Skill Requirements for Initial Supplier Integration in Industry 4.0: A Case-Based Research in the German Metal Manufacturing Industry

Author: Phillip Strauch
University of Twente
P.O. Box 217, 7500AE Enschede
The Netherlands

ABSTRACT,

Within the growing body of Industry 4.0 related research, an increasing number of sophisticating technologies can be identified that connects buying and supplying organizations. However, the initial integration of suppliers in these systems and the buying company is a function within the Purchasing and Supply Management department that got little attention regarding the required skills in literature. As skill development is crucial for the company's success, this research aims to understand the technological system interfaces that prescribe the needed role and ultimately find the function-/ and role-specific skill requirements. Furthermore, it aims to understand the impact of the international distance towards the supplier and the product portfolio on these requirements. By conducting qualitative research in the form of eight semi-structured interviews in the German metal manufacturing industry, a new skill cluster for the initial supplier integration has been found. Starting with system usage, a high current share of eProcurement technologies with the perspective for Big Data and automation is connected to the role of the Cross-functional Supplier Onboarding Manager. This role stresses the system-specific integration embedded in the cross-functional management task. The required skills reflect this bipolar orientation so that Communication skills, Cross-functional abilities & knowledge, and Networking skills represent the cross-functional management, and Computer Literacy and Product Knowledge the technical task. The direct impact of internationality adds Language skills and Cultural Awareness to this portfolio. Indirectly impacting is the product portfolio by changing the system interface. Non-critical items use more standardized interfaces, shifting the focus on the technical onboarding, whereas strategic items sourcing employ individual communicative systems, stressing the need for closer personal interactions. Limited are these findings by the qualitative methodological approach, the industrial and geographical specification, and only two influencing variables. Hence, future research directions are discussed and suggested.

Graduation Committee members:

1st Supervisor: **Vincent F. Delke**
2nd Supervisor: **Dr. Niels J. Pulles**

Keywords:
Industry 4.0; Initial Supplier Integration; Skill Requirements; Case-study

July 6th, 2021, University of Twente, Enschede, The Netherlands

1. INTRODUCTION

In recent years the Purchasing and Supply Management (PSM) function within organisations developed towards a strategic orientation. Strategic sourcing is, within this development, essential for the overall organisation's success (Carr & Pearson, 2002, p. 1049; Kim, Suresh, & Kocabasoglu-Hillmer, 2015, p. 10). Next to this function-specific development, the business environment changes over time too, pushed by customer expectations and technological developments (Gottge, Menzel, & Forslund, 2020, p. 1). Scientists refer this to the emerging fourth industrial revolution or Industry 4.0 (Fatorachian & Kazemi, 2021, p. 64; Oesterreich & Teuteberg, 2016, p. 122; Schiele & Torn, 2020, p. 508). Whereas digitalisation, automation and the interface between human and machines characterised the third industrial revolution(Schiele & Torn, 2020), will the fourth revolution most likely be "[…] characterised by cyber-physical systems with autonomous machine-to-machine communication" (Schiele & Torn, 2020, pp. 512-513). The need for that is reasoned by decreasing efficiency gains of third revolution technologies (Schiele & Torn, 2020, p. 512), although there is no clear, distinct separation between both (Schiele & Torn, 2020, p. 522). However, Industry 4.0 is not yet fully developed, precise definitions are still missing (Glas & Kleemann, 2016, p. 55), and its evolution consists of many incremental improvements of technologies.

Although 37% of German companies implemented some Industry 4.0 technologies, only one-third of them have made purchasing adjustments (Gottge et al., 2020, p. 2), leading to a largely unknown impact on this specific business function (Glas & Kleemann, 2016, p. 55). Especially the integration and involvement of suppliers is one step towards the maturity of Industry 4.0 (Schiele & Torn, 2020, p. 521). Having new technologies means that suppliers need to be connected with these technologies and integrated in the whole company. PSM professionals must secure that these connections or interfaces are established, aligned, and managed, referred to as initial supplier integration. Therefore, crucial for understanding this integration is the knowledge about the technologies used in connection to suppliers, currently and in the future. In this research, these buyer-supplier interfaces prescribe the personal requirements needed to fulfil the function of initially integrating suppliers. Therefore, the digital advancement is not purely regarding technical aspects but also regarding people using them (Aboramadan, as cited in Velinov, Maly, Petrenko, Denisov, & Vassilev, 2020, p. 5). In line with that, new roles within the PSM came up, reflecting the emerging Industry 4.0 (Delke, Schiele, & Buchholz, 2021, p. 10). Next to their basic understanding of the purchasing domain itself, purchasing professionals will require, within their roles, new role-specific skills. Hence, roles are the bundling shell for tasks and needed skills to contribute to the assigned function. Critical to the implementation of the “new purchasing” (Gottge et al., 2020, p. 15) is, therefore, human development or “Human readiness” (Schiele, Bos-Nehles, Delke, Stegmaier, & Torn, 2021, pp. 3, 7, 8; Schiele & Torn, 2020, p. 521). The ability to shift and keep the purchasing function throughout this change towards its strategic orientation as well as sustain the competitive advantage, depends on the "ability to develop superior PSM skills […]" (van Weele & van Raaij, 2014, p. 68) as well as the training, recruiting, or displacing of employees (L. Giunipero, Handfield, & Eltantawy, 2006, p. 826; Hohenstein, Feisel, & Hartmann, 2014, p. 436; Kamann, Dullaert, & de Leeuw, 2016, p. 156). Companies need to win the “war for digital talents” during this change (Hohenstein et al., 2014, p. 436; von der Gracht, Giunipero, & Schüller, 2016, p. 46). Focusing on the initial supplier integration and the electronic onboarding high level of proficiency are required (von Haartman & Bengtsson, 2015, p. 1303). However, with the digital systems and open electronic markets, also the distance between buyer and supplier becomes more unimportant, leading to a higher internationalisation or globalisation of supply chains and businesses in general (Denicolai, Zucchella, & Magnani, 2021, p. 3), often also referred as "Internet-enabled internationalisation" (Denicolai et al., 2021, p. 3). Furthermore, prior research identified the influence on different purchasing skills needed, depending on different sourced products (Louise Knight, Tu, & Preston, 2014, pp. 278, 279). If this applies to the skills required during the initial supplier integration remains open in literature.

Following the identified lack of skill understanding in the emerging Industry 4.0, connected to the newly defined roles by Delke, Schiele, and Buchholz (2021, p. 7), this research tries to fill this gap in the context of Initial Supplier Integration. The first objective is to understand the technological connections between both companies, marked by emerging sophisticating, integrating, and connecting software. By understanding the buyer-supplier interfaces, role-specific task description can be identified. These task descriptions will enclose the required skills. The objective is to find this set of skills.

To differentiate the findings further, the last two objectives are to understand the dependence and variety of these skills. First, the variety of skills on the buyer-supplier distance with increasing level of internationalisation, as supply chains are often embedded into an international context. Second, the variety of skills on the product portfolio that is purchased. For example, different products might require different skills during the integration, based on their strategic importance or complexity.

Following these objectives, the main research question is:

RQ (1) Which purchasing skills are needed for the initial supplier integration in Industry 4.0?

Subsequently, the following questions will be answered:

RQ (1.1) Which systems shape the buyer-supplier interface?

RQ (1.2) Which role is required during the initial supplier integration?

RQ (1.3) What impact does the international distance towards the supplier have on the skill requirements?

RQ (1.4) What impact does the sourced product portfolio have on the skill requirements?

After introducing the paper's topic, the second chapter outlines the theoretical framework by identifying the main literature findings. In chapter three, the methodology and research design are introduced, followed by the results of the interviews, in connection to their analysis and findings in chapter four. In line with the only slowly emerging technological development towards Industry 4.0, it is the Cross-functional management that determines the role needed throughout the initial supplier integration. Also, the skill requirements reflect, next to the technical focus, this cross-functional working. Additional skills are required if international suppliers are integrated. Only indirectly impacting the skill requirements is the product portfolio. The academic and managerial implications of these findings are discussed in chapter five, before limitations, and further research directions to this research are suggested in chapter six.

2. THEORETICAL REVIEW

In order to answer the aforementioned research questions, this research relies on the suggested theoretical framework (see Fig. 1). It reflects and illustrates the research objectives, research questions, and underlying assumptions. The following section is partially based on a systematic literature review, pursued on "scopus.com". The keyword list used for the scan is attached in

Appendix C and resulted in 1144 articles, from which 39 were selected for an in-depth scan based on a first abstract review.

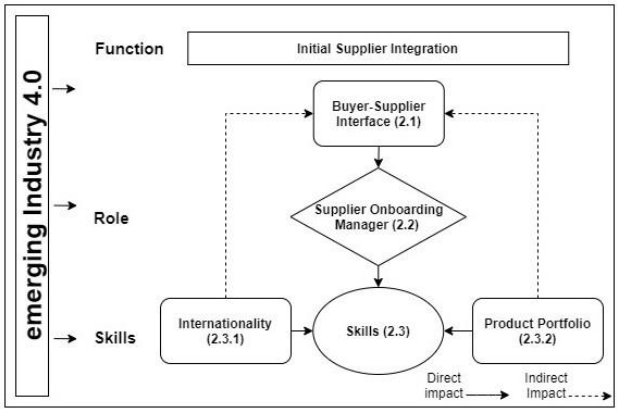

Figure 1: Theoretical Framework (based on Delke et al. (2021, p. 4) on Jones, 2013))

2.1 Technical Buyer-Supplier Interfaces: Development and Organizational Effect

Buyer-supplier interfaces. At the beginning of the framework are the buyer-supplier specific interfaces. These consist of the systems, software, and relationships that define how buyers and suppliers interact. According to Bastholm and Munksgaard (2020, p. 160) on Enrico Baraldi (2003), interfaces "are understood as contact points, where resources are combined". Thus, these contact points are not static but vary along with the technological development and overall changing business environment. In recent years the business environment is changing rapidly (Kamann et al., 2016, p. 155; L. Knight, Meehan, Tapinos, Menzies, & Pfeiffer, 2020, p. 1). Companies increasingly rely on web-based IT systems (L. Giunipero et al., 2006, pp. 823, 824), also for the interactions towards other companies.

Considering the **system-specific development** within PSM, Glas and Kleemann (2016, p. 58) started with the Material Resource Planning systems and the evolution towards Enterprise Resource Planning (ERP) systems, before these got revolutionised by electronic Procurement (eProcurement) systems. Nevertheless, such eProcurement systems are also constantly changing. The development points towards automated and autonomous systems, robotics and cognitive computing (Fatorachian & Kazemi, 2021, p. 63; von der Gracht et al., 2016, p. 34), referred to Industry 4.0, and has happened or is happening alongside two key dimensions; The increasing functional and inter-organisational integration, as well as the reduction of manual operative work in PSM (Glas & Kleemann, 2016, p. 59). Often also called 'Procurement 4.0', it relates to "the ultimate digitalisation and automation of the function within its company and supplier environment" (Glas & Kleemann, 2016, p. 59). As such revolutions are always emerging with or ignited by a pacemaker technology, a leading technological innovation in Industry 4.0 are most likely Cyber-Physical Systems (CPS) and not the internet (Schiele & Torn, 2020, p. 511; Zhou, Taigang, & Lifeng, 2015, p. 2147). Next to CPS, the Internet of Things (IoT), Blockchain, Big Data, Artificial Intelligence and Cloud Computing has been identified as powerful technologies of Industry 4.0 (Fatorachian & Kazemi, 2021, p. 69; Nürk, 2021, pp. 162-164; Schiele et al., 2021, p. 3). Appendix B presents an overview of explanations and applications of considered technologies.

Talking about the **effect of systems**, the functional integration of PSM also in connection to internal IT departments (Kamann et al., 2016, p. 156) increased. Moreover, suppliers are no longer seen as external systems, but, due to open and integrating IT systems, as integrated entities (L. Giunipero et al., 2006, p. 833; Kamann et al., 2016, p. 156). For example, collaboration platforms based on cloud computing (Zhou et al., 2015, p. 2150) could connect the manufacturer with its suppliers, offering sharing possibilities for resources and information (Gottge et al., 2020, p. 8). Generally, more supply chains are opened up, facilitating digital and open marketplaces (Schiele et al., 2021, p. 5; Schiele & Torn, 2020, p. 521). Furthermore, digitalising technologies improve the data and information exchange coordination and responsiveness, upgrading micro-processes in supply chains (Cassetta, Monarca, Dileo, Di Berardino, & Pini, 2020, p. 332) and improving the collaboration (Fatorachian & Kazemi, 2021, p. 77). Supply chains are thus becoming "value networks" (Fontes & Schiele, 2021, p. 2). However, supply chains can not only be opened by such technologies. Theoretically, the exact opposite could also be the case, making the used technologies a significant determinant to what extent supply chains are opened or closed in the future. Blockchain technologies, for example, can be set up as a private or public chain system (Bekrar, Cadi, Todosijevic, & Sarkis, 2021, pp. 6, 7), thus integrating a supply chain towards one buyer, tightly connecting the systems in this specific supply chain. Accordingly, the supply chain gets into a lock-in position to its current constitution, and an open market gets closed to outside suppliers. Nevertheless, exact proof of this phenomenon has not been found in the literature. Though, the Internet and CPS are also contributing to the increasingly connected business environment (Fatorachian & Kazemi, 2021, p. 64; Öberg & Graham, 2016, p. 533).

Taking the **effects on the supplier integration** into consideration, Gottge et al. (2020, p. 12) identified the "Purchasing 4.0 process", including the impacts of Industry 4.0 technologies, next to the opening and closure of supply chains. As more data can be acquired, partially in real-time (Fatorachian & Kazemi, 2021, p. 70), the selection and later evaluation of supplier can be improved, assisted by, for example, Big Data and Big Data Analytics (G. Wang, A. Gunasekaran, E. W. Ngai, & T. Papadopoulos, 2016, p. 101). The predictability of supply chain disruptions (G. Wang, A. Gunasekaran, E. W. T. Ngai, & T. Papadopoulos, 2016, p. 101), thereby enabling better risk management during the supplier evaluation (Fatorachian & Kazemi, 2021, pp. 70, 71). In addition to improved visibility and transparency of operations, the decision making can be accelerated and optimised (Fatorachian & Kazemi, 2021, p. 70; Nürk, 2021, p. 163; Gang Wang et al., 2016, p. 101). Automated analysis of audit data (von der Gracht et al., 2016, pp. 8, 9) during the selection process, automated procurement (Glas & Kleemann, 2016, p. 62), or smart contracts (Daher, Ruiz-Huidobro, Chmielewski, & Jayaraj, 2017, p. 3) are just a few examples of how the whole processes and tasks can be automated and digitalised. Approximately 46% of all tasks (Jain & Woodcock, 2017, p. 4) will potentially be done by Industry 4.0 technologies and systems. That reliefs the human workforce, especially from operative and standardised tasks (von der Gracht et al., 2016, pp. 8, 9). Therefore, the requirements and tasks of employees will change alongside changing technologies. "Specific human resources" are needed (Gang Wang et al., 2016, p. 106), which not necessarily consists of IT-specific capabilities (Glas & Kleemann, 2016, p. 62). According to Manyika et al. (2017, p. 17), these are "intrinsically human capabilities" that machines cannot pursue.

2.2 Roles in Literature: Focusing on the Supplier Onboarding Manager

Defining roles. Therefore, crucial for every organisation within the Industry 4.0 is the development of its human workforce. von der Gracht et al. (2016, p. 6) sums this up by saying: "In the

course of our economy's digital transformation, new job profiles and business models are created which demand completely new role requirements, key competencies and brand-new skills". Especially interfaces and relationships with new suppliers and other internal functions, reflecting the strategic as well as the collaborative orientation of PSM, require new roles and skills to access and obtain supplier resources (Bastholm & Munksgaard, 2020, p. 168). Thus, roles are often labelled differently in the scientific literature (Faes, Knight, & Matthyssens, 2001, p. 204; Johnson, Leenders, & Fearon, 1998, p. 8; Mulder, Wesselink, & Bruijstens, 2005, p. 186; Schiele, 2019, p. 53), although the general concept and construct is often the same. As identified by Delke, Schiele, and Buchholz (2021, p. 4) a role can best be defined as "[…] a concept for an organisation. Each role is bound to responsibilities and tasks within the organisation. To carry out these tasks, each role requires a specific set of skills […]". To ensure consistency, this definition was used as the basis for this research project.

Identifying roles. Although the concepts are often the same, different roles have been identified in different contexts. Whereas Faes et al. (2001, p. 204) found five profiles of effective buyers and the connected most important traits or skills, Schiele (2019, pp. 53-54) identified seven role models in purchasing, thus, without a clear connection to specific skill requirements. Bildsten and Manley (2015, pp. 869-870) based on Webster and Wind (1972)) identified the user, the influencer, the decider, the purchaser and the gatekeeper as specific roles. Especially the gatekeeper suits the purpose of this paper, as this role controls the information and manages relationships with current and potential suppliers and stakeholders (Bildsten & Manley, 2015). Sartor, Orzes, Nassimbeni, Jia, and Lamming (2015, p. 1129) also found the gatekeeper, next to the cultural broker, the coordinator, and seven more roles. A different approach was developed by Mulder et al. (2005, p. 192). He defined the roles on a hierarchical level, for example, the 'senior buyer' and 'buyer'. For this research, such a hierarchical approach is not of interest, but more responsibility and technological oriented to connect to the Industry 4.0 and strategic aspect of purchasing. Therefore, this paper connects to the roles defined by Delke, Schiele, and Buchholz (2021, p. 7). The *Supplier Onboarding Manager* (SOM) next to six more roles has been identified in an Industry 4.0 context (Delke, Schiele, & Buchholz, 2021, p. 7). Linked to the concept of Jones (2013) the SOM is "responsible for setting up the digital interface between the buying firm and suppliers, involving the harmonisation of data and effective stakeholder communication" (Delke, Schiele, & Buchholz, 2021, p. 7). Therewith, this role is an essential element throughout the initial supplier integration and builds the connection between the technical systems and the skill requirements.

2.3 Skill Requirements and Their Variability

Definition and categorization of skills. The last crucial element of the framework (see Fig. 1) are the skill requirements for the initial supplier integration. Roles within a function are linked to specific required skills (Delke, Schiele, & Buchholz, 2021, p. 1). In this case, they reflect the changing business environment, thus the specific technical background that arises from different buyer-supplier interfaces, requiring new skillsets within PSM (L. C. Giunipero, Denslow, & Eltantawy, 2005, p. 612). To orientate the PSM function strategically while successfully implementing the connection of internal and external customers of PSM, new skills and knowledge need to be developed (Feisel, Hartmann, & Giunipero, 2011, p. 55; L. Giunipero et al., 2006, p. 825). It is often unambiguous what is meant by discussing skills, competencies, capabilities, and job requirements (Le Deist & Winterton, 2005, p. 29). To keep it consistent throughout this research, all these concepts are referred to as skill or skills and are defined as "the ability to carry out the tasks and duties of a job in a competent manner" (Elias & McKnight, 2001, p. 511). Moreover, different categorisations for skills are described in the literature. A first approach by L. C. Giunipero and Pearcy (2000, p. 10) resulted in broad categories of skills (e.g. Strategic skills, Process Management skills, Team skills, etc.). Umbenhauer, Flynn, and Mitchell (2019, pp. 22-24) refer to Technical, Soft, and Digital skills. Further, Bals, Schulze, Kelly, and Stek (2019, p. 7) refer to technical, interpersonal, internal/external enterprise, and strategic business skills. As the research of Bals et al. (2019, p. 3) builds on the holistic understanding of Tassabehji and Moorhouse (2008) research of skills and includes a forward-looking view, as well as the strategic component of these skills, it suits best the interests of this paper, so that their framework (see Appendix D) is used throughout the paper.

Technical skills. Next to these groupings of skills, there are three broad categories of skills identified in the literature that seem to support the PSM function, especially the integration process: technical, flexible and strategic skills. Technical skills are "virtual competence necessary to properly manage suppliers in these virtual spaces" (von der Gracht et al., 2016, pp. 9, 10). These seem to be the basic skills required by purchasing professionals nowadays, including computer literacy and category management skills (Feisel et al., 2011, pp. 55,56). Furthermore, technical skills refer to external suppliers and internal integration, building the "supplier collaboration module" (L. Giunipero et al., 2006, p. 839).

Flexibility. Next to technical skills, "dynaxability" (von der Gracht et al., 2016, p. 6) or the flexibility of purchasing professionals was identified to have a positive impact on the PSM performance as a "key dimension of competitive strategy" (L. C. Giunipero et al., 2005, p. 603). In addition, flexibility, which is the adaption to changing conditions in PSM, can support the ability to cope with increased environmental uncertainty and increase the adaptability to a faster pace of market changes (L. C. Giunipero et al., 2005, p. 603). Specific skills are Creativity, Risk Management, Interpersonal Communication, Influencing and Persuasion, Planning, Decision Making, and Internal Motivation (L. C. Giunipero et al., 2005, p. 606).

Strategic skills. Lastly, Strategic skills are increasingly crucial in procurement and can contribute to the organisation's long term goals (L. Giunipero et al., 2006, pp. 823, 825). Examples are Strategic Planning, broader Financial skills (L. Giunipero et al., 2006, p. 836), Critical/Strategic Thinking, Risk Management, or Holistic Supply Chain Thinking (Bals et al., 2019, p. 7). By considering the relationship to a supplier as a strategic decision, Strategic Thinking can support mutual beneficial relationship, improving the influence of purchasing on these goals (L. C. Giunipero & Pearcy, 2000, p. 8). Summed up, "the trend towards adopting strategic alliances implies that purchasers need to develop the skills needed to manage relationships with suppliers, in order to attain corporate goals" (L. C. Giunipero et al., 2005, pp. 604, 605).

Specified skills. Although there is a whole research stream on skills in PSM literature (Hohenstein et al., 2014, p. 441), focusing on specific skills instead of broad skill groups or clusters, the literature review has shown that the implementation of suppliers on IT systems is rarely researched and no direct specific skills are found. However, several skills have been found related to supplier integration, although not always explicitly related to technological implementation. Delke, Schiele, Buchholz, and Stek (2021, p. 7) identified several Industry 4.0 related skills, namely E-procurement Technology skills, Robotic Process Automation (RPA) skills, Digital Contract Management and Legal skills, Digital Partnership Management skills, Digital Negotiation skills, and Digital Leadership skills. According to L.

C. Giunipero and Pearcy (2000, p. 8), essential skills are Interpersonal Communication, Decision-Making, Team-Working, analytical skills, negotiation, managing change, customer focus, influencing and persuasion, and understanding business conditions. Kauppi, Brandon-Jones, Ronchi, and van Raaij (2013, p. 844) claim that companies possessing next to technical abilities also learning abilities tend to succeed more likely while implementing e-purchasing tools.

2.3.1 Effect of Geographical Distance

In the context of the first differentiating variable (see Fig. 1), the supply network perspective is a crucial concept and describes the interdependent networks of actors, activities and connected resources a company is acting in (Brito & Roseira, 2005, p. 56). Being integrated into such a network and controlling it is the basis for competitive advantage nowadays (Brito & Roseira, 2005, p. 57). Especially the interactions within networks, and thus also the interfaces of buyer and supplier, are important for managing supplier networks (Brito & Roseira, 2005, p. 61). Therefore, it not only focuses on vertical interactions between supplier and a buying firm, but additionally also on the horizontal interactions within a supplying network, between supplier, as a whole called buyer-supplier relationships (Lazzarini, Chaddad, & Cook, 2001, p. 15). The management of such relationships is comparable with the "Supply Network Management skills" by Delke, Schiele, Buchholz, et al. (2021, p. 7) and could have several dimensions (geographical, cultural, demographical) (Lorentz, Kumar, & Srai, 2018, pp. 340-341).

Having an **international supply network** is often referred to as offshoring activities, or "offshore buying" (L. C. Giunipero & Monczka, 1997, p. 323). It is pushed by standardisation and formalisation of activities (Mugurusi & Bals, 2017, p. 78), often represented by using technologies for interactions, and is remarkable for the last decades (Sartor et al., 2015, p. 1125; von Haartman & Bengtsson, 2015, p. 1295). However, the physical distance between the buying firm and the supplier also seems to have drawbacks, which might change the involved employees' skill requirement. Cultural differences and the quality of communication influence the long-term relationships between the buyer and the supplier (Ashby, 2016, p. 77). In a global supply chain context, the focus on transnational and inter-organisational aspects increases (Reinecke, Donaghey, Wilkinson, & Wood, 2018, p. 462), so that global purchasing skills are one success factor of international sourcing (Monczka and Giunipero, as cited in Sartor et al., 2015, p. 1129). Cross-cultural knowledge is one crucial aspect of this context (Sartor et al., 2015, p. 1144).

In contrast, **local supply networks** often focuses more on relational aspects in a network (Ashby, 2016, p. 78). Trust is built through close social interactions. This is also reflected by the current trend of reshoring activities and the reasons for such activities. Reshoring, although not consolidated in its definition (Fratocchi, Di Mauro, Barbieri, Nassimbeni, & Zanoni, 2014), can be defined as: "Moving manufacturing back to the country of its parent company" (Ellram, 2013, p. 3). Next to a closer location of suppliers to research and development facilities, the need for greater control of buying firms, reduced risk factors, improved brand reputation (Moretto, Patrucco, & Harland, 2020, pp. 5930-5935), rising costs, poor product qualities, and scarcity of skilled human resources (E. Baraldi, Ciabuschi, Lindahl, & Fratocchi, 2018, p. 156), it is the potential for improved communication (Ashby, 2016, p. 78) and improved performance (Narasimhan & Nair, 2005, p. 311) that forces organisations to relocate their supply network. Combining the low quality of communication in international buyer-supplier relationships, the technical possibilities, and the improved social aspect in local supplier networks lead to the assumption that the skill requirements in international relationships are more technically focused, thus more relational focused, considering local supplier networks.

2.3.2 Influence of the Purchased Product Portfolio

In order to differentiate the skills further, the product types and the category groups of purchased items are investigated (Schiele, 2019, pp. 52, 56). According to Kauppi et al. (2013, pp. 843-846), organisations increasingly use different tools for different product categories. Following Louise Knight et al. (2014, p. 271), "different types of purchases need different sourcing strategies, underpinned by distinct sets of resources and practices", referring to Kraljic (1977, 1983) and his matrix on different product types of purchased items. Of interest is the implication of different types of products on the skills requirements. The dimensions of this matrix are divided into the external factor of supply market complexity and the internal factor of the profit impact (Kraljic, 1983). Four quadrants are identifiable: strategic items, bottleneck items, leverage items, and non-critical items (see Fig. 2).

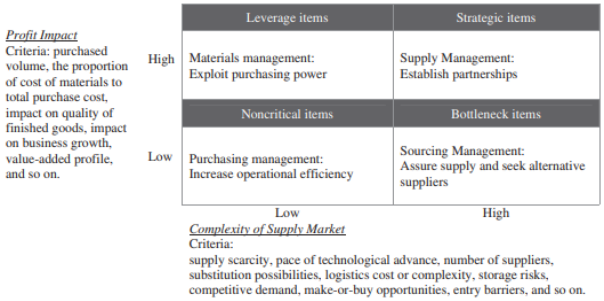

Figure 2: Kraljic matrix (Kraljic, 1983, p. 111, modified by Knight et al. (2014, p. 273))

Another internal differentiation of products is made in the PSM literature, namely whether purchased products directly contributing towards the finished product, or indirect materials, focusing on supporting materials for the production (Schiele, 2019, p. 51). The underlying assumption is that different products have different requirements on the skills of a purchaser. Either directly by adding new skills, or indirectly by changing the needed interface for a specific product type or purchasing situation (see Fig. 1). Louise Knight et al. (2014, pp. 272, 278, 279) researched a similar setting and identified that different product types lead to different skill clusters that are required. For example, strategic items, having a high-profit impact and requiring a high level of adjustments between the buyer and supplier, require different skill requirements than tactical items or routine products. However, different systems or interfaces that are used in connection to the products require different skills. Bastholm and Munksgaard (2020, p. 160, based on Araujo et al. (1999)) identified such interfaces dependent on the product purchased, namely, standard interfaces, specified interfaces, translation interfaces, and interactive interfaces. A step further, focusing on specific systems, Hawking, Stein, Wyld, and Foster (2004, p. 12) showed that eProcurement is more often used for direct materials than indirect materials. Next, Fontes and Schiele (2021, p. 7) identified Robotic Process Automation to be suitable for catalogue products (e.g. industrial production, spare parts, packaging or raw materials), automatically requested by algorithms based on Material Resource Planning models.

3. METHODOLOGY

3.1 Grounded Theory: Inductive Case-Based Research

The general research design consists of grounded theory, utilising semi-structured interviews for case-based research, with

seven medium to large metal manufacturing companies located in Germany.

Grounded theory is a qualitative form of research for constructing theory (Corbin, 2017, p. 301) which can be defined as a "[…] theory [that] is developed in a bottom-up, inductive way, in which preconceptions about the topic of interest are put aside as much as possible so that the resulting understanding or theory is closely tied to the data from which it is derived, or grounded." (Rennie, 2006, p. 61). Especially in the context of an emerging topic (Industry 4.0), qualitative bottom-up research is helpful to find a basis of theory to start with. Supported is this choice of methodology by the identified gap in the literature regarding the skill requirements for the initial supplier integration. Survey approaches can later be used to test the found theory, or aspects of it, on a larger scale. Especially the open-ended way of asking (see 3.1.2.1) shall enclose novel insights regarding the single elements and their connections within the chosen theoretical framework (see Fig. 1), that 'multiple-choice' or 'scale' questions cannot deliver. The academic and practical use is to understand the complex social phenomena of skills in the mentioned industrial context (Yin, 1994, p. 35). Therefore, the goal is to develop theory about the skill requirements during the initial supplier integration in Industry 4.0, based on the Supplier Onboarding Manager (Delke, Schiele, & Buchholz, 2021, p. 7). The data used to develop concepts and theory is gathered through fieldwork (Corbin, 2017, p. 301). This also reflects the inductive approach, meaning that the "resulting theory is an accumulation and representation of all the cases" (Corbin, 2017, p. 301), or " 'cross-case' conclusions"(Yin, 1994, p. 49). Therefore, inductive approaches are considered with qualitative research (Bryman, 2016, p. 24), and case studies are suitable (Van Thiel, 2014, p. 86).

3.1.1 Appropriateness of Case-Studies and Semi-Structured Interviews

The general goal of case studies is to build theory from these cases (Eisenhardt, 1989, p. 548), and in addition to that, "understanding the dynamics present within single settings" (Eisenhardt, 1989, p. 534). Depth in this understanding is more important than the breadth of data collected (Van Thiel, 2014, p. 87). Thus, the close relationship between the empirical reality and developed theory is crucial to this research approach's novelty, testability, and empirical validity (Eisenhardt, 1989, p. 548; Glaser, Strauss, & Strutzel, 1968). Case studies are often used for research domains in their early stages, where little is known, or the literature is outdated, leading to a "fresh perspective" (Eisenhardt, 1989, p. 549). This is applicable in this research due to the emerging frame of Industry 4.0. In such a qualitative research approach, where words instead of numbers are utilised (Eisenhardt, 1989, p. 534), the data collection method is the main factor influencing the quality and trustworthiness of the resulting theory (Kitto, as cited in Kallio, 2016, p. 2955). Interviews are most common for this purpose (Taylor, 2005, p. 39), and more specifically, semi-structured interviews (DiCicco-Bloom & Crabtree, 2006, pp. 315-316), which are therefore also considered as "qualitative interview[s]" (Kallio et al., 2016, p. 2955). They are used to explore and find evidence where little is known and unique insights are needed (Gill, Stewart, Treasure, & Chadwick, 2008, p. 292). Gathered data is the building block for later theoretical conclusions (Van Thiel, 2014, p. 92).

3.1.2 Increasing Internal Validity

3.1.2.1 The Interview Guide

In order to enable this cross-case analysis and increase the internal validity and replicability from interview to interview, the interviews shall, despite their flexible style, be based on an internally consistent structure (Van Thiel, 2014, p. 100). Therefore, a semi-structured interview guide, based on previous studies and in close relationship to the theoretical framework (Van Thiel, 2014, p. 100), has been developed (see Appendix A). This guide includes a predetermined set of questions, in this case, seven questions, which are embedded in the possibility of asking additional follow-up questions during the interview (Kallio et al., 2016, p. 2960). The main questions are open-ended and theoretically driven, searching for the opinion and experiences of the interviewee (Int) (Galletta, 2013, p. 45). Moreover, they are participant oriented, unleading, and unambiguously directing towards in-depth, spontaneous answers (Kallio et al., 2016, p. 2960; Van Thiel, 2014, p. 95). The questions in an inductive approach shall reflect the questions asked in the problem statement and start with light questions, leading to insights about the respondent and his or her experience, before increasing in depth during the interview (Galletta, 2013, p. 48). Nevertheless, maintaining a natural course of the interview (Van Thiel, 2014, p. 95). Constrained is the decision for open-ended questions, especially for the skill requirements, by the absence of judgement about their relative importance. Only if explicitly mentioned by the interviewee, a ranking of the skills can be justified.

3.1.2.2 Sampling Framework

To identify a skill-related theoretical framework in a specific industrial and regional context, a non-probability sampling or a purposive selection of companies has been used (Van Thiel, 2014, p. 90). The selected companies are all somehow working with metal as raw material. They produce high tech machinery, which is sold globally. They act in the agricultural, automotive, and high-tech metal supply industry and are located in Germany (see Table 1). Industry 4.0 initially originating from the German government (Zhou et al., 2015, p. 2147), in combination with high relative shares of sourced products to overall production costs in metal manufacturing organisations, led to the assumption that top-level expertise and proficiency can be found in these cases. To guarantee the comparability of different PSM departments towards their orientation and position within the organisations, all cases should have departmental goals aligned towards the organisation's overall goals.

Moreover, it is about the mental concepts of the interviewees as the objects of analysis in grounded theory (Corbin, 2017, p. 301). One interview will be conducted per interviewee, reflecting one measurement of time (Van Thiel, 2014, p. 91). Reasoned is this by the interest in the outlook towards required skills and not the development of these expectations or outlooks over time, although this single view could potentially limit the perspective on the organisation and its practices (Van Thiel, 2014, p. 91). Further, same as for the sampling of companies, the interviewees' overall sampling needs to be homogeneous and share similarities to the research objectives (Kuzel, as cited in DiCicco-Bloom & Crabtree, 2006, p. 317).

3.2 Data Collection and Analysis

Eight interviews have been conducted, representing seven medium to large organisations in the german metal manufacturing industry. The interviews lasted on average 46,6 minutes and were held online due to the ongoing Covid-19 pandemic (see Appendix E). As Yin (1994, p. 138) suggested, the interviews were audio-recorded for higher accuracy of collected data. Originally held and transcribed in German, quotes for the final paper were later directly translated into English. For confidentiality reasons, all company details and personal information were excluded from this paper. In Appendix G, an overview of collected data can be seen, as the full transcripts are excluded as well.

After transcribing the interviews, a two-step approach, as suggested by Eisenhardt (1989, pp. 539, 540), was used to analyse the gathered data. First, a within-case analysis was

pursued in each transcript. All results were summarised in a data file, which was then used for the cross-case analysis. Information processing biases are overcome through the cross-case comparisons and constant analysis of similarities and differences, increasing the internal validity of developed theory (Corbin, 2017, p. 302; Eisenhardt, 1989, p. 541). Following Yin (1994, p. 165), the general strategy for the analysis was to base it on the theoretical framework (see Fig. 1) that also co-shaped the interview guide, reflecting the literature review. To further increase the comparability of the cases within the analysis, the skill framework of Bals et al. (2019, p. 7) was used to classify the mentioned skills by the interviewees. Open-ended questions often result in many different mentioned skills, although the meaning is often the same. As skill clusters reflect the underlying meaning or orientation of many skills, they are utilised to provide an easily accessible overview of the classified skills (see Table 1).

4. FINDINGS

In order to validate the results towards their comparability, all interviewees indicated the alignment of departmental goals with the long-term goals of the whole organisation. Therefore, the strategic orientation of PSM is given in all cases.

4.1 High Share of eProcurement Systems and Increasing Efforts for Industry 4.0

Getting into the framework, it starts with the interfaces of the buying firm towards its suppliers. It needs to be said that provided explanations of the interviewees do not always lead to a precise determination of the type of system. Sometimes descriptions were vague and included characteristics of multiple core systems. Moreover, systems are suited to the specific needs and characteristics of the company and its supply network (Int A). Therefore, the categorisation can be falsified for single systems. The usage of systems has been divided into current usage, marked by an 'X', and future intended usages, marked by an '(X)' (see Table 1).

Current system usage. Identifiable for the current usage is a high share of eProcurement technologies, as all mentioned at least one system that can be classified as an eProcurement technology. The most used system is an ERP system, as indicated by all interviewees. Other commonly used systems are Email-ordering, electronic marketplaces, as well as electronic catalogues. Other internet-based systems were used too. For example, interviewees E and C use a server to provide information about ordering details connected to their supplier, e.g., "*delivery-scheduling procedure*" (Int C). The specific connection points between buyer's and supplier's systems are primarily Electronic Data Interchanges (EDI). Nevertheless, not all suppliers are yet capable of such an electronic connection, as supposed by interviewee B and G. Remarkable is also that any interviewee did not report a fully automated sourcing. However, also Industry 4.0 technologies are currently used among the interviewees. For example, interviewee D uses self-communicating systems (IoT) in connection with Cloud Computing. Moreover, interviewees A and E started pilot projects using Big Data and Artificial Intelligence. Already implemented as a system is this combination of technologies at interviewees F, G, and H. Light versions of CPS are only found at interviewee B, and E. Blockchain technologies have not been identified. The high current usage of eProcurement technologies and low level of automation let assume that Industry 4.0 is still in its beginnings and considerably high shares of operative tasks need to be done. Thus, as interviewee E summarises, the potential of future technologies has been recognised, "*But we have seen, that especially regarding new technologies, it has been promising*".

Future system usage. This is also reflected by the indication of future systems by each interviewee. Except for interviewee C, all interviewees have communicated plans for the utilisation of industry 4.0 technologies. By stating that where they can automate, they will automate, interviewee A shows that especially the automation of processes or the Procurement 4.0 is of considerable interest. Regarding the automation of the onboarding process specifically, several opinions have been mentioned. Interviewee E does not think that full automation will come. In contrast, interviewee D claims, "*I would go into the direction and say, that supplier integration is something that should happen completely automatically*", also covering the expectations of interviewee F. Next to the automation of the process, specific systems also increase in their usage. For example, Big Data and related technologies like Artificial Intelligence or Cloud Computing seem to gain importance. Interviewee A, D, E, F, G and H want to extend the usage, while interviewee B will introduce such technology. Interestingly, all interviewees, who indicated increasing automation of processes, also indicated Big Data and Artificial Intelligence. Based on the sample, the assumption would then be that these technologies are in line with efforts to automate. Thus, only mentioned once are CPS. Interviewee B explicitly mentioned an extension of CPS usage in the future, whereas interviewees D and F point out efforts for the extension of "smarter systems, that communicate automatically (IoT)" (Int D). Moreover, company five recently introduced a big project including Cloud Computing in connection with IoT. The finished platform shall facilitate the interconnectedness of the organisation-wide supplier base towards all subsidiary companies. This is in line with efforts to improve the efficiency between different functions and the central PSM department in all organisations, as well as reducing electronic breaks within the flow of information (Int F). Not mentioned again are Blockchain technologies. Therefore, CPS, IoT applications and especially Blockchain technologies are underrepresented in the sample, both currently and in the future. Clear indications of what factors, next to the product portfolio (see 4.3.2), influence the usage of these systems have not been found, though it is not the focus of this research. However, a gap is identifiable between the scientific literature of Industry 4.0 technologies and the actual industrial application of such technologies. Especially in terms of CPS, Blockchain and IoT, there are rarely use-cases identifiable, and the usage mainly focuses on eProcurement technologies and Big Data applications.

4.2 Suggesting the Cross-functional Supplier Onboarding Manager

Introduction of a SOM. Asking the interviewees whether they see the need for or already have implemented the role of a SOM (Delke, Schiele, & Buchholz, 2021, p. 7) led to a highly differing outcome. Interviewees A, E, and H see a perspective need for such a role within the purchasing department because "*it needs people in purchasing, that regards the onboarding of supplier as their core task*" (Int A). Nevertheless, interviewee E narrows the scope of the specific role so that there is "*no specific need for a role in purchasing that technically connects the supplier with an EDI*", thus excluding the onboarding on technical systems. Contrasted is this by interviewee F and H. Interviewee H stresses exactly this technical onboarding management for this role. Also, interviewee F, who already has such a role, that is specifically set up as a team, focuses more on the technical aspects, especially the reactive assistance during the technical onboarding process. Interviewee G has an onboarding team too, thus, his role description is closer to the original definition by Delke, Schiele, and Buchholz (2021, p. 7)**.** Also currently using this role is

Table 1: Overview of Findings

	INT A	INT B	INT C	INT D	INT E	INT F	INT G	INT H
Systems								
eProcurement	X (X)	X	X (X)	X	X	X	X	X
Procurement 4.0	(X)	(X)		(X)	(X)	(X)	X (X)	(X)
Big Data (+AI and Cloud Computing)	X (X)	(X)		X (X)	X (X)	X (X)	X (X)	X (X)
Blockchain								
IoT				X (X)		(X)		
CPS		X (X)			X			
Role (based on Delke, 2021)								
Supplier Onboarding Manager	(X)	X			(X)	X	X	(X)
Skills (based on Bals et al., 2019)								
Technical Skills	X	X		-	X	X	X	X
Interpersonal Skills	X		X	-	X		X	
Internal/External Enterprise Skills	X	X	X	-	X	X	X	X
Strategic Business Skills			X	-	X	X		X
Impact on Skill Requirements								
Internationality	direct	direct	direct	-	direct	direct	direct	direct
Product Portfolio	indirect	indirect	indirect	-	direct	none	indirect	indirect
Interviewee Information								
Position	Head of Procurement	Commodity Buyer (indirect)	Commodity buyer (direct)	Head of Project Procurement	Senior Commodity Buyer	-	Supplier Manager	-
Industry	Metal supplies	Agriculture and Transport	Agriculture and Transport	Truck	Automotive supplies	Automotive	Agriculture	Automotive supplies
#employees in PSM	<50	<50	<50	500-1000	100-500	>1000	100-500	<100
'X'= current usage; '(X)'= future usage								

interviewee B. Although the specific employee is still located in the IT department, he or she is responsible for the described technical task of a SOM and belongs to the purchasing department. Seeing no need at all for such the SOM in the purchasing department are interviewees D and C. As already mentioned before, interviewee D supposes that the process needs to be automated; hence there is no need for a specific role. Interviewee E speculated about the influence of the company size towards the reason to introduce this specific role. However, this cannot be identified within the sample, either for the size of the purchasing function. The size only seems to influence the implementation of the role, either as a team in larger organisations (Int F, G) or a single role for relatively smaller organisations (Int A, B, E, H). Moreover, also a dependence on the extent to what technologies are used within the organisations is not identifiable. Using more or fewer technologies, currently and in the future, seems not to influence the introduction or usage of a SOM.

Cross-functional task description. What has been identified is the cross-functional management of the integration process as the SOM's major task description. All interviewees indicated that throughout their specific onboarding process, several internal functions are involved, for example, quality assurance (Int A, C, D, E, H), finance and accounting (Int A, B, C, D, G), the IT department as a significant technological contributor (Int A, B, C, D, E, F, G, H), and logistics (Int C, D, H). Interviewee A summarised it as a future role that oversees the whole onboarding process while facilitating cross-functional communication and coordination, internally and externally. The competencies that are needed for different steps of the onboarding process lay decentralised in each department. "*The more complex such a process is, the more departments are involved*" (Int A). Outlooking to future systems, he stated that "*through the use of other connecting systems, and an increasing number of tasks, one could prove that the cross-functional, integrative role of a purchasing professional will increasingly come out*". Nevertheless, not only the systems seem to have an impact on the cross-functionality of this role, as mentioned by interviewee G. Product characteristics, like its complexity, security-related and legal aspects, are directly leading to an increasing cross-functional process that needs to be observed and managed by the SOM (Int G).

Taking both together, the SOM seems not to be a role that will be introduced with certainty. Nevertheless, the sample shows that there is a role or job profile in purchasing, not restricted to one person, that has the task to observe, assist, and manage the onboarding process throughout and in combination with expert departments. In these departments, the skills and competencies about certain aspects, like IT, are concentrated and just need to be brought together. Suggested is, therefore, the role of a **Cross-functional Supplier Onboarding Manager (CFSOM)**, which stresses the technical side of this role and the integrative task during the initial supplier integration.

4.3 Function-/ and Role-Specific Skill Requirements

After having identified the tasks of the CFSOM, specific skills are needed to fulfil them. Labelled and grouped, suiting the framework of Bals et al. (2019, p. 7), the first part in this section focuses on the skill clusters, based on the single skills mentioned by the interviewees (see Table 1). However, as the determination of specific skills and in addition to that their grouping is sometimes vague, it can be falsified. Moreover, interviewee D could not provide specific skills and is excluded in this section.

Broad skill clusters. Throughout the sample, one skill cluster has been identified in all cases, Internal/External Enterprise skills. This cluster relates not the procurement specific skills but the skills in combination with other functions internally and externally (Tassabehji & Moorhouse, 2008, p. 60). Next to this cluster, technical, procurement-specific, skills are mentioned by all interviewees except interviewee C. Mentioned by only five interviewees are interpersonal skills. The same holds for strategic business skills. Outstanding in the sample is interviewee E, who indicates skills related to all four skill clusters.

Specific skill requirements. Continuing with the specific skills within the clusters (see Appendix F), Communication skills were mentioned in all cases. According to interviewee A "*regarding this part (onboarding) of a strategic task, […] it means that*

people suddenly need to be way more communicative […]". Next to communication, Networking skills are essential for interviewees B, E, and H. Interviewee E said, "*One cannot know everything […] one just need to know whom to ask*". Interviewee A and interviewees F and H also indicated the need for Cross-functional Abilities and Knowledge. Extended is this by interviewee G, stressing the need for Enthusiasm for the onboarding process across functions. Furthermore, the "*sovereign appearance in front of a supplier is important*" has been claimed by interviewee B. All these skills belong to the Internal and External Enterprise skills. Next to them are Technical skills. Basic Computer Literacy was mentioned by interviewee A, B, E, F, and G. Interviewee A commented this by saying, "*The topic of IT is something no one could get away from today*". Comprehensive knowledge about these technological processes is required for interviewee H. Worth to mention is that no specific Computer Literacy about Industry 4.0 technologies has been claimed by any of the interviewees, except interviewee F, for whom the 'Data Governance' in Big Data systems is a crucial skill for the SOM, next to the knowledge about interface connection points. Besides Computer Literacy, also identified in four cases is Product Knowledge. Except for interviewees A, F and G, all interviewees prescribe a basic knowledge about the sourced product. More fundamental knowledge regarding the product and also the processes is required for interviewee E, "*He should be well versed about the special requirements [of the products and processes]*" (on the SOM role). Further, mentioned for Technical skills has been negotiation by interviewee B next to Basic Knowledge on PSM Roles & Processes by interviewees H and E, stating that "*If I should have to define the perfect onboarding manager, I would definitely not take a newbie*". For interpersonal skills, interviewee C mentioned the particular focus during the onboarding process on a Structured Way of Working. Not mentioned in the work of Bals et al. (2019, p. 7), but suited to personal and interpersonal skills, interviewee A added Empathy and life-long learning, interviewee B added assertiveness and interviewee G improvising skills. The last group of skills regards Strategic Business Skills. Interviewees C, E, and H mentioned strategic thinking as a specific skill. Thus, company E also adds critical thinking in the form of auditor qualities that a SOM needs to evaluate a single supplier correctly. To evaluate the supply security across multiple supplier levels, interviewee F also focused on a Holistic Supply Chain View. By considering the future development of the skill requirements, it has been found that the Cross-functional Working of employees in this role will increase, as mentioned by interviewees A, B and E. Although, except for interviewees B and F, that specific skill was not mentioned as an essential skill. Next to Cross-Functional working, interviewees B, C and E also see at least the same level of communication in the future, with the tendency to increase. Technical skills seem to increase only slightly, mentioned by interviewees B, C and E so that no heavy development towards IT knowledge is identifiable and "*a normal purchaser will remain a user of IT systems*" (Int C).

Interestingly, interviewees A, F, and G mentioned a further distinction within the required skills, between hard skills and soft skills. Hard skills, for example, focus on Technical skills, like Computer Literacy (Int G), whereas soft skills are interpersonal and intrapersonal focused (Int A and G). Although identified within the sample, this distinction and its impact are not further examined throughout the analysis. Therefore, focusing solely on the mentioned skill requirements, the analysis discloses a strong focus on Internal/External Enterprise and Technical skills, especially **Communication skills**, **Computer Literacy** and **Product Knowledge** (see Table 2). Especially the Internal/External Enterprise skills are in the context of the Cross-functional management task a good reflection of the role description that has been identified before. It again underlines the shift in focus of the SOM towards the CFSOM. From the technical perspective, the skill requirements need to be divided into IT-related Computer Literacy and Product specific technical knowledge. Basic IT-related skills, thus not the main focus of the CFSOM, reflect the technological development and increasing emergence of more sophisticating technologies in connection to the suppliers. Thus, a strong IT knowledge, except for interview F, has not been found, showing that technological integration is not the main focus, as initially suggested in the definition of Delke, Schiele, and Buchholz (2021, p. 7). Computer Literacy primarily regards the use of the systems. Technical onboarding is therefore often done by the IT department, as stated by interview E "*The [IT department] cares about the technical connection*", again underlying the cross-functional management (Int H). Nevertheless, a connection between the use of systems in general and the technical focus can be identified. Taking interviewee C as an example, he was the only interviewee not mentioning Computer Literacy as a skill and indicated the lowest use of systems within the procurement department, solely focusing on eProcurement technologies. Therefore, a total absence of Industry 4.0 technologies seems to influence the technical focus of required skills. Considering the product-specific knowledge, basic knowledge can be needed due to the metal manufacturing background of all interviewees. Next to the technical focus, another remarkable point is the relative underrepresentation of Strategic Business Skills. All interviewees indicated an overall strategic alignment of the purchasing department within their organisations. However, Strategic Business skills of Bals et al. (2019, p. 7) seem not to play a crucial role within this sample.

Table 2: Skill Requirements for Initial Supplier Integration

Skills
Communication skills (7)
Computer Literacy (6)
Product Knowledge (4)
Cross-functional Abilities & Knowledge (3)
Networking (3)
Strategic Thinking (3)

(# = times mentioned)

4.3.1 Added Skills Due to International Supplier Integration

English Language skill and Cultural Awareness. Focusing on the international geographical distance towards the supplier, it has been indicated that the onboarding process itself remains the same, either here or overseas (Int B). Thus, all interviews added new skills towards the skill requirements during the supplier integration. Mentioned was the English Language as a crucial skill. Interviewee A frames the function of this skill "*to integrate with the [the foreign supplier] linguistically*". The focus on the English language is reasoned by the leading position as a business language, *"also in cooperation with Chinese*" (Int B), supporting its worldwide applicability. Next to language skills, Cultural Awareness has been indicated by interviewees A, C, E, F, and H. An employee working in this role "*should take the cultural aspects into account*" (Int E). Especially Asian countries seem to differ highly in terms of how to do business, compared to more western cultures. For example, they would never refuse anything, which is essential to know to build one's communication upon this knowledge (Int F). To successfully do business depends, therefore, on the capability to recognise and behave according to the local rules. Closely connected to Cultural Awareness is the Openness towards novelties (Int C). Such novelties can, for example, be a new foreign supplier. Another aspect relating to cultural issues, but more business-related, is Understanding Foreign Market Dynamics. Interviewee A relates this to interpersonal and market-specific mechanisms and practices that vary in different countries. He describes this in addition to cultural aspects that need to be taking into account.

Excluding indirect technological impacts. Next to the specific skills, interviewees B, C, D and E agreed that the internet was a leading enabler of internationalisation, also referred to as the "international-enabled digitalisation" (Denicolai et al., 2021, p. 3). Interviewee E claims that the internet was "*essentially involved*". Interviewee C overall agreed to the term by Denicolai et al. (2021, p. 3), but see the internet more as a contributor but not the main reason "*one could say, that it would not have been globalised to that extent without the internet […]. But globalisation would have happened nonetheless*", which also reflects the opinion of interviewee G and H. However, the systems used in connection with the suppliers seem to be the same internationally. Except for a slight variation in specific systems, there has been a high agreement that systems are used regardless of the geographical distance towards the supplier, excluding an indirect impact on the skill requirements. Moreover, no additional technic specific skills have been mentioned in connection to the international buyer-supplier distance.

Refused impact of reshoring. The second assumption is the influence of reshoring and more relational-based interfaces in local relationships. While asking for the impact of reshoring, interviewee D and E indicated an increasing reshoring focus connected to software developments for electrical parts. Thus, interviewee D refers such efforts more to developing such technologies in connection with regional companies instead of buying the software nearby. Furthermore, interviewee A sees no reshoring need for specific products. For some products, according to him, an international cluster of expertise will remain. Moreover, he sees the reason for reshoring in bad decision making, often being only cost focused. Interviewee G connects reshoring mainly with the security of backup supplier. For interviewee B and C, or company two, no reshoring activities has been identified. Additional skills or increasing importance of already mentioned skills have not been mentioned in this context.

Concluding a direct impact. By arguing about the impact on the skill requirement, a direct impact due to the international geographical distance of the supplier can be concluded. Without any changes to the onboarding process itself or the systems in use, but an additional set of skills required for the role, any indirect influences are excluded. Therefore, the task description itself remains. Changed are the skill requirements, as language-specific and cultural related skills are added to the list of skills needed for a CFSOM (see Appendix F). However, these skills are only required when dealing with international suppliers. Surprisingly no supplier-network specific skills have been identified, taking a holistic supply chain picture into account. Also not mentioned is a technical focus in international relations. Although the internet seems to have had a high impact on internationalisation, the integration of suppliers is unaffected and not focused more on technological connections with an increasing geographical distance. Supported is this by the non-varying system use towards such suppliers. Therefore, taking the standardised process and the independence of system usage into account, it can be assumed that the CFSOM regards standardised tasks, which varies in its interpersonal aspects when boarding international suppliers. However, this impact is direct. The standardised interface is additionally supported by the revised assumption about the impact of reshoring activities. Identified within the sample is a product-specific need for reshoring activities, but not any impact of this decision regarding the skill requirements of a CFSOM. As the interfaces tend to be independent of the distance towards the supplier, reshoring has no identified influence.

4.3.2 Indirect Impact of Purchased Product by Changing the Buyer-Supplier Interface

Regarding the second differentiating variable of the skill requirements, no clear, direct connection has been identified, meaning that the interviewees mentioned no specific additional skill requirements. Overall, the interviewed companies differentiating between direct and indirect procurement. Within these broad groups, the products are again grouped in commodities. The commodity groups vary regarding their constitution and range from raw material groups to more specific product parts. Multiple levels of commodities describe the depth of differentiation.

The case of interviewee B. Important are not only the commodities but also the characteristics that distinguish different products within the commodities. Exemplary presented is the case of interviewee B. Regarding Kraljic's matrix (see Fig. 2), he differentiated between non-critical items, which are small, standardised, everyday parts, or mass products, and strategic items, representing the bigger monetary investments, being less standardised and low in volume. He also connects the different items with different systems in use. Non-critical items are used in connection to electronic marketplaces, electronic catalogues, and CPS, whereas the strategic items are sourced on the internet. The reason for this is the higher need for closer interactions with the supplier, also focusing on only one supplier for this item.

Inclusion or exclusion of systems. Moreover, some interviewees tend to differentiate the use of specific systems based on the direct or indirect products sourced. Although no clear pattern is recognisable regarding which systems are used for which category, it seems to impact the system usage. For example, electronic catalogues, mentioned in relation to indirect product sourcing (Int A and G). Furthermore, Interviewees A and C also indicated the inclusion and exclusion of different technologies for different products, depending on the sourcing volume and complexity. Additionally, the degree of cross-functional management for the CFSOM itself can vary by the complexity, as well as security and legally related issues regarding a product (Int G). The more complex the product, the more organisational functions need to be brought together and managed.

Concluding an indirect impact. Bringing this observation into the contexts of skills, an indirect impact of the products sourced on the skill requirements can be identified. Knowing that non-critical parts can be sourced in connection to more electronic, standardised, more automated systems, and strategic items with systems that offer greater possibilities of close interpersonal interaction, also the skill requirements for the CFSOM changes. Whereas the focus for non-critical items is on the more technological onboarding to the systems, is the focus for strategic items on the more individual communicative interaction with the supplier. Whether this communication regards product specifications or the facilitating communication between different functions, like engineering, has not been identified. Moreover, several product characteristics seem to include or exclude the specific usage of different systems.

No impact has been identified in interview F. Although company five sometimes differentiates between the system used for direct or indirect materials, they indicated overall product independent usage of systems. As the CFSOM has a very technical orientation (Computer Literacy), the skills are not changing due to the product portfolio.

Product specification at interviewee E. An exceptional case is interviewee E. In his company, the same systems are used for all products too. Moreover, he requires the most specific skills related to the sourced item. Although interviewees B, C and H also see the need for general product knowledge, interviewee E mentioning that a SOM would require specific process and Product Knowledge in combination with Auditor Qualifications in his or her specific commodity. Thus, company four also has

more employees within PSM than company two or seven (see Table 1). Although the general skill of product knowledge has been mentioned for a relatively small purchasing department too (Int B, C, and H), its operationalisation focuses mainly on the general knowledge of the products. The extent to which more specific Product Knowledge is prescribed, if needed at all, could be impacted by the size of the purchasing department, measured by the human workforce. The impact on the skill requirements, due to the product unspecific usage of systems by interviewee E, is, therefore, more direct (see Fig. 3) than the aforementioned indirect impact due to changing systems. Worth mentioning is that this impact is about the specialisation of the already identified skill of Product Knowledge and not the constitution of the skill requirements.

4.4 Brining the Elements Together: Skills for the Initial Supplier Integration

Based on the findings of this multiple case study, the suggested theoretical framework (see Fig. 1) has been modified. As presented in Figure 3, the frame of the emerging Industry 4.0 will remain.

Embedded in this frame, for the system-specific part (**RQ 1.1**), a high current share of eProcurement technologies and Big Data applications currently shape the buyer-supplier interfaces. Other Industry 4.0 specific systems seem to emerge, despite single pilot projects slowly. Especially the outlook for the future discloses the use of Big Data related systems in combination with automation efforts. CPS and IoT systems usage rarely have been found.

Although many different roles or job profiles are discussed in the literature, the SOM (Delke, Schiele, & Buchholz, 2021, p. 7) bridges best the role for the initial supplier integration with regard to the technical system interface. Thus, a highly varying picture of current usage, future need and no need for this role can be observed. Nevertheless, reasoned by the highly cross-functional task description during the onboarding process, the Cross-functional Supplier Onboarding Manager resulted from the interviews (**RQ 1.2**). Next to the technical focus is cross-functional integration a significant determinant of this role within an organisation.

As a specific set of skills operationalises a role, the CFSOM in this sample requires multiple skills for the initial supplier integration (**RQ 1**). Based on the skills framework of Bals et al. (2019), the six most important skills are Communication skills, Computer Literacy, Product Knowledge, Cross-functional Abilities & Knowledge, Networking, and Strategic Thinking (see Table 2). On the one hand side, they reflect the technical expertise, and on the other hand, the internal and external enterprise management that characterises the CFSOM. Combining both, it is the technically enabled cross-functional and inter-organisational integration that is underlined by these findings (L. Giunipero et al., 2006, p. 833; Kamann et al., 2016, p. 156). Yet unclear are the exact operationalisations (e.g., responsibilities) of these skills, such as Computer Literacy. However, the highly technological onboarding on the systems is mainly done by the IT departments.

Regarding the variety of these skills, a direct impact on skills due to the geographical distance (internationality), has been found (**RQ 1.3**). Language skills, focusing primarily on the English language, and Cultural Awareness are two aspects that are important when dealing with faraway suppliers. Supplier networking skills or more technical skills due to changing technical interfaces in international relationships have not been identified. The same holds for the impact of reshoring activities on the skill requirements.

Thus, influencing the choice for a specific system in connection with the supplier is the product portfolio. Linking to Kraljic's matrix (see Fig. 2), electronic, standardising, and automated systems are used for non-critical items, stressing the technical onboarding for the CFSOM. In contrast to that, systems offering greater potential for personal interaction, stressing the cross-functional communication as an important aspect during the onboarding, are used for strategic items. Therefore, an indirect influence on the skill requirements has been identified due to the sourced product portfolio (**RQ 1.4**). Exceptions, nevertheless, showed that the Product Knowledge as a specific skill or the cross-functional aspect during the onboarding process could directly be impacted if certain conditions are met.

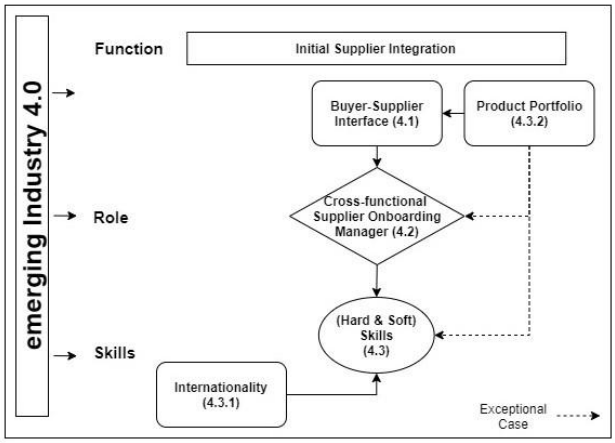

Figure 3: Modified Framework for Initial Supplier Integration

5. DISCUSSION OF IMPLICATIONS

Following the need for a better skill understanding during the emerging Industry 4.0, this study focused on the initial supplier integration. It aimed to understand the buyer-supplier interfaces, especially the usage of technologies. Connected by the emerging role of the Supplier Onboarding Manager (Delke, Schiele, & Buchholz, 2021, p. 7), skill requirements should be identified, needed for the initial integration of supplier in organisational systems. Moreover, it aimed to examine the impact of the geographical distance of suppliers and the sourced product portfolio on the skill requirements. Following these objectives, the academic and practical implications are discussed based on the presented findings.

5.1 Academic Implications

Academically, this research contributes in multiple ways. **First**, it agrees to the increasing use of web-based systems and applications (L. Giunipero et al., 2006, pp. 823, 824) and their increasing automation (von der Gracht et al., 2016, pp. 8, 9). However, the use of autonomous systems is not found (Fatorachian & Kazemi, 2021, p. 63; von der Gracht et al., 2016, p. 34). This indicates a gap regarding system usages between research suggestions and practical implementation. Although proofing a more integrative relationship with suppliers due to technologies (L. Giunipero et al., 2006, p. 833; Kamann et al., 2016, p. 156), it stays an open discussion if supply chains are going to be opened up or closed by the usage of more technologies (Schiele et al., 2021, p. 5; Schiele & Torn, 2020, p. 521). Critical for interviewee F, for example, is the trust requiring close social interactions (Ashby, 2016, p. 78) that need to be built between the buyer and suppliers, locking in specific trusting suppliers in a Blockchain. Trust in this case means the security of sensitive data in a competitive context, shared throughout the Blockchain (Int F). Only if shared data are guaranteed to be protected against any unintended usages to the disadvantage of suppliers, supply chains will be kept open to new suppliers (Int F).

Second, regarding the roles, this research agrees to the general definition of Delke, Schiele, and Buchholz (2021, p. 4), proving the need for a specific construct (role) described by tasks that require specific skills to perform them, either set up for a single person or a team. The task description of the SOM has been extended by the inter-/ and intra-organizational cross-functional management of initial supplier integration, suggesting the CFSOM. Purely IT-related tasks are often transferred to the IT department, confirming Kamann et al. (2016, p. 156). Thus, the role is comparable to the gatekeeper or coordinator, as identified by Bildsten and Manley (2015); Sartor et al. (2015, p. 1129).
Third, the findings fill the research gap of skills, important for the initial supplier integration. It adds a new function-/ and role-specific cluster connected to two impacting factors to the general skills framework of Bals et al. (2019, p. 7). It opens up research possibilities for other function-/ and role-oriented skill research. Overall these skills reflect the "intrinsically human capabilities" that are needed (Manyika et al., 2017, p. 17). However, to what extend the found skills are strategic (L. Giunipero et al., 2006, p. 836), regardless of their grouping in the framework of Bals et al. (2019, p. 7), remains unclear. Another discussion point is the distinction between soft and hard skills. Especially the educability and development of soft skills seem to be more difficult and complex. Although first ways of soft skill academic education and training were suggested (Stek, 2021, pp. 235, 236), hard skills development is easier and more common in an organisational context. However, to develop hard skills, often soft skills are required (Ahmed, Capretz, Bouktif, & Campbell, 2012, p. 62). Further analysis is needed to find the exact impact of this distinction and how the skills can best be educated.
Fourth, talking about the international distance, this research agrees to the cultural focus that is needed, as well as a different communicational basis, regarding the language requirements (Ashby, 2016, p. 77; Reinecke et al., 2018, p. 462; Sartor et al., 2015, p. 1144). Nevertheless, closer relationships and an increasing focus on supplier network aspects have not been identified (Ashby, 2016, p. 78; Brito & Roseira, 2005, p. 61).
Fifth, regarding the impact of the product portfolio, the direct impact, as identified by Louise Knight et al. (2014), cannot be completely confirmed. However, an indirect impact on the skill requirements is identifiable, which leads at least to the same clusters of skills (e.g., strategic and routine products). Directly affected by the product portfolio is the system that is used (Kauppi et al., 2013, pp. 843-846), hence, the interface towards the supplier (Bastholm & Munksgaard, 2020, p. 160, based on Araujo et al. (1999)).
An additional influencing factor, not only on the skill requirements but also on other elements of the framework, is the size of the company and the PSM department. Several potential points of influence have already been identified, for example, the specialisation of product knowledge skills or the implementation of the CFSOM. However, also in the literature, no studies researching this factor have been found, opening the potential for further research.

5.2 Practical Implications: Preparation of Human Workforce

The managerial implications of this research shed light on the management process to prepare its workforce for the digital transformation with the skills needed during the initial supplier integration. First, an understanding is required for the product portfolio and the suiting systems used in connection to the suppliers to determine the general focus of the role. Currently, high shares of eProcurement technologies shape the buyer-supplier interfaces but showing the tendency towards higher shares of Big Data technologies and automation of processes. Once determined, it is essential to consciously decide to introduce a Cross-functional Supplier Onboarding Manager who focuses on the cross-functional management of the technically shaped supplier onboarding. The CFSOM can be an additional role for an employee, a role for one employee, or the role description of a whole team. Whether or not to hire new employees for this function or rely on current employees depends to a certain extent on the existence of the required soft skills and hard skills and the educability of missing skills. Required are Communication Skills, Computer Literacy, Product Knowledge, Cross-functional abilities & knowledge, Networking, and Strategic Thinking. The balance of skills, however, need to be customized, suiting the individual requirements of the organization. To guarantee the competitive advantage for the initial integration of international suppliers, the workforce requires two additional skills: Cultural awareness and English Language skills. Following this process and preparing the workforce with the suggested skills will lead to a competitive advantage due to the initial supplier integration (L. Giunipero et al., 2006, p. 826; Hohenstein et al., 2014, p. 436; Kamann et al., 2016, p. 156; van Weele & van Raaij, 2014, p. 68).

6. LIMITATIONS AND FURTHER RESEARCH

Thus, offering new insights, this research is also limited by multiple factors. First of all, it is limited by the determination and classification of mentioned skills in connection with the framework of Bals et al. (2019, p. 7) as well as the individual systems. Without a second reviewer, personal judgment could lead to misclassified skills and systems with falsified findings.
Next to that, it is limited by the chosen methodological approach. While pursuing interviews, qualitative data is gathered, leading to certain conclusions. However, these conclusions cannot be generalised due to the missing proof by, for example, quantitative data regarding specific correlations (e.g., relative importance of skill requirements). Furthermore, only eight interviews have been conducted, which means that the sample is undersized, potentially leading to falsified generalisations of findings. It requires larger sample, quantitative research for further validation.
Additionally, the industry-specific selection and geographical concentration of selected companies set boundaries to the generalisation of this research. Findings from this sample cannot be drawn on other regions or other industries without prior scientific proof. Moreover, only two influencing variables on the skill requirements have been researched. Thus, the sample has shown that additionally the size of the purchasing department or the whole company can potentially have an impact. Further factors need to be examined for their influence to understand the skill requirements and their variability better.
Reasoned by the limitations and presented findings, future research is suggested to focus on the larger scale quantitative analysis of the presented findings in changing industrial and geographical settings, leading to more meaningful findings (e.g., relative importance of skill requirements). Content-wise, the exact effect of Industry 4.0 technologies, like Blockchains, on the openness of supply chains towards new suppliers remains an interesting open topic. Furthermore, additional influencing factors, like the size, can be tested on their effects and implications for the framework. Regarding the skills, other function-/ and role-specific skill requirements in Industry 4.0 can be examined. Moreover, the exact operationalisation of the skill requirements and methods that educate these skills effectively need to be researched. Especially the distinction between soft skills and hard skills in connection to their education needs further elaboration to implement the CFSOM successfully.

ACKNOWLEDGEMENTS

At this point, I want to express my gratitude to my first supervisor Vincent F. Delke for the guidance and support throughout the whole project. Further, I want to thank him and my second supervisor Dr. Niels Pulles for the feedback, which helped improve my thesis's overall quality. My gratitude also goes to all interview partners who supported this research with their valuable time and insights.

REFERENCES

Aboramadan, M. (2020). Top management teams characteristics and firms performance: literature review and avenues for future research. *International Journal of Organizational Analysis, ahead-of-print*(ahead-of-print). doi:10.1108/IJOA-02-2020-2046

Ahmed, F., Capretz, L. F., Bouktif, S., & Campbell, P. (2012). Soft skills requirements in software development jobs: A cross-cultural empirical study. *Journal of systems and information technology*.

Alladi, T., Chamola, V., Parizi, R. M., & Choo, K. K. R. (2019). Blockchain Applications for Industry 4.0 and Industrial IoT: A Review. *IEEE Access, 7*, 176935-176951. doi:10.1109/ACCESS.2019.2956748

Ashby, A. (2016). From global to local: reshoring for sustainability. *Operations Management Research, 9*(3-4), 75-88. doi:10.1007/s12063-016-0117-9

Aslam, J., Saleem, A., Khan, N. T., & Kim, Y. B. (2021). Factors influencing blockchain adoption in supply chain management practices: A study based on the oil industry. *Journal of Innovation and Knowledge, 6*(2), 124-134. doi:10.1016/j.jik.2021.01.002

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, 25*(5). doi:10.1016/j.pursup.2019.100572

Baraldi, E. (2003). When information technology faces resource interaction. Using IT tools to handle products at IKEA and Edsbyn (Sweden).

Baraldi, E., Ciabuschi, F., Lindahl, O., & Fratocchi, L. (2018). A network perspective on the reshoring process: The relevance of the home- and the host-country contexts. *Industrial Marketing Management, 70*, 156-166. doi:10.1016/j.indmarman.2017.08.016

Bastholm, S. M., & Munksgaard, K. B. (2020). Purchasing's tasks at the interface between internal and external networks. *Journal of Business and Industrial Marketing, 35*(1), 159-171. doi:10.1108/JBIM-12-2018-0393

Bekrar, A., Cadi, A. A. E., Todosijevic, R., & Sarkis, J. (2021). Digitalizing the closing-of-the-loop for supply chains: A transportation and blockchain perspective. *Sustainability (Switzerland), 13*(5), 1-25. doi:10.3390/su13052895

Bildsten, L., & Manley, K. (2015). A framework for understanding purchasing in building construction companies. *Construction Management and Economics, 33*(11), 865-879. doi:10.1080/01446193.2016.1164325

Bodkhe, U., Tanwar, S., Parekh, K., Khanpara, P., Tyagi, S., Kumar, N., & Alazab, M. (2020). Blockchain for Industry 4.0: A comprehensive review. *IEEE Access, 8*, 79764-79800. doi:10.1109/ACCESS.2020.2988579

Brito, C., & Roseira, C. (2005). A Model for understanding supply chain networks. *Journal on Chain and Network Science, 5*(2), 55-63. doi:10.3920/JCNS2005.x055

Bryman, A. (2016). *Social research methods*: Oxford university press.

Carr, A. S., & Pearson, J. N. (2002). The impact of purchasing and supplier involvement on strategic purchasing and its impact on firm's performance. *International Journal of Operations and Production Management, 22*(9-10), 1032-1053. doi:10.1108/01443570210440528

Cassetta, E., Monarca, U., Dileo, I., Di Berardino, C., & Pini, M. (2020). The relationship between digital technologies and internationalisation. Evidence from Italian SMEs. *Industry and Innovation, 27*(4), 311-339. doi:10.1080/13662716.2019.1696182

Chakkol, M., Finne, M., Raja, J. Z., & Johnson, M. (2018). Social capital is not for sale: a supply network perspective on mergers and acquisitions. *Supply Chain Management, 23*(5), 377-395. doi:10.1108/SCM-02-2017-0052

Choe, J. M. (2018). Electronic commerce, MCSs cha nge, a nd the improvement of supply-chain performance. *Global Business and Finance Review, 23*(2), 30-48. doi:10.17549/gbfr.2018.23.2.30

Corbin, J. (2017). Grounded theory. *Journal of Positive Psychology, 12*(3), 301-302. doi:10.1080/17439760.2016.1262614

Daher, M., Ruiz-Huidobro, R., Chmielewski, J., & Jayaraj, V. (2017). New Capabilities from Disruptive Technologies. *Digital Procurement* 1-11.

Delke, V. (2021). Conducting Delphi Studies on future PSM roles and competencies in the era of Industry 4.0. *PERSIST Erasmus+* (IO3), 1-46.

Delke, V., Schiele, H., & Buchholz, W. (2021). Specifying roles in purchasing and supply management in the era of Industry 4.0: A Delphi study. *EurOMA 2021*, 1-13.

Delke, V., Schiele, H., Buchholz, W., & Stek, K. (2021). Defining Industry 4.0 skills in purchasing and supply management. *EurOMA 2021*, 1-13.

Denicolai, S., Zucchella, A., & Magnani, G. (2021). Internationalization, digitalization, and sustainability: Are SMEs ready? A survey on synergies and substituting effects among growth paths. *Technological Forecasting and Social Change, 166*. doi:10.1016/j.techfore.2021.120650

Deszczyński, B., Fonfara, K., & Dymitrowski, A. (2017). The role of relationships in initiating the internationalisation process in B2B markets. *Entrepreneurial Business and Economics Review, 5*(4), 91-109. doi:10.15678/EBER.2017.050404

DiCicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. *Medical Education, 40*(4), 314-321. doi:10.1111/j.1365-2929.2006.02418.x

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management review, 14*(4), 532-550.

Elias, P., & McKnight, A. (2001). Skill measurement in official statistics: recent developments in the UK and the rest of Europe. *Oxford economic papers, 53*(3), 508-540.

Ellram, L. M. (2013). Offshoring, reshoring and the manufacturing location decision. *Journal of Supply Chain Management, 49*(2), 3-5. doi:10.1111/jscm.12023

Faes, W., Knight, L., & Matthyssens, P. (2001). Buyer profiles: an empirical investigation of changing organizational requirements. *European Journal of Purchasing & Supply Management, 7*(3), 197-208.

Fatorachian, H., & Kazemi, H. (2021). Impact of Industry 4.0 on supply chain performance. *Production Planning and Control, 32*(1), 63-81. doi:10.1080/09537287.2020.1712487

Feisel, E., Hartmann, E., & Giunipero, L. (2011). The importance of the human aspect in the supply function: Strategies for developing PSM proficiency. *Journal of Purchasing and Supply Management, 17*(1), 54-67. doi:10.1016/j.pursup.2010.07.001

Fontes, F., & Schiele, H. (2021). RPA improves procurement process and support digital transformation. *Procurement Digital Transformation*.

Fratocchi, L., Di Mauro, C., Barbieri, P., Nassimbeni, G., & Zanoni, A. (2014). When manufacturing moves back: Concepts and questions. *Journal of Purchasing and Supply Management, 20*(1), 54-59. doi:https://doi.org/10.1016/j.pursup.2014.01.004

Galletta, A. (2013). *Mastering the semi-structured interview and beyond: From research design to analysis and publication* (Vol. 18): NYU press.

Gao, Y., Driouchi, T., & Bennett, D. J. (2018). Ambiguity aversion in buyer-seller relationships: A contingent-claims and social network explanation. *International Journal of Production Economics, 200*, 50-67. doi:10.1016/j.ijpe.2018.02.004

Geisberger, E., & Broy, M. (2012). *agendaCPS: Integrierte Forschungsagenda Cyber-Physical Systems* (Vol. 1): Springer-Verlag.

Gill, P., Stewart, K., Treasure, E., & Chadwick, B. (2008). Methods of data collection in qualitative research: Interviews and focus groups. *British Dental Journal, 204*(6), 291-295. doi:10.1038/bdj.2008.192

Giunipero, L., Handfield, R. B., & Eltantawy, R. (2006). Supply management's evolution: Key skill sets for the supply manager of the future. *International Journal of Operations and Production Management, 26*(7), 822-844. doi:10.1108/01443570610672257

Giunipero, L. C., Denslow, D., & Eltantawy, R. (2005). Purchasing/supply chain management flexibility: Moving to an entrepreneurial skill set. *Industrial Marketing Management, 34*(6 SPEC. ISS.), 602-613. doi:10.1016/j.indmarman.2004.11.004

Giunipero, L. C., & Handfield, R. B. (2004). *Purchasing education and training II*: CAPS Research Tempe, AZ.

Giunipero, L. C., Hooker, R. E., Joseph-Matthews, S., Yoon, T. E., & Brudvig, S. (2008). A decade of SCM literature: Past, present and future implications. *Journal of Supply Chain Management, 44*(4), 66-86. doi:10.1111/j.1745-493X.2008.00073.x

Giunipero, L. C., & Monczka, R. M. (1997). Organizational approaches to managing international sourcing. *International Journal of Physical Distribution & Logistics Management, 27*(5-6), 321-336. doi:10.1108/09600039710175903

Giunipero, L. C., & Pearcy, D. H. (2000). World-class purchasing skills: An empirical investigation. *Journal of Supply Chain Management, 36*(3), 4-13. doi:10.1111/j.1745-493X.2000.tb00081.x

Glas, A. H., & Kleemann, F. C. (2016). The impact of industry 4.0 on procurement and supply management: A conceptual and qualitative analysis. *International Journal of Business and Management Invention, 5*(6), 55-66.

Glaser, B. G., Strauss, A. L., & Strutzel, E. (1968). The Discovery of Grounded Theory; Strategies for Qualitative Research. *Nursing Research, 17*(4), 364. Retrieved from https://journals.lww.com/nursingresearchonline/Fulltext/1968/07000/The_Discovery_of_Grounded_Theory__Strategies_for.14.aspx

Gottge, S., Menzel, T., & Forslund, H. (2020). Industry 4.0 technologies in the purchasing process. *Industrial Management and Data Systems, 120*(4), 730-748. doi:10.1108/IMDS-05-2019-0304

Harrington, T. S., & Srai, J. S. (2017). Understanding stages of supply network emergence in technology commercialisation. *International Journal of Manufacturing Technology and Management, 31*(1-3), 4-36. doi:10.1504/IJMTM.2017.082015

Hawking, P., Stein, A., Wyld, D. C., & Foster, S. (2004). E-procurement: Is the ugly duckling actually a swan down under? *Asia Pacific Journal of Marketing and Logistics, 16*(1), 3-26. doi:10.1108/13555850410765140

He, L., Xue, M., & Gu, B. (2020). Internet-of-things enabled supply chain planning and coordination with big data services: Certain theoretic implications. *Journal of Management Science and Engineering, 5*(1), 1-22. doi:10.1016/j.jmse.2020.03.002

Hohenstein, N. O., Feisel, E., & Hartmann, E. (2014). Human resource management issues in supply chain management research: A systematic literature review from 1998 to 2014. *International Journal of Physical Distribution and Logistics Management, 44*(6), 434-463. doi:10.1108/IJPDLM-06-2013-0175

Jääskeläinen, A., Schiele, H., & Aarikka-Stenroos, L. (2020). Getting the best solution from a supplier – A social capital perspective. *Journal of Purchasing and Supply Management, 26*(5). doi:10.1016/j.pursup.2020.100648

Jain, K., & Woodcock, E. (2017). A road map for digitizing source-to-pay. *Retrieved June, 30*, 2019.

Johnson, P. F., Leenders, M. R., & Fearon, H. E. (1998). Evolving roles and responsibilities of purchasing organizations. *International Journal of Purchasing and Materials Management, 34*(4), 2-11.

Jones, G. R. (2013). *Organizational theory, design, and change*: Upper Saddle River, NJ: Pearson.

Kallio, H., Pietilä, A. M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing, 72*(12), 2954-2965. doi:10.1111/jan.13031

Kamann, D. J. F., Dullaert, W., & de Leeuw, S. (2016). Preparing for new competitive challenges: Special issue on the 24th annual IPSERA conference. *Journal of Purchasing and Supply Management, 22*(3), 155-159. doi:10.1016/j.pursup.2016.05.005

Kauppi, K., Brandon-Jones, A., Ronchi, S., & van Raaij, E. M. (2013). Tools without skills: Exploring the moderating effect of absorptive capacity on the

relationship between e-purchasing tools and category performance. *International Journal of Operations and Production Management, 33*(7), 828-857. doi:10.1108/IJOPM-12-2011-0445

Kim, M., Suresh, N. C., & Kocabasoglu-Hillmer, C. (2015). A contextual analysis of the impact of strategic sourcing and E-Procurement on performance. *Journal of Business and Industrial Marketing, 30*(1), 1-16. doi:10.1108/JBIM-01-2012-0010

Kitto, S. C., Chesters, J., & Grbich, C. (2008). Qualiy in qualitative research: Criteria for authors and assessors in the submission and assessment of qualitative research articles for the Medical Journal of Australia. *Medical Journal of Australia, 188*(4), 243-246. doi:10.5694/j.1326-5377.2008.tb01595.x

Knight, L., Meehan, J., Tapinos, E., Menzies, L., & Pfeiffer, A. (2020). Researching the future of purchasing and supply management: The purpose and potential of scenarios. *Journal of Purchasing and Supply Management, 26*(3). doi:10.1016/j.pursup.2020.100624

Knight, L., Tu, Y.-H., & Preston, J. (2014). Integrating skills profiling and purchasing portfolio management: An opportunity for building purchasing capability. *International Journal of Production Economics, 147*, 271-283. doi:https://doi.org/10.1016/j.ijpe.2013.06.013

Kraljic, P. (1977). Neue Wege im Beschaffungsmarketing. *manager magazin, 7*(11), 72-80.

Kraljic, P. (1983). Purchasing must become supply management. *Harvard business review, 61*(5), 109-117.

Kuzel, A. J. (1992). Sampling in qualitative inquiry. In *Doing qualitative research.* (pp. 31-44). Thousand Oaks, CA, US: Sage Publications, Inc.

Lazzarini, S. G., Chaddad, F. R., & Cook, M. L. (2001). Integrating supply chain and network analyses: The study of netchains. *Journal on Chain and Network Science, 1*(1), 7-22. doi:10.3920/JCNS2001.x002

Le Deist, F. D., & Winterton, J. (2005). What is competence? *Human Resource Development International, 8*(1), 27-46.

Lee, J., Bagheri, B., & Kao, H. A. (2015). A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems. *Manufacturing Letters, 3*, 18-23. doi:10.1016/j.mfglet.2014.12.001

Levenson, A. (2012). Talent management: Challenges of building cross-functional capability in high-performance work systems environments. *Asia Pacific Journal of Human Resources, 50*(2), 187-204. doi:10.1111/j.1744-7941.2011.00022.x

Lorentz, H., Kumar, M., & Srai, J. S. (2018). Managing distance in international purchasing and supply: a systematic review of literature from the resource-based view perspective. *International Business Review, 27*(2), 339-354. doi:10.1016/j.ibusrev.2017.09.002

Luzzini, D., & Ronchi, S. (2016). Cinderella purchasing transformation: linking purchasing status to purchasing practices and business performance. *Production Planning and Control, 27*(10), 787-796. doi:10.1080/09537287.2015.1137986

Manyika, J., Chui, M., Miremadi, M., Bughin, J., George, K., Willmott, P., & Dewhurst, M. (2017). Harnessing automation for a future that works. *McKinsey Global Institute*.

Meehan, J., Touboulic, A., & Walker, H. (2016). Time to get real: The case for critical action research in purchasing and supply management. *Journal of Purchasing and Supply Management, 22*(4), 255-257. doi:10.1016/j.pursup.2016.08.006

Monostori, L. (2014). *Cyber-physical production systems: Roots, expectations and R&D challenges.* Paper presented at the Procedia CIRP.

Moretto, A., Patrucco, A. S., & Harland, C. M. (2020). The dynamics of reshoring decisions and the role of purchasing. *International Journal of Production Research, 58*(19), 5929-5944. doi:10.1080/00207543.2019.1661534

Mugurusi, G., & Bals, L. (2017). A processual analysis of the purchasing and supply organization in transition: the impact of offshoring. *Operations Management Research, 10*(1-2), 64-83. doi:10.1007/s12063-016-0119-7

Mulder, M., Wesselink, R., & Bruijstens, H. C. J. (2005). Job profile research for the purchasing profession. *International Journal of Training and Development, 9*(3), 185-204.

Narasimhan, R., & Nair, A. (2005). The antecedent role of quality, information sharing and supply chain proximity on strategic alliance formation and performance. *International Journal of Production Economics, 96*(3), 301-313. doi:https://doi.org/10.1016/j.ijpe.2003.06.004

Nürk, J. (2021). Smart information system capabilities of digital supply chain business models. *European Journal of Business Science and Technology, 5*(2), 143-184. doi:10.11118/EJOBSAT.V5I2.175

Öberg, C., & Graham, G. (2016). How smart cities will change supply chain management: A technical viewpoint. *Production Planning and Control, 27*(6), 529-538. doi:10.1080/09537287.2016.1147095

Oesterreich, T. D., & Teuteberg, F. (2016). Understanding the implications of digitisation and automation in the context of Industry 4.0: A triangulation approach and elements of a research agenda for the construction industry. *Computers in Industry, 83*, 121-139. doi:10.1016/j.compind.2016.09.006

Ogulin, R., Selen, W., & Ashayeri, J. (2012). Determinants of informal coordination in networked supply chains. *Journal of Enterprise Information Management, 25*(4), 328-348. doi:10.1108/17410391211245829

Park, H., Bellamy, M. A., & Basole, R. C. (2016). Visual analytics for supply network management: System design and evaluation. *Decision Support Systems, 91*, 89-102. doi:10.1016/j.dss.2016.08.003

Pekkanen, P., Niemi, P., Puolakka, T., Pirttilä, T., & Huiskonen, J. (2020). Building integration skills in supply chain and operations management study programs. *International Journal of Production Economics, 225*, 107593. doi:https://doi.org/10.1016/j.ijpe.2019.107593

Petrick, I. J. (2007). Tipping the balance of power: The case of Large Scale Systems Integrators and their supply chains. *International Journal of Foresight and Innovation Policy, 3*(3), 240-255. doi:10.1504/IJFIP.2007.014009

Reinecke, J., Donaghey, J., Wilkinson, A., & Wood, G. (2018). Global supply chains and social relations at work: Brokering across boundaries. *Human Relations, 71*(4), 459-480. doi:10.1177/0018726718756497

Rennie, D. L. (2006). The Grounded Theory Method. Application of a Variant of its Procedure of Constant

Comparative Analysis to Psychotherapy Research. In *Qualitative Research Methods for Psychologists* (pp. 59-78).

Robles-Velasco, A., Muñuzuri, J., Onieva, L., & Rodríguez-Palero, M. (2021). Trends and applications of machine learning in water supply networks management. *Journal of Industrial Engineering and Management, 14*(1), 45-54. doi:10.3926/jiem.3280

Sartor, M., Orzes, G., Nassimbeni, G., Jia, F., & Lamming, R. (2015). International purchasing offices in china: Roles and resource/capability requirements. *International Journal of Operations and Production Management, 35*(8), 1125-1157. doi:10.1108/IJOPM-09-2013-0440

Schiele, H. (2019). Purchasing and Supply Management. In H. Zijm, M. Klumpp, A. Regattieri, & S. Heragu (Eds.), *Operations, Logistics and Supply Chain Management* (pp. 45-73). Cham: Springer International Publishing.

Schiele, H., Bos-Nehles, A., Delke, V., Stegmaier, P., & Torn, R. J. (2021). Interpreting the industry 4.0 future: technology, business, society and people. *Journal of Business Strategy*. doi:10.1108/JBS-08-2020-0181

Schiele, H., & Torn, R. J. (2020). Cyber-physical systems with autonomous machine-to-machine communication: Industry 4.0 and its particular potential for purchasing and supply management. *International Journal of Procurement Management, 13*(4), 507-530. doi:10.1504/IJPM.2020.108627

Schulze, H., Bals, L., & Johnsen, T. E. (2019). Individual competences for sustainable purchasing and supply management (SPSM): A literature and practice perspective. *International Journal of Physical Distribution and Logistics Management, 49*(3), 287-304. doi:10.1108/IJPDLM-01-2018-0036

Smart, A. (2005). Exploring supply chain opportunities in the UK utilities sector and the supporting role of eMarketplaces. *Supply Chain Management, 10*(4), 264-271. doi:10.1108/13598540510612730

Smeltzer, L. R., Manship, J. A., & Rossetti, C. L. (2003). An Analysis of the Integration of Strategic Sourcing and Negotiation Planning. *Journal of Supply Chain Management, 39*(3), 16-25. doi:10.1111/j.1745-493X.2003.tb00161.x

Stek, K. (2021). Purchasing Skills Leading to Success: How to Succeed in Innovation Sourcing.

Stevens, G. C., & Johnson, M. (2016). Integrating the Supply Chain … 25 years on. *International Journal of Physical Distribution and Logistics Management, 46*(1), 19-42. doi:10.1108/IJPDLM-07-2015-0175

Storti, A. T., Paiva, E., & Vieira, L. M. (2018). Internationalization and relationships in supply chains. *Brazilian Business Review, 15*(6), 551-567. doi:10.15728/bbr.2018.15.6.3

Tassabehji, R., & Moorhouse, A. (2008). The changing role of procurement: Developing professional effectiveness. *Journal of Purchasing and Supply Management, 14*(1), 55-68. doi:https://doi.org/10.1016/j.pursup.2008.01.005

Taylor, M. C. (2005). Interviewing. *Qualitative research in health care*, 39-55.

Umbenhauer, B., Flynn, R. P., & Mitchell, P. (2019). Complexity: Overcoming obstacles and seizing opportunities. *The Deloitte Global Chief Procurement Officer Survery*, 1-36.

Van Thiel, S. (2014). *Research methods in public administration and public management: An introduction*: Routledge.

van Weele, A. J., & van Raaij, E. M. (2014). The future of purchasing and supply management research: About relevance and rigor. *Journal of Supply Chain Management, 50*(1), 56-72. doi:10.1111/jscm.12042

Velinov, E., Maly, M., Petrenko, Y., Denisov, I., & Vassilev, V. (2020). The role of top management team digitalization and firm internationalization for sustainable business. *Sustainability (Switzerland), 12*(22), 1-11. doi:10.3390/su12229502

von der Gracht, H., Giunipero, L., & Schüller, M. (2016). Future-proof procurement-Now or never: the big procurement transformation. *Berlin: KPMG AG, 59*. Retrieved from https://advisory.kpmg.us/articles/2017/future-proof-procurement.html

von Haartman, R., & Bengtsson, L. (2015). The impact of global purchasing and supplier integration on product innovation. *International Journal of Operations and Production Management, 35*(9), 1295-1311. doi:10.1108/IJOPM-03-2015-0128

Wang, G., Gunasekaran, A., Ngai, E. W., & Papadopoulos, T. (2016). Big data analytics in logistics and supply chain management: Certain investigations for research and applications. *International Journal of Production Economics, 176*, 98-110.

Wang, G., Gunasekaran, A., Ngai, E. W. T., & Papadopoulos, T. (2016). Big data analytics in logistics and supply chain management: Certain investigations for research and applications. *International Journal of Production Economics, 176*, 98-110. doi:10.1016/j.ijpe.2016.03.014

Yildiz, H., Yoon, J., Talluri, S., & Ho, W. (2016). Reliable Supply Chain Network Design. *Decision Sciences, 47*(4), 661-698. doi:10.1111/deci.12160

Yin, R. K. (1994). Case study research: Design and methods, applied social research. *Methods series, 5*.

Yudhistyra, W. I., Risal, E. M., Raungratanaamporn, I. S., & Ratanavaraha, V. (2020). Exploring big data research: A review of published articles from 2010 to 2018 related to logistics and supply chains. *Operations and Supply Chain Management, 13*(2), 134-149. doi:10.31387/OSCM0410258

Zhou, K., Taigang, L., & Lifeng, Z. (2015, 15-17 Aug. 2015). *Industry 4.0: Towards future industrial opportunities and challenges.* Paper presented at the 2015 12th International Conference on Fuzzy Systems and Knowledge Discovery (FSKD).

APPENDIX

Appendix A – Interview Guide

Introduction

- Personal introduction
- Recording allowance
- Research introduction
    i. Development of Industry 4.0 and the effect on purchasing skills
    ii. New roles developed over time that a purchasing professional must comply with
- Interview introduction
    i. 7 main questions with 2-4 sub questions and possible follow up questions
- Procedure of interview (Ethical instructions)
    i. Open for questions at any time
    ii. Freedom to leave at any point
    iii. Open to refuse an answer (in any case of un comfortability)
    iv. In case you said something that should not be transcribed, please indicate this directly
- **Questions from interviewee**

Questions

1. May I ask you to briefly introduce yourself (position, responsibilities, work experience)

Literature: -

---

2. Can you give a short overall introduction in your purchasing department?
    a. Would you consider your purchasing department to be aligned with the overall company's long-term strategy and goals?
    b. Which products are purchased and are there special groups of products?
        i. How do you differentiate products based on their value?
    c. Talking about the supplier, how are these selected and potentially grouped?
        i. How do you differentiate the products based on their supply risks?

Literature: Often purchasing departments refer to category groups of purchased items, which are reflecting one sourcing market or one supplier to source these products from (Schiele, 2019, p. 55). The strategic connection between the purchasing department and the overall company is reflected by sharing the same long term goals (Smeltzer, Manship, & Rossetti, 2003, p. 16). Differences in grouping of products can be based on the value of the product and the supply risk, as identified by Kraljic (1983, p. 111)

Back-up:

- Category groups of products:

Distinguished by material: Metal parts; Electronic parts; plastic parts and other material parts

Distinguished by purchasing situation: Direct and indirect

-Differentiation criteria:

Product value: purchased volume, proportion of cost of materials to total purchase costs, impact on quality of finished goods, impact on business growth, value-added profile

Supply risk: Supply scarcity, pace of technological advance, number of suppliers, substitution possibilities, logistics cost or complexity, storage risk, competitive demand, make o buy opportunities, entry barriers…

- constitution of supply network

---

3. Regarding the ordering of products, which systems do you use to connect to the supplier?
    a. Are different systems used for different products/product groups or different supplier?
        i. if yes, can you name an example of a product group and why you chose the specific system?
        ii. If yes, what product or supply characteristics are you distinguishing regarding the choice of a different system and which system?
    b. If you are looking for new supplier, which systems do you use?

Literature: Many purchasing departments rely on internet-enabled systems (Daher et al., 2017, p. 5). These are closely tied to the third industrial revolution and the connected digitalization and automation of processes (Schiele

& Torn, 2020). eProcurement technologies refer technologies e.g. for the connection of suppliers with the ordering company by means of electronic data interchange (EDI) systems (Glas & Kleemann, 2016, p. 59).

Back-up:

- Systems and technologies:
  - EDI
  - E-sourcing
  - E-catalogues
  - E-procurement
  - E-auctions
  - E-invoicing

---

4. Which systems currently used will most likely be replaced by newer, more efficient systems?

a. Why do you update systems?

b. What kind of systems will you use?

c. If a supplier is initially implemented in current systems, how and at what point does this happen, and who is responsible for that in your department?

i. Are other departments involved?

Literature: The development towards the fourth industrial revolution requires less human interactions and a higher degree of fully autonomous systems, that connect the virtual world with digital systems (Schiele et al., 2021, p. 4). New purchasing specific systems emerge based on these technological advancements (Daher et al., 2017, p. 3). It is essential for PSM to continually update and be flexible with regard to changes in the business environment and near future requirements (like the introduction of industry 4.0)(L. C. Giunipero et al., 2005, p. 612; von der Gracht et al., 2016, p. 6)

Back-up:

- Future system (development)
  - Industry 4.0 technologies
  - Higher degree of autonomous systems
  - Purchasing specific systems: intelligence content extraction, predictive/advanced analytics, collaboration networks, or cyber tracking, smart contracts
  - Predictive procurement systems, smart contracts etc.

---

5. Do you see the need for a specific *Supplier Onboarding Manager* in the upcoming future?

a. What would best describe the job profile or role of an employee, who integrates suppliers within your company?

b. How will the level of human interaction develop within the supplier onboarding process?

Literature: Specific task and skill requirements are bundled in Roles or Job Profiles. Different roles can be identified based on the specific tasks and responsibilities that are pursued (Delke, 2021, p. 21; Mulder et al., 2005; Schiele, 2019). Different firm-specific purchasing characteristics, like product categories, have an influence on the definition of the role (Delke, Schiele, & Buchholz, 2021, p. 1).. In course with the digital technological development new job profiles are created (von der Gracht et al., 2016, p. 6)

Back-up:

-Definition Supplier Onboarding Manager:

"*The Supplier Onboarding Manager in purchasing is responsible for setting up the digital interface between the buying firm and suppliers, involving the harmonization of data and effective stakeholder communication*"

---

6. What specific skills are required for this role/ these role?

a. Are you actively searching for employees with these skills, or do you also train current employees?

b. Can I ask you to give a personal outlook, how you think these skill requirements will broadly change or develop in the upcoming years?

Roles consists of general skills that one need to possess and generic skills suiting the specific function within the purchasing department (Pekkanen, Niemi, Puolakka, Pirttilä, & Huiskonen, 2020). The development of knowledge and skills is crucial in order to sustain the competitive advantage(Larry Carl Giunipero & Handfield, 2004, p. 24; Stevens & Johnson, 2016, p. 26) and depends on developments and changes within the purchasing function and its environment (L. C. Giunipero & Pearcy, 2000, p. 4) . According to Bals et al. (2019) future purchaser need to master technical, interpersonal, internal/external enterprise, as well as strategic business skills in an upcoming Industry 4.0.

Back-up:

- (skills table EUROMA paper)

---

7. **What influence do the international locations of different suppliers have on the relationship and connection towards these suppliers?**
    a. **What do you think about the term "internet-enabled internationalization"?**
    b. **Are you using different systems for international supplier in comparison to local?**
    c. **Are there any skill groups (e.g., relational, technical) that are more important considering international supplier?**
    d. **What impact does the current trend of "reshoring" have?**

Literature: (Ashby, 2016, p. 77) pointed out that offshoring activities or the increasing physical distance towards supplier can decrease the quality of communication and increase the cultural differences in a supply network. This can partially be explained by a higher use of internet enabled technologies, that are used to communicate with supplier abroad, also called the "internet-enabled internationalisation" (Denicolai et al., 2021, p. 3). Reshoring or nearshoring offers potential for improved communication and closer relationships with supplier, indirectly lowering overall sourcing costs (Ashby, 2016, p. 78).

Back-up:

- Local: more heavily relying on relational aspects, trust, and human interaction (lower overall sourcing costs)

- international: more relying on electronic systems, less human interaction (decreasing quality of communication)

Closing

- summary of interview
- outline of follow up procedure (what happens next)
    - interview is transcribed and audio file will be deleted
    - results are cross analysed
- Room for questions and remarks from the interviewee

Appendix B - Description and Application of Systems

In order to fully comprehend the implications of technological development, a basic understanding of the functioning and application of procurement technologies and Industry 4.0 technologies is crucial. In the following section, eProcurement, Procurement 4.0, Big Data (and related technologies), Blockchain, Internet of Things, and Cyber Physical Systems are described. Worth mentioning that many technologies cannot be seen as single standalone systems but deeply connected networks of interrelating systems.

eProcurement

Starting with electronic procurement systems, these are defined as "the use of electronic technologies to streamline and enable the procurement activities of an organization" (OGO (1999), as cited in Hawking et al., 2004, p. 5). These activities can be internal but also external in connection to suppliers. This is enabled by Electronic Data Interchanges (EDI) (Glas & Kleemann, 2016, p. 59), which are the main connection points between two organizations and their systems. Throughout recent years, especially the internet sped up the use of eProcurement technologies (L. Giunipero et al., 2006, p. 824). Many different systems are connected to the topic of eProcurement, for example, simple email solutions, internet-enabled supporting systems or platforms (e.g., electronic auctions, electronic catalogues), the internet itself, or Enterprise Resource Planning systems (ERP). These can be classified into four categories, as suggested by (Hawking et al., 2004, p. 6), buy-side applications, sell-side applications, electronic marketplaces, and content applications. It is important to understand that by eProcurement, the actual system is meant, and by 'Procurement 4.0', the automation of procurement processes using technologies (Glas & Kleemann, 2016, p. 59). Procurement 4.0 is therefore characterized by the free flow of information that requires borderless companies with regard to their systems (Glas & Kleemann, 2016, pp. 59, 63).

Big Data, Cloud Computing and Artificial Intelligence

Big Data and Big Data analytics are remarkable technologies as an increasing amount of differing data are collected from multiple input sources like sensors or other software nearly all the time. Therefore, Nürk (2021, p. 163) defines

the management of Big Data as “processing huge amounts of data to get appropriate data for faster decision making to increase business performance”. New technologies facilitate this analysis of structured and unstructured data and make their patterns and insights accessible (Zhou et al., 2015, p. 2150). Examples of these systems are Artificial Intelligence and, more specifically, Machine Learning, capable of learning and developing algorithms to process these kinds of data (Robles-Velasco, Muñuzuri, Onieva, & Rodríguez-Palero, 2021, p. 46). Supported is the in-/ and output of Big Data systems by the internet-enabled and enterprise overarching transfer of data, also called Cloud Computing (Fatorachian & Kazemi, 2021, p. 71). Potentially the combination of Big Data and Artificial Intelligence can facilitate ‘smart contracts’ in the future (von der Gracht et al., 2016, p. 34). Nevertheless, as pointed out by Yudhistyra, Risal, Raungratanaamporn, and Ratanavaraha (2020, p. 145), the implementation of Big Data still lacks scientific research.

Blockchain

Talking about Blockchain technologies, most people think of Bitcoin, Ethereum and other cryptocurrencies. Thus, this often refers to the first generation of Blockchain technologies, or Blockchain 1.0 (Alladi, Chamola, Parizi, & Choo, 2019, p. 176935; Bodkhe et al., 2020, p. 79770). However, new generations emerged, which extended the functional usage and application of Blockchain systems towards Industry 4.0 applications and the digital society (Alladi et al., 2019, p. 176935; Bodkhe et al., 2020, p. 79770). Blockchain technology “provides an immutable, trusted and secure platform for multiple entities to exchange data/assets, collaborate and perform transactions [thus it is a] cryptographically linked and continuously growing list of immutable data records” (Alladi et al., 2019, p. 176935). A basic Blockchain network consists of the verification of inserted data and three reference networks (Bodkhe et al., 2020, pp. 79770, 79771). Transactions of information records happen in real-time throughout these networks (Aslam, Saleem, Khan, & Kim, 2021, p. 128). The carriers of the stored information are so-called ledgers. The gathering or recording of data is pursued by public ledgers, whereas the storage of these data is done in network-wide distributed ledgers (Alladi et al., 2019, p. 176935). One of the main features of Blockchains is closely connected to this network structure. As there is no single owner of the data and the change of data needs to be authorized by all members following predefined rules or a standard protocol, data are highly secure against manipulation of single members (Alladi et al., 2019, p. 176935; Bodkhe et al., 2020, p. 79770; Nürk, 2021, p. 164). Examples of data are such produced by CPS systems regarding status changes within the purchasing process throughout a supply chain (Nürk, 2021, p. 164). Nevertheless, as some data include sensitive data that are valuable to third parties, especially in highly competitive environments such as supply chains, data privacy is a major issue (Alladi et al., 2019, p. 176940).

IoT and Cyber Physical Systems

One of the most remarkable technologies connected to the fourth industrial revolution is the Internet of Things. According to (Fatorachian & Kazemi, 2021, pp. 69-70), "IoT […] defines a global environment where the Internet is the centre of connectivity for all the connected and intelligent devices, processes and systems", in addition to that building the basis for Cyber Physical Systems (Alladi et al., 2019, p. 176936) and smart systems. It supports the wireless and sensory connection between humans and the digital world (Alladi et al., 2019, p. 176936; Gottge et al., 2020, p. 3). This connection is based on using the internet (Bodkhe et al., 2020, p. 79784).

Closely connected to the Internet of Things are Cyber Physical Systems. Identified as the fourth Industrial Revolution's potential pacemaker technology, it is defined as "smart systems that combine communication and computing capabilities with physical and engineering systems" (Fatorachian & Kazemi, 2021, p. 69). Such systems consist of two main parts, first the advanced connection of the real world and the digital world, for example, through sensor technologies, and second, the analytical tools to process the gathered data in the digital environment (Lee, Bagheri, & Kao, 2015, p. 19). According to Monostori (2014, p. 10), CPS results from the parallel development of Computer Science and Information Communication Technologies. Main drivers are embedded connected systems, the use of the internet as a platform to do business on, as well as the semantic web, meaning the communities and the data or information within such (Geisberger & Broy, 2012, pp. 20, 21). Using the Internet of Things, CPS can also automatically communicate with other smart systems throughout the supply chain and gather its data in real time (Fatorachian & Kazemi, 2021, p. 70; Nürk, 2021, p. 163). Moreover, ‘sensomotoric skills' help CPS handle unforeseen events like supply chain disruptions (Nürk, 2021, p. 163). Summed up, CPS are supporting the use of Big Data and push machine-to-machine communication (Lee et al., 2015, p. 18). However, CPS are still in their early stages. Further development of inter-system cooperation, CPS integration, as well as thorough testing of them is needed.

Appendix C - Literature review overview

Keywords	Citations and titles	Detailed review	Used in thesis
Purchasing roles (263)	(Bildsten & Manley, 2015) A framework for understanding purchasing in building construction companies	X	X
	(Deszczyński, Fonfara, & Dymitrowski, 2017) The role of relationships in initiating the internationalization process In B2B markets	–	–
	(Gao, Driouchi, & Bennett, 2018) Ambiguity aversion in buyer-seller relationships: a contingent-claims and social network explanation	–	–
	(Gottge et al., 2020) Industry 4.0 technologies in the purchasing process	X	X
	(Jääskeläinen, Schiele, & Aarikka-Stenroos, 2020) Getting the best solution from supplier - a social capital perspective	X	–
	(L. Knight et al., 2020) Researching the future of purchasing and supply management: The purpose and potential of scenarios	X	X
	(Luzzini & Ronchi, 2016) Cinderella purchasing transformation: linking purchasing status to purchasing practices and business performance	X	–
	(Meehan, Touboulic, & Walker, 2016) Time to get real: The case of critical action research in purchasing and supply management	X	X
	(Sartor et al., 2015) International purchasing offices in china: roles and resources/capability requirements	X	X
	(Moretto et al., 2020) The dynamics of reshoring decisions and the role of purchasing	X	X
	(von Haartman & Bengtsson, 2015) The impact of global purchasing and supplier integration on product innovation	X	X
	(Petrick, 2007) Tipping the balance of power: The case of large-scale systems integrators and their supply chains	–	–
Future purchasing competencies (3)	(Bals et al., 2019) Purchasing and supply management (PSM) competencies: current and future requirements	X	X
psm or purchasing or procurement and skills or skill or capabilities or capability or competencies or competence (162)	(Schulze, Bals, & Johnsen, 2019) Individual competences for sustainable purchasing and supply management (SPSM): A literature and practice perspective	X	–
	(Louise Knight et al., 2014) Integrating skills profiling and purchasing portfolio management: An opportunity for building purchasing capability	X	X
	(Lorentz et al., 2018) Managing distance in international purchasing and supply: a systematic review of literature from the resource-based view perspective	X	X
	(Levenson, 2012) Talent management: challenges of building cross-functional capability in high-performance work systems environments	X	–
	(Mugurusi & Bals, 2017) A processual analysis of the purchasing and supply organization in transition: the impact of offshoring	X	X
	(Kauppi et al., 2013) Tools without skills: Exploring the moderating effect of absorptive capacity on the relationships between e-purchasing tools and category performance	X	X
	(van Weele & van Raaij, 2014) The future of purchasing and supply management research: about relevance and rigor	X	X
	(Bastholm & Munksgaard, 2020) Purchasing's tasks at the interface between internal and external networks	X	X
	(Fatorachian & Kazemi, 2021) Impact of Industry 4.0 on supply chain performance	X	X
	(Smart, 2005) exploring supply chain opportunities in the UK utilities sector and the supporting role of eMarketplaces	–	–
Supply network perspective (167)	(Storti, Paiva, & Vieira, 2018) Internationalization and relationships in supply chains	–	–

	(Chakkol, Finne, Raja, & Johnson, 2018) Social capital is not for sale: a supply network perspective on mergers and acquisition	–	–
	(Reinecke et al., 2018) Global supply chains and social relations at work: Brokering across boundaries	X	X
	(Choe, 2018) Electronic commerce, MCSs change, and the improvement of supply-chain performance	–	–
	(Harrington & Srai, 2017) Understanding stages if supply network emergence in technology commercialisation	not accessible	–
	(Park, Bellamy, & Basole, 2016) Visual analytics for supply network management: System design and evaluation	–	–
	(Ogulin, Selen, & Ashayeri, 2012) Determinants of informal coordination in networked supply chains	not accessible	–
Supply network management (549)	(Nürk, 2021) Smart information system capabilities of digital supply chain business models	X	X
	(Aslam et al., 2021) Factors influencing blockchain adoption in supply chain management practices: a study based on the oil industry	X	X
	(Robles-Velasco et al., 2021) Trends and applications of machine learning in water supply networks management	X	X
	(He, Xue, & Gu, 2020) Internet-of-things enabled supply chain planning and coordination with big data services: Certain theoretic implications	–	–
	(Yudhistyra et al., 2020) Exploring big data research: A review of published articles from 2010 to 2018 related to logistics and supply chains	X	X
	(Ashby, 2016) From global to local: reshoring for sustainability	X	X
	(Yildiz, Yoon, Talluri, & Ho, 2016) Reliable Supply chain network design	X	_
	(Stevens & Johnson, 2016) Integrating the supply chain … 25 years on	_	_
	(L. C. Giunipero, Hooker, Joseph-Matthews, Yoon, & Brudvig, 2008) A decade of SCM literature: past, present and future implications	X	_
Output has been limited to: (LIMIT-TO (OA , "all")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SUBJAREA , "BUSI")) AND (LIMIT-TO (LANGUAGE , "English"))			

Appendix D – Skills framework (retrieved from Bals et al., 2019, p. 7)

Competencies matching with Tassabehji and Moorhouse (2008) and additional competencies gathered in interviews.

Technical Skills	Interpersonal Skills	Internal/External Enterprise Skills	Strategic Business Skills
Matching competencies – competencies identified by Tassabehji and Moorhouse (2008) and found in the interviews			
Basic knowledge on PSM role & processes	Analytical skills	Change Management	Business Acumen
Computer Literacy	Conflict Resolution	Communication skills	Financial acumen
Contract Management	Creativity	Cross-functional abilities & knowledge	PSM Best Practice Intelligence Scouting
Cost savings	Decision making	Engineering	Risk management
eProcurement Technology	Effective questioning techniques	Finance	Strategic thinking
Intellectual Property	Integrity	Logistics	
KPI Reporting Design	Interpersonal Communication	Manufacturing/Production	
Languages	Knowledge sharing	Marketing	
Negotiation	Leadership	Quality (QHSE)	
Process optimization	Learning agility	R&D	
Product knowledge	Prioritization	Supply Chain	
Project Management	Remote Virtual Working	Sales	
Quality assurance	Results focus driving for results	Cultural awareness	
Strategic sourcing	Structured way of working	Customer Focus	
Tools and Systems Implementation	Teamwork-working in teams	Networking	
		Stakeholder Relationship Management	
		Supplier management	
Additional competencies – competencies NOT identified by Tassabehji and Moorhouse (2008) and found in the interviews			
Automation	Curiosity		Critical thinking
Big Data Analytics	Deal with ambiguity		Holistic Supply Chain Thinking
Innovation sourcing	Humility		Sustainability
Innovative sourcing approaches	Mobility		
	Openness, Open-minded		
	Passion		
	Resilience		
	Self-confidence		
	Self-reflection		
	Self-reliance		

Appendix E – Overview of Interviews

Interviewee	Duration in min	Platform	Company
INT A	54	MS Teams	1
INT B	45	MS Teams	2
INT C	45	MS Teams	2
INT D	29	MS Teams	3
INT E	56	Ciscio Webex	4
INT F	44	MS Teams	5
INT G	47	Skype Business	6
INT H	53	Zoom	7
total	46.6		

Appendix F – Overview of mentioned skills

	INT A	INT B	INT C	INT D	INT E	INT F	INT G	INT H
skills	Communication skills	Communication skills	Communication skills	-	Communication skills	Communication skills	Communication skills	Communication skills
	Computer Literacy	Negotiation	Strategic Thinking	-	Product Knowledge	Computer Literacy (Data Governance*, Interface knowledge*)	Computer Literacy	Computer Literacy
	Cross-functional Abilities & Knowledge	Assertiveness*	Product Knowledge	-	Basic Knowledge on PSM Role & Processes	Cross-functional Abilities & Knowledge	Project Management	Strategic Thinking
	Openness, open minded (life-long-learning*)	Professional Appearance*	Structured Way of Working	-	Critical Thinking (Auditor Qualifications*)	Holistic Supply Chain Thinking	Improvising*	Product Knowledge
	Empathy*	Computer Literacy	Networking	-	Networking	Tools Systems and Implementatin	Enthusiasm*	Cross-functional Abilities & Knowledge
		Product Knowledge		-	Strategic Thinking			Networking
				-	Computer Literacy			Basic Knowledge on PSM Role & Processes
Additional skills (internationality)	Languages (english)	Languages (english)	Languages (english)		Languages (english)	Language	Language (english)	Language (english + local)
	Cultural Awareness		Cultural Awareness		Cultural Awareness	Cutlrual Awareness		Cultural Awareness
	Understanding of Foreign Market Dynamics*		Openness					Global Thinking

(Based on the classification of Bals et al., 2019 p. 7; * = not included in Bals)

Appendix G – Summary of interview transcripts

Overall Product Portfolio Structure	
INT A	direct indirect; direct divided into commodities; 2 level commodity matrix; 10 commodities with further differentiation on second level
INT B	direct indirect; indirect: construction, services and investments: site interior, maintenance
INT C	Purchasing controlling (2 people analysing prices and other monetary developments); Direct/serial purchasing: Commodity division e.g., Electronics, Hydraulic, melting parts; purely strategic purchasers; operative part (disposition (own department)) --> responsible for ordering
INT D	direct/indirect; commodities within both segments
INT E	Organizational purchasing and central purchasing --> central purchasing divided into direct and indirect; subparts of direct e.g., electronics, mechanical raw material (further into plastics and metals); subparts in indirect e.g., services, risk management; plus a single "innovation team" responsible for innovation tracking, supplier development (connected to central purchasing)
INT F	Production material (P Suppliers); System and Service providers (A Suppliers); further commodity separation within both categories
INT G	Production materials (direct) and non-production materials (indirect); Profit-teams within both groups (=strategic teams for the overall orientation of commodities within the group); differentiating characteristics: complexity and volume
INT H	direct/indirect division; direct: Project purchasing, strategic purchasing, supplier development (+incoming quality control); Commodities: 5 main commodities
Supplier Related Portfolio	
INT A	based on risk analysis; dependent on size of commodity or part to source from one or multiple suppliers; usually multiple suppliers within a commodity group reasons: risk, negotiation; no single sourcing in risk countries; risk management not only by dual sourcing, but also by safety stocks; not the case for nearby suppliers that are easily exchangeable
INT B	some suppliers are used for multiple commodities; for projects often a supplier portfolio is used, often standard suppliers; for important parts multiple sourcing (dual sourcing most often), but preferably single sourcing for after-care reasons
INT C	dual sourcing for higher sourcing volume; single sourcing for better traceability
INT D	differentiation based on: product volume, traceability of parts (especially electronics); two-supplier strategy to have a better negotiation basis

INT E	single sourcing (90%), because of high investment that the company need to pay (tools that are needed); otherwise, many advantages --> supply security, negotiation leaver
INT F	-
INT G	-
INT H	-
Current System Usage	
INT A	operative ordering: Email, ERP (ERP is completely cyclical in P2P processes), catalogue buying, eAuctions, digital freight publication, Kanban systems; Connection to supplier by EDI (dependent on volume); EDI is not needed for catalogue and eAuctions; systems also need to suit the company as a whole
INT B	ERP; eMarketplace; eCatalogs; CPS "Paternoster" system --> automatic recognition of low stock and direct replenishment bookings, not possible for all parts;
INT C	ERP (Dispo-cockpit) (EDI; Email; Fax), "delivery-scheduling procedure" which automatically sends a plan to the supplier so he can plan the supply accordingly (predefined within contracts) (Email or EDI); electronic marketplace; no automatic ordering
INT D	internal, self-developed Systems; different communicating systems; robot solutions; Big Data; ERP system
INT E	ERP system (EDI connection); Email; server for supplier information; CPS for some tasks (e.g., checking incoming letters for any additions)
INT F	Own developments (exceptions for some programs); electronic Catalogs; electronic auction systems; web-application; online ordering systems; systems are building upon each other; Big Data as an underlying construct; In connection to supplier EDI
INT G	automated electronic catalogues; ERP system; Big Data
INT H	ERP; web-based solutions; Server based exchange of Big Data; different Database tools; Big Data
Differentiation of Product Groups and Systems	
INT A	-
INT B	eMarketplace (smaller/standard parts; strategically unimportant); Internet, closer also personal interaction with suppliers (bigger investments; strategically important); eCatalogs (everyday parts, ordered directly by the worker); CPS (Mass products/standardized and low monetary value)
INT C	Mostly ERP; For small parts (eMarketplace)
INT D	-
INT E	For all the same
INT F	eCatalogs for indirect products (small supplies); web-applications for production parts
INT G	frequent products EDI; non-frequent more complex more direct contact; Big Data (forecast of complex parts); automated electronic catalogs (non-production materials)
INT H	Only exceptional, mostly ERP
Search for New Suppliers	
INT A	Supplier form on website (checked by HoP); low success rate like "gold hunting"; social media (Xing; LinkedIn); own analysis (product-market analysis ->longlisting-> shortlisting->approaching (dependent also on commercial aspects)); Internet (IHK)
INT B	Internet search; eMarketplace
INT C	Internet search: industry fairs (products are sometimes too specific to use an algorithm for it (--> need for humans to interact))
INT D	connected to XXX systems (internal platform); Supply scouting (especially start ups)-> Google market research, international fairs
INT E	Internet; tool for supplier requests (clear cost breakdown scheme); Big Data tool with tax number tracking; internal suggestions from operations or R&D
INT F	-
INT G	-
INT H	-
Reason for Exchange of Systems	
INT A	ERP system enables a high degree of automation when used to full potential --> fewer operative tasks; reduction of operative/human input, while maximizing the output
INT B	Efficiency (line workers just need to order and everything is pre-filled)

INT C	-
INT D	reduction of operative tasks in order to focus on strategic tasks
INT E	-
INT F	Reduction of breaks within the information flow during the onboarding process ("Media-breaks"); reduction of operative tasks; offering independent connection points; illuminating the human source of errors; achieving an equal interface within all functions of the company; same language and data for all functions --> increasing centrality of information; getting full view on supplier (from all functions) --> increasing the integration of functions
INT G	Supply security / risk management
INT H	increasing interactivity (also in connection to suppliers); increasing automation
Future System Usage	
INT A	Big Data (cloud) + AI (for supplier search) (assistance in long and shortlisting) --> test in two commodities; classical platforms in connection to catalogs (currently very product specific, there are not all-inclusive platforms) --> standardized products (mostly used for high volume products), but also for specific drawings (specified products) -->no need for ERP connection; purchasing through platforms in addition to ERP system (for indirect items)
INT B	Big Data (big summary of catalogs of different companies; automatic updates; cloud solution); CPS usage will drastically increase
INT C	Procurement will remain working with SAP; development of a supplier portal
INT D	smarter systems (self-communicating); delivery of data input and the actualization --> task for the supplier; fully automated onboarding process
INT E	Big Data; AI; high potential in automation, although a complete automation seems to be impossible
INT F	One industry-wide network with an underlying Big Data Cloud Computing Network (same language for all); Machine learning (AI) for the development of bidding lists
INT G	Big data
INT H	ERP; Big Data in connection to AI; Cloud solutions;
Strategic Orientation of PSM	
INT A	heavily operative but with strategic aspirations; need for strategically thinking employees rises
INT B	negotiation of products (yearly for the automatic supply systems), supplier integration --> more strategic activities; clear connection and alignment to overall organizational goals (strategic orientation); increasing efforts to centralize
INT C	clear strategic role of purchasing
INT D	clear strategic role of purchasing, clear connection to company's long-term goals; clear separation from material flow in logistics and the purchasing department with strategic task focus
INT E	clear strategic orientation, very high alignment of goals, head of purchasing = CEO
INT F	highly strategic role within the company (board representation)
INT G	important strategic part of the company; presented for all bigger topics
INT H	Clear strategic connection
Cross Functional Integration Process	
INT A	department for quality assurance; Finance department ("four eye principle" --> sensible account data); connection through EDI and technical integration --> IT department; Purchasing department (complete) --> observing and managing role during integration process and responsible for testing the connection to the supplier, also communicative role during integration process
INT B	onboarding files need to be filled by supplier; site visits (including social and environmental standards); Integration to ERP through Accounting department (no OCI just the data); if OCI connection then this is IT's responsibility
INT C	Disposition; Quality assurance; engineering department; quality and environmental agreements; Accounting (setting up a creditor for a new supplier); IT department (EDI connection)
INT D	Not important that the supplier is connected to the ERP system, but that the supplier is enlisted in the Database; before implementation, first audit visits (product, process audits); after audits, and after the development phase --> integration or onboarding in ERP system (connection points with financing, accounting, logistics etc are established)
INT E	during the supplier building, after supplier scouting, supplier audits (quality (certificates), sustainability, general appearance, process and product audits, risk analysis/stability (monetary)) and "decision-meeting"; IT responsible for technical onboarding; no involvement of purchasing department during technical onboarding, also not in the future
INT F	old: one onboarding for each function; new onboarding team = cross functional (one function that cares for all connections and an equal technical interface for all functions)

INT G	Responsible for the process is the purchaser; assistance for building of connections through IT; the more complex and legal issue or security related the product, the more departments are involved (increasing cross functionality of role (Quality control, engineering...); onboarding stays the same process for the technical connection
INT H	strategic purchaser responsible for sourcing; interdisciplinary team: Quality department, Purchasing, Logistics, R&D,
Need for the Supplier Onboarding Manager	
INT A	need for people that seeing the Supplier Integration as a key task
INT B	Already existing (still in IT department, but is responsible for Purchasing department)
INT C	No need, also no intention in this direction
INT D	No need, supplier integration should be automated
INT E	there is a need, but without the focus on the technical onboarding, but all the other processes around; dependent on the size of the company; already there but labelled as supplier developer
INT F	Supplier Integration Team already existing (thus more passive role) ("they are not acting, they are reacting"); Also seen, that supplier built up such functions/roles; administrative role for technical onboarding; focused on IT process related tasks (data governance function)
INT G	there is already such a role, but not for a single person but a group that share main responsibilities a SOM would have
INT H	central role for managing the supplier interfaces; no need for a one-on-one role for each supplier (Supplier Owner --> strategic purchaser)
Development of Human Interaction for Initial Supplier Integration	
INT A	operative human interaction decreases
INT B	operative task can all be done through OCI connections, but for the initial integration human interaction is needed (first evaluation)
INT C	wishful to use standards in the process; based on experience the level of human interaction will remain; but the human interaction will change itself (more technical); --> basis of any business relationship (the human interaction); products are sometimes too specific to use an algorithm for it (need for humans to interact)
INT D	Tendency towards no human interaction within the onboarding process
INT E	a lot of human interaction; next to technical aspects, still high degree of human interaction, especially during supplier building
INT F	-
INT G	already very technical; not getting more or less technically or human cantered, will remain on this level (tendency: unpersonal, digital and automatic)
INT H	efforts to shift the responsibility for Data input in onboarding process towards the supplier (automation); human interaction will remain for important relationships, but what can be automated should be automated
Skill Requirements	
INT A	communication; higher IT knowledge; Life-long learning; willingness to change; solution-oriented thinking
INT B	high degree of communicative skills; professional appearance; negotiation skills; assertiveness; technical understanding (related to the product that is purchased); IT skills for implementation is needed, but communication and assertiveness is more important;
INT C	communicative; strategic thinking; technical knowledge about the products; structured working; networking skills
INT D	-
INT E	technical industry/product knowledge; auditor/process qualities/knowledge; networking; strategic skills; flexibility; communication
INT F	data governance; Computer literacy about those connection points; holistic supply chain knowledge; broad view/ cross functional thinking and cross organizational view; communication; basic process knowledge; Computer literacy about those connection points;
INT G	project management; improvising; System and software affinity; communication skills; enthusiasm
INT H	knowledge about the process (IT); strategic point of view; Networking; technical understanding (product); Communication; cross-functional working; basic process knowledge
Flexibility skills	
INT A	strong development towards cross functional working off purchasing professionals (regarding the onboarding of suppliers); the more complex the process gets; the more other functions are involved
INT B	also in future, high for the ability to work with other functions
INT C	need to know who to approach in case of any problems

INT D	-
INT E	high importance of cross functional working
INT F	-
INT G	-
INT H	-
Development of Skill Requirements	
INT A	more cross functional
INT B	communication and negotiation skills will remain important, no heavy development in directions of IT knowledge
INT C	communication will remain and increase in importance; English skills will increase in importance; not more technical, it will remain a general role, without high product specificity (general role, not specific) until a specific company size, so that specialization is needed;
INT D	-
INT E	to some extent more technical; communication will remain on high level; cross functional working increases in importance
INT F	Data governance will increase
INT G	if they developed, more IT related aspects
INT H	technological perspective; future oriented thinking
"Internet-enabled internationalization"	
INT A	-
INT B	not the case for indirect purchasing; mostly stay within arm-length supplier contact in local regions; for serial production: yes, that is the case --> internet increased competition on a global scale
INT C	not the only reason, globalization would have happened without, but the severance of international business wouldn't be so high
INT D	definitely yes
INT E	internet was essentially involved in internationalization
INT F	-
INT G	not completely, offshoring also existed during times without internet; but impact is not negligible
INT H	still the human behind the whole process, internet more as a facilitator
International Skill Variety	
INT A	importance of understanding of market dynamics in foreign countries; cross cultural management; language skills (English)
INT B	language skills are crucial (English); Process remains the same
INT C	English language skills; cultural knowledge/understanding (openness against new things (language, culture))
INT D	process is the same; only difference, an audit in the home country is faster
INT E	no impact on process itself; but cultural skills are very important, next to language
INT F	Language skills; cross-cultural knowledge (focus on cultural behaviour and values like data security)
INT G	Language skills (English)
INT H	Global thinking; cultural aspects; language skills (English, but also more local basics); traveling
Reshoring Activities	
INT A	reasoned by the wrong thinking years ago, searching only the cheapest but not best supplier; re-answering this question, also because of covid and other country specific factors (turkey); it will remain that some product clusters are the best worldwide; high product specifity; supply risk is one factor; increasing transportation costs
INT B	never offshored in indirect procurement; individualized products are easier to source from local suppliers
INT C	not applicable/no impact at the moment
INT D	not much offshoring in the past; focus on local supply (keeping core competencies); onshoring for software products (inhouse development or nearby sourcing); onshoring/reshoring a topic for modern software solutions, than in classic technologies; onshoring more a topic of make or buy and is regarding the development of parts (IP work is inhouse or nearby)
INT E	Development of software got reshored; scouting is on a more local level
INT F	-

INT G	there are initiatives regarding the reshoring (B-Supplier); but focus will stay on the best and cheapest supplier, securing the highest product quality
INT H	focus still on cost, over the long term still a lot of offshoring
International System Variety	
INT A	-
INT B	no system variety (nearly no international sourcing)
INT C	no impact found
INT D	no influence at all, same process and system worldwide
INT E	no influence, same process and systems
INT F	-
INT G	There are exceptions, but mainly same systems
INT H	-