the alternatives available in the supply market.

In traditional purchasing departments, purchasers were responsible for a wide range of materials, which limited their ability to develop industry expertise and led to inconsistencies in supplier interactions and purchasing terms. To address these challenges, category management is introduced. As mentioned earlier, the groups of goods and services are not formed according to product characteristics or technical parameters but rather based on the available alternatives in the market. In this structure, procurement professionals are assigned to specific categories of goods and are responsible for managing all procurement activities within that category, such as sourcing, negotiation, contract management, and so on. This specialization allows for better coordinated information processing and decision-making, as professionals only have to focus on their own area of expertise (Richter et al., 2019). The main advantages associated with category management are increased efficiency, improved risk management and better supplier relationships.

Another organisational structure that can be used in purchasing and supply chain management is the project-based structure. This structure is designed around projects, instead of functional areas or categories of goods and services. In a project-based structure, PSM professionals are mostly required to work on extensive procurement projects for a pre-defined period of time then move on to the next one (Wei et al., 2021).This structure has its own benefits, such as it provides greater flexibility, improved collaboration between cross-functional project teams, and increased accountability for procurement outcomes as specific employees are assigned to each project This structure also enables the purchasing function to be more flexible, while increased accountability is maintained for various procurement projects.

Besides the above-mentioned structures, the allocation of roles and skills are also part of the organisation and its structure.

2.3 Human Resources in Purchasing and Supply Chain Management

Human resource management plays a key role in finding the most skilled individuals that can contribute to the success of the company. The initiation of Industry 4.0 poses new challenges for the HR department, because during this transition, they also have to adapt and understand what competencies are becoming important. Retaining talent might be harder than ever before as there seems to be a shift from long-term to task-based employment (Sony & Naik, 2020). Therefore, HR professionals have to be ready for the circulation of high-skilled people within the industry. On the other hand, automation of processes is also an option for HR activities, hence there will be more time for HR employees to spot talented workforce (Sivathanu & Pillai, 2018). Big data analytics combined with the use of AI can provide many benefits, such as automated resume screening, social media platform monitoring, performance tracking and schedule creation (Verma et al., 2021; Samarasinghe & Medis, 2020; Puhovichova & Jankelova, 2020).

When it comes to purchasing, a mature organisation requires proper job descriptions as emphasized by Schiele (2007). Job descriptions define the exact function of each purchasing employee as well as the required technical competencies. In the most ideal scenario, purchasing functions should be described in detail and agreed upon in collaboration with cross-functional partners. Standardized purchasing function descriptions should consistently be implemented across all sites and units. Moreover, to reach the full potential of purchasing, ongoing monitoring of job profile advancements and trends must be conducted and reviewed by the organisation on a group level. Other than proper description of purchasing functions, technical competences should also be well defined and continuously developed for all substantial commodity areas. This implies that when a well-established human resources management approach is implemented in the procurement sector, it results in having a more capable workforce, which in turn, contributes to achieving better performance in purchasing activities (Delke & te Raa, 2022).

2.3.1 New future purchasing roles are expected to emerge due to Industry 4.0

Before introducing future purchasing roles, four jobs had been distinguished in procurement by Mulder (2005) in the past. These general roles in the purchasing profession are purchasing manager, senior buyer, buyer, and assistant buyer. For these jobs, a great number of tasks have also been identified (105 in total), which were then divided into four categories: purchasing management, information and communication, initial purchasing, and operational purchasing.

Schiele (2019) has also identified distinctive purchasing roles which require diverse skill sets; therefore, different personnel development options are desired. The main roles which were distinguished are operative procurement, responsible for day-to-day tasks like order placement and order follow-up, purchaser for direct materials who manages the sourcing of direct materials for production, purchaser for indirect materials, public procurement roles, purchasing engineer, and chief procurement officer.

When it comes to future purchasing roles, a data analyst and a data manager are both highly desirable roles by any firm working with e-procurement systems because digitalization is fully data-driven. Employees in these roles support decision-making within the purchasing processes as they align the physical and digital world by continuously interpreting and reporting the data available at hand (Delke, 2022, p. 129). With the huge amount of data extracted in the company's system, data privacy and security are becoming a top priority. A legislation specialist is needed to advise based on the legal background of safe data management, and cope with the implications of using blockchain technology and smart contracts which are the results of automating supply chain processes (Delke, 2022, p. 131). Arranging the connection between the organisation and its suppliers through a digital interface and mediating the communication is the job of the supplier onboarding manager.

Stakeholders need a person they can rely on when making sure all of the interested parties are involved, the relevant data is collected, and the processes are explained transparently (Delke, 2022). A process automation manager is key to the smooth operation of the company by being responsible for setting robotic process automation tasks to run without human intervention (Delke, 2022, p. 132). Detecting new technologies and implementing them are the main functions of the system innovation scout who advises purchasing professionals about what the next useful tool could be in the future of the company. Lastly, a chief happiness officer is vital for the well-being of employees, who makes sure all human needs are met in the digitalised work environment (Delke, 2022).

2.3.2 Current and future purchasing skills in procurement

Before describing the most essential future purchasing skills as a result of Industry 4.0, it is worthwhile to mention that purchasing professionals need to possess a wide range of other skills, including technical, interpersonal, enterprise and strategic business skills which enable them to excel in various procurement processes (Tassabehji & Moorhouse, 2008). The most prevalent professional skills involve analytical skills, business acumen, computer literacy, contract management, cost savings, finance, logistics, supply chain management and so on. Generally, buyers should also demonstrate a strong set of interpersonal and soft skills, such as change management, communication, conflict resolution, creativity, cultural awareness, customer focus, integrity, negotiation, leadership, networking and many more.

Bals et al. (2019) have identified ten general future competencies which are relevant in procurement. These competencies include analytical skills, automation, big data analytics, computer literacy, e-procurement technology, holistic supply chain thinking, process optimisation, strategic sourcing, strategic thinking, and sustainability. By looking at the category of these competences, they either belong to the technical, enterprise or strategic business skill set. A few of these competencies can directly be linked to Industry 4.0, involving automation, big data analytics and e-procurement technology.

The use of advanced technological innovations require high level of technical skills and recruiters have to be aware of what exactly they are looking for. Just as mentioned above, data analytics were found to be one of the most important skills in procurement, which not only includes finding, handling, analysing and visualizing data but also identifies patterns and forecasts based on current results (Delke, 2022, p. 159). The impact of digitalization on the procurement process is massive as most tasks and activities are handled via computers. Supplier audits, negotiation, contracting, partnership, and people management are all going through e-procurement systems, which require unique skills to operate them effectively (Delke, 2022, p. 159). However, not only digital skills are essential for future employees in procurement, but critical thinking, judgement, decision-making, active learning, and complex problem solving were also highlighted by employers in the Indonesian automotive industry as the most wanted skills (ADB, 2021). Other necessary business skills include cognitive flexibility, adaptive thinking ability and qualitative skills (Islam, 2022).

When it comes to the assessment of purchasing skills, direct and indirect procurement can be separated from each other as they require different skill sets. According to Delke et al. (2022) there is a notable contrast in skills between direct and indirect material procurement. Specifically, two skills, 'co-development with supplier' and 'supplier relationship management', stand out in relation to direct purchasing. On the other hand, four skills, namely cross-cultural awareness, communication, flexibility and agility, and change management hold greater significance for indirect material procurement. Additionally, there are two skills, namely purchasing technology and (e)-tool skills, and decision-making which might be worth considering for direct material procurement.

The table below summarizes the before-mentioned current and future purchasing skills by category:

Skill Categories	Examples of Skills	Sources
Technical skills	data analytics, process optimization supplier audits, contracting, computer literacy	Bals et al. (2019), Delke (2022)
Enterprise skills	business acumen, finance, logistics, supply chain management, decision-making, cost savings	Tassabehji & Moorhouse (2008) Bals et al. (2019)
Strategic business skills	strategic thinking, holistic supply chain thinking, strategic sourcing	Bals et al. (2019)
Industry 4.0 skills	automation, big data analytics e-procurement technology	Bals et al. (2019), Delke (2022)
Interpersonal skills	communication, conflict resolution, change management, leadership negotiation, partnership	Tassabehji & Moorhouse (2008) Delke (2022)
Soft skills	analytical thinking, creativity, active learning, cultural awareness, customer focus, networking, critical thinking, integrity, problem-solving, adaptability, judgement, people management, cognitive flexibility	Tassabehji & Moorhouse (2008) Delke (2022), ADB (2021) Islam (2022)

5. Table - Current and future purchasing skills

To wrap up, the future of purchasing skills in the era of Industry 4.0 involves a mix of technical, interpersonal, enterprise, and strategic abilities. These range from analytical and negotiation skills to digital know-how. As Industry 4.0 shapes procurement, technological skills like automation, big data analytics, and e-procurement become more significant. However, cognitive flexibility, judgment, and problem-solving skill remain vital. Notably, different skills matter for direct and indirect procurement, with supplier relationship management and cross-cultural awareness being key.

The competence model developed by Hecklau et al. (2016) provides an in-depth analysis about the various fields future employees need to have an expertise at. After assessing applicants with this tool, HR professionals can identify skill gaps and evaluate the readiness of the new employee for any given role.

2.4 Skill development options for closing the gap for missing talent and skill allocation

To close the gap for missing talent and skill allocation and educate the current and future workforce, specific educational methods are required which will be described in this section. The aim is to provide actionable strategies for developing the necessary skills, either through training or recruitment. By outlining specific skill development pathways, this part directly addresses the challenge of ensuring that the procurement department is equipped with the right skills and competencies for future roles.

One of the possible skill development options is providing training courses and development plans to employees about Industry 4.0 technologies which will be present in the future purchasing organisation (Stek, 2021). These training courses have the goal of helping PSM professionals understand the effects of Industry 4.0 innovations on their job, and therefore, assist them to obtain knowledge about how they can apply these new technologies to achieve an improved purchasing performance. Such trainings should include an overview about the principles of Industry 4.0 involving the use of big data analytics, artificial intelligence, the Internet of Things.

Employee education is an on-going necessity that must be coordinated thoroughly with systematic recurrence; hence subordinates are always up-to-date with the latest improvements. Each learning task have to be accompanied with the most adequately fitting training method to keep employees engaged and achieve a common understanding.

These methods among many others include for example mentoring sessions, handbooks, self-education via the Internet, lectures, group projects and video conferences (Stachová et al., 2019). Before providing trainings, companies should evaluate the adaptability of each employee and design learning strategies accordingly, because it is highly likely that not all workers are on the same level in every subject. Some might have more knowledge, hence require less effort to educate, while others need more time to adapt to new circumstances (Sony & Mekoth, 2022). Beyond acquiring operational knowledge, health, safety and security coaching should not be neglected either, as being aware of the possible risks and what to do when there is an emergency is highly important when transitioning to employee 4.0 (Gajek et al., 2022).

Another way of acquiring the required skills is recruiting new employees. During recruitment, the purchasing organisation needs to be aware of what competencies are needed to maintain efficient operations, thus, it is necessary to perform standardised interviews which analyse and measure if applicants possess the required skills levels by the organisation (Schiele, 2007). Other than hiring new employees, it has been proposed by Schiele et al. (2022) that PSM professionals should continuously obtain new skills. The main principle behind lifelong learning is that one employee will not be responsible for the exact same tasks during his/her entire career, so this means, new tasks are likely to emerge due to globalisation, technological development, and the increasing importance of sustainability.

Lifelong learning can be achieved by several means of training opportunities, such as instructor-led classroom training, mentorship, simulators, job rotations and apprenticeship (Chatzimouratidis et al., 2012). These professional development methods are usually provided to the current workforce to fill skill discrepancies; therefore, young professionals in the early stages of their career need a different training method. Higher educational institutes can tailor the learning objectives of young PSM professionals according to the requirements of the business environment (Pekannen et al. 2020).

Educational method	Description
Training Courses and Development Plans	Structured training programs focusing on Industry 4.0 technologies (e.g., AI, IoT) and negotiation. Development plans aligned with roles.
Customized Learning Strategies	Tailored learning approaches based on adaptability and existing knowledge. Mentoring, handbooks, online resources, etc.
Health, Safety, and Security Coaching	Education on safety protocols, emergency response, and risk management associated with Industry 4.0 technologies.
Lifelong Learning	Continuous skill development throughout a career due to evolving tasks.
Professional Development Opportunities	Training options: classroom sessions, mentorship, simulators, job rotations, apprenticeships addressing skill gaps.
Collaboration with Higher Educational Institutes	Collaborate to design learning objectives for young professionals entering the field, keeping pace with business trends.
Employee-Driven Learning	Encouraging self-driven learning through online courses, workshops, seminars to stay updated on Industry 4.0 trends.

*6. Table - Possible educational methods (*Chatzimouratidis et al., 2012; Pekannen et al. 2020)

2.5 Integration of organization, roles, skills, and educational methods in the changing landscape of procurement

The paper delves into the developing responsibilities of procurement within the automotive industry influenced by Industry 4.0. In this section, the relationship is evaluated between the before-mentioned four significant elements: organization, roles, skills, and educational methods. These elements collectively form a perspective that highlights the complex connection underlying the evolving procurement domain.

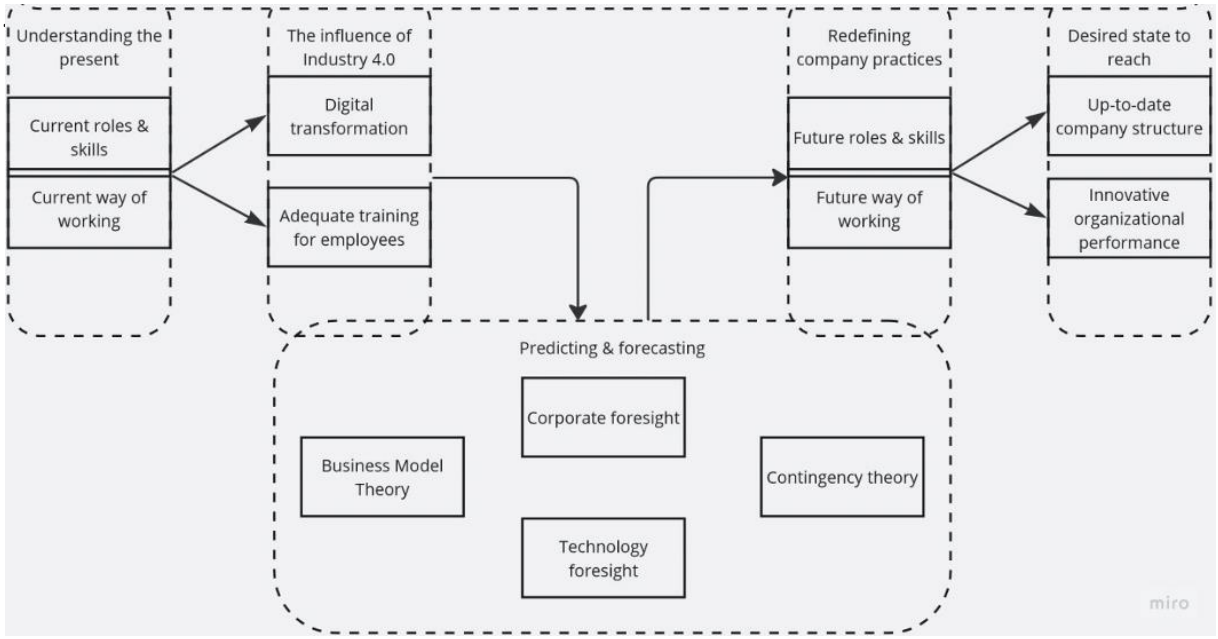
Central to this perspective is the organizational structure which responds and changes in accordance with the various consequences of Industry 4.0 technologies (Cimini et al., 2021). This transformation has background effects that spread throughout the procurement processes and operations causing changes in the associated roles (Chen et al., 2017). As purchasing roles and job profiles modified by the technologies of the 4th Industrial Revolution, future skill requirements are also expected to change as these new technological advancements have the ability to profoundly influence the operational landscapes of organisations' purchasing and supply chain management (Delke et al., 2022).

Educational approaches serve as the means for acquiring new procurement skills and proficiencies (Stek, 2021). As new skill requirements evolve, education must keep ahead of these developments, while harmonizing with fluctuating organizational dynamics. This interplay between educational methods and competencies becomes particularly important in addressing skill gaps, being a key component as pointed out in this research.

The basis of effective purchasing is strongly influenced by the abilities of procurement experts (Tassabehji & Moorhouse, 2008); thus, it is very important to carefully assess the required skillsets. Literature stresses the progression of new skills and competencies, for example, big data analytics, automation, and e-procurement technology skills due to Industry 4.0 (Bals et al., 2019). Despite the emergence of Industry 4.0, the fundamental procurement skills remain relevant, such as negotiation, contract management, problem-solving and so on (Beske-Janssen et al., 2023). These skills combined create a guiding map that assists procurement professionals in navigating the complexities of Industry 4.0. From the viewpoint of this paper, precise definition of skills is crucial to better understand possible educational approaches and training opportunities to close the gap between missing talent and skill allocation. By having the right talents with the required skillsets, together with the integration of advanced Industry 4.0 technologies, corporations can achieve a competitive advantage in the form of innovative organisational performance (Ibrahim & Daniel, 2018).

Figure 2 represents the pathway through which procurement organisations can achieve the desired state via digital transformation. This pathway enables the integration of future purchasing roles and associated competencies within their organizational framework, leading to the realization of innovative organizational performance and up-to-date corporate structure. As described earlier, the organisational structure which involves current roles and skills and the current way of working is expected to change by the influence of Industry 4.0 (Cimini et al., 2021). Industry 4.0 enables digital transformation (Yaqub & Alsabban, 2023) which affects the development of new roles and skills (Delke et al., 2022) in the procurement terrain. To properly incorporate these future roles and competences into the organisational structure, training is crucial for existing and new employees (Stek, 2021). In order for organisation to anticipate changes in the business landscape and align their strategies to meet future demands, they can use many of the existing theories, such as the Corporate Foresight Theory which help to identify evolving roles and skills in the purchasing function (Dadkhah et al, 2018).

Other than the Corporate Foresight Theory, the Business Model Theory can also be utilized by organizations to provide a framework for structuring business operations and adapting to changing market conditions (Mishra & Zachary, 2014). This approach involves the development of new roles and skills, strategically aligned with the emerging industry needs. The Contingency Theory also assists organisation in the integration of future roles and competences by enabling them to consider various scenarios and choose the strategy which fits best per condition (Lidegaard et al., 2015). Essentially, this approach allows corporations to tailor procurement roles and skills to match the unique circumstances of the environment and business itself. Last but not least, the Technology Foresight Theory might also be considered by organisations when moving towards to the redefinition of company practices, including the future way of working and new procurement roles. This theory can be used as an instrument for harnessing the potential of emerging technologies by aligning organizational strategies with the unfolding technological landscape. Through the lens of the Technology foresight theory, corporations can evaluate any technological advancement on the horizon (Khoury et al., 2022). As soon as company practices are redefined in accordance with the implementation of Industry 4.0 technologies, businesses can achieve an improved organisational performance in the evolving realm of digitalisation (Ali & Xie, 2021).



2. Figure: Organisational transformation due to Industry 4.0

To summarize, Figure 2 outlines a roadmap for procurement organizations to leverage digital transformation. The advancing industry 4.0 landscape requires organizations to redefine their structure; this includes the creation of new roles and the acquisition of new competencies. By employing strategies such as Corporate Foresight, Business Model, Contingency, and Technology Foresight, businesses are enabled to react to environmental changes, optimize their practices, and align their objectives with the advancing technological tools. Through this approach, businesses can assure increased performance and optimal preparedness in a period which is characterized by transformative shifts.

3 Method

Researching how future purchasing roles and skills could fit into the organisational structure, first it is required to select a company that operates in the automotive industry and is yet to adopt Industry 4.0 technologies. This company is the main source for building a case study, where the goal is to help them implement changes and benefit from the results presented. Data for the research was collected through semi-structured interviews with experts working in the field of purchasing, whose deep knowledge and strong opinion shed light on any shortages in skills regarding the use of new technologies and potential gaps in the organisational structure. The research procedure of the paper is visualized below, in Figure 3.

3. Figure: Research method

This study is focusing on a single case, with the main goal of finding and integrating future purchasing roles and skills into the current organizational structure of companies in the automotive industry. A case study can have outstanding benefits over other methods, as it allows for a more comprehensive exploration of a topic, and answer not only the 'what', but the 'why' and 'how' questions as well (Bakis et al., 2006). It is a widely used method in academic research, because extensive studying of a single case can help in understanding a similar phenomenon in a large number of comparable cases (Baskarada 2014). It is proven to be an effective method for researching the competency gap between current and future professionals due to Industry 4.0 in a manufacturer company (Kannan & Garad, 2020). After laying down the theoretical foundation and realising that conducting a case study is the best possible approach for this research, the participants have to be contacted (Rashid et al, 2019).

The research uses a qualitative method to extract data as it allows for a deeper understanding of the issue, while having a more flexible approach. Interviews were used for acquiring a richly detailed overview about how the company operates to better understand current roles and explore possible future improvements. Expert interviews are proven to be an insightful research design tool, which involves company stakeholders from various fields of expertise (Bogner et al., 2009). Theoretical proficiency and years of working experience can be concentrated into an expert interview which supports the research with valuable details about the company's processes (Schiele et al., 2022). The current and future practices of purchasing commodities are the main topics of this study, which requires in-depth knowledge about how each of them is being organized. As a result, individual interviews were conducted in which different PSM professionals will not be able to influence each other's opinion like in an open discussion scenario.

Conducting interviews can be done in several ways, but for this research the semi-structured format has been chosen. This method outlines a clear frame about the topics to be touched upon, while allowing the conversation to go into unexpected directions when useful insights are provided (Fylan, 2005). PSM professionals should be able to talk freely about anything they find important regarding the topic, thus careful listening is required in order to react with appropriate follow-up questions. These experts have the most comprehensive knowledge about the procurement processes; hence it is essential to listen to their opinion and encourage them to express possible concerns. The interviews took place through online meetings, and the sessions were recorded for later analyses. A list of questions was developed in order to have a guide throughout the interview, although sometimes they were rephrased or not even asked depending on the received answers. For conducting this single case study, a specific German company was selected from the automotive industry.

3.1 Data collection

To answer the first sub-question information was gathered on the automotive industry based on literature study. The second sub-question which focuses on the current organisational structure and job profiles of the case company was answered according to the collected information of semi-structured expert interviews, case analyses and internal reports. The third sub-question is about required future roles and skills of the case company which was answered by studying the literature and connecting it with the outcome of the semi-structured interviews. The fourth sub-question refers to the future organisational structure of the purchasing department and was answered in the same way as the third sub-question. The fifth and last sub-question which is about closing the gap for missing talent and skill allocation was answered by analysing the results of the interviews and connecting it with existing literature.

3.1.1 Sample

The participants in this research involve a variety of roles, including commodity buyers, project buyers, sub-commodity managers, global commodity managers, a regional purchasing leader and a regional purchasing director. A sample size of 13 was determined through discussions with industry professionals, and these discussions aimed to identify suitable interview candidates from diverse countries and functional domains to provide a comprehensive perspective. The sample mainly focuses on the European region, while also involving professionals from Americas and China. The selection of interview partners was guided by the aim to include individuals currently engaged in different roles and positions to develop a more thorough overview. The selection process was approached with a strategic perspective, deliberately chosen for its ability to incorporate various aspects. By following this approach, there are several advantages, including insights from diverse viewpoints as these distinct roles collectively contribute to the understanding of purchasing organizations within the automotive industry. By involving participants from different positions and regions, the aim is to uncover valuable insights applicable not only to specific companies but also to purchasing organizations across the automotive sector.

Interviewee's Number	Job title	Experience in purchase (years)	Commodity	Number of subordinates	Minutes of interview
1	Sub-commodity manager	Not mentioned	Mechatronics, nano compounds and displays	0	51
2	Global commodity manager	17	PCB, metals and die casting	2	44
3	Project buyer	17	Mechanical	0	65
4	Global commodity manager	20+	Semi-conductors	2,5	50
5	Regional purchasing leader	2	Electronics, mechatronics, plastics and metals	10+	51
6	Strategic purchasing team leader	13	Plastic	4	57
7	Regional purchasing director	20+	All regional commodities	13	61
8	Global commodity manager	Not mentioned	Mechatronics	10	31
9	Commodity buyer	5	Plastic	13	54
10	APC manager	13	APC	10	44
11	Project buyer major	Not mentioned	All regional commodities	6	50
12	Commodity buyer	10+	Electronics and semi-conductors	0	49
13	Global commodity manager	12	PCB and die casting	2	57

7. Table - Interview sample

3.1.2 Questionnaire

The structure of the questionnaire is designed to align with the research model, ensuring that the questions properly address the research questions. The research model serves as a guide which facilitates a consistent progression from data collection to actionable recommendations. The model begins with the initial stage of conducting interviews with participants outlined in Section 1 of the questionnaire. This section serves to provide a fundamental understanding of each individual's functions and duties, essential for the next stages of the study. Then in Section 2, the concentration on the present organizational structure and expertise allocation mirrors the action of researching new opportunities as a second step of the model. By collecting observations of the existing roles and responsibilities, the goal is to investigate potential areas for improvement and innovation. Section 3 incorporates a diversity of questions regarding the effects of technology on the purchasing department which correlates with the step of analyzing data in the research model.

Here, the questionnaire examines the practical application of technology by identifying trends and patterns that become apparent from the answers of the respondents. Section 4 aligns with the next phase of the research model which is about identifying opportunities. The questions about Industry 4.0 technologies and their adoption highlight potential areas for advancements and transformation within the procurement domain. Sections 5 and 6 mirror the step of recommending based on results. These segments intently encourage interviewees to come up with future purchasing skills, roles, and organizational structures. By carrying out this action, not solely are their views taken into account but also the stage for generating insightful recommendations is set. Lastly, Section 7 bridges the gap between data collection and recommendations by addressing the challenges and potential solutions in educating the workforce. This segment furnishes insights into the training landscape and the potential challenges in adapting to new systems, particularly for different generations of employees.

In essence, the research model which consists of conducting interviews, researching new possibilities, analyzing data, identifying opportunities, and recommending based on results serves as the guiding framework that highlights the development of the questionnaire. Each section aligns with a specific phase of this model, allowing a purposeful approach to address the main research question: "How can organizations in the automotive industry integrate future purchasing roles with attached relevant skills into their organizational structure?" By strategically designing the questionnaire in this manner, the expectation is to come up with actionable insights which are relevant to the research objectives.

3.2 Data analysis

Wrapping up the last interview marked the end of the data collection procedure. The recorded videos then had to be transcribed to make sense out of the large amount of information received during the sessions. Atlas.ti is the software that assisted in this process, as it supports multimedia uploads and transcribes the source file into text (Friese, 2019). Attentive listening was also required to find and understand the main points when replaying the recordings. Afterwards, the interpreted data is communicated in a methodological manner, where the various talking points are presented in order with relevant quotes from the interviews (Widodo, 2014).

The process of coding involved the creation of a systematic framework to categorize the interview data. The chosen codes were derived from the analysis of the interview content. Each code represented a recurring theme or concept that emerged across different interviews. The coding process was dynamic and involved iterative refinement to ensure accuracy and consistency. To align the coding with the research structure, the established sections of the questionnaire were used as a guiding framework. The identified codes were directly linked to the sub-questions posed in the research; thus, creating a connection between the data and the intended inquiries.

This approach facilitated a systematic analysis by enabling to evaluate how each code related to the specific facets of the research model. The group of codes included ‘commodity’, ‘current way of working’, ‘future way of working’, ‘Industry 4.0’, ‘roles & responsibilities’, ‘skills & competencies’, and ‘structure of the purchasing organization (current vs ideal)’. These codes were created based on the alignment with the sections of the questionnaire which had been designed to mirror the research sub-questions. Each code formed a conceptual link to the relevant segment of the research, enabling a comprehensive and structured analysis of the collected data. By intertwining the codes with the research questions and the interview structure, the coding process achieved a dual purpose: capturing the nuances of participant responses and effectively organizing the data for subsequent analysis. The iterative nature of the coding ensured a thorough exploration of the collected information, while the strategic alignment with the research structure enhanced the relevance of the analysis.

4 Results

4.1 Overview of all results in a cross-interview table

The table presents a comprehensive overview of procurement departments across various countries, shedding light on their sizes, current organizational structures, roles, skills, utilized technologies, and future aspirations. Across the sampled countries—Germany, Ireland, Mexico, Brazil, Macedonia, China, and Bulgaria—the procurement departments vary in terms of their size, composition, strategies, and future considerations.

4.1.1 Size of the department

The size of procurement departments varies significantly, ranging from smaller teams with 3 members to larger ones with up to 18 members. This reflects the diverse operational scales across different countries.

	Germany	Ireland	Mexico	Brazil	Macedonia	China	Bulgaria
Size of the department	N/A	3	18	14	8	11	7

4.1.2 Current organizational structure

Purchasing organisations in multiple nations possess an assortment of organizational models, such as matrix, flat, functional, project-oriented, and cross-functional structures. This variety facilitates procurement bureaucracies to adjust to singular operational necessities and objectives.

	Germany	Ireland	Mexico	Brazil	Macedonia	China	Bulgaria
Current organizational structure	Matrix	Flat	Flat	Functional	Project-based	Product-based	Cross structure (project-based)

4.1.3 Current roles

The roles within procurement departments are very different, ranging from plant buyers, commodity buyers, sub-commodity managers, commodity managers, and several specialized and quality-focused roles. These roles highlight the diverse nature of procurement functions.

	Germany	Ireland	Mexico	Brazil	Macedonia	China	Bulgaria
Current roles	Plant buyers, commodity buyers, sub-commodity managers, commodity manager, technical and quality employees	Commodity buyers	Commodity buyers, indirect purchasing manager, direct purchasing manager, risk managers	Buyers, purchasing managers, supplier quality employees	commodity buyers, sub-commodity manager, commodity manager, quality expert, data analyst	Purchasing director, APC manager, strategic buyers, supplier quality employees	Purchasing manager, project purchasing major, project buyers

4.1.4 Current skills

The current skillsets in procurement job profiles change depending on the particular responsibilities. Proficiency in negotiations, knowledge of the market, technical proficiency, and the ability to make sound strategic choices are all commonplace, demonstrating the various facets of procurement duties.

	Germany	Ireland	Mexico	Brazil	Macedonia	China	Bulgaria
Current skills	Negotiation, strategic decision-making	Limited skills with current technologies	Purchasing know-how, negotiation	N/A, English is missing	Market knowledge, negotiation, cost analysis, decision-making	Negotiation, technical knowledge, SAP analytics	Time management and change management

4.1.5 Currently used technology

Adoption of technology is clear in procurement departments, with the widespread use of SAP, Excel, Business Warehouses, and other specialized tools, i.e., for supplier evaluation. These methods aid in data-driven decision-making and make operational processes smoother.

	Germany	Ireland	Mexico	Brazil	Macedonia	China	Bulgaria
Currently used technology	SAP, business warehouse, analytic clouds, CDB	SAP, Excel, Jira, CDB	Excel, Business Warehouse	Supplier evaluation tool	ERP system, Jira, SAP, Excel, Business Warehouse	SAP, knowledge management system (Km)	SIM database, RND for quality

4.1.6 Suggested future technologies

Looking ahead, the adaptation of future technologies is projected to range broadly, including AI-driven accuracy, forecast tools, negotiation platforms, and robotic process automation (RPA). The purpose of these instruments is to expand productivity, improve accuracy and decision-making within purchasing functions.

	Germany	Ireland	Mexico	Brazil	Macedonia	China	Bulgaria
Suggested future technologies	Figure accuracy and forecast tool for planning, contract management tool, AI	App for supplier relationship management, AI	Tool for negotiation, RPA for administrative daily tasks	Catalog (Ariba), RPA, AI for supplier reports	RPA for simple tasks between Excel and SAP, AI for market research and automatic order placing	RPA, auction mechanism for negotiation and supplier relationship management	Dashboard for milestones and related activities, tool for risk management, RPA

4.1.7 Suggested future structure

Future organizational structures are expected to maintain continuity while incorporating emerging roles. This highlights a strategic approach by ensuring the integration of new responsibilities without compromising existing efficiencies.

	Germany	Ireland	Mexico	Brazil	Macedonia	China	Bulgaria
Future suggested structure	Same structure involving future roles	Integrated entities with shared resources on a local level	Same structure with clear alignment of roles and responsibilities	Same structure with the involvement of future PSM roles	Flat organisational structure with a commodity manager on top	Same structure with process optimisation	Same structure involving future roles

4.1.8 Future roles

The emerging roles of the different purchasing departments include data analysts, master data managers, and procurement engineers. These are the most prevalent roles emphasized by Delke (2022) as a result of digitalization.

	Germany	Ireland	Mexico	Brazil	Macedonia	China	Bulgaria
Future roles	Procurement engineer, data analyst, master data manager	Data analyst	Master data manager	Data analyst	Data analyst, master data manager, digital leader	Data analyst	Data analyst, certified auditor, cost engineer

4.1.9 Future skills

Skills such as data analytics, communication, and digital negotiation, reflecting the growing reliance on data-driven strategies are found to be the most desired ones by PSM professionals.

	Germany	Ireland	Mexico	Brazil	Macedonia	China	Bulgaria
Future skills	SAP analytics, general knowledge about business administration, data reporting, communication	Data reporting and analytics	Supplier relationship management	Reading, understanding, and reporting data	Risk management, data reporting, digital negotiation, relationship management	Data management, data analytics	Data analytics, mainly same skills as now

4.1.10 Desired training method

The desired future training methods vary per region, including opportunities for continuous (lifelong) learning with hands-on techniques, online courses about emerging technologies, guided tutorials by professionals, and personalized interactions with experienced colleagues. This diverse educational approach ensures skill development options while meeting personal needs of PSM professionals.

	Germany	Ireland	Mexico	Brazil	Macedonia	China	Bulgaria
Training method	Lifelong learning with practical approach	KTLS online courses on the new technologies	KTLS online and human trainings for career development	Training course for negotiation followed by practical learning	Training courses on technical backgrounds	Personalized trainings from more experienced colleagues	Interactive trainings on most topics

4.1.11 Age difference considered in training

In most countries of the case company, age differences are not consistently considered when providing training methods, however, in Brazil this factor is acknowledge by hiring young talents as trainees, allowing them to acquire specialized skills over time.

	Germany	Ireland	Mexico	Brazil	Macedonia	China	Bulgaria
Age difference considered in training	No	No	No	Yes, young people are hired as trainees and get trained afterwards	No	No	No

The whole cross-table representing all results can be found in the appendix.

4.2 How does technology change the job profiles in future procurement organizations?

Technology is set to have a significant impact on job profiles within future procurement organizations. Technology can change these profiles in the following ways:

Based on the interviews, it became clear that certain Industry 4.0 innovations could provide useful assistance to PSM professionals. Interviewee 1, 2, 7 and 13 mentioned AI as a potentially helpful tool, which should be integrated in the everyday life of the company. Writing reports from all the available data is time consuming, but AI is able to generate quality summaries in seconds. As interviewee 4 mentioned during the interview: “we can use this intelligence to make this automation of some highlights, to collect this information and to put a report as we need.” An employee working with suppliers on a daily basis added that “an extra step to digitalize can be (…) to have a tool that is able to - digitally speaking - you click a button, and you get, a cost analysis of the portfolio of one supplier.” It can also come handy at the supplier scouting phase of a new project, because “it will give us a lot more possibilities and information about the market.” Furthermore, AI can be programmed to alert when alternative material options pop up on the market and buyers “can get suggestions that instead of material A, I can get material B, which is cheaper, more durable, can lead to some savings.”

RPA was another hot topic during the discussions. Most of the daily tasks require employees to execute repetitive actions, “so it's a lot of manual work at the end. Maybe if there is a possibility of some kind of automatization, it will be really good.” A huge advantage of using these automations is that they are not restricted by working hours, hence “during the night the robot can continue to process the information and create purchase orders based on what already was negotiated.” There is certainly aspiration in the company to introduce this technology, as it would make stock monitoring way easier. “We are working on a software for automatically following (…) what we have currently on stock and when there will be some minimum stock quantity, it rises and PO automatically and plays the PO to the supplier.” In China, RPA has been introduced recently for carrying out simple tasks between Excel tables and the SAP system, like creating reports or updating prices automatically. However, there are certain duties that cannot be automated, such as negotiations with suppliers. One commodity buyer puts it this way: “It's something like you have to get a feeling. And this feeling for price discussions is different at every purchaser. Every purchaser is doing this in a different way… “

With the combination of AI and RPA, a new platform could be developed, which collects all the necessary data about suppliers and gets updated automatically on a regular basis. Their business history, price comparisons, qualifications, product portfolios, etc. should be available with just a few clicks for every employee. “All supplier information we have somewhere in our heads and our mails in wherever. Bring all that together and be able to run a report at any time that gives a kind of overview for specific questions.” It saves a lot of time for them by not having to search for hours on different platforms and creates transparency. Each department connected to a certain project would be able to view the same information and react faster when it is their turn. Something like this is working at the moment in Bulgaria in a smaller scale, where project milestones are tracked in a system and “all of the responsibilities of each department are described there. All of us can see which is the due date of the activities which we need to perform.” Making a globally accessible board with every piece of data that can be relevant for anyone working in purchasing would eliminate the “big issue that we have the information somewhere available, but we are not able to take a look inside in a consolidated way.”

When asked about what the effect will be of using these innovations, the usual response was something, like: “it's going to give me loads of time, free time to do other things.” The common goal of employees with being open to Industry 4.0 and improve the current way of working is “to focus more on value added tasks in the future. To bring more value add to the company.”

Overall, technology will transform job profiles in procurement organizations by automating routine tasks, providing data-driven insights, enabling strategic decision-making, improving supplier management, enhancing supply chain visibility, and promoting sustainability practices. Procurement professionals will need to upskill and adapt to these changes to remain relevant and add value in the future.

To sum up, technology holds potential to revolutionize job roles in purchasing by merging the capacities of AI and robotic process automation (RPA). Interview results highlights the potential benefits these technological advancements. AI assists in automating tasks that involve handling records, such as generating reports and conducting cost-effectiveness analyses. On the other hand, RPA has the ability to streamline repetitive tasks beyond regular working hours. The integration of AI and RPA is anticipated to give rise to a system which consolidates supplier information and data for easy accessibility, thereby fostering collaboration. This digital transformation is anticipated to free up employees' time, enabling them to focus on more valuable projects and long-term initiatives. The primary objective of this transition is to enhance procurement processes, gain insights into procurement supply chains, and increase value addition.

4.3 What is the current organizational structure in the purchasing department of the case company?

4.3.1 Structure of the purchasing organisation

The current structure of the purchasing organisation of the case company is a very complex matrix structure, where the complete picture is difficult to follow even for the workers. „That's really a hard question to answer" said an employee when asked about the hierarchy and branching of various departments between entities. What makes it complicated to unravel the web of connections is the double system, which means that most subordinates have two responsibilities, one locally and one globally. „Sub-commodities are acting globally. Locally, I would say that in each organization, every purchaser is acting for his commodity organization. And when support is needed in the global negotiations, we all give our support there." This is the standard formula, which makes it confusing sometimes to track how responsibilities are distributed between the employees. A commodity manager also shared his remarks regarding the current structure: „it is very complex and honestly speaking, not ideal how it is organized in this way, because it creates always conflicts in terms of responsibilities and tasks of urgency." When there is an issue for example at a local plant, the focus shifts over there, and the employee is likely to neglect global duties, even though the working hours should be shared evenly between local and global tasks. This can result in holding a global project back, where a whole team's progression might depend on that one person's job. Sometimes completing projects is even more difficult because the amount of support buyers get can be very low depending on the project. „That is a problem we have at the moment, being responsible, but do not have a team behind you which helps you make the work."

Going deeper into the structure, it is clear that every regional entity is built slightly differently. In Mexico, direct and indirect purchasing are separated from each other. „We have divided it and we have commodities as one team and the second team is for indirect." It is mainly because of the large number of indirect suppliers they have; it is easier to keep track of them if handled by another group. Also, in this way commodity buyers can concentrate more on developing valued relationships with direct suppliers who they are working with the most often. The Brazilian entity also splits buyers into these two groups.

On the other hand, the Bulgarian team is very small, and they are all working on specific projects, usually even more than one at a time. There is no hierarchy or special group distribution, everyone is part of the same team, which consists of employees from various departments, involving quality and logistics too. In contrast, the Chinese entity is the largest, where they „all share the strategic purchasing people and supplier quality people" between the projects, without splitting them based on any criteria. Every buyer is responsible for a sub-commodity, which they dedicate most of their working time to. In some regions, like in Macedonia, „there are also data analysts who are supporting the commodity management in collecting data."

When looking at the similarities, it is noticeable that most commodities share the same structural elements. Usually, there is a „split between the areas or different departments of the purchasing entity. In the commodities we have some on commercial side, some on technical side and also on quality side." The focus of this research is on the commercial side, where the actual purchasing happens. A commodity manager is on top, who is holding together all of the sub-commodities that are branching out from the main commodity. This person is in charge for the global tasks and employees report to him/her. The commodity manager is not dealing with operational duties, only focuses on the strategic aspects, as one of the interviewee's explained: „we are responsible for the supplier management, for the supplier quality, for global contracts, global negotiation and everything what has

the definition of strategic suppliers, strategic material groups, strategic products. Our main goal is to find the best technical and best supplier which fits the company." Each of the sub-commodities have a purchasing manager that is responsible for all the buyers and occasionally other supportive colleagues within that sub-commodity. He/she is the link between most employees working on projects for the sub-commodity. The person taking on this role is „interacting with the supplier as well as our other colleagues from R&D, from project purchasing and quality…." All of the buyers have dedicated roles, meaning that every one of them has a specific part category, or more part categories that they focus on and purchase from. As mentioned earlier, they are taking on global and local duties usually in a 50-50-time distribution. Their main job is „portfolio and supplier base management, like doing contracts, doing annual price negotiations, escalations all topics related to components and suppliers."

In conclusion, the organizational structure of the case company's purchasing department is complex and challenging due to its matrix structure and dual system of local and global responsibilities. This complexity can lead to conflicts and make efficient task completion more difficult. Regional entities differ in their structures - Brazil divides buyers into groups, Bulgaria has an integrated team working on specific projects, and China shares resources among projects. However, most commodities share common structural elements, such as commodity managers oversee sub-commodities, each with a purchasing manager and dedicated buyers. Commodity managers handle global tasks while buyers manage specific part categories, balancing global and local responsibilities. These buyers are responsible for supplier management, contracts, negotiations, and other related tasks.

4.4 Which future skills and roles are needed in the case's procurement department?

4.4.1 Future purchasing roles

According to the interviews, the most required future purchasing roles are related to data management. Numerous roles have been identified which will be described in more detail below.

Data analyst: it is one of the most necessary roles which is desired on a global level at the case company. Several interviewees believe that a data analyst would greatly assist to reduce the workload of data management, which is associated with getting the right data, translating it, and understanding it. According to interviewee 1, analysing data is an inevitable part of his day-to-day job which requires a great amount of time; thus, a data analyst would allow him to focus more on strategy formulation of his commodity by taking over data management. One employee highlights the importance of hiring a data analyst which mainly derives from the fact that a lot of risk assessment is involved in his duties, therefore; it is essential to possess and work with the right data to achieve reasonable results. He adds: "...but at the end, it is also recurring work to take a look on all the supplier evaluations" [interviewee 4], this implies that a data analyst could provide the right data for the supplier evaluation forms and save time for the commodity. Another employee, responsible for indirect and direct purchasing, believes that a data analyst would be very useful when it comes to the monitoring of the supplier's financial condition: "data analyst, I think we are missing in order to see if supplier is going in good financial health" [said a commodity manager] based on his statement, a data analyst could be held responsible for the collection of data about how much a specific supplier is exporting, who their competitors are and other relevant market data. By analysing historical data on supplier performance, a data analyst can assess factors like on-time delivery, product quality and responsiveness. This analysis helps to identify suppliers with a track record of meeting or failing to meet expectations. As visible, a data analyst has the ability to support PSM professionals in various areas, including risk assessment, supplier identification and evaluation as well as marketplace analysis to enhance business practices. A data analyst role can be implemented on a regional level per commodity, connecting different sub-

commodities. This centralized approach ensures that data is consistent, comprehensive, and accessible per region.

Process automation manager: According to the interviews, robotic process automation has already been initiated at Mexico of the case company for the preparation of purchase orders. The best person to take care of all the tasks associated with RPA is the process automation manager. Besides, another employee at Brazil has also highlighted the need for an RPA to address operational issues of a catalog system (Ariba). The Brazilian team is looking to apply a catalog which is a centralized system for managing and organizing information about products, services, and suppliers. This catalog system is intended to streamline the procurement process, improve transparency, and facilitate decision-making: “and if we start to use this catalog, it means that we can, let's say, be faster, be more transparent” [Interviewee 5].To further enhance the efficiency of catalog-related operations, the use of RPA is proposed which involves software bots to automate repetitive and rule-based tasks. By employing RPA, the aim is to eliminate operational issues associated with using the catalog system. According to the interview, here the main goal is to overcome the bureaucratic nature of creating purchase orders.

By implementing RPA, this process will be automated which allows the software robots to generate and input the required information into the purchase orders, thereby it reduces manual effort and potential errors. In this context, RPA is viewed as a complementary technology to the catalog system, with the goal of further optimizing and streamlining operations related to the catalog. By combining RPA with a catalog system, the final goal is to enhance the efficiency and effectiveness of catalog management, resulting in improved overall performance in purchasing. There should be at least one person responsible for the management of process automation in each global entity of the organisations. In the Chinese subsidiary of the diecasting commodity, RPA is already utilised for the automation of simpler tasks, such as for the creation of reports and price updates based on Excel sheets where the data is extracted from and then inserted into SAP. Other than smaller automations, China is having its own software, a knowledge management system, called Km which is linked to SAP. Km contains data regarding prices, supplier data, risk evaluation, expenses, and even personal information. Prices fixed in Km are automatically uploaded to SAP, so this integration eliminates redundant work and ensures that updates made in Km are automatically reflected in SAP.

Master data manager: Currently, robotic process automation is in progress for indirect purchasing which concerns the creation of purchase orders (POs) at Mexico. The expectation is that the indirect purchasing team will be able to optimize 65% of their time with the use of RPA, because purchase order creation will fully be automated, therefore; it will no longer be necessary to manually create and spend time on purchase orders. However, the main barrier here is to clean and sort the data of the system which enables robotic process automation. Currently, there is no master data manager who could take care of this task and clean the data, so buyers are the responsible ones for doing so. According to an employee, after the implementation of RPA for indirect purchasing, the team is planning to map the process to identify possible benefits and extend robotic process automation to different areas, such as direct purchasing. The main focus is to automate those tasks that are most time-consuming, so mainly operative, and repetitive activities are targeted. Later on, as RPA will be even more widely used across the company, a master data manager must be able to assist in data management, so buyers will have more capacity to focus on the strategic parts of purchasing. Other entities can also make good use of a master data manager as digitalization is further implemented. For example, one employee at Macedonia of the case company emphasized the importance of having digital roles in the future, including a master data manager, digital leader, and data analyst.

One master data manager can be hired for one global commodity to avoid duplication of efforts and ensure that data supports the commodity's overall goals and strategies.

Purchasing engineer: A purchasing engineer has already been hired for the semiconductors commodity who is expected to bridge the gap between commodity and development, particularly in the context of new technologies. According to interviewee 5, the procurement engineer's responsibility is to collaborate with the development team and define the requirements and objectives for the upcoming years, including 2025 and 2026. In addition to working with suppliers, the procurement engineer is also responsible for gathering information from the development team regarding their future needs and monitoring suppliers to anticipate upcoming advancements. The aim is to establish effective communication and collaboration with the supplier side and development side, ensuring that the organization stays informed about emerging technologies and can leverage them appropriately. This role is seen as essential for staying ahead in the industry and successfully incorporating new technologies into the organization's operations. A purchasing engineer role can be implemented in each sub-commodity because each sub-commodity requires different technical background due to the variation in products.

System innovation scout: Finally, to support digital transformation, including process automation and data management, a system innovation scout is a crucial role for the organisation. The scout can contribute to the organization's digital transformation efforts by identifying opportunities to implement Industry 4.0 technologies within the purchasing department of various commodities. They can explore automation possibilities, digitalise processes, and introduce innovative solutions. Additionally, they facilitate strategic partnerships with technology vendors and start-ups working on Industry 4.0 solutions. Furthermore, they can identify potential collaborators, evaluate their offerings, and initiate discussions for partnerships that align with the organization's objectives. One system innovation scout is enough for the numerous purchasing teams across the globe as a single scout can ensure consistency in the evaluation of technologies and innovations which prevents the possibility of conflicting recommendations from multiple scouts.

4.4.2 Future purchasing skills

Along with purchasing roles, future purchasing skills have also been identified during the interviews and will be defined in the section below.

Data analytics skills: one of the most required future skills is data analytics. According to more employees, it is crucial to be able to read, understand and correctly report data: “So the most important thing is, and I see this also now in my commodity, the understanding of the data. It does not need to be very complex data, just simple one and to know how to read it and use it.” Furthermore, another employee finds it important to understand how data is linked together and what buyers should do to maximize the system’s potential they are working with: “somehow understand how information is linked to each other and what you need to do to get the desired results”. Cost analytics regarding the prices of suppliers is also part of data analytics skills and found to be very important, because it enables PSM professionals to determine whether it is economically more beneficial to produce or purchase a certain component: “we have persons that are doing cost analyses and they take the part itself that we need to buy from a supplier, and do this cost analysis about how much the part would cost if we produced it, and then we take that data and go in front of the supplier and confront with their price.”

Digital negotiation: another very important skill which was mentioned by more PSM professionals is (digital) negotiation skills. Some employees think that negotiating in person or face-to-face is even better and more efficient than negotiating online, because “you can get a lot of more content from

your negotiation partner if you can see his gestures and body language". According to a different employee, the main focus should not only be on negotiations but also on long-term supplier relationship management to engage more with suppliers, instead of doing the administrative and repetitive daily tasks which will be automated in the future. To have a good relationship with the supplier is found to be one of the most important aspects because in this way, "you can always manage any kind of issue or any kind of blocking stones on the way."

Other employees think that future skills and competencies will not change significantly but remain the same even if technology is involved. These skills mainly consider negotiation, communication, and leadership. It was stated that employees would need to possess the same level of skills regardless digitalization, because they have to be aware of how things work and understand what they are optimizing or automating: "the personnel nevertheless need to have the skills. No matter of the optimization of the process or whatever." Based on the provided information, skills that will not become obsolete or change over time are mostly interpersonal skills. Other skills that will be needed in the future just as now are risk and time management especially for project buyers.

Future procurement roles can be connected to the skills listed in the section above:

Roles	Required skills
Data Analyst:	Data analytics skills (ability to read, understand, and report data), cost analytics skills.
Process Automation Manager:	Process automation skills for managing RPA initiatives
Master Data Manager:	Data analytics skills for ensuring data quality of RPA, interpersonal skills when collaborating with buyers
Purchasing Engineer:	Technical expertise for understanding and incorporating emerging technologies of Industry 4.0
System Innovation Scout:	Identifying Industry 4.0 opportunities, digital negotiation skills, data analytics skills for exploring automation possibilities

8. Table - Purchasing skills assigned to future purchasing roles

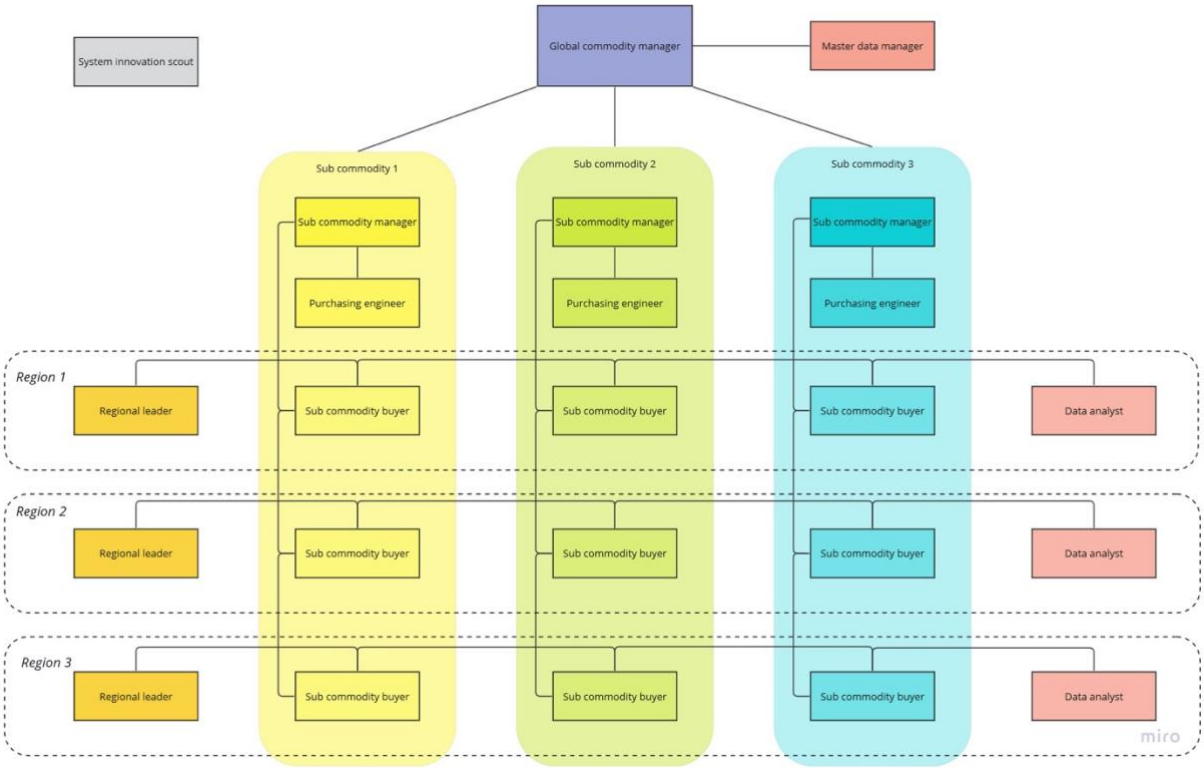
4.5 How to layout future organisational structure of the purchasing department?

The ideal structure is more transparent in which there are no misunderstandings regarding the responsibilities of each member, and it should also provide more support to employees, thus, enabling them to use their working hours in the most efficient manner. Purchasing has to be more centralized, meaning that all locations would be connected to one of the „three purchasing entities, one in Europe, one in Americas and one in Asia." Someone else was thinking in the same way when stating „there will be more and more integration between all purchasing entities and more into one purchasing entity, be it local or global." The important aspect is that more interviewees' have mentioned „operational and strategic procurement should be separated from each other." People working at the plants should only deal with operational tasks, such as logistics, delivery issues, administration of invoices, parts, purchase orders and so on. They could even have their own small commodity, with a head of plant purchasing on top and focus only on these issues.

In order to continuously produce outstanding results and make great revenue for the company, commodity buyers have to dedicate their time to strategic tasks, such as „benchmarking, price negotiations, preparing for price negotiations, cost of avoidance, implementing new suppliers, etc." This will help them to be more prepared for business meetings and give them an advantage at the table to seal profitable deals with suppliers. Maintaining positive relationships with suppliers and being agile during negotiations are the two most important characteristics of a good commodity buyer. Both of these aspects need time and care, hence, to do their job in the most efficient way, the operational

workload has to be minimized or even completely transferred to other employees and advanced technologies. To reach this desired state, „new personnel will be needed since the flow of work is increased. So definitely there will be need for new positions."

The following organisational structure has been developed on the example of one global commodity of the case company:



4. Figure: Future organisational structure

The layout of the new structure starts on a commodity level. On top of the commodities there is one manager „and he would be like an octopus with many tools in his hands, sub-commodity guys that will support him on every field and also using all the available software and tools that would help him to improve his position on the market." To keep the system up-to-date and always look into possible installations of emerging technologies, a system innovation scout is placed right next to the commodity manager. The scout can provide suggestions tailored to the specific needs of the commodity based on discussions with the members. A master data manager is also placed right next to the manager, because the person taking this role needs to have a good overview on all of the data flowing around. Having someone that can access any kind of data within the commodity is a must, otherwise employees need to search for the information by contacting their colleagues one-by-one. A commodity buyer explained it like that: „I need to collect the data of everybody in order to go there and confront the supplier (…), and that is a daily problem."

Moving downwards in the structure, each sub-commodity should include „ a procurement engineer, and (…) a data analyst, so the back office who will keep the standard work away from the commodity buyers." Every sub-commodity has a manager who is responsible for their own team, which consists of buyers and a purchasing engineer. Each buyer contributes to one of the regions, concentrating on that area, while having some local responsibilities too, so their workload is reduced from 50-50 to a

80-20 ratio in favour of the global/regional duties. Their local tasks mainly consist of supporting the local team in supplier negotiations and other strategic actions, but operational obligations are completely erased from their to-do list. This is possible partly because of the new hired personnel and partly because of the recommended small local commodity, which will take care of operational issues around the plant. Below the commodity manager, the purchasing engineer takes place. Ideally, every sub-commodity should have one, because each of them require different technological background knowledge, especially when it comes to electronic parts. This person is also the mediator between the Research & Development team and strategic employees, like buyers. Data analysts per sub-commodity is not necessarily required, so instead of hiring one for each sub-commodity, data analyst could be allocated regionally, either in Europe, Asia or Americas, and deal with the given area's data respectively. Although, the workload might be higher but in this way, data analysts can access one entity's entire dataset related to the whole commodity in the region. They can also perform market analysis based on external data, hence distributing them regionally makes the most out of their work. They will be able to provide better assistance by having all the necessary information about regional suppliers at hand and avoid creating duplicate records.

All projects have to be better supported too, so there are not only one or two people in charge, but a whole team shares the responsibility. „There should be a project, let's say leader. The project purchaser should be the leader, but the team behind him, like quality, cost, engineer, logistics and of course, someone doing the price requests and comparisons." A well-structured team can achieve better results in less time, which would only be beneficial for the company.

To move towards a more generalized organisational structure which is applicable for various companies in the automotive industry, the following section has been developed based on the information of the interviews and scientific papers: in the continuously changing automotive industry, the planned organizational structure of the procurement department has a significant impact on the achievement of the desired results. The structure should emphasize clarity, efficiency, and a clear division of tasks, roles and responsibilities while embedding the emerging technological innovation of the 4th Industrial Revolution.

Essential to the optimal structure is transparency, ensuring that roles and responsibilities are well-defined, thus, minimizing misunderstandings among co-workers. According to the literature, many organisations opt for a hybrid procurement structure which incorporates aspects of centralised and decentralised systems. This approach works to benefit from the advantages of each structure while limiting their potential drawbacks. When establishing the purchasing organisation, the allocation of responsibilities has to be evaluated as it affects the decision about whether to centralized or decentralize the structure. However, it has been scientifically supported that complete coordination between various business units is vital for effective procurement results (Kanepejs & Kirikova, 2021).

Based on the conducted interviews, a key component of the proposed structure is the clear division of the operational and strategic procurement roles. The primary activities associated with this, such as logistics, invoicing, and ordering of materials will take place at the plant level. This means the creation of localised purchasing entities, with a Plant Purchasing Manager in charge will be solely responsible for operational functions. Dividing these tasks in such a way allows the factory-based teams to focus on developing their performance in operational fields, as well as build up relationships with regional suppliers. On the contrary, commodity buyers should concentrate on strategic activities that will yield profits and encourage innovation (Nair et al., 2015). Examples include conducting market comparisons, negotiating prices, onboarding suppliers, and so forth. These roles require dedication and focus. To make this feasible, the organization aims to streamline operational tasks through job delegation and

sophisticated technology. As the demand for roles grows, especially those associated with digital transformation, it is expected that new positions will be necessary to manage the increased workload.

4.6 How to close the gap for missing talent and skill allocation?

Currently, trainings are available on KTLS which is the internal platform of the case company for education. At the beginning of the year, employees have the opportunity to develop training plans in a collaborative way involving the manager as well as the human resources (HR) department. This implies that employees play an important role in identifying their own areas of improvement and development needs. The manager guides and supports the employee's development by working closely with the employee to understand their performance gaps and help identify the most suitable training opportunities. The HR department is also involved in the process to help in assessing the potential of the employee and identifying areas of improvement. This means, the development of training plans is done collaboratively, involving multiple stakeholders: the manager, HR, and the employee itself. Even though the current way of training employees has a collaborative approach, instruction manuals and general online trainings cannot fully prepare employees for the real life; thus, more specific, precise, and up-to-date education is needed, followed by practical learning.

According to the interviews, one of the best ways to close the gap for missing talent and skills is to provide trainings which are tailored to different commodities: “what I see is there are no special trainings regarding to the commodity itself. There is nothing about semiconductors, there is nothing about tools, processes.” Another employee adds: “There is no commodity-specific training available. We have access to the trainings that are available for all employees.”

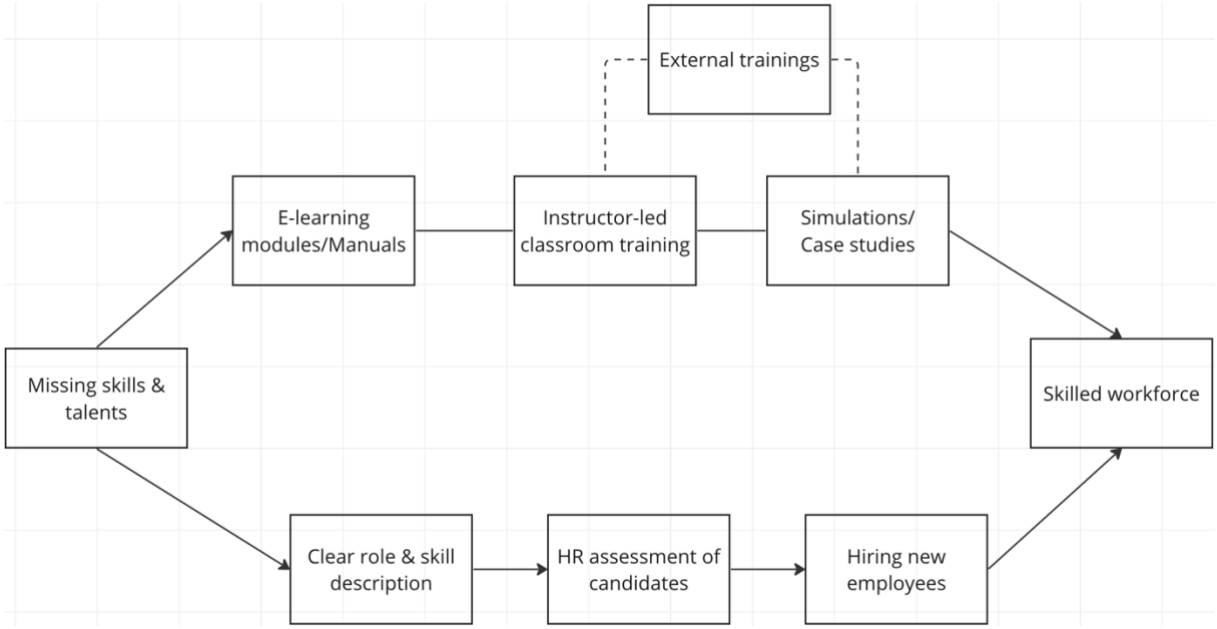
Tailored trainings about a specific product group or commodity could be provided externally, because the company lacks experts who can educate fellow co-workers. These kinds of trainings should not be general ones but heavily focussed on a specific commodity to meet the unique needs and challenges of the purchasing function, and therefore, enhance the skills and capabilities of PSM professionals. Instructor-led classroom trainings are suitable means for providing technical knowledge about commodities where employees can ask questions in the end (Chatzimouratidis et al., 2012).

Other than providing tailored trainings, the current ones should be more interactive. One of the employees expressed dissatisfaction with the current approach as trainings have a traditional style where a teacher simply stands in front of a class and states his phrases, and then employees have to keep them in mind for the test. This suggests that trainings are mainly theoretical and there is a preference for a more interactive and practical education that allows participants to apply what they have learned. Practical learning and real-world application of knowledge is desired to acquire hands-on experiences and put theory into practice. One of the most sought-after trainings which has been emphasized by more employees is negotiation and supplier relationship management: “maybe something like an education, training, how you really start negotiation discussions with the supplier.” A practical approach for providing negotiation trainings is seen as a very effective teaching style for granting knowledge and useful skills to employees. Case studies and simulations promote a more practical approach along with role-playing exercises. By creating different scenarios, employees will have the opportunity to take on different roles in a simulated environment, thus, negotiation can be practiced as well as conflict resolution.

Finally, to close the gap for missing talent, it is also a possibility to hire new employees with the assistance of human resource management. According to the interviews, there are certain roles which are missing and described in the section above. The purchasing organisation should develop specific skill profiles by performing job analyses to explore the most required skills for different positions. These skill and job profiles must continuously be assessed because technological development

reshapes the future skill requirements for buyers. With the help of HR, the job profiles can easily be reviewed and further improved by providing clear role descriptions along with pre-defined skill sets.

Based on this information, the following figure has been created which visualizes how to close the gap for missing talent and skill allocation.



5. Figure - Closing the gap for missing talent and skill allocation

5 Discussions

5.1 Concluding model

Technology has a major influence on the type of knowledge, skills and competencies that are required to perform well at a given field of expertise, hence it shapes the profiles that companies are looking for when recruiting new employees for certain roles. The job of PSM professionals have also changed due to digitalisation and the 4th Industrial Revolution. Based on the theoretical background and findings of the research, the following conclusions can be drawn:

The introduction of Industry 4.0 has caused companies to re-evaluate and alter their organizational structure. Since the implementation of Industry 4.0, various background effects have had implications for procurement strategies, resulting in modifications of tasks and duties. In order to maximize the full potential of Industry 4.0, the organizational structure needs to be adapted to those changes; thus, modifications in purchasing positions and job descriptions are seen as necessary. A straight consequence of this is that the currently required capabilities and skills for purchasing positions are also expected to change. Big data analytics, automation, and e-procurement technology skills become crucial, while essential abilities such as negotiation, contract management, and problem-solving continue to be relevant. This transformation necessitates a review of abilities and job specifications on a regular basis. To bridge the gap between missing skill and talent allocation, tailored educational methods are found to be vital for the purchasing function. Such methods involve customized learning strategies, employee-driven learning, and professional development opportunities in the form of classroom sessions, mentorship, simulators and so on. These educational methods should also consider the integration of new technological advancements, and therefore, provide training programs based on adaptability, safety coaching, and lifelong learning principles to existing and new PSM employees. The utilization of Industry 4.0 technologies along with talent acquisition and skill development options lead to improved organisational performance by achieving a competitive edge through digital transformation. By strategically implementing new technologies, such as artificial intelligence, big data analytics and robotic process automation, organisations can stay up-to-date in the rapidly changing environment. To facilitate the digital transformation of purchasing, businesses can apply one of the various existing theories, such as Corporate Foresight, Business Model, Contingency, and Technology foresight. These theories offer frameworks for anticipating and aligning with future roles and competencies by offering instructions on how to structure business operations, adapting to market conditions, and utilizing innovative technologies. Additionally, employing these theories strategically can help companies specifically identify new roles and skill requirements, while enhancing competitiveness in the business landscape.

When it comes to the appearance of new purchasing roles, a data analyst is seen as one of the essential ones with great impact on purchasing operations, because the management and interpretation of complex data is handled by this person. As a result, PSM professionals become enabled to focus on strategic decision-making and risk assessment instead of analysing vast amounts of data. Another highly significant role influenced by Industry 4.0 is the process automation manager who focuses on the optimisation of operational tasks through the integration of robotic process automation. This can be especially useful when combined with catalog systems, thus, simplified workflows, and improved transparency can be achieved. The master data manager role emerges as an important addition to the future purchasing organisation by ensuring data accuracy and legitimacy, especially as the organization capitalizes on robotic process automation for improved effectiveness. Purchasing engineers bridge the gap between procurement and development, ensuring the alignment of objectives and requirements for upcoming years.. Lastly, the responsibility of a system innovation scout becomes imperative in promoting digital transformation by facilitating the identification and integration of Industry 4.0

technologies across various purchasing commodities. The before-mentioned roles contribute to improved organisational efficiency and data-driven decision-making by leveraging advanced analytics, streamlining workflows, and maintaining accurate and accessible data within different procurement teams.

Along with purchasing roles, new skills are also expected to emerge which are essential for dealing with the challenges and opportunities of Industry 4.0. Data analytics skill stands as a highly relevant capability, helping experts to correctly understand and use the information obtained for decision-making. Additionally, it is suggested that precise knowledge of digital negotiation is central to supplier relationship management as well as the ability of creative problem-solving. Whilst technology developments are revolutionizing the procurement arena, certain underlying skills such as negotiation, communication, and leadership continue to hold principal value, as they supply the fundamental knowledge for proficient assimilation to a digitized atmosphere. Moreover, interpersonal competencies, coupled with risk and time management, are cardinal in attaining efficient buying performance.

5.2 Theoretical contributions

The theoretical contributions of this research derive from the literature review and the interviews conducted with different PSM professional of the case company. The contributions mainly focus on the comprehensive framework of providing guidance about how to implement Industry 4.0 technologies and future purchasing roles within the context of the automotive industry.

The research conducted by Delke (2022) sheds light on the evolving roles and skills that are becoming crucial for leading companies across various industries. However, the study falls short in providing a clear roadmap for how these future roles and skills, particularly those associated with Industry 4.0 technologies, can be effectively integrated into the organizational structure of companies.

On the other hand, the works by Islam (2022) specifically focus on the automotive industry and expand the list of essential future roles and skills. These studies are valuable in extending the understanding of what roles will be important in the context of the automotive sector's transformation. However, similar to Delke's study, it also lacks the practical guidance on how these identified roles can be seamlessly incorporated within the organizational structure, especially in light of the integration of Industry 4.0 technologies. Current literature seems to acknowledge the significance of both elements but does not dig into the critical question of ‘how’. Simply identifying the skills and roles is not enough; understanding how these roles fit within the existing framework or how the structure needs to adapt is equally important. This is especially true in the complex and specialized context of the automotive industry, where efficient integration of technology and roles can greatly impact a company's success.

Secondly, the research contributes to theory by the depiction of Figure 2 which is a well-thought-out approach for procurement organizations to achieve digital transformation, involving potential future roles and attributes within their organizational structures. By visually presenting this roadmap, the figure contributes to the understanding of how organizations can navigate the complex process of adopting Industry 4.0 technologies and adapting their structures to align with the evolving business landscape. The figure's representation of the interconnected stages necessary for successful transformation. It provides a valuable guide for organizations aiming to harness the potential of digitalization by incorporating emerging procurement roles and skills. The inclusion of pre-existing theories, such as Corporate Foresight Theory, Business Model Theory, Contingency Theory, and Technology Foresight Theory, the figure presents a detail-oriented approach to adaptation based on various concepts and frameworks. To sum up, the graphic Figure 2 provides a theoretical contribution

as it illustrates a pathway that procurement departments can take towards adopting digital transformation and incorporating new job roles and abilities.

5.3 Managerial contributions

The findings of this research offer practical implications for businesses, particularly those operating in the automotive industry. The study provides a clear guideline for the case company and similar to those, on how to effectively integrate future purchasing roles and skills into their organisational structures. Moreover, the research provides tailored recommendations for applying digitalization methods that give rise to new roles and skills within the procurement sector.

It is anticipated that organizations similar to the case company can draw valuable insights from this research, providing them with best practices and strategies for smoothly incorporating Industry 4.0 technologies into their procurement processes and corporate structure. By applying the insights of the research, organizations can enhance their procurement functions, streamline operational effectiveness, and maintain their competitive edge within the continuously evolving automotive landscape. This means, the potential for knowledge absorption extends beyond the case company because similar organizations within the automotive sector can also gain valuable insights from this research by accessing described strategies. Equipped with this knowledge, businesses can take proactive measures to optimize their procurement processes, enhance operational efficiency, and foster innovation.

When it comes to specific recommendations for the enterprises operating in the automotive industry, there is to say to enhance organizational transparency and support. By establishing a more transparent organizational structure, roles and responsibilities will be clarified which will help avoid misunderstandings and promote effective collaboration among the different departments and roles. Additionally, by providing comprehensive support to employees, it enables co-workers to use their working hours more efficiently and focus on value-added tasks that cannot be automated. A transparent structure does not just clarify individual roles; it also highlights how different departments and procurement roles interact with each other by promoting effective cross-functional collaboration between different parties. When employees are aware of how their work connects to others' efforts, they can coordinate more efficiently.

Another recommendation is to separate operational and strategic procurement by implementing a clear separation of procurement activities. Operational tasks, such as logistics, delivery issues, and administrative tasks can be delegated to specialized personnel as this separation enables commodity buyers to dedicate their time and expertise to strategic activities, such as benchmarking, negotiations, and supplier relationship management. These tasks require more input of human skills such as communication, strategic thinking, and adaptability. Commodity buyers will be empowered to fully utilize their capabilities, and therefore, ensure better supplier interactions, improved negotiation outcomes, and a more responsive procurement strategy.

By leveraging the findings and recommendations of the research, organizations can stay ahead of the competition and maintain a competitive advantage. The integration of Industry 4.0 technologies is not just a technological transition but rather a strategic shift that requires careful planning and execution. With the insights from this study, companies can make informed decisions and navigate the transformation in the automotive sector.

6 Limitations and future research

While this study strives to provide valuable insights into the integration of Industry 4.0 technologies and future roles in the procurement domain of the automotive industry, it is important to note its limitations. One significant limitation considers the method of data collection, particularly the interviews conducted with professionals from the case company.

The researcher is aware of her relatively limited experience in conducting interviews, which might have impacted the depth along with the received responses. Inconsistent answers to interview questions also posed a challenge, possibly due to varying levels of familiarity with the emerging concepts of Industry 4.0.

Another limitation derives from the focus of a single case company within the automotive industry. While this approach enabled a deep exploration of the case company's complexities, it might limit the generalizability of the findings across the broader automotive sector. For example, the generalization of closing the gap for missing talent and skill allocation is not entirely feasible due to the unique organizational structures and industry-specific demands. The insights gained from the case company's procurement organization may not completely apply to all companies within the automotive sector or other industries. Factors such as company size, geographical location, and other relevant aspects might impact the applicability of the suggested recommendations. The specific challenges faced by the case company's procurement organization, along with the solutions proposed might not be directly applicable to companies with different structures and priorities. What works well for a decentralized structure in one company may not translate well to a more centralized or hybrid structure of another. Moreover, the required skillsets, and talent gaps can differ based on the technological landscape and procurement goals of one company.

To conclude, due to the variations in organizational structures, technological implementation, and strategic priorities across different companies could potentially affect the applicability of the research's recommendations. To address the challenge of generalizability, future research could extend the scope by conducting cross-industry comparative studies. Comparing the integration of Industry 4.0 technologies and future roles across various industries could reveal common challenges and effective strategies that overstep sector-specific boundaries.

Bibliography

Abdelmajied, F. Y. (2022). Industry 4.0 and Its Implications: Concept, Opportunities, and Future Directions. *Supply Chain-Recent Advances and New Perspectives in the Industry 4.0 Era.* IntechOpen.

Aguirre, S., & Rodriguez, A. (2017). Automation of a business process using robotic process automation (RPA): A case study. In *Applied Computer Sciences in Engineering: 4th Workshop on Engineering Applications, WEA 2017, Cartagena, Colombia, September 27-29, 2017, Proceedings 4* (pp. 65-71). Springer International Publishing.

Albawwat, I., & Frijat, Y. (2021). An analysis of auditors' perceptions towards artificial intelligence and its contribution to audit quality. *Accounting, 7*(4), 755-762.

AlNuaimi, B. K., Khan, M., & Ajmal, M. M. (2021). The role of big data analytics capabilities in greening e-procurement: A higher order PLS-SEM analysis. *Technological Forecasting and Social Change*, *169*, 120808.

Aris, I. B., Sahbusdin, R. K. Z., & Amin, A. F. M. (2015, May). Impacts of IoT and big data to automotive industry. In *2015 10th Asian control conference (ASCC)* (pp. 1-5). IEEE.

Arizu, B., Gencer, D., & Maurer, L. (2006). Centralized Purchasing Arrangements: international practices and lessons learned on variations to the Single Buyer Model. *Energy and Mining Sector Board Discussion Paper*, (16).

ASIAN DEVELOPMENT BANK. (2021). *REAPING THE BENEFITS OF INDUSTRY 4.0 THROUGH SKILLS DEVELOPMENT IN INDONESIA*. ASIAN DEVELOPMENT BANK. Page 25

Bakis, N., Kagioglou, M., & Aouad, G. (2006, April). Evaluating the business benefits of information systems. In *3rd International SCRI Symposium*.

Bals, L., Schulze, H., Kelly, S., Stek, K. (2019). Purchasing and supply management (PSM) competencies: Current and future requirements. *Journal of Purchasing and Supply Management, (2019), 100572, 25(5)*

Baskarada, S. (2014). Qualitative case study guidelines. *Baškarada, S.(2014). Qualitative case studies guidelines. The Qualitative Report*, *19*(40), 1-25.

Beske-Janssen, P., Johnsen, T., Constant, F., & Wieland, A. (2023). New competences enhancing Procurement's contribution to innovation and sustainability. Journal of Purchasing and Supply Management, (2023), 100847, 29(3)

Biazzin, C., & Castro-Carvalho, L. (2019). Big data in procurement: the role of people behavior and organization alignment. *Dimensión Empresarial*, *17*(4), 10-28.

Bienhaus, F., & Haddud, A. (2018). Procurement 4.0: factors influencing the digitisation of procurement and supply chains. *Business Process Management Journal*.

Bogner, A., Littig, B., & Menz, W. (Eds.). (2009). *Interviewing experts*. Springer.

Chatzimouratidis, A., Theotokas, I., Lagoudis, I. N. (2012). Decision support systems for human resource training and development. *The International Journal of Human Resource Management, 23*(4), 662-693

Chen, B., Wan, J., Shu, L., Li, P., Mukherjee, M., & Yin, B. (2017). Smart factory of industry 4.0: Key technologies, application case, and challenges. *Ieee Access, 6*, 6505-6519.

Cimini, C., Boffelli, A., Lagorio, A., Kalchschmidt, M., & Pinto, R. (2021). How do industry 4.0 technologies influence organisational change? An empirical analysis of Italian SMEs. *Journal of Manufacturing Technology Management, 32*(3), 695-721

DeCanio, S. J., Dibble, C., & Amir-Atefi, K. (2000). The importance of organizational structure for the adoption of innovations. *Management science*, *46*(10), 1285-1299.

Delke, V. F. (2022). *Industry 4.0 in Purchasing and Supply Management. Defining future roles and skills*.

Delke, V. F., & te Raa, J. (2022). Developing a Human Resources Development Model for Lifelong Learning in Purchasing and Supply Management

Delke, V., Schiele, H. and Buchholz, W. (2023). 'Differentiating between direct and indirect procurement: roles, skills, and Industry 4.0', Int. J. Procurement Management, Vol. 16, No. 1, pp.1–30.
Dunn, S. C. (2001). Motivation by project and functional managers in matrix organizations. *Engineering Management Journal*, *13*(2), 3-10.

Delke, V., Schiele, H. and Buchholz, W. (2022). Implementing Industry 4.0 Technologies: Future Roles in Purchasing and Supply Management

Fiedler, F. (1958). Fiedler's contingency theory. Leader attitudes and group effectiveness.

Flechsig, C., Anslinger, F., & Lasch, R. (2022). Robotic Process Automation in purchasing and supply management: A multiple case study on potentials, barriers, and implementation. *Journal of Purchasing and Supply Management*, *28*(1), 100718.

Ford, R. C., & Randolph, W. A. (1992). Cross-functional structures: A review and integration of matrix organization and project management. *Journal of management, 18*(2), 267-294.

Friese, S. (2019). Qualitative data analysis with ATLAS. ti. Sage.

Fröhlich, E., & Steinbiß, K. (2020). Supplier Relationship Management Goes Digital: First Empirical Insights. *Universal Journal of Management*, *8*(3), 63-73,

Fylan, F. (2005). Semi-structured interviewing. A handbook of research methods for clinical and health psychology, 5(2), 65-78.

Gajek, A., Fabiano, B., Laurent, A., & Jensen, N. (2022). Process safety education of future employee 4.0 in Industry 4.0. *Journal of Loss Prevention in the Process Industries, 75*, 104691.

Gassmann, O., & Von Zedtwitz, M. (1999). New concepts and trends in international R&D organization. *Research policy*, *28*(2-3), 231-250.

Georgios, L., Kerstin, S., & Theofylaktos, A. (2019). Internet of things in the context of industry 4.0: An overview. *International Journal of Entrepreneurial Knowledge*, *7*(1).

Ghosh, R. K., Banerjee, A., Aich, P., Basu, D., & Ghosh, U. (2022). Intelligent IoT for Automotive Industry 4.0: Challenges, Opportunities, and Future Trends. *Intelligent Internet of Things for Healthcare and Industry,* 327-352.

Gianakis, G. A., & Wang, X. (2000). Decentralization of the purchasing function in municipal government: A national survey. *Journal of Public Budgeting, Accounting & Financial Management, 12*(3), 421-440.

Gokhale, P., Bhat, O., & Bhat, S. (2018). Introduction to IOT. *International Advanced Research Journal in Science, Engineering and Technology, 5*(1), 41-44.

Gottge, S., Menzel, T., & Forslund, H. (2020). Industry 4.0 technologies in the purchasing process. *Industrial Management & Data Systems*, *120*(4), 730-748.

Guadalupe, M., Li, H., & Wulf, J. (2014). Who lives in the C-suite? Organizational structure and the division of labor in top management. *Management Science*, *60*(4), 824-844.

Guida, M., Caniato, F., Moretto, A., & Ronchi, S. (2023). The role of artificial intelligence in the procurement process: State of the art and research agenda. *Journal of Purchasing and Supply Management*, 100823.

Handfield, R., Jeong, S., & Choi, T. (2019). Emerging procurement technology: data analytics and cognitive analytics. *International Journal of Physical Distribution & Logistics Management, 49*(10), 972-1002.

Hecklau, F., Galeitzke, M., Flachs, S., & Kohl, H. (2016). Holistic approach for human resource management in Industry 4.0. *Procedia Cirp*, *54*, 1-6.

Hofmann, P., Samp, C., & Urbach, N. (2020). Robotic process automation. *Electronic Markets, 30*(1), 99-106.

Islam, M. A. (2022). Industry 4.0: Skill set for employability. *Social Sciences & Humanities Open*, *6*(1), 100280.

Jahani, N., Sepehri, A., Vandchali, H. R., & Tirkolaee, E. B. (2021). Application of industry 4.0 in the procurement processes of supply chains: a systematic literature review. *Sustainability*, *13*(14), 7520.

Johnson, P. F., & Leenders, M. R. (2006). A longitudinal study of supply organizational change. *Journal of Purchasing and Supply Management, 12*(6), 332-342.

Kalaiarasan, R., Olhager, J., Agrawal, T., & Wiktorsson, M. (2022). The ABCDE of supply chain visibility: A systematic literature review and framework. *International Journal of Production Economics*, 108464, 248

Kannan, K. S. P., & Garad, A. (2020). Competencies of quality professionals in the era of industry 4.0: a case study of electronics manufacturer from Malaysia. *International Journal of Quality & Reliability Management*, *38*(3), 839-871.

Kehayov, M., Holder, L., & Koch, V. (2022). Application of artificial intelligence technology in the manufacturing process and purchasing and supply management. *Procedia Computer Science, 200*, 1209-1217.

Khanna, D. & Sharma, A. (2019). Internet of Things Challenges and Opportunities. *International Journal For Technological Research In Engineering, 6*(12).

Kokina, J., & Davenport, T. H. (2017). The emergence of artificial intelligence: How automation is changing auditing. *Journal of emerging technologies in accounting, 14*(1), 115-122.

Kuprenas, J. A. (2003). Implementation and performance of a matrix organization structure. *International Journal of Project Management, 21*(1), 51-62.

Král, P., & Králová, V. (2016). Approaches to changing organizational structure: The effect of drivers and communication. *Journal of Business Research*, *69*(11), 5169-5174.

Lacity, M., Willcocks, L., & Craig, A. (2017). Service automation: cognitive virtual agents at SEB bank. *The Outsourcing Unit Working Research Paper Series, 17*(01).

Legenvre, H., Henke, M., & Ruile, H. (2020). Making sense of the impact of the internet of things on Purchasing and Supply Management: A tension perspective. *Journal of Purchasing and Supply Management*, *26*(1), 100596.

Li, J., & Shi, V. (2019). The benefit of horizontal decentralization in durable good procurement. *Omega, 82*, 13-23.

Lidegaard, N., Boer, H., Møller, M. (2015). Organising purchasing and (strategic) sourcing: Towards a typological theory. *International Journal of Technology Intelligence and Planning, (2015), 254-272, 10(3-4)*

Mähler, V., & Westergren, U. H. (2019). Working with IoT–a case study detailing workplace digitalization through IoT system adoption. In *Internet of Things. Information Processing in an Increasingly Connected World: First IFIP International Cross-Domain Conference, IFIPIoT 2018, Held at the 24th IFIP World Computer Congress, WCC 2018, Poznan, Poland, September 18-19, 2018, Revised Selected Papers 1* (pp. 178-193). Springer International Publishing

Mavidis, A., & Folinas, D. (2022). From Public E-Procurement 3.0 to E-Procurement 4.0; A Critical Literature Review. *Sustainability*, *14*(18), 11252.

McCue, C. P., & Pitzer, J. T. (2000). Centralized vs. decentralized purchasing: Current trends in governmental procurement practices. *Journal of Public Budgeting, Accounting & Financial Management*.

Mulder, P., Wesselink, R., Chr Bruijstens Martin Mulder, H., Chr Bruijstens, H., Mulder, M. (2005). Job profile research for the purchasing profession Introduction and research questions. *International Journal of Training and Development*

Munson, C. L., & Hu, J. (2010). Incorporating quantity discounts and their inventory impacts into the centralized purchasing decision. *European Journal of operational research, 201*(2), 581-592.

Nguyen, T., Li, Z. H. O. U., Spiegler, V., Ieromonachou, P., & Lin, Y. (2018). Big data analytics in supply chain management: A state-of-the-art literature review. *Computers & Operations Research, 98*, 254-264.

Pekannen, P., Niemi, P., Puolakka, T., Pirrtila, T., Huiskonen, J. (2020). Building integration skills. in supply chain and operations management study programs. *International Journal of Production Economics, 225(2), 1-10*

Puhovichova, D., & Jankelova, N. (2020). Changes of human resource management in the context of impact of the fourth industrial revolution. Industry 4.0, 5(3), 138-141.

Rashid, Y., Rashid, A., Warraich, M. A., Sabir, S. S., & Waseem, A. (2019). Case study method: A step-by-step guide for business researchers. *International journal of qualitative methods*, *18*, 1609406919862424.

Rejeb, A., & Appolloni, A. (2022). The Nexus of Industry 4.0 and Circular Procurement: A Systematic Literature Review and Research Agenda. Sustainability, Vol. 14, Page 15633, (2022), 15633, 14(23)

Richter, N. F., Schlaegel, C., Midgley, D. F., & Tressin, T. (2019). Organizational structure characteristics' influences on international purchasing performance in different purchasing locations. *Journal of Purchasing and Supply Management*, *25*(4), 100523.

Samarasinghe, K. R., & Medis, A. (2020). Artificial intelligence based strategic human resource management (AISHRM) for industry 4.0. *Global Journal of Management and Business Research*, *20*(G2), 7-13.

Schiele, H. (2007). Supply-management maturity, cost savings and purchasing absorptive capacity: Testing the procurement-performance link. *Journal of Purchasing and Supply Management, 13(4), 274-293*

Schiele, H. (2019). Handbook – Operations, Logistics and Supply Chain Management

Schiele, H., Bos-Nehles, A., Delke, V., Stegmaier, P., Tom, R. J. (2022). Interpreting the industry 4.0 future: technology, business, society, and people. *Journal of Business Strategy, 43(3), 157-167*

Schiele, H., Krummaker, S., Hoffmann, P., & Kowalski, R. (2022). The “research world café” as method of scientific enquiry: Combining rigor with relevance and speed. *Journal of business research, 140*, 280-296.

Singh, S. K., Rathore, S., & Park, J. H. (2020). Blockiotintelligence: A blockchain-enabled intelligent IoT architecture with artificial intelligence. *Future Generation Computer Systems*, *110*, 721-743.

Sivathanu, B., & Pillai, R. (2018). Smart HR 4.0–how industry 4.0 is disrupting HR. *Human Resource Management International Digest*, *26*(4), 7-11.

Stek, K., Schiele, H., (2021). How to train supply managers – Necessary and sufficient purchasing skills leading to success. *Journal of Purchasing and Supply Management, (2021), 100700, 27(4)*

Sony, M., & Mekoth, N. (2022). Employee adaptability skills for Industry 4.0 success: a road map. *Production & Manufacturing Research, 10*(1), 24-41.

Sony, M., & Naik, S. (2020). Critical factors for the successful implementation of Industry 4.0: a review and future research direction. *Production Planning & Control*, *31*(10), 799-815.

Stachová, K., Papula, J., Stacho, Z., & Kohnová, L. (2019). External partnerships in employee education and development as the key to facing industry 4.0 challenges. *Sustainability, 11*(2), 345.

Stange, R., Schiele, H., & Henseler, J. (2022). Advancing purchasing as a design science: Publication guidelines to shift towards more relevant purchasing research. *Journal of purchasing and supply management*, *28*(1), 100750.

Tassabehji, R., & Moorhouse, A. (2008). The changing role of procurement: Developing professional effectiveness. *Journal of purchasing and supply management, 14*(1), 55-68.

Torn, I. A. R. (2017). *The future of purchasing and industry 4.0: how purchasing can progress and benefit the fourth industrial revolution* (Master's thesis, University of Twente).

Trautmann, G., Bals, L., & Hartmann, E. (2009). Global sourcing in integrated network structures: The case of hybrid purchasing organizations. *Journal of International Management*, *15*(2), 194-208.

Van Weele, A. J. (2010). P*urchasing and supply chain management: Analysis, strategy, planning and practice*. Cengage Learning, London.

Venable, J., & Baskerville, R. (2012). Eating our own cooking: Toward a more rigorous design science of research methods. *Electronic Journal of Business Research Methods, 10*(2), 141-153.

Verma, S., Singh, V., & Bhattacharyya, S. S. (2021). Do big data-driven HR practices improve HR service quality and innovation competency of SMEs. *International Journal of Organizational Analysis*, 29(4), 950-973.

vom Brocke, J., Hevner, A., & Maedche, A. (2020). Introduction to design science research. *Design science research. Cases*, 1-13.

Wei, X., Prybutok, V., & Sauser, B. (2021). Review of supply chain management within project management. *Project Leadership and Society*, *2*, 100013.

Widodo, H. P. (2014). Methodological considerations in interview data transcription. *International Journal of Innovation in English Language Teaching and Research*, *3*(1), 101-107.

Yang, H., Kumara, S., Bukkapatnam, S. T., & Tsung, F. (2019). The internet of things for smart manufacturing: A review. *IISE transactions*, *51*(11), 1190-1216.

Zhang, G., Yang, Y., & Yang, G. (2023). Smart supply chain management in Industry 4.0: the review, research agenda and strategies in North America. *Annals of Operations Research,* 1075-1117, 322(2)

Zheng, P., Wang, H., Sang, Z., Zhong, R. Y., Liu, Y., Liu, C., ... & Xu, X. (2018). Smart manufacturing systems for Industry 4.0: Conceptual framework, scenarios, and future perspectives. *Frontiers of Mechanical Engineering, 13*, 137-150.

Appendix

Appendix A – Interview questions for PSM professionals

Section 1 – General information

1.1 Could you please introduce yourself?

What is your role and what are your responsibilities at the case company?

Section 2 – Current organization structure and skills

2.1 How does the current organizational structure of your commodity/project look like?

2.2 How do you distribute responsibilities between the different people in the department?

Do you have dedicated roles for each employee?

What roles do you have in your department?

2.3 How do you determine the needed level of skills and competencies?

Do these skill profiles link to the roles?

Section 3 - The impact of technology on the department

3.1 Do you see any practices in your commodity/project that are outdated and needs improvement?

Explain why

3.2 What kind of software/tools are currently being used in your commodity/project?

How are technologies liked to the responsibilities of the purchasing roles?

3.3 What future software/tools are you currently implementing?

How do you see innovation in procurement systems and processes in your commodity/project?

Are you satisfied with recent upgrades in equipment, computer systems, personnel, etc.?

Section 4 - Industry 4.0

4.1 Are there any Industry 4.0 related technologies that the company adopted/is planning to adopt?

Are you familiar with the concept Industry 4.0 and its impact on procurement?

What impact do you think Industry 4.0 currently has/will have on your commodity/project?

Section 5 – Future skills and roles

5.1 In your department, do you face any shortcomings in the roles implemented or skills present?

Why do you see these shortcomings?

5.2 What are the future required skills and competencies to fulfil (roles) responsibilities?

Do you feel like you have the necessary skills to perform well in the future, after implementing Industry 4.0 technologies?

Section 6 – Future organizational structure

6.1 What do you think the future organizational structure of procurement and your department should be (in relation to implementing new roles)?

Out of your head, design an organization approach (combination of roles and technology) that suites the future of the case company.

What are the aspects that you find important to change in order to achieve this desired state?

Section 7 – Closing the gap for missing talent and skills

7.1 Do you think the case company provides sufficient education and training with a systematic approach?

What kind of trainings are available to you and your team?

Have you ever used KTLS (Purchasing Academy)?

Are there any shortages in trainings that you are facing during your day-to-day job, or you are simply aware of (especially within your commodity)?

7.2 Do you see any difficulties in educating the older generation of employee to learn to new systems and processes compared to younger professionals?

Section 8 – Closing

8.1 Do you have any additional remarks that could be useful regarding this research?

Appendix B – Cross-table including all interview results

	Germany	Ireland	Mexico	Brazil	Macedonia	China	Bulgaria
Size of the department	N/A	3	18	14	8	11	7
Current organizational structure	Matrix	Flat	Flat	Functional	Project-based	Product-based	Cross structure (project-based)
Current roles	Plant buyers, commodity buyers, sub-commodity managers, commodity manager, technical and quality employees	Commodity buyers	Commodity buyers, indirect purchasing manager, direct purchasing manager, risk managers	Buyers, purchasing managers, supplier quality employees	commodity buyers, sub-commodity manager, commodity manager, quality expert, data analyst	Purchasing director, APC manager, strategic buyers, supplier quality employees	Purchasing manager, project purchasing major, project buyers
Current skills	Negotiation, strategic decision-making	Limited skills with current technologies	Purchasing know-how, negotiation	N/A, English is missing	Market knowledge, negotiation, cost analysis, decision-making	Negotiation, technical knowledge, SAP analytics	Time management and change management
Currently used technology	SAP, business warehouse, analytic clouds, CDB	SAP, Excel, Jira, CDB	Excel, Business warehouse	Supplier evaluation tool	ERP system, Jira, FRA (for finance), SAP, Excel, Business warehouse	SAP, knowledge management system	SIM database, RND for quality
Suggested future technologies	Figure accuracy and forecast tool for planning, contract management tool, AI	App for supplier relationship management, AI	Tool for negotiation, RPA for administrative daily tasks	Catalog (Ariba), RPA, AI for supplier reports	RPA for simple tasks between Excel and SAP, AI for market research and automatic order placing	RPA, auction mechanism for negotiation and supplier relationship management	Dashboard for milestones and related activities, tool for risk management, RPA
Future suggested structure	Same structure involving future roles	Integrated entities with shared resources on a local level	Same structure with clear alignment of roles and responsibilities	Same structure with the involvement of future PSM roles	Flat organisational structure with commodity manager on top	Same structure with process optimisation	Same structure involving future roles
Future roles	Procurement engineer, data analyst, master data manager	Data analyst	Master data manager	Data analyst	Data analyst, master data manager, digital leader	Data analyst	Data analyst, certified auditor, cost engineer
Future skills	SAP analytics, general knowledge about business administration, data reporting, communication	Data reporting and analytics	Supplier relationship management	Reading, understanding, and reporting data	Risk management, data reporting, digital negotiation, relationship management	Data management, data analytics	Data analytics, mainly same skills as now
Training method	Lifelong learning with practical approach	KTLS online courses on the new technologies	KTLS online and human trainings for career development	Training course for negotiation followed by practical learning	Training courses on technical backgrounds	Personal trainings from more experienced colleagues	Interactive trainings for mainly every topic
Age difference considered in training	No	No	No	Yes, young people are hired as trainees and get trained afterwards	No	No	No