The System Innovation Scout and the Supplier Onboarding Manager: implementing digital systems in purchasing

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ABSTRACT,
The transition towards Industry 4.0 is affecting the purchasing function. Although little research is yet done about how Industry 4.0 will change purchasing, it is wise to prepare future purchasing professionals with future purchasing skills. Delke, Schiele, and Buchholz (2021a, pp. 7-10) have defined seven future purchasing roles and Delke, Schiele, Buchholz, and Stek (2021b, pp. 7-10) have defined future purchasing competencies. This research aims to investigate what competencies the System Innovation Scout and the Supplier Onboarding Manager need to successfully contribute to their purpose, namely implementing digital systems in purchasing. A literature review was performed in order to grasp the context and significance of Industry 4.0 and both the future purchasing roles and competencies. Subsequently, interviews with purchasing professionals were held in order to identify which competencies are perceived as necessary for both roles. The results revealed that for the System Innovation Scout, the necessary competencies are Digital Leadership skills, Strategic Management skills, E-Procurement Technology skills, and Robotic Process Automation skills. For the Supplier Onboarding Manager, the most important skills are Digital Leadership skills and Digital Partnership Management skills. These suggested lists of competencies need to be allocated to the respective roles. Educating and training these competencies will result in higher specialization levels.

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1. INTRODUCTION

The function of purchasing in companies is growing in importance (Baily, Farmer, Crocker, Jessop, & Jones, 2008, p. 12; Schiele, 2019, p. 46). Where this function was earlier seen as just a helpful tool for cost reduction, it has now become an integrated and strategic function within the firm (Andersen & Rask, 2003, pp. 91-92; Schütz, Kässer, Blome, & Foerstl, 2020, p. 1). According to Schiele (2019, p. 48), gaining competitive advantage is an objective of purchasing. One way to gain competitive advantage is by guaranteeing privileged access to sources of supply. Taghipour, Hoang, and Cao (2020, p. 43) state that a manufacturing firm's survival is dependent on its ability to produce a high-quality product at a price as low as possible and on time. This is what a well-functioning purchasing department does. In theory, supplying the company with qualitative but cheaper materials is the means to producing end-products quicker, with better quality, and at a better price.

Trends such as the fourth industrial revolution affect the purchasing function. This revolution is relatively new and still going on. Therefore, it is currently getting a lot of attention. Scientists are also getting involved as publications about the so-called Industry 4.0 are increasing exponentially (Schiele & Torn, 2020, p. 507). As of March 2021, close to 18.000 documents regarding Industry 4.0 can be found on Scopus. For Google Scholar, close to 3.5 million articles can be found. The origins of Industry 4.0 lie in manufacturing and it is "characterized by cyber-physical systems with autonomous machine-to-machine (M2M) communication" (Schiele & Torn, 2020, p. 512). A reason for the "hype" is that Industry 4.0 holds high expectations in manufacturing such as increased flexibility, mass customization, better quality, and improved productivity (Zhong, Xu, Klotz, & Newman, 2017, p. 616).

Although the origins of Industry 4.0 lie in manufacturing, its impact will be significant across the whole supply chain (Tjahjono, Esplugues, Ares, & Pelaez, 2017, p. 1176). However, little research is yet done about how Industry 4.0 will affect purchasing (Schiele & Torn, 2020, p. 508). Little is yet known about what changes Industry 4.0 will cause. However, Zheng, Knight, Harland, Humby, and James (2007, pp. 77-78) state that purchasing, in general, can adapt to changes through preparing future purchasing professionals in terms of knowledge, skills, and competencies. Recently, research was published by Delke et al. (2021b, p. 1); and Delke et al. (2021a, p. 1) about the difference in the roles and competencies required in Industry 4.0 purchasing compared with the current roles and competencies in purchasing. Both of the research is also mentioned in Persist (2021, p. 9). The seven future roles in purchasing that were identified are Process Automation Manager, Data Analyst, Supplier Onboarding Manager, Master Data Manager, System Innovation Scout, and Legislation Specialist (Delke et al., 2021a, p. 7).

Next to new roles, also new systems need to be implemented in the transition towards Industry 4.0 (Schiele & Torn, 2020, p. 507). Schiele and Torn (2020, p. 507) mention examples of new systems such as contract analysis software. Deloitte (2017, p. 5) gives examples of maturing Industry 4.0 technologies such as Blockchain and Virtual Reality. The role responsible for identifying and implementing these new Industry 4.0 technologies or systems within purchasing is the System Innovation Scout (Delke et al., 2021a, p. 9; Persist, 2021, p. 24). As purchasing is about buying goods from suppliers, their perspective also needs to be included. And because the suppliers will also be affected by the introduction of new systems within purchasing, the person accountable for dealing with the new digitalized buyer-supplier relationship is also becoming of crucial importance. This means that, next to the System Innovation Scout, the role of Supplier Onboarding Manager also needs to be included. This is the role responsible for setting up the digital interface between the buying firm and suppliers (Delke et al., 2021a, p. 8; Persist, 2021, p. 24).

This research will contribute to both theory and practice by linking the roles that support the purchasing organization in utilizing these systems whilst considering external supplier requirements, the System Innovation Scout and the Supplier Onboarding Manager, to the competencies required by these roles to contribute effectively to the implementation of digital systems in purchasing.

This research aims to investigate what competencies the System Innovation Scout and the Supplier Onboarding Manager need to successfully contribute to implementing digital systems in purchasing whilst considering external requirements, as well as investigating in what way the System Innovation Scout and the supplier onboarding can be effective contributors to the implementation of digital systems in the purchasing domain. The differences in current and future purchasing roles are important factors to consider for organizational management. This is because purchasing has become a central success factor for modern (Schiele, 2019, p. 45) and most likely future firms. Also, because new technologies will affect the interface between buyer and supplier, it can be stated that this interface, and the people managing this interface, are becoming of strategic importance. Furthermore, to better understand the context of Industry 4.0, research will be done about what implications of Industry 4.0 organizations experience and what digital systems they use.

This leads to the research question:

What competencies do the System Innovation Scout and the Supplier Onboarding Manager need to effectively contribute to the implementation of digital systems?

This question is made up of three sub-questions:

1) *What implications, caused by Industry 4.0, do organizations experience in practice?*
2) *What digital systems are implemented in (future) purchasing?*
3) *In what way are the System Innovation Scout and the Supplier Onboarding Manager contributing to the implementation of purchasing systems?*

The research question is answered by ordering the competencies, mentioned by the interviewees that participated in this research, based on frequency. This was done for both roles. For the System Innovation Scout, the necessary competencies are Digital Leadership skills, Strategic Management skills, E-Procurement Technology skills, and Robotic Process Automation (RPA) skills. For the Supplier Onboarding Manager, the most important skills are Digital Leadership skills and Digital Partnership Management skills.

2. THEORETICAL FRAMEWORK

2.1 Industry 4.0

2.1.1 Various definitions

Literature about Industry 4.0 is relatively young. Therefore there are still lots of unclarities which makes that there is no accepted definition of this paradigm shift yet. The term Industry 4.0 is developed by the German Federal Government and was used to promote its high-tech strategy (Oesterreich & Teuteberg, 2016, p. 122). The term includes a number of different concepts from different disciplines without making a clear distinction (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014, p. 240). Definitions vary from being more abstract such as "a novel manufacturing

paradigm ensuring flexibility and adaptability of production systems and value chains in order to maintain the future global competitiveness of manufacturing enterprises" (Kiel, Arnold, Collisi, & Voigt, 2016, p. 673), and "the organization of production processes based on technology and devices autonomously communicating with each other along the value chain" (Smit, Kreutzer, Moeller, & Carlberg, 2016, pp. 20-21) to being more detailed: "the term Industry 4.0 […] refers to the 'fourth industrial revolution or the introduction of internet technology in the manufacturing industry […] and integrates customers more closely into the product definition stage as well as business partners into the value and logistic chains" (Stork, 2015, p. 21). For the purpose of this research, one of the most recent definitions will be used. Schiele and Torn (2020, p. 512) define Industry 4.0 as: "Industry 4.0 is characterized by cyber-physical systems with autonomous machine-to-machine (M2M) communication." Kagermann, Wahlster, and Helbig (2013, pp. 31-32) state that different key features are required for the successful implementation of Industry 4.0: horizontal integration within value networks; end-to-end digital integration of engineering within the whole supply chain; and vertical integration and networked manufacturing systems.

2.1.2 Comparison with Industry 3.0

Industry 3.0 is based on the development and usage of information technology in the manufacturing industry. The usage of this information technology is able to accelerate the automation of production (Zhou, Liu, & Zhou, 2016, p. 2147). However, in Industry 3.0, the focus is especially on the human-machine interface (Schiele & Torn, 2020, p. 513). Machines and computers are not ready to solve problems by themselves which means that computers and digitalization are highly dependent on human input. Consequently, the main improvements of Industry 4.0 relative to Industry 3.0 can be described as the shift from focusing on the automation of single machines and processes to end-to-end digitization that encompasses the digitalization of all physical assets (Geissbauer, Vedso, & Schrauf, 2016, p. 6). Concluding, the human-machine interface, digitalization, and automation within Industry 3.0 are replaced by Cyber-Physical Systems (CPSs), autonomous self-optimizing systems within the entire supply chain, and M2M communication (Schiele & Torn, 2020, pp. 512-513). This transformation is illustrated in Figure 1. The three improvements will now be explained.

CPSs are the first improvement by Industry 4.0. CPSs are defined as "transformative technologies for managing interconnected systems between its physical assets and computational capabilities" (J. Lee, Bagheri, & Kao, 2015, p. 21). E. A. Lee (2008, p. 4) states that the radical change of CPS is on networking various devices. This is in contrast to traditional embedded systems, which are normally designed as stand-alone devices (Jazdi, 2014, p. 1). The main new feature of CPSs is that it intensively connects collaborating computational entities with the surrounding physical world and its ongoing processes (Monostori, 2014, p. 1). Sztipanovits and Ying (2013, pp. 31-32) state that "the potential of CPS to change every aspect of life is enormous. Concepts such as autonomous cars, robotic surgery, intelligent buildings, smart electric grid, smart manufacturing, and implanted medical devices are just some of the practical examples that have already emerged." Schiele and Torn (2020, p. 513) provide a purchasing-related example: "A purchasing example would be an electronic catalog, which is a digital device requiring a human purchaser to enter the desired products. In a CPS, on the other hand, the demand is detected by sensors, which observe that a specific material needs to be ordered, without the need for direct human intervention." Ultimately, with the help of CPS, supply chains will be fully integrated and automated (Hwang, 2016, p. 12).

Autonomy is the second improvement of Industry 4.0. Schiele and Torn (2020, p. 513) state that a system is autonomous when it can decide for itself. They state that an autonomous system does not require human intervention to function and makes its decisions based on predefined algorithms, expert systems, or artificial intelligence (AI). Allal-Chérif, Simón-Moya, and Ballester (2021, pp. 70-71) summarize the current and future implications of AI in the purchasing function: automation and optimization of purchasing processes; supplier selection using matching systems; predictive buying and decision aids; supplier relationship management; and collaborative project management and open innovation.

M2M communication is the last mentioned improvement of Industry 4.0. M2M communication is defined by Etsi (2010, p. 6) as "M2M communications is the communication between two or more entities that do not necessarily need any direct human intervention". Etsi (2010, p. 6) states that M2M services are intended to automate processes and decision-making. It is therefore an important factor in the transformation towards autonomy. A purchasing related example of M2M communication is provided by Schiele and Torn (2020, p. 513): "For purchasing, machine-to-machine communication can mean, for example, that the computer of the buying firm negotiates prices with the computer of the supplier without a direct intervention from a human procurement agent."

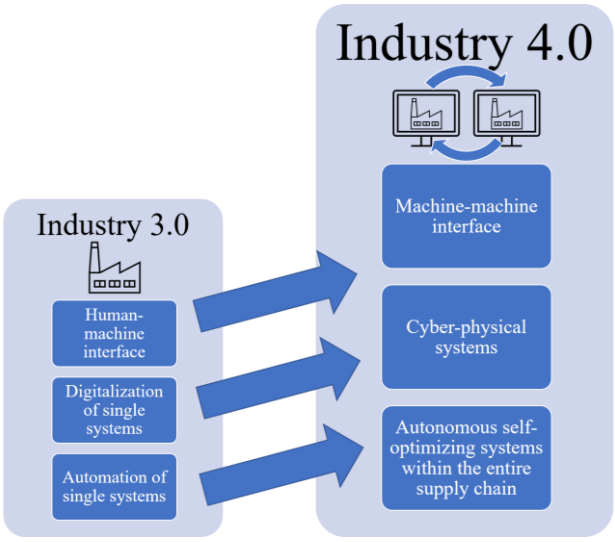

Figure 1. The transformation of Industry 3.0 to Industry 4.0, based on Ströhnisch (2019, p. 16) and Schiele and Torn (2020, pp. 512-513).

2.1.3 Practical implications of Industry 4.0

A limited amount of research is yet done about how Industry 4.0 will affect organizations in practice. The main implications seem to be collaboration platforms and the strategic purchaser role (Gottge, Menzel, & Forslund, 2020, p. 8). Collaboration platforms seem to include integrated interfaces through the whole supply chain that uses real-time, high-quality data. The strategic purchaser role is enabled by Industry 4.0 as digitalization eases the operative tasks.

Another research, by Cimini, Pezzotta, Pinto, and Cavalieri (2018, pp. 6-9), states that Industry 4.0 has different impacts on different areas of the manufacturing industry. They state that these impacts are: productivity and efficiency; revenue growth; employment; sustainability and energy efficiency; quality management; supply chain management; and engineering.

2.2 Industry 4.0 systems in purchasing

Oztemel and Gursev (2020, p. 10) have done a comprehensive content analysis of technologies within Industry 4.0 based on 620 publications. They declare the core concepts of Industry 4.0 to be: CPS; Cloud systems; M2M communication; Smart factories; Big Data; Internet of things; simulation tools; artificial intelligence; and the processing of real-life data. These concepts seem to overlap with the previously mentioned concepts of Schiele and Torn (2020, pp. 512-513). However, the research of Oztemel and Gursev (2020) looks solely at Industry 4.0 in relation to manufacturing while Schiele and Torn (2020) try to connect Industry 4.0 to purchasing.

Tjahjono et al. (2017, p. 1176) state that, although the origins of Industry 4.0 lie, in fact, in manufacturing, its impact will be felt across the whole supply chain. This claim is supported by Deloitte (2017, p. 2), who states that procurement is already fundamentally altered by Industry 4.0 in the way that strategic sourcing is becoming more predictive and supplier relationship management is becoming more proactive while transactional procurement, also called purchasing, is becoming more automated. Lasi et al. (2014, p. 240) state that new systems are the fundamental concepts in Industry 4.0. These are, among others, new cyber-physical systems, new systems in distribution and procurement, and new systems in the development of products and services (Lasi et al., 2014, p. 240). They thus see purchasing as one part of the whole concept.

Schiele and Torn (2020, pp. 512-513) try to link the entire concept of Industry 4.0 to purchasing. They state that Industry 4.0 is characterized by CPSs, autonomy, and M2M communication. They also give multiple examples of Industry 4.0 systems that are now implemented in purchasing such as analysis software and the possibility of negotiating digitally (Schiele & Torn, 2020, p. 507). Deloitte (2017, p. 5), distinguishes three groups of concrete technologies based on the degree to which the capabilities are currently being utilized in procurement: core; maturing; and emerging technologies. Because, instead of technological concepts, Deloitte (2017, p. 5) discusses concrete technologies used in purchasing, these three groups will be discussed in the following paragraphs.

2.2.1 Core technologies

Deloitte (2017, p. 4) describes core technologies as the procurement centerpieces for many organizations that will also be relevant for many organizations in the future. Deloitte (2017, p. 5) mentions the following core technologies: (1) Spend Analytics provides procurement with insights into a firm's entire set of purchases (Monczka, Handfield, Giunipero, & Patterson, 2016, p. 201); (2) eSourcing is described as "the process of identifying new suppliers for a specific category of purchasing requirements using Internet technology" (De Boer, Harink, & Heijboer, 2002, p. 26); (3) Electronic Catalogs are low-dollar purchase systems that enable online ordering and can also be used to identify suppliers. (Monczka et al., 2016, p. 81); (4) Contract Management is "a process associated with defining the contract, defining roles and responsibilities of both parties, and advising when to modify and ensure appropriate escalation" (Monczka et al., 2016, p. 48); (5) Supplier Information Management provides management and governance over the massive volume of supplier data coming from different sources (Flynn, 2017); (6) eProcurement includes "the panel of functionalities and electronic tools adaptable to automate the supply process, which includes the transactional activities after the contract subscription, starting from order placement and including the whole order-to-pay cycle" (Caniato, Longoni, & Moretto, 2012, pp. 935-936); (7) eInvoicing includes the utilization of electronic means for the sending and receiving of invoices (Sandberg, Wahlberg, & Pan, 2009, p. 289); (8) eAuctions are an electronic competitive bidding tool where potential qualified suppliers go online and bid against each other to get the business (Monczka et al., 2016, p. 65).

2.2.2 Maturing technologies

Deloitte (2017, p. 4) states that maturing technologies are technologies that are not yet implemented by all Chief Procurement Officers but that are expected to soon become the minimum requirements for competitive advantage. Deloitte (2017, p. 5) describes and mentions the following maturing technologies: (1) Cognitive Computing and Artificial Intelligence provide new insights and opportunities by using leverages pattern recognition software and iterative machine learning algorithms that can quickly categorize unstructured spending, cost, contract, and supplier data; (2) Intelligent Content Extraction uses Optical Character Recognition (OCR) and learning algorithms to read unstructured documents and quickly extracts critical pieces of data that would have taken days or weeks to assemble manually; (3) Predictive and Advanced Analytics enables proactive decision-making by predicting the most likely scenarios based on combining modeling, statistics, machine learning, and artificial intelligence with multiple third-party data sources; (4) Visualization simplifies decision-making by transforming data into user-friendly formats; (5) Collaboration Networks are platforms that deliver insights into opportunities and risks by providing buyers and suppliers with visibility into all elements of their joint value chains; (6) Crowdsourcing gives an organization insights into trends and events impacting supply chains and supplier performance through capturing large and diverse inputs; (7) 3D Printing can quickly make a physical object based on a digital model. It can be used for rapid prototyping; (8) Robotic Process Automation software recognizes and learns patterns to perform rule-based tasks. It can be used to replace repetitive manual tasks.

2.2.3 Emerging technologies

Deloitte (2017, p. 4) describes emerging technologies as technologies that are expected to impact procurement in the future. Deloitte (2017, p. 5) mentions and describes the following emerging technologies: (1) Blockchain is a cryptologic data structure that uses a peer-to-peer network to create digital transaction ledgers. It can be used to trigger automated payment; (2) Sensors and Wearables are devices that detect, capture and record physical data. With this data, the devices can observe the movement of goods and inventory levels which can improve reordering, and enable audit tracking during site visits; (3) Cyber Tracking uses real-time tracking of online or physical activity. It can deliver trends and predictions on supply chain risks and can therefore be used to provide proactive monitoring of supplier behavior and performance; (4) Virtual Reality and Spatial Analytics allow procurement professionals to easily gain data by detecting events or changes of status using video, location data, or pattern analysis and conducting supplier visits or audits.

As described by Deloitte (2017, p. 4), core technologies require huge investments and integration work while maturing and emerging technologies are much quicker to deploy and need few to no integration.

2.3 The roles of the System Innovation Scout and the Supplier Onboarding Manager to benefit digital system implementation

2.3.1 A brief literature review about roles in purchasing

Different research is published about the multiple roles involved in purchasing. Faes, Knight, and Matthyssens (2001, p. 204) described buyer profiles; Mulder, Wesselink, and Bruijstens (2005, p. 192) described job profiles; and more recently Schiele (2019, pp. 53-54), Persist (2021, p. 22), and Delke et al. (2021a, pp. 7-10) described roles. Schiele (2019, pp. 53-54), for example, described the following roles for purchasing: Operative procurement; Purchaser for direct materials; Purchaser for indirect materials; Public procurement; Purchasing engineer; and Chief Purchasing Officer. Delke et al. (2021a, pp. 7-10) have defined seven future roles in purchasing: Process Automation Manager; Data Analyst; Supplier Onboarding Manager; Master Data Manager; System Innovation Scout; and Legislation Specialist. The roles that support the purchasing organization in utilizing these systems, the System Innovation Scout and the Supplier Onboarding Manager. The latter is focused on integrating external requirements from supplies. Since these roles are designed for the future, with due consideration of the transition towards Industry 4.0, they are the most relevant for this research.

2.3.2 The System Innovation Scout as the role being responsible for identifying and implementing new Industry 4.0 technologies

Delke et al. (2021a, p. 7) define the System Innovation Scout as "being responsible for identifying and implementing new Industry 4.0 technologies or systems within purchasing." This is needed for developing towards Industry 4.0. Responsibility of the System Innovation Scout is split into two dimensions named the new technologies discovery and the companies innovation adaptability. The latter refers to the implementation of technology. It is argued that this role could have a significant impact on the future of PSM (Persist, 2021, p. 25). They state that, within firms, this role is needed in procurement "to ensure up-to-dateness, IT-wise, from a purchasing point of view,". Summarizing, implementing the role should include identifying the purchasing departments' needs, formulating requirements, and scouting suitable technologies (Persist, 2021, p. 25).

2.3.3 The Supplier Onboarding Manager as the role being responsible for setting up the digital interface between the buying firm and suppliers

Delke et al. (2021a, p. 7) describe the Supplier Onboarding Manager in purchasing as "being responsible for setting up the digital interface between the buying firm and suppliers, involving the harmonization of data and effective stakeholder communication." When assuming that more systems will in the future be implemented within the buyer-supplier interface, this purchasing role will become important. Delke et al. (2021a, p. 8) state that the responsibilities of this role are onboarding suppliers and involving stakeholders in the organization's digital environments and practices. They also state that this role is especially needed when the link between the supplier and buyer is created, which will be during the first phase of supplier integration. A perfect connection and alignment between stakeholders are necessary when in Industry 4.0 advanced systems can run autonomously (Delke et al., 2021a, p. 8).

2.3.4 Competencies found crucial for the roles of the System Innovation Scout and the Supplier Onboarding Manager

Through the years different researchers have investigated the competencies needed in the purchasing domain. Knight, Tu, and Preston (2014, p. 278) present a list of 33 purchasing skills and divide them into three clusters being strategic, tactical and, routine skills. Bals, Schulze, Kelly, and Stek (2019, p. 7) group current and future competencies for Purchasing and Supply Management professionals in four clusters called Technical Skills, Interpersonal Skills, Internal / External Enterprise Skills, and Strategic Business Skills. They also present a table of the "top 10 future competencies". The most recent research, however, shows that there are nine different future skills being Data Analytics skills, Strategic Management skills, Supply Network Management skills, E-Procurement Technology skills, Robotic Process Automation skills, Digital Contract Management and Legal skills, Digital Partnership Management skills, Digital Negotiation skills, and Digital Leadership skills (Delke et al., 2021b, pp. 7-10). The difference between the research of Bals et al. (2019, p. 7) and Delke et al. (2021b, pp. 7-10) lay in the fact that the latter provides a detailed description of the future competencies where the former lacks a description of the competencies.

Table 1. Future competencies of purchasers in literature

Future competencies by Bals et al. (2019, p. 18)	Future competencies by Delke et al. (2021b, pp. 7-10)
Analytical skills	Data Analytics skills
Automation	Digital Contract Management and Legal skills
Big Data Analytics	Digital Leadership skills
Computer Literacy	Digital Negotiation skills
eProcurement Technology	Digital Partnership Management skills
Holistic supply chain thinking	E-Procurement Technology skills
Process optimization	Robotic Process Automation (RPA) skills
Strategic Sourcing	Strategic Management skills
Strategic thinking	Supply Network Management skills
Sustainability	

At first sight, multiple skills seem to overlap: "Analytical skills" and "Big Data Analytics" overlap with "Data Analytics skills", "eProcurement Technology" overlaps with "E-Procurement Technology skills", and "Automation" overlaps with RPA skills. However, since Bals et al. (2019) do not provide descriptions, this can not be stated with certainty.

3. METHODOLOGY

3.1 An exploratory multiple-case study

The main aim of this research is to investigate what competencies the System Innovation Scout and the Supplier Onboarding Manager need to successfully contribute to implementing digital systems in purchasing whilst considering external requirements.

In order to answer the research questions well, an exploratory multiple-case study will be held. This exploratory case study is a qualitative method. Anderson (2010, p. 1) describes qualitative research as research that: "involves the collection, analysis, and interpretation of data that are not easily reduced to numbers." A

case study is a helpful method when a research question starts with "how" or "why" (Yin, 2013, p. 22), and is therefore useful to answer the question on how to support digital system implementation in PSM. The distinction between a single-case study and a multiple-case study is that evidence of a multiple-case study is often found more compelling (Yin, 2013, p. 46). Exploratory research is the "preliminary research to clarify the exact nature of a problem to be solved" (Law, 2009). It is necessary to focus on exploratory research because due to the newness of the topic, little published research is available about how Industry 4.0 will affect purchasing (Schiele & Torn, 2020, p. 508) and how the System Innovation Scout and the Supplier Onboarding Manager can contribute to digital systems in procurement. Since this manner of research focuses on preliminary research and building theory there will no hypotheses be formulated. Testing hypotheses is not relevant for this research because to the lack of research on the subject might lead to false assumptions.

The information gathered by answering the sub-questions will be combined and additional interview questions will be asked in order to answer the research question. Since Delke et al. (2021a), present the most recent findings of the System Innovation Scout and the Supplier Onboarding Manager, much of the information about those roles will be based on their research. The literature about competencies by Delke et al. (2021b, pp. 7-10) will be used to compare literature to the answers found in the interviews since they provide detailed descriptions of the competencies. Other literature that will be used will come from Google Scholar, Scopus, and educational books.

3.2 Semi-structured interviews

A qualitative interview is an essential research method and is called the primary method in qualitative research (Oltmann, 2016, p. 1). It is called the most direct, research-focused interaction between research and participant by Kazmer and Xie (2008, p. 258). For this research, semi-structured interviews will be held. The approach will be based on the interview guide, developed by Kallio, Pietilä, Johnson, and Kangasniemi (2016, pp. 11-17). They state that the development of an interview guide includes five phases: identifying the prerequisites for using semi-structured interviews; retrieving and using previous knowledge; formulating the preliminary semi-structured interview guide; pilot testing the guide; and presenting the complete semi-structured interview guide. The interview questions are based on both literature and the research questions of this research. Interview questions 1 and 2 address sub-question 1, interview question 3 addresses sub-question 2, and interview questions 4 until 8 address sub-question 3. The main research question of this research will be answered with the help of interview questions 9 and 10. The interview guide, which in detail shows what literature is used for what interview question, can be found in Appendix A. After conducting the interviews, the results will be compared to the literature. Interview questions 9 and 10 are about, for instance, what skills and competencies are needed for the System Innovation Scout and Supplier Onboarding Manager respectively. These skills and competencies will then be compared to skills and competencies found in the literature to see whether there is overlap.

For the interviews, the participant's companies must be actively involved in purchasing. This means that they must be manufacturing, wholesaling, or merchandising companies and not service companies. There are no further requirements since it will be interesting to know whether companies are already transitioning towards Industry 4.0 or what holds them back and whether they already integrate new roles such as the System Innovation Scout and the Supplier Onboarding Manager or why they use "older" roles. The interviewee will be asked to answer questions honestly and can demand the signing of a non-disclosure agreement.

3.3 Coding

The data from the interviews were transcribed and coded in order to be able to compare and analyze the information. For the transcriptions, the intelligent verbatim style was used. The coding strategy that was used was the inductive content analytic coding strategy, outlined by Gioia, Corley, and Hamilton (2013). The nine different future skills of purchasers, identified by Delke et al. (2021b, pp. 7-10), provide the basis for the coding scheme. A division was made based on whether the identified competence was necessary for the System Innovation Scout or the Supplier Onboarding Manager. Next to the main theme, other themes were recognized during the coding process as well. One of the code groups that became apparent was concerned with the practical implications of Industry 4.0. This group was divided into implications that were in line with either Gottge et al. (2020, p. 8) or Cimini et al. (2018, pp. 6-9). Another code group was related to the digital systems used in purchasing. This group was divided based on the purchasing activity the system was used for. Schiele (2019, p. 48) mentioned 6 activities that will be used in this research. These are (1) planning supply, (2) selecting supplier, (3) contracting supplier, (4) ordering material, (5) expediting order, and (6) paying delivery. Also, especially for this group a third-order category was made to distinguish Industry 3.0 and Industry 4.0 systems. The last two themes that were identified were concerned with the relevance of the System Innovation Scout and the Supplier Onboarding Manager. These themes were divided into 7 categories.

Within the interviews, a total of 34 second-order categories were identified. These second-order categories were divided into 6 main themes. The coding scheme can be found in Appendix B Thee codes provide the basis of the results of this research. The first-order categories are the codes that were identified during the coding process of the transcriptions. These codes were used to come up with certain second-order and third-order categories or used to link to the previously mentioned categories which are based on, Delke et al. (2021b, pp. 7-10), Gottge et al. (2020, p. 8) and Cimini et al. (2018, pp. 6-9), and Schiele (2019, p. 48). All of the interviews have been carefully analyzed and the relevant data has been used in the best interest of this research.

4. ANALYSIS AND FINDINGS

4.1 Company introduction

All of the companies that took part in the interview were active in purchasing. They were manufacturing, wholesaling, and merchandising companies and active in different industries ranging from electronics to retail food stores and e-commerce. The companies also differed in size. The smallest companies employed between 30 and 40 workers and the largest company employed about 380.000 workers worldwide. The participants were all either purchasers or purchasing managers, and two of them also fulfilled a sales role next to their purchasing function.

4.2 Cross-case comparison table

The cross-case comparison table will present the main findings of the 6 interviews (see Table 2). The main findings are divided into issues. These issues are selected based on their relevance regarding answering the research questions. Every company received a rating based on its Industry 4.0 maturity according to the Three Stage Maturity Model, designed by Ganzarain and Errasti (2016, pp. 1125-1126). Their model can be found in Appendix C. The ratings are given, based on objective conclusions after conducting the interview and evaluating the

answers. These ratings will, later on, be considered when deciding upon the relevance of an in-depth case analysis.

The results of analyzing the interviews have led to the distinction of 6 main categories: (1) Practical implications of Industry 4.0; (2) Digital systems used in (future) purchasing; (3&4) Relevance of and the System Innovation Scout and the Supplier Onboarding Manager; and (5&6) competencies for the System Innovation Scout and the Supplier Onboarding Manager.

Table 2. Cross-case comparison table

Issue	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Function	Purchasing manager	Purchasing manager	Purchaser	Purchaser and salesman	Purchasing manager	Purchaser and salesman
Industry	Manufacturing electronic goods	Wholesaling textile goods	Wholesaling decoration	Manufacturing and wholesaling furniture	Retail food stores and e-commerce	Wholesaling metals
Company size	500-1000 employees	0-100 employees	0-100 employees	0-100 employees	>100.000 employees	0-100 employees
Industry 4.0 maturity	4MM	1MM	3MM	3MM	5MM	2MM
Duration of the interview	±45 minutes	±32 minutes	±34 minutes	±22 minutes	±25 minutes	±34 minutes
Practical implications of Industry 4.0	Reduced time spent Reduced human mistakes Reduced amount of workers needed Ultimately reduced costs	Not relevant for this company since *"the products are too diverse to automatically purchase."**	Reduced human work Reduced time spent	Reduced human mistakes Reduced time spent Reduced costs	Reduced workforce Reduced time spent Reduce human effort Reduced stress about processes	M2M communication is hard for this company to implement because of the large variety of suppliers
Digital systems used in purchasing	Enterprise Resource Planning (ERP) system Electronic Data Interchange (EDI) system The "SmartBin"	E-mail Phone calls WhatsApp WeChat	Inventory management system E-mail Phone calls WhatsApp Zoom	ERP system Excel E-mail Phone calls WhatsApp WeChat	An advanced replenishment system Vendor portal EDI system	ERP system E-mail Phone calls E-catalog
The focus of the systems	Both on internal and external requirements	Both on internal and external requirements	On internal requirements	Both on internal and external requirements	Both on internal and external requirements	On internal requirements
Perceived relevance of the System Innovation Scout	*"Both roles will definitely have a future, new systems have to be identified timely …"**	*"These roles are eventually required in purchasing, however, the implementation will require lots of time and effort."**	*"The System Innovation Scout can contribute by giving new insights that are beyond our imagination."**	*"Both roles will be required in organizations in the upcoming 5 to 10 years. The System Innovation Scout is necessary for scouting and implementing the newest systems …"**	*"The System Innovation Scout is important because you always want to be steps ahead of your competition."**	Not sure whether both roles will be necessary
Necessary competencies of the System Innovation Scout	Curiosity Technical knowledge Management skills Communication skills	Analytical skills Networking skills Legal know-how Curiosity Open-mindedness Critical thinking and reflection skills	Technical knowledge Innovativeness Progressiveness Proactiveness Organizational awareness	Listening Proactiveness Adaptability	Technical knowledge Strategic knowledge Analytical skills Pragmatism Stakeholder management skills Communication skills	Technical knowledge Organizational awareness
Perceived relevance of the Supplier Onboarding Manager	*"… and good communication and negotiation is needed between the supplying and buying organizations"**	See "Perceived relevance of the System Innovation Scout"	*"He contributes by staying in contact with the supplier and solve potential conflicts."**	*" … and the Supplier Onboarding Manager has to link the systems through the whole supply chain."**	*"The Supplier Onboarding Manager is important for guiding suppliers and making sure no mistakes will be made."**	See "Perceived relevance of the System Innovation Scout"
Necessary competencies of the Supplier Onboarding Manager	Communication skills Negotiation skills Relationship skills	Analytical skills Negotiation skills Networking skills E-procurement know-how Legal know-how Automatic process know-how	Communication skills Relationship skills Organizational awareness	Accuracy Proactiveness Convincingness Communication skills Networking skills Ability to build coalitions	Supply chain knowledge Patience Bilingualism Technical knowledge	Listening Ability to serve different interests

*See Appendix D for the Dutch translations of the citations

4.3 Practical implications of Industry 4.0

This first category describes what consequences, caused by, Industry 4.0 companies experience. The four consequences that were identified during the interviews were affected financial results, less employment, the strategic purchaser role, and reduced mistakes. I1 summarizes *"less manual ordering means that there is less time needed. Also, the amount of mistakes is heavily reduced since things go automatically. You need fewer people and as a purchaser, you spend less time on ordering. Ultimately, this all saves money." (I1)*[1]

The first implication that was found was related to financial results. Companies experience a significant effect on their financials due to the introduction and implementation of Industry 4.0 systems. Firstly, revenue is increased by forecasting and ordering more accurately. And secondly, costs are decreased by spending less time and employees on automatable tasks. Improved financials are often the motivation for going through changes and transitions and the same goes for transitioning towards Industry 4.0. This implication is also in line with "Revenue growth", previously identified by Cimini et al. (2018, p. 7). However, the interviewees emphasized that, when looking at financials, cost reduction is more rewarding than revenue growth. And cost reduction is not concretely mentioned by Cimini et al. (2018).

Spending less time and employees is the second found implication and has to do with employment. Manual tasks that are being automated by machines will reduce the number of employees that are needed by an organization. This implication results in reduced costs which, in turn, improves financial results. However, the job loss, created by the automation of manual tasks could also be solved by shifting employees towards new jobs, created by new smart-technology-business-opportunities. The implication is in line with "Employment", identified by Cimini et al. (2018, p. 7) who also indicated the opportunity of relocating employees.

Another implication of Industry 4.0 that companies experience is the strategic purchaser role. The utilization of Industry 4.0 technologies offers the opportunity to digitalize and automate simple and repetitive tasks so that buyers are able to focus on the strategic- instead of the operative side of purchasing. This implication is also one of the main findings of Gottge et al. (2020, p. 8). They state that the strategic purchasing sub-processes, defining specification, selecting suppliers, negotiating/contracting, and change management, will be impacted by Industry 4.0.

The third and last implication that companies experience is reduced mistakes. Firstly, computers are able to predict more accurately than humans are. This causes that automated ordering creates e.g. fewer excessive inventory with less product loss as a result. Secondly, by automating human activities, the occurrence of human mistakes is reduced. However, "*(…) everything that you put into a system can be put into the system incorrectly. A system can only work when everything that is entered is 100% in line with how you want it to be" (I4)*[2].

In the way that "reduced mistakes" is defined by the interviewees, it is in line with "Quality management" and "Supply chain management", identified by Cimini et al. (2018, p. 8). This implication can again help with reducing organizational costs. Therefore, reducing costs is the main practical implication of Industry 4.0, based on this research. The other findings are revenue growth, less employment, the strategic purchaser role, and reduced mistakes.

The last notable finding regarding implications is that the implications differ between companies. Organizations that buy routine products experience different effects of Industry 4.0 than organizations that buy hand-made or trend products. Also, the company's size seems to matter. Companies with high turnover and amount of employees seem to easier transition towards Industry 4.0. A possible rationale for this is that larger organizations generally have a higher research and development budget.

4.4 Digital systems used in purchasing

This category describes the different systems that are used in the organizations that participated in this research. Thereafter, these systems will be linked to the purchasing activity where the digital systems are utilized. For this, the purchasing activities described by Schiele (2019, p. 48) are used. Remarkably, digital systems are used in every purchasing activity. Also, a clear distinction can be made between the Industry 3.0 systems and the Industry 4.0 systems. For the Industry 4.0 systems, it will be investigated whether they overlap with the systems by Deloitte (2017, p. 5).

The Industry 3.0 systems that are often used within purchasing are Excel, e-mail, phone calls, Whatsapp, WeChat, and Zoom. These systems are often not integrated with other systems not to mention with supplier's systems. This makes M2M communication impossible. Therefore these systems are categorized as Industry 3.0 systems.

Excel is used for ordering and planning and is thus implemented in the purchasing activities planning supply, contracting supplier, ordering material, and expediting order. The other technologies are used for communication purposes and are therefore implemented in the purchasing activities selecting supplier, contracting supplier, ordering material, expediting order, and paying delivery.

In contrast, the Industry 4.0 systems that were identified during the interviews are all eligible for M2M communication. All of the systems are also integrated with other systems through the supply chain. This includes other internal systems and mostly external systems from suppliers. The systems that were found to be used are ERP systems, replenishment systems, EDI systems, and Inventory Management (IM) systems. An example of a replenishment system will be given in paragraph 4.7, where an in-depth analysis of case 5 will be presented. Examples of IM systems are SmartBins. *"These are scales that contain screws. The weight is tracked by sensors and when the tray falls below a certain weight, a signal is sent to the supplier that says that new supply is needed." (I1)*[3]

The first three Industry 4.0 systems are used in all purchasing activities. This is probably due to the high level of integration of

[1] "*Minder handmatig bestellen betekent dat er minder tijd nodig is. Ook het aantal fouten wordt een stuk minder want het gebeurt automatisch. Je hebt minder mensen nodig en als inkoper ben je minder tijd kwijt aan bestellen. Uiteindelijk scheelt dit allemaal geld." (I1)*

[2] "*… en dat is dat alles wat je in een systeem zet kan ook met fouten erin worden gezet. Een systeem kan alleen draaien wanneer 100% er in staat zoals jij het wilt hebben." (I4)*

[3] *"Dat zijn weegschalen waar schroeven inliggen. Door sensoren wordt het gewicht bijgehouden en wanneer het bakje onder een bepaald gewicht komt gaat er een signaal naar de leverancier dat zegt dat er voorraad afgestuurd moet worden." (I1)*

the systems. The IM system is initially used only for planning supply. But when the system is integrated with other systems such as the ERP system, it can also serve other purchasing activities.

Another finding is that the larger organizations use more sophisticated digital systems and also seem to have a higher level of integration between different systems. A possible argument for this is that larger companies tend to have bigger research and development budgets.

Concerning the technology groups by Deloitte (2017, p. 5), the core technologies are seen most often within the organizations. Systems like the ERP system, the replenishment system, and the EDI system all seem to include and enable core technologies. Since the ERP system and the replenishment system are broader systems, they also include more core technologies. A system like the Inventory Management System also includes Predictive / Advanced Analytics, which is a maturing technology. The example of the SmartBin does this by using Sensors, which is an emerging technology. The Electronic Catalog was also mentioned and is a core technology. The vendor portal, mentioned by Interviewee 5, is an example of a Collaboration Network, which is a maturing technology.

As expected, the core technologies are present the most. This is in line with the description of this technology which is "the procurement centerpieces for many organizations that will also be relevant for many organizations in the future" Deloitte (2017, p. 5). With Predictive / Advanced Analytics and Collaboration Network, also maturing technologies were mentioned during the research. The only emerging technology that was identified was the SmartBin which made use of sensors. The low amount of mentions for the last two technologies is in line with expectations as their definition shows that they are not yet implemented everywhere.

The last finding regarding digital systems used in purchasing is that four out of the six interviewees indicated that the focus of the digital systems is on matching, at least partially, external requirements. Among the four companies that include these external requirements are the two companies with the highest Industry 4.0 maturity. This could emphasize the need for a Supplier Onboarding Manager.

4.5 Perceived relevance of the System Innovation Scout and the Supplier Onboarding Manager

4.5.1 The System Innovation Scout to help with staying up-to-date, broadening the company's view, and attaining competitive advantage

This theme describes for what purposes both roles are perceived by the interviewees as relevant. Thereafter, it will be discussed whether the interviewees perceive the same level of desirability of the System Innovation Scout as the results reported by Delke et al. (2021b, p. 7) indicate.

The three purposes of the System innovation scout are: (1) Keeping the company up-to-date will be one of the main "tasks" of the role. As a System Innovation Scout, it is your job to identify and implement new systems timely. So, it seems obvious that keeping the company up-to-date is one of the role's main purposes; (2) Broadening the company's view is also one of the purposes of the System Innovation Scout. The role does this by giving new insights into certain systems and processes that are beyond the imagination of other roles; (3) helping the company with attaining a competitive advantage. Where this should be the purpose of everyone inside of an organization, this purpose was specifically mentioned for this role. Providing the company with the newest and finest systems will allow organizations to be steps ahead of the competition.

It appears that the System Innovation Scout is associated with important purposes. Also, five out of the six interviewees indicated that they found the role a requirement in the future. This matches with the "Desirable" score, given by Delke et al. (2021a, p. 7). Therefore, this score can now be justified based on this research.

4.5.2 The Supplier Onboarding Manager to help with improving buyer-supplier relationships, automating processes, improving processes, and exploiting business opportunities

This theme includes the perceived purposes of the Supplier Onboarding Manager. These are: (1) Improving the buyer-supplier relationship was mentioned the most often by the interviewees and is one of the most important purposes of the role. The Supplier Onboarding Manager can do this by guiding suppliers and by solving potential conflicts; (2) Automating processes is another purpose of the Supplier Onboarding Manager. The role does this integrating and linking systems through the whole supply chain; (3) Next to automating processes, the Supplier Onboarding Manager should also be used for improving processes. This is done by reducing miscommunications between and resulting mistakes; and (4) Exploiting business opportunities should be the last purpose of the Supplier Onboarding Manager. The role should be a strong negotiator and negotiate in favor of the organization. This should help with creating and exploiting business opportunities.

It seems that the Supplier Onboarding Manager's purposes are, just as the System Innovation Scout's, important. And again, five out of the six interviewees indicated that they found the role desirable in the future. Delke et al. (2021a, p. 7) gave the Supplier Onboarding Manager also a "Desirable" score. This score is, again, justified.

Summarizing the relevance of both roles: "*a trend or new system has to be identified timely, and from there good negotiation and communication is necessary between those who came up with the system and the people on the inside." (I1)*[4]

4.6 Necessary competencies of the roles

4.6.1 The System Innovation Manager to possess Digital Leadership skills, Strategic Management skills, E-Procurement Technology skills, and RPA skills

This last category describes what competencies the 6 interviewees perceive as relevant for the System Innovation Scout. However, these competencies will be first divided into the corresponding competencies, as identified and described by Delke et al. (2021b, pp. 7-10).

The most important competencies will be identified when ordering the competencies based on the frequency by which they were mentioned. For the System Innovation Scout, the most important competencies are: (1) Digital Leadership skills include organizing and managing people within a digital environment. This is necessary during the transformation towards Industry 4.0

[4] *"Omdat er tijdig een trend of nieuw systeem ontdekt moet worden, en vanaf daar moet er goed onderhandeld en gecommuniceerd worden tussen diegene die het systeem bedenken en de mensen intern" (I1)*

as well as when a company reaches Industry 4.0 maturity; (2) Strategic Management skills address the ability to ensure the up-to-datedness with current global trends. This includes the transition towards Industry 4.0. It also includes assessing how global trends such as Industry 4.0 could contribute to competitive advantage; (3) E-Procurement Technology skills are necessary for keeping up with new operational purchasing technologies. An example of such a technology is catalog-based purchasing. These skills include working with e-procurement systems and defining future system development requirements. They help with preparing organizations for digital-like value chains; and (4) "RPA skills include implementing RPA in purchasing by configuring software bots." It includes every skill necessary for working in an RPA-environment.

Other skills that were mentioned are Data Analytics skills, Digital Contract Management and Legal skills, and Supply Network Management skills. However, these skills were not sufficiently mentioned to be labeled as important. The same goes for Supply Network Management skills and Digital Partnership Management skills which were not mentioned once. A possible rationale for the irrelevancy of these skills might be that the interviewees associate these skills more with other roles such as the Data Analyst, the Legislation Specialist, or the Supplier Onboarding Manager.

4.6.2 The Supplier Onboarding Manager to possess Digital Leadership skills and Digital Partnership Management skills

This paragraph will present the findings regarding the Supplier Onboarding Manager. These results plus the results of the previous paragraph about the System Innovation Scout's necessary competencies will together answer the research question:

What competencies do the System Innovation Scout and the Supplier Onboarding Manager need to effectively contribute to the implementation of digital systems

Again, the most important competencies will be determined based on the frequency by which these were mentioned. For the Supplier Onboarding Manager, these appeared to be Digital Leadership skills and Digital Partnership Management skills. Digital Leadership Management was defined in the previous paragraph where the System Innovation Scout's competencies were presented. Digital Partnership Management skills include solving issues with internal and external stakeholders with personal communication that goes further than communicating by using electronic systems only.

Although Digital Negotiation skills were not mentioned frequently enough to be labeled as necessary, they were mentioned enough to be labeled as important. The remainder of skills, Data Analytics skills, Digital Contract Management and Legal skills, E-Procurement Technology skills, RPA skills, Strategic Management skills, and Supply Network Management skills were all mentioned but not enough to state that these are necessary competencies. However, since the skills are mentioned they can not be neglected in this research.

It seems that this role needs to be capable of more different skills than the System Innovation Scout. A possible explanation for this is that the System Innovation Scout is only focused on internal requirements where the Supplier Onboarding Manager has to include external conditions. This raises the need for being capable of a greater variety of skills.

4.7 In-depth analysis of case 5

The fifth company that was interviewed operates in retail food stores and e-commerce. The company is listed on the Euronext Amsterdam Stock Exchange and employs about 380.000 workers worldwide. They operate in different countries all over the world including The Netherlands and the United States. The participant is a Purchasing Manager active at the headquarters in The Netherlands and he has been working at the company for about 2 years. The reason for in-depth analysis is that this company is rated the highest on Industry 4.0 maturity.

Interviewee 5 stated that Industry 4.0 has affected their purchasing department in the following way: *"Actually, as a buyer, you don't have to worry as much about what goes to the store, but you can focus more on other processes. Ultimately, this saves people, time, effort, and a lot of hassle because you can just assume that everything will work out."(I5)*[5]

Further, the organization uses a sophisticated replenishment system that is fully automated. This allows that *"(…) as soon as a product is paid for at a cash register, the stock is automatically written off, which triggers the demand for products, which goes to a distribution center, and the acquiring of the products triggers an order with a supplier."(I5)*[6]

This whole process works autonomously and automatically. Only the inventory levels often need to be manually adjusted. Furthermore, they use vendor portals. These are dashboards that are accessible to the supplier. Via these dashboards, suppliers get a demand planning four weeks before planned delivery. Further buyer-supplier is, with the exception of unforeseen circumstances, redundant.

Regarding the roles of the System Innovation Scout and the Supplier Onboarding Manager, Interviewee 5 indicated that they already have implemented both roles in the organization. The former is part of the supply chain department and the latter is part of the sourcing department in the form of the supply chain coordinator. Interviewee 5 stated that the purpose of the System Innovation Scout is to help the organization to be steps ahead of the competition. The purpose of the Supplier Onboarding Manager is *"(…) to guide the supplier and to make sure they understand everything and do not make mistakes." (I5)*[7]

Concerning the competencies for the System Innovation Scout, Interviewee 5 mentioned what he found important: IT knowledge; strategic know-how; the ability to translate needs and concerns into IT solutions; analytic skills; pragmatism; stakeholder management skills; and communication skills. This fits with "Data Analytics skills", "Strategic Management skills, "E-Procurement Technology skills", "RPA skills", "Digital Leadership skills", and " Supply Network Management skills" by Delke et al. (2021b, pp. 7-10). When comparing these competencies to the necessary competencies presented in paragraph 4.6.1, similarities arise.

For the Supplier Onboarding Manager, Interviewee 5 thought to be important supply chain knowledge, patience, bilingualism, and technical knowledge. This matches with "Supply Network

[5] *"Eigenlijk als inkoper hoef je hierdoor minder bezig te zijn met wat er naar de winkel gaat, maar kan je meer bezig zijn met andere dingen. Uiteindelijk bespaart dit mensen, tijd, moeite en een hoop gezeik omdat je er gewoon vanuit kan gaan dat dat het allemaal wel loopt." (I5)*

[6] *"(…) zodra er een product wordt afgerekend bij een kassa, dat de voorraad automatisch wordt afgeboekt, wat triggered hoeveel producten er nodig zijn, dat gaat naar een distributiecentrum, en de afname daarvan triggered een order bij een leverancier"(I5)*

[7] "*(…) om dan de leverancier bij de hand te nemen en te zorgen dat ze alles begrijpen en er geen fouten worden gemaakt." (I5)*

Management skills", "Digital Leadership skills", "E-Procurement Technology skills", and "RPA skills" by Delke et al. (2021b, pp. 7-10). This list of competencies seems to differ from the competencies presented in paragraph 4.6.2 in this research. When concluding which competencies are necessary for the Supplier Onboarding Manager, the competencies mentioned by Interviewee 5 are worth noting since the company already employs a similar role.

5. DISCUSSION

5.1 Theoretical implications

The literature of and Delke et al. (2021a) and Delke et al. (2021b) provided the basis for this research. The identified roles, mentioned by the former, and the competencies, mentioned by the latter, were the basis on where this research was built on.

The main objective of this research was to investigate what competencies the System Innovation Scout and the Supplier Onboarding Manager need to successfully contribute to implementing digital systems in purchasing whilst considering external requirements. For this purpose, the following research question was established:

What competencies do the System Innovation Scout and the Supplier Onboarding Manager need to effectively contribute to the implementation of digital systems?

By answering this research question, and thus matching relevant competencies to the roles, this research complements the research of Delke et al. (2021b). This research also includes an order of importance for the competencies based on the frequency of mention in interviews. For the System Innovation Scout, the necessary competencies, in order of importance, seemed to be: Strategic Management skills, Digital Leadership skills, E-Procurement Technology skills, and RPA skills. Less important skills for this role are Data Analytics skills; Digital Contract Management and Legal skills; and Supply Network Management skills. Non-important skills are Supply Network Management skills and Digital Partnership Management. For the Supplier Onboarding Manager, the necessary competencies were Digital Leadership skills and Digital Partnership Management skills. Digital Negotiation skills were also perceived as important skills for this role. Less important skills for this role are Data Analytics skills, Digital Contract Management and Legal skills, E-Procurement Technology skills, RPA skills, Strategic Management skills, and Supply Network Management skills.

Furthermore, by investigating the roles of the System Innovation Scout and the Supplier Onboarding Manager, this research extends the work of Delke et al. (2021a). The identified purposes of the roles provide an understanding of the relevance of both roles that go beyond labeling both roles as important. The purposes of the System Innovation Scout were found to be staying up-to-date, broadening the company's view, and ultimately helping the company with attaining competitive advantage. For the Supplier Onboarding Manager, these were improving buyer-supplier relationships, automating processes, improving processes, and exploiting business opportunities. When comparing the desirability of both roles found by Delke et al. (2021a, p. 7) to the perceived desirability of the roles by the interviewees, the same results are found. Both studies conclude that the roles are perceived as "Desirable". Furthermore, by identifying that 4 out of the 6 organizations integrate external requirements within their digital systems, the need for a Supplier Onboarding Manager is highlighted.

This research also examines and complements the research of Gottge et al. (2020) and Cimini et al. (2018) regarding the practical implications of Industry 4.0. Firstly, it agrees with Gottge et al. (2020, p. 8) that the strategic purchaser role is one of the main implications of Industry 4.0 for purchasing. And secondly, it argues with Cimini et al. (2018, p. 7) for mentioning "Revenue growth" regarding financials and not "Cost reduction" since the latter was perceived as more important by the interviewees who participated in this research. When combining the results of this research with the researches of Gottge et al. (2020) and Cimini et al. (2018), the following list of practical implications of Industry 4.0 can be formed: collaboration platforms; the strategic purchaser role; productivity and efficiency; improved financials; employment; sustainability and energy efficiency; quality management; supply chain management; and engineering.

Lastly, this research contributes to the literature by examining what technologies, mentioned by Deloitte (2017, p. 5), are currently utilized in practice. Similarities arise between what is described as "Core"; "Maturing"; and "Emerging"; and how often certain technologies are used in practice.

5.2 Practical implications

Within this research, benefits for organizations, such as the strategic purchaser role, improved financials, and increased productivity are found out to be practical implications of Industry 4.0. This list can be used for motivational purposes when considering transitioning towards Industry 4.0.

To attain these benefits, Industry 4.0 systems need to be implemented. At the moment, many core technologies are already implemented. However, to optimize, for example, the financials, managers need to implement maturing technologies such as Predictive and Advanced Analytics or emerging technologies such as Spatial Analytics.

The System Innovation Scout and Supplier Onboarding Manager are good roles for helping the organization to introduce and implement such systems. Both roles also have other purposes, which are also mentioned within this research. These purposes need to be considered when deciding upon implementing both roles.

When having decided to implement both roles, this research presents a list of necessary competencies for both the System Innovation Scout and the Supplier Onboarding Manager. This list can be used to organize human resources management in purchasing and education. Educating and training current purchasing professionals in future purchasing roles allows higher specialization levels. The suggested list of competencies needs to be allocated towards future roles.

Finally, this research also provides a "best-case" description of the company with the highest Industry 4.0 maturity. This case description can set an example for managers.

6. LIMITATIONS AND FUTURE RESEARCH

Due to the small sample size of 6 interviewees, the sample size is undersized. Therefore, the findings can not be generalized. Otherwise, this would lead to falsified results. A suggestion for future research would therefore be research on a larger scale also using quantitative data analysis. This would lead to significant results.

Secondly, only Dutch companies have been interviewed. And although some companies do operate globally, this may have narrowed the scope of this interview. When broadening the scope of this research, an understanding could be created about how the future roles and skills are perceived in different countries.

The fact that the interviews were coded by one researcher only also limits the reliability of the results. A suggestion for future research would be to let different researchers code the

information and test the intercoder reliability. A high intercoder reliability value is essential for statistical analysis and hypothesis testing (Burla et al., 2008, p. 115).

Finally, there are limitations based on the content of the research. For example, a research question, and subsequently an interview question were made concerning which new systems would be implemented within the organizations in the future. The results showed that no organizations planned to implement new systems. However, they planned on upgrading existent systems. This was not included in the research because the research question, as well as the interview question, were formulated in a way that only radical innovations could be identified. This canceled out the opportunity for identifying incremental innovations. In future research, incremental innovations should also be included.

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APPENDIX

A. Interview Guide

Interview Guide

Introduction: Introduction of interview moderator

Briefing: **Is it possible to record the interview? The recording will be deleted after finishing this research. The company name, and your name will be kept anonymously. If desired, the final research can be sent to you. You will receive my e-mail address for any other questions or remarks after the interview.**

Purpose of research

Purpose of interview

Explain the interview procedure

Question: **Do you have any questions before starting the interview?**

Introductory questions:

Question A: Would you be so kind to introduce yourself and the company you work for? This can include information on your position, what your responsibilities are, how long you have been doing this and the size of the company.

Question B: What are your daily tasks and your responsibilities?

Question C: Could you give information on your suppliers? E.g. the interaction, number of suppliers, relationship with suppliers, different importance.

Main questions:

Sub-question 1:

Schiele and Torn (2020, p. 512) define Industry 4.0 as: "Industry 4.0 is characterized by cyber-physical systems with autonomous machine-to-machine (M2M) communication." Kagermann et al. (2013, pp. 31-32) state that different key features are required for the successful implementation of Industry 4.0: horizontal integration within value networks; end-to-end digital integration of engineering within the whole supply chain; and vertical integration and networked manufacturing systems.

Question 1: *Is your company active in transitioning towards Industry 4.0?*

Back-up: Do you have a digitalization strategy?

Question 1b: *Why?*

Question 2: *In what way has Industry 4.0 affected your company? And in specific your purchasing department?*

Question 2b: *Do you see created value for purchasing, based on Industry 4.0 (or digitalization)?*

Sub-question 2:

Deloitte (2017, p. 5), distinguishes three groups of concrete technologies based on the degree to which the capabilities are currently being utilized in procurement: core; maturing; and emerging technologies. Because, instead of technological concepts, Deloitte (2017, p. 5) discusses concrete technologies used in purchasing, these three groups will be discussed in the following paragraphs.

Question 3: *What are the most important systems that are implemented within your purchasing department?*

Question 3b: *What are the most important systems that are planned on being implemented in the future within your purchasing department?*

Question 3c: *Are these systems focused internally, so based on your requirements, or also based on external requirements from suppliers?*

Sub-question 3:

Delke, Schiele, and Buchholz (2021, pp. 7-10) have defined seven future roles in purchasing: Process Automation Manager; Data Analyst; Supplier Onboarding Manager; Master Data Manager; System Innovation Scout; and Legislation Specialist.

Question 4: *Are you familiar with these roles?*

If no:

"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."
"The **System Innovation Scout** is responsible for identifying and implementing new Industry 4.0 technologies or systems within purchasing."

Back-up broader definition:

Delke, Schiele, and Buchholz (2021, p. 7) define the System Innovation Scout as "being responsible for identifying and implementing new Industry 4.0 technologies or systems within purchasing." This is needed for developing towards Industry 4.0. Responsibility of the System Innovation Scout is split into two dimensions named the new technologies discovery and the companies innovation adaptability. The latter refers to the implementation of technology. It is argued that this role could have a significant impact on the future of PSM (IO3, 2021, p. 25). They state that, within firms, this role is needed in procurement "to ensure up-to-dateness, IT-wise, from a purchasing point of view,". Summarizing, implementing the role should include identifying the purchasing departments' needs, formulating requirements, and scouting suitable technologies (IO3, 2021, p. 25)

Delke et al. (2021a, p. 7) describe the Supplier Onboarding Manager in purchasing as "being responsible for setting up the digital interface between the buying firm and suppliers, involving the harmonization of data and effective stakeholder communication." When assuming that more systems will in the future be implemented within the buyer-supplier interface, this purchasing role will become important. Delke et al. (2021a, p. 8) state that the responsibilities of this role are onboarding suppliers and involving stakeholders in the organization's digital environments and practices. They also state that this role is especially needed when the link between the supplier and buyer is created, which will be during the first phase of supplier integration. A perfect connection and alignment between stakeholders are necessary when in Industry 4.0 advanced systems can run autonomously (Delke et al., 2021a, p. 8).

Question 5: *Who is involved in and responsible for identifying and implementing new Industry 4.0 technologies or systems within purchasing?*

Question 6: *Who is involved in and responsible for setting up the digital interface between the buying firm and suppliers?*

Question 7: *Would you consider implementing one or both roles within your purchasing department?*

Question 8: *Why do(n't) you think that the system innovation scout and the supplier onboarding manager contribute to the implementation of digital systems in purchasing*?

Research question:

Question 9: *What skills and competencies do you think are needed for being a good system innovation scout?*

Question 10: *What skills and competencies do you think are needed for being a good supplier onboarding manager?*

If participant has difficulty with answering, show tables with competencies.

Debriefing: Summarizing the main points mentioned during the interview.
From my side, there are no further questions. Is there anything else you want to bring up before finishing the interview?

Closure: Thank you for participating in the interview. When the research is finished I will share my results.

B. Coding scheme

First-order categories	Second-order categories	Third-order categories	Key themes
Costs are reduced 2x	Affected financial results 3x	N/A	Practical implications of Industry 4.0
Higher turnover			
Less workers are needed 2x	Employment 5x		
Less time is needed 3x			
Less effort spent on automatable tasks	The strategic purchaser role 3x		
Ability to focus on strategic tasks			
Less products have to be ordered manually			
Better accuracy	Reduced mistakes 3x		
Fewer mistakes are made 2x			
Electronic Resource Planning (ERP) system 3x	All purchasing activities 6x	Industry 4.0 systems	Digital systems used in purchasing
An advanced replenishment system			
Electronic Data Interchange (EDI) system 2x			
Inventory management system 2x	Planning supply 2x		
E-catalog	Selecting supplier		
Vendor portal	Contracting supplier, Ordering material, Expediting order, and Paying delivery		
Excel	Planning supply, Contracting supplier, Ordering material, and Expediting order	Industry 3.0 systems	
E-mail 4x	Selecting supplier, Contracting supplier, Ordering material, Expediting order, and Paying delivery 14x		
Phone calls 4x			
WhatsApp 3x			
WeChat 2x			
Zoom			
Identifying new systems timely	Staying up-to-date 2x	N/A	Relevance of the System Innovation Scout
Scouting and implementing the newest systems			
Giving new insights that are beyond our imagination	Broadening view		
Being steps ahead of your competition	Attaining competitive advantage		
Guiding suppliers 3x	Improving buyer-supplier relationship 4x	N/A	Relevance of the Supplier Onboarding Manager
Solving potential conflicts			
Linking the systems through the whole supply chain	Automating processes		
Making sure no mistakes will be made	Improving processes		
Negotiating in favor of the company	Exploiting business opportunities		
Analytical skills 2x	Data Analytics skills 2x	N/A	Necessary competencies for the System Innovation Scout
Legal know-how	Digital Contract Management and Legal skills		
Adaptability	Digital Leadership skills 5x		
Critical thinking and reflection skills			
Listening			
Pragmatism			
Progressiveness			
Communication skills 2x	Digital Partnership Management skills 2x		
Curiosity 2x	E-Procurement Technology skills 4x		
Open-mindedness			
Innovativeness			
Technical knowledge 4x	Robotic Process Automation (RPA) skills 4x		
Management skills	Strategic Management skills 6x		
Organizational awareness 2x			
Proactiveness 2x			
Strategic knowledge			
Networking skills	Supply Network Management skills 2x		
Stakeholder management skills			
Analytical skills	Data Analytics skills	N/A	Necessary competencies for the Supplier Onboarding Manager
Legal know-how	Digital Contract Management and Legal skills		
Accuracy	Digital Leadership skills 4x		
Bilingualism			
Listening			
Patience			
Convincingness	Digital Negotiation skills 3x		
Negotiation skills 2x			
Ability to build coalitions	Digital Partnership Management skills 9x		
Ability to serve different interests			
Communication skills 3x			
Networking skills 2x			
Relationship skills 2x			
E-procurement know-how	E-Procurement Technology skills		
Automatic process know-how	Robotic Process Automation (RPA) skills 2x		
Technical knowledge			
Organizational awareness	Strategic Management skills 2x		
Proactiveness			
Supply chain knowledge	Supply Network Management skills		

C. Industry 4.0 Maturity Model by Ganzarain and Errasti (2016, p. 1126)

	V	B	A
	ENVISION	**ENABLE**	**ENACT**
1MM	It doesn,t exist a company specific industry 4.0 vision		
2 MM	Tailored Undustry 4.0 Vision	Customer segments and customer expectation defined	Portfolio projects withot prioritize
3MM	Develop its understanding I4.0 with specific capabilities and resources	Customer segments and expectation defined and value proposition defined	Projects evaluated and resource and collaboration needed identified
4MM	Opportunity map described in I 4.0	Customer segments and expectation, VPM and technologies/resources defined	Actual and Future portfolio Project detailed
5MM	Future challenges by the I4.0		

D. Translated citations used in the cross-case comparison table

Issue	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Function	N/A	N/A	N/A	N/A	N/A	N/A
Industry	N/A	N/A	N/A	N/A	N/A	N/A
Company size	N/A	N/A	N/A	N/A	N/A	N/A
Industry 4.0 maturity	N/A	N/A	N/A	N/A	N/A	N/A
Duration of the interview	N/A	N/A	N/A	N/A	N/A	N/A
Practical implications of Industry 4.0	N/A	Niet relevant voor deze organisatie omdat zij *"een diversiteit aan artikelen hebben wat maakt dat je niet digitaal iets kan inkopen."*	N/A	N/A	N/A	N/A
Digital systems used in purchasing	N/A	N/A	N/A	N/A	N/A	N/A
The focus of the systems	N/A	N/A	N/A	N/A	N/A	N/A
Perceived relevance of the System Innovation Scout	*"… omdat er tijdig een trend of nieuw systeem ontdekt moet worden …"*	*"Implementatie hier van zou veel tijd nodig hebben maar ik denk zeker dat dat toekomst heeft.."**	*"De System Innovation Scout zou kunnen bijdragen met het geven van nieuwe inzichten die voor ons bedrijf nu niet voor te stellen zijn."**	*"Ik denk dat dat zelfs de aankomende 5 tot 10 jaar een vereiste is, dat je zulke mensen aan boord hebt. … er moet iemand zijn die een systeem bedenkt en implementeert…"**	*"Ik denk dat de System Innovation Scout belangrijk kan zijn omdat je als bedrijf zijnde altijd vooruit wilt lopen op de rest."**	*"Niet echt als specifieke rol … is het zeker het overwegen waard"*
Necessary competencies of the System Innovation Scout	N/A	N/A	N/A	N/A	N/A	N/A
Perceived relevance of the Supplier Onboarding Manager	*"…en vanaf daar moet er goed onderhandeld en gecommuniceerd worden tussen diegene die het systeem bedenken en de mensen intern."*	N/A	*"Hij draagt bij aan het contact houden met de leverancier en eventuele problemen oplossen."**	*" … de laatste links legt voor het volledig automatisch maken van een klantenbestelling naar een bestelling van ons bij een leverancier."**	*"De Supplier Onboarding Manager is een hele goede rol om dan de leverancier bij de hand te nemen en te zorgen dat ze alles begrijpen en er geen fouten worden gemaakt."**	N/A
Necessary competencies of the Supplier Onboarding Manager	N/A	N/A	N/A	N/A	N/A	N/A