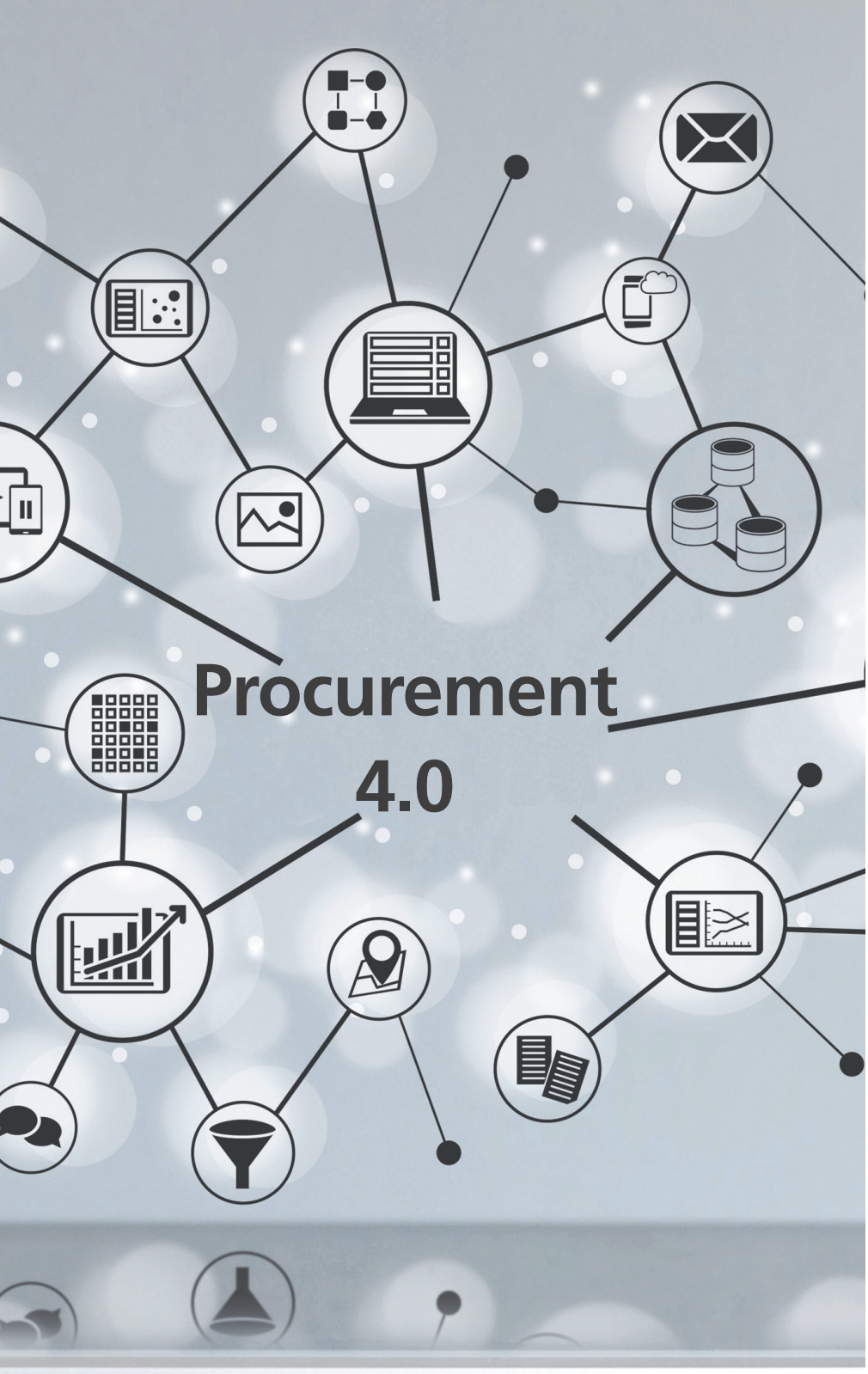

Bundesverband
Materialwirtschaft,
Einkauf und Logistik e.V.

Pilot Study

Procurement 4.0

The Digitalisation of Procurement

Fraunhofer
IML

Title
Pilot Study on Procurement 4.0 – The Digitalisation of Procurement

Publishers
Fraunhofer Institute for Material Flow and Logistics (IML)
Prof. Dr Michael Henke
Joseph-von-Fraunhofer-Strasse 2-4
44227 Dortmund, Germany
www.iml.fraunhofer.de

Bundesverband Materialwirtschaft, Einkauf und Logistik e.V. (BME)
Dr Christoph Feldmann
Bolongarostrasse 82
65929 Frankfurt, Germany
www.bme.de

Contacts
Fraunhofer Institute for Material Flow and Logistics (IML)
Center for Logistics and Mobility, HOLM (House of Logistics and Mobility)
Dr Axel T. Schulte
Bessie-Coleman-Strasse 7, Gateway Gardens
60549 Frankfurt, Germany
fraunhofer-frankfurt@iml.fraunhofer.de

Bundesverband Materialwirtschaft, Einkauf und Logistik e.V. (BME)
Judith Richard
Bolongarostrasse 82
65929 Frankfurt, Germany
judith.richard@bme.de

Design/layout/figures/printing
CitySatz GmbH

Procurement 4.0

The Digitalisation of Procurement

Authors

Fraunhofer IML
Karolin Pellengahr, Dr Axel T. Schulte

BME e.V.
Judith Richard, Matthias Berg

List of Figures

Dear readers,

Prof. Dr
Michael Henke

Industry 4.0, also known as the fourth industrial revolution, is currently the hot topic on everyone's lips. Everybody is talking about its impacts on value creation, production and logistics. Up until a few months ago, however, these discussions featured an unanswered question with regard to when and how the consequences of digitalisation, the development of autonomy and individualisation as the basic principles of Industry 4.0 on the field of procurement are actually being discussed.

In order to finally provide answers to this question, the Bundesverband Materialwirtschaft, Einkauf und Logistik e.V. (BME) and the Fraunhofer Institute for Material Flow and Logistics (IML) announced a strategic cooperation focusing on the central topic of Procurement 4.0 last November. This pilot study on the digitalisation of procurement represents the first result of this cooperation.

On the basis of interviews conducted with leading procurement managers in the German economy, employees at BME and the IML have analysed the current situation of Procurement 4.0 in corporate practice. The analysis reveals that the opinions of experts are, in some cases, extremely different: While some consider digitalisation to represent a historic opportunity for the world of procurement to also continue to live up to its strategic importance in the future, others believe that it tends to play a supporting role rather than be an active driving force within this context. Only one thing is certain: Procurement needs to position itself within this context in order to avoid being left behind and prevent other corporate functions from taking over.

In the fields of production and logistics, for example, the topics of Production 4.0 and Logistics 4.0 have already been a focus of discussion for several years. As a result, logistics is now often referred to as the area of application for cyber-physical systems and a driving force behind the fourth industrial revolution. The field of procurement, on the other hand, is barely ever mentioned in such discussions. This needs to change! As the business area with the most interfaces both within and outside of a company, procurement also needs to be a leading authority for questions concerning Industry 4.0 and its implementation alongside its current role as an innovation scout and expert for technology and management in the future.

I would like to take this opportunity to thank all participants actively involved in procurement at their respective companies for supporting our pilot study. Their assessments and opinions help to provide a clearer insight into the potential offered by the use of „Industry 4.0" in the field of procurement. Against this background, this pilot study is only able to provide initial orientation tools and starting points for the more extensive and in-depth discussions that are required with regard to this topic. We would like to expressly invite you to participate in these discussions. Please make the most of the opportunity to be actively involved in the digital improvement of the world of procurement and in doing so, make your procurement activities fit for the digital future..

I hope that you will enjoy reading this publication and look forward to receiving your feedback!

Prof. Dr Michael Henke

TU Dortmund University (Chair of Enterprise Logistics at the faculty of Mechanical Engineering) and the Fraunhofer Institute for Material Flow and Logistics IML (Director of the Enterprise Logistics section)

Dear readers,

Dr
Christoph Feldmann

The digitalisation of the economy will also lead to major changes in the field of industrial procurement. A changing procurement portfolio, the opportunity to establish networks with partners along the supply chain and the real-time availability of internal and external data are just a few of the developments that reveal the opportunities and challenges connected to this digitalisation. Industry 4.0 will cover all departments and divisions, especially in the world of procurement. When it comes to the role that it will play, the procurement managers from leading companies in the German economy are currently of extremely different opinions. This was also confirmed by our study on „The Digitalisation of Procurement – Procurement 4.0", which was conducted by the Fraunhofer Institute for Material Flow and Logistics (IML) in cooperation with the Bundesverband Materialwirtschaft, Einkauf und Logistik e.V. (BME), which is internationally known as the Association Supply Chain Management, Procurement and Logistics.

Many of the Chief Procurement Officers surveyed in the study consider digitalisation to be a historic opportunity that procurement needs to use in order to also continue to do justice to its strategic importance in the future. The decision makers in the field of procurement are of the opinion that procurement must play a leading role as a driving force behind the upcoming transformation. The main new development offered by Industry 4.0 is the establishment of digital networks between several different companies. This is precisely where procurement is expected to pave the way by setting the pace for this process. The experience gathered by procurement departments will enable them to successfully establish this new quality when working in cooperation with different companies.

The aim of the development is to work together to advance innovations within a value creation network. This approach extends far beyond the in-house optimisation measures that have already been feasible to date. On top of this, the Internet of Things is placing even stronger demands on strategic procurement, meaning that new alliances and partnerships are required in order to create customer-specific solutions. Conventional products and commodities are becoming „intelligent" and therefore developing into core components of Industry 4.0. The process competence and market expertise of the field of procurement is absolutely essential when it comes to using these components.

In contrast, other participants in our survey do not consider such a pioneering role to be suitable and/or do not believe that it can be sufficiently implemented in practice. They tend to view procurement as an area that actively paves the way for and supports innovative ideas by introducing them to the company but does not act as a driving force. Digitalisation has also put procurement in an ideal starting position in which it can fully perform its function as a gatekeeper and in doing so, make a significant contribution towards a company's business success. In order to achieve this, however, it is also essential that corporate management teams establish and advance digitalisation within their companies. As a result, it can most definitely be said that procurement departments need to adopt a clear position within companies with regard to the topic of „Procurement 4.0" in order to ensure that they are not left behind.

I would like to take this opportunity to thank all of the decision makers in the field of procurement who participated in our study for their support. Their input has played a significant role in making this study so successful. On the basis of their statements, we were able to detect important trends in Procurement 4.0. We hope that these results of our study will provide you with up-to-date facts, figures and statements that will enable you to find answers to important strategic questions.

I hope that reading this publication will provide you with new information and valuable ideas and impetus for your successful management of Procurement 4.0.

Dr Christoph Feldmann, CEO of BME e.V.

Management Summary

The fourth industrial revolution is a reality. Regardless of how the developments driven by digitalisation opportunities are labelled, the way in which products and services are created and offered and the communication, transportation and even payment activities involved are going to change radically. The fact that these changes concern all corporate functions is by no means new. As a central interface to internal and external partners in the value chain, procurement is sure to play a special role against this background.

This study was therefore initially based on the theory that the fourth industrial revolution offers procurement a unique opportunity to meet the demand that it plays a strategic role. The opinions of the surveyed procurement managers and CPOs from a total of 25 companies and two universities form the core of this pilot study, which is designed to act as a source and starting point for more extensive and detailed investigations into the topic of Procurement 4.0. The opinions can be summarised as follows:

1. **Procurement is shrinking and operative procurement is becoming autonomous in most areas.**

   Operative procurement processes can be virtually completely digitalised, even to the extent that they are becoming autonomous. Once this happens, strategic procurement is only able to manage and monitor these processes.

2. **The demands placed on and expectations of strategic procurement are growing and the demand for a higher value contribution is therefore increasing.**

   The tasks that purchasers are expected to fulfil and the demands placed on them will become more and more complex in the future. The fact that companies are now offering their customers hybrid complete solutions rather than only offering individual products is increasing the demands placed on the field of procurement. Several products including services are now being sold to customers and procurement needs to factor in this development accordingly.

3. **In the future, procurement will take on a completely different form and traditional purchasers will be a thing of the past.**

   In the future, purchasers will need to offer a multitude of different talents. They will work as interface managers on both an internal and external level and will additionally need to display a high level of technical understanding given that they will increasingly transform into product developers. The development of purchasers into data analysts has already begun.

4. **Personal relationships will also continue to be extremely important in Procurement 4.0.**

   Although technologies create a multitude of new opportunities for companies, they do not replace personal relationships. They may indeed make communication even easier but they do not necessarily improve it. Personal relationships with suppliers and internal customers continue to form an important basis, especially in the field of procurement.

5. **5. Procurement is not fully responsible for the implementation of Industry 4.0 but it does play an essential role.**

   A company's executive board or management team is responsible for advancing Industry 4.0 at the company in question. Procurement plays an important role by taking on a share of this responsibility.

6. **The changes taking place relate to all relevant dimensions: technologies and systems, organisation and processes, management and people and also business models.**

   Digitalisation changes all areas of a company and the developments connected to digitalisation cannot be viewed as separate entities.

7. **Creating transparency is the most important requirement in order to be able to implement Industry 4.0.**

   Creating transparency means that knowledge is provided in a clear structure. When it comes to the topic of „Industry 4.0", much more clarification is still needed in order to remove existing hurdles and enable companies to approach the implementation of Industry 4.0.

8. **Big data and data processing technologies are key technologies involved in digitalisation and play a decisive role, above all in connection with networking.**

   The fact that all stakeholders within a company and within the supply chain can view the same amount of data from a shared perspective and have the same analysis options improves communication between these stakeholders and leads to quick decisions.

9. **Procurement needs to adapt its own structures and processes to suit digitalisation.**

   In the future, procurement departments need to be able to react in real-time and provide meaningful information. In order to do so, they need to digitalise their processes to the furthest possible extent so that they can focus on core processes. Working with big data and data and using assistance systems or augmented reality solutions support the digitalisation of procurement.

10. **Procurement needs to manage a procurement portfolio that has been partially modified and is becoming increasingly digitalised.**

    Both procurement processes and the products that need to be procured are subject to the digital transformation. Alongside a modified product portfolio, procurement departments also need to procure new machines, tools and raw materials for manufacturing new products. New business models therefore also need to be developed in these procurement departments.

11. **Vertical and horizontal networking (by means of technologies) facilitates the transformation from a functional perspective to a process-based perspective - This opens up the possibility for the unrestricted digitalisation of procurement and the entire procurement portfolio.**

    Vertical and horizontal networking brings about the process-based perspective and in turn, the use of technologies and systems enables networking activities. Networking is the essential factor when it comes to this development. After all, stakeholders cannot benefit from the advantages of digitalisation without sharing their expertise with others.

12. **Procurement is a driving force behind horizontal networking.**

    When it comes to horizontal networking, procurement bears the full responsibility. Procurement therefore plays an essential role in the implementation of Industry 4.0. It needs to bring innovations and technologies to a company so that the company is able to successfully master the fourth industrial revolution.

These initial findings and focuses need to be promptly discussed in more detail and used to create a roadmap containing concrete recommended measures and a plan of action.

The Fraunhofer IML and BME e.V. are therefore creating a Think Tank for Procurement 4.0 in which proven experts from the fields of industry and science will immediately work together to tackle these tasks.

1 Introduction

1.1 Initial Situation and Objectives

Industry 4.0 is currently the main topic of discussion at many companies. Nevertheless, the fourth industrial revolution is only just beginning. In light of the wide variety of the opportunities and the international race to become the pioneer of Industry 4.0, companies need to use the new possibilities available to them and quickly make the existing ideas a reality. The main focus of this pilot study is placed on digitalisation in the corporate area of procurement. In order to explore this topic, the Fraunhofer IML and BME e.V. have put forward the following initial hypothesis:

The fourth industrial revolution offers procurement the unique opportunity to meet the demand that it plays a strategic role.

Given its direct interface to suppliers, the field of procurement can bring innovations into a company and therefore has the opportunity to establish a new position within the entire network (both on an internal level and outside the company) and become strategically relevant. This external networking also enables procurement to make a significant contribution towards the establishment of new business models on a company level. In the future, new digital opportunities such as the real-time availability of data will lead to the improved management of procurement organisation activities and the development of more efficient procurement processes. The opportunities made available by digitalisation give procurement departments the chance to establish themselves as value creation managers and innovation scouts both within and outside of a company and to increase the value that they contribute to the company on the whole.

In order to also be able to use these opportunities, procurement needs to actively explore digitalisation and play a role in shaping it. When doing so, it does not need to completely reinvent itself but instead build on its existing strengths. The fourth industrial revolution offers procurement a unique opportunity to meet the demand that it plays a strategic role. The pilot study on „Procurement 4.0 – The Digitalisation of Procurement" examines this thesis and uses expert interviews as a basis to provide initial orientation tools that can be used successfully implement the repositioning of procurement departments.

1.2 The Approach and Structure of the Pilot Study

The aim of this pilot study is to identify trends, developments and initial problem-solving approaches and to use them to identify the first fields of action involved in shaping the change connected to digitalisation for the field of procurement. In line with this aim, the main focus was placed on recording the current level of knowledge and the current technological progress of companies in order to establish the right foundation for providing orientation tools at the end of the study.

The pilot study is based on interviews with experienced procurement experts, CPOs and high-ranking procurement managers from well-known companies. When selecting respondents, the focus was placed on achieving a highly heterogeneous participant structure featuring experts from companies representing different sectors and of different sizes. Only companies with headquarters based in Germany, Austria and Switzerland were surveyed as part of the study. Chapter 1.3 provides information on the precise participant structure.

The impacts of the fourth industrial revolution not only affect the field of procurement but also all other corporate departments and divisions. The companies were therefore not only asked about the specific impacts and their significance in terms of procurement, but also their general opinions on digitalisation and Industry 4.0 and the importance for the company as a whole.

This pilot study is an exploratory study given that Industry 4.0 in general and Procurement 4.0 in particular are topics that are only just beginning to be implemented in companies, meaning that concrete problem-solving approaches are rarely available. The data were collected from personal interviews and interviews conducted over the telephone by the Fraunhofer IML and BME e.V. The interviews were based on 15 central questions (see appendix 1), most of which were posed as open questions based on the fact that the formulation of closed questions is neither possible nor appropriate given the current state of research on Procurement 4.0. The QDA (qualitative data analysis) software NVivo was used to support the analysis of the interview results and the evaluation of the data obtained (http://www.qsrinternational.com/). The software was used to process the data obtained, for example by compacting and encoding them in order to objectify trend statements and tendencies.

The structure of the pilot study (see figure 1) and the corresponding presentation of the interview results are explained in the paragraphs below.

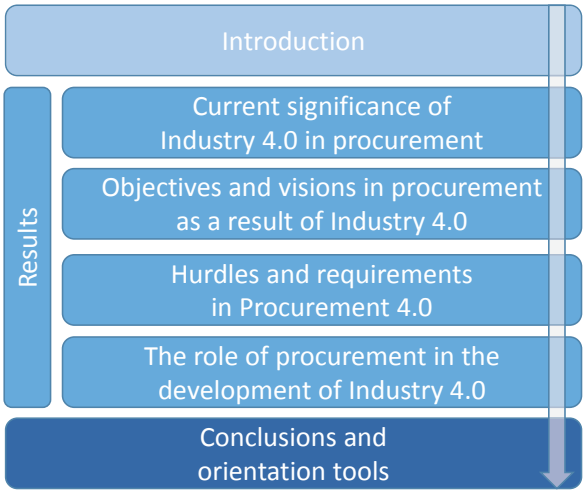

Figure 1: The structure of the pilot study

The first stage of the study presents and analyses the current value of Industry 4.0 and Procurement 4.0 in practice, especially with regard to the prevailing state of knowledge and the progress made with the implementation of Industry 4.0 technologies (chapter 2.1).

For this purpose, different definitions of the term „Industry 4.0" were recorded. The next stage of the study focuses on the personal opinions of all respondents with regard to the influence that the prevailing developments are having on their company as a whole and on its procurement department. The study then goes on to present an evaluation of the technological progress made on the basis of the current use of specific technologies that are already available at companies or are currently being introduced.

Alongside the personal opinions of the respondents, the study also examined how firmly digitalisation is established in the companies' corporate and procurement strategies. In order to determine whether digitalisation is being actively advanced at the companies surveyed, the coordination of activities was analysed. The final stage of this part of the study presents different perceptions of the role that will be played by procurement in the future.

After the concluded investigation into the current value of Industry 4.0 in procurement, the expert interviews are used as a basis to determine the most important objectives of procurement with regard to Industry 4.0 and to illustrate visions for the world procurement in the future (chapter 2.2). These objectives and visions help to provide an insight into the desired target state. In order to systematise the objectives, four dimensions in which changes need to occur and requirements need to be established were identified. These are the dimensions of „Technologies and Systems", „Organisation and Processes", „Management and People" and „Business Models". This study identifies the current obstacles that are impeding the development of Procurement 4.0 in each of these dimensions. It then identifies the requirements that need to be established in each dimension in order to enable the desired objectives to be achieved (chapter 2.3). The results of the study are concluded with a presentation of opinions on the role played by procurement in the development of Industry 4.0 (chapter 2.4).

On the basis of the results of the study, chapter 3 presents three perspectives that procurement should pursue in the future. The perspectives are then used to propose a number of different orientation tools that should ensure the successful establishment and development of the most important topics involved in the field of procurement. The pilot study concludes with a look into the future in which it brings together the core statements made in the pilot study in order to prepare for the more extensive and detailed investigations and discussions that need to take place.

1.3 Facts and Figures

Interviews were conducted with a total of 25 respondents from different companies and two representatives from universities (see figure 3). The process used to select these respondents guaranteed a highly heterogeneous participant structure.

Figure 2 shows the distribution of the participating sectors and the turnover, procurement volume and number of employees of the companies surveyed and their procurement departments.

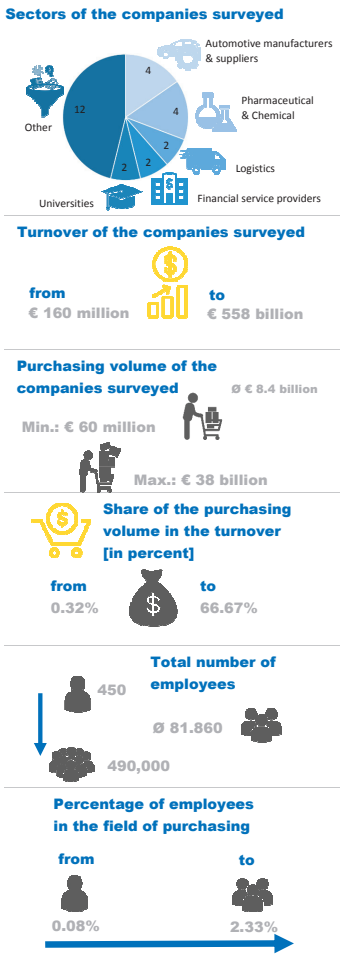

Figure 2: Facts and figures on the interview paparticipants

*The facts and figures only account for the values of Audi AG (and not the entire Volkswagen Group).

AGCO	AGCO Corporation
ARCHROMA	Archroma Ibérica SLU
VOLKSWAGEN / Audi	Audi AG / Volkswagen AG
AXA	AXA Versicherung AG
BMW	Bayerische Motoren Werke Aktiengesellschaft
COMMERZBANK	Commerzbank Aktiengesellschaft
Deutsche Post DHL Group	Deutsche Post DHL Group
Deutsche Telekom	Deutsche Telekom AG
Dräxlmaier	Dräxlmaier Group
HELLWEG Die Profi-Baumärkte	Die Profi-Baumärkte GmbH & Co. KG
kfw BANKENGRUPPE	KfW Bankengruppe
K+S	K+S AG
THE LINDE GROUP	Linde AG
MERCK	Merck KGaA
nolte KÜCHEN	Nolte SE
PHOENIX CONTACT	Phoenix Contact GmbH & Co. KG
DIE POST	Post CH AG
Queisser PHARMA	Queisser Pharma GmbH & Co. KG
RWE The energy to lead	RWE AG
SANOFI	Sanofi-Aventis Deutschland GmbH
SIEMENS	Siemens AG
STABILUS	Stabilus GmbH
TALENT-net People for Procurement & Supply Chain Management	TALENT-net GmbH
wilo	WILO SE
DHBW Duale Hochschule Baden-Württemberg	Duale Hochschule Baden-Württemberg
der Bundeswehr Universität München	Universität der Bundeswehr München

Figure 3: The companies and organisations involved in the pilot study

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2 The Results of the Pilot Study in Detail

This chapter of the study presents the detailed results of the expert interviews. The results are not presented on the basis of the survey structure but instead discussed according to the identified focuses of the individual interview statements. The chapter initially focuses on the current significance of Industry 4.0 for the field of procurement and presents the current state of knowledge and development. This is followed by a description of the expectations placed on the new digital era, which are reflected in both the objectives for and visions of the new profile of procurement. The chapter then goes on to explain the current obstacles and requirements facing the development of Industry 4.0. Chapter 2 is concluded with a presentation of opinions on the role played by procurement departments when it comes to supporting, promoting and shaping Industry 4.0 in the field of procurement.

2.1 The Current Significance of Industry 4.0 in Procurement

What is the significance of the developments of the new digital era for companies and for procurement in particular? How are companies dealing with these developments? The relevance of „Industry 4.0 in procurement" in the present day and whether its significance for the future is being recognised is presented below.

At the beginning of the interviews, the respondents were asked to evaluate the influence of Industry 4.0 on their company and its procurement department. The participants consistently rate the influence that Industry 4.0 has on their company on the whole as very high and expect it to tend to strengthen over the coming years. In the responses to this question, the participants use words such as significant, strong, revolutionary, gigantic and enormous. The experts all agree that digitalisation will lead to fundamental changes in the way in which companies and people currently work. Despite the consistent evaluation of the influence of Industry 4.0 on companies as a whole, there is no clear assessment of the influence that Industry 4.0 will have on procurement. While some experts believe that its influence on procurement will be minor in comparison, others are of the opinion that procurement cannot be viewed as a separate entity from the company as a whole and therefore believe that its strong influence applies equally in this corporate area.

2.1.1 Current Definitions and Technological Progress

Figure 4 on the following page shows different definitions and opinions concerning the concept of „Industry 4.0". While some experts describe Industry 4.0 as the establishment of a network between all of the partners in the supply chain, others use synonyms such as automation and self-control to outline the concept. The use of the term „automation" in this context is interesting given that this factor can definitely be attributed to the third industrial revolution. This gives rise to the question of whether these responses also refer to the process of becoming autonomous. At this stage of the study, it is already evident that there are a number of different perceptions of the concept of Industry 4.0 that frequently have different scopes. The differences in the definition of the concept are particularly evident when it comes to the number of stages that respondents believe are involved in the value chain. Some respondents focus on the networking, digitalisation and development of autonomy of all internal interfaces within a company, while other companies also factor in all external interfaces. The explanations provided by the companies with regard to this factor tend to be rather short, not very concrete and lacking in expressiveness. This already indicates that a large amount of different information is available with regard to the concept of Industry 4.0 and that the content-based classification of the concept is still partially unclear. A clear boundary between Industry 4.0 and the preceding era (Industry 3.0) is also not evident.

The experts were asked about their personal opinions with regard to the current progress being made in the implementation of Industry 4.0 applications in practice at their company and in its procurement department. The opinions were classified according to a scale of 1-7 that represents the companies' level of progress with regard to the implementation of Industry 4.0 applications.

The lowest mark on the scale indicates that no „4.0 technologies" have been implemented in a company or its procurement organisation to date. The highest mark on the scale indicates that a company has already been able to implement three or more applications. Figure 5 below shows the quantitative results of this question.

Only 5% of the respondents stated that their companies have not implemented any activities to date. Slightly more than a quarter of the survey participants claimed that the first applications are now being implemented.

Figure 4: Definitions of Industry 4.0

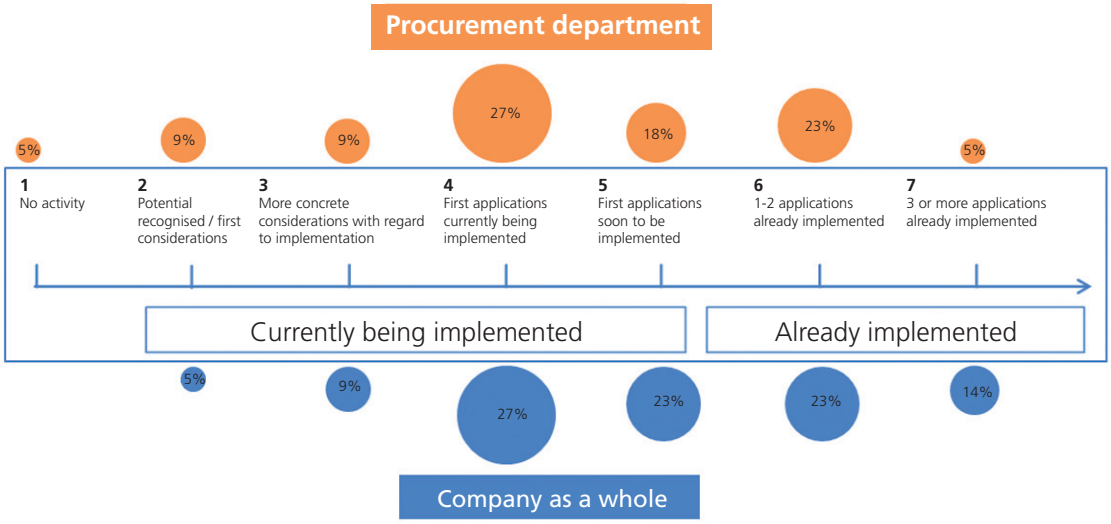

Figure 5: The experts' personal opinions on the current progress being made in the implementation of Industry 4.0 applications at their company and in its procurement department

Some applications that partially affect procedures and processes within an organisation but also partially make the incorporation of external interfaces easier have already been implemented.

The technologies that have already been implemented and planned primarily concern the area of data collection and processing. Alongside applications in the field of sensor technology, remote RFID and barcode systems are used to read customer, product and production data. In order to increase their service orientation on their interface with end customers, the companies are working on launching their digital market presence and developing apps. Initial activities are still being carried out in the area of assistance systems that are designed to support employees in their day-to-day work (e.g. pick-by-light technology, smart glasses (augmented reality) and mobile devices). In individual cases, observations are also made with regard to achieving autonomy. These developments substantiate the roadmap describing the journey towards Industry 4.0 that was published in the study on „Erschließen der Potenziale der Anwendung von Industrie 4.0 im Mittelstand" („Tapping into the Potential of the Application of Industry 4.0 at Medium-Sized Enterprises") conducted by the German Federal Ministry for Economic Affairs and Energy (BMWi).

The use of electronic procurement systems in the form of catalogue systems is already widespread in the field of procurement in the present day. The increasing digitalisation of order and purchase-to-pay processes (P2P) can be expected in the future. On the interface with suppliers, the trend is developing towards the introduction of electronic platforms that are designed to simplify communication and provide important data and information.

The results of chapter 2.1.1 can be summarised as follows:

The results clearly confirm that digitalisation has a huge influence. They do not, however, sufficiently substantiate why this influence is so large and what changes can be expected in detail.

The definitions of the concept of Industry 4.0 vary and have different scopes. They are also very short and lacking in meaning in part.

The technology and systems specified above demonstrate that this area of the study not only involves the discussion and evaluation of future-oriented „4.0 Technologies" but also, to a certain extent, the digitalisation of processes that other companies not involved in the survey have already been using in digital form for many years and would therefore probably not consider to be a sign of progress in the development of Industry 4.0.

It is clear that the companies involved in the survey have very different starting points and that their knowledge when it comes to Industry 4.0 is partly incomplete. The significance and scope of the changes that Industry 4.0 brings for procurement departments and companies have also not yet ‚arrived' at every company..

2.1.2 1.4.2 The Incorporation of Industry 4.0 in Corporate and Procurement Strategies

Although the terms of „Procurement 4.0" and „Industry 4.0" are not normally directly mentioned in the strategy, digitalisation is normally factored into the corporate strategy formulated by most companies with just a few exceptions. These strategies use terms such as innovation, digitalisation and development of autonomy and discuss the use of tools and systems. Corporate strategies often additionally contain concrete objectives that can only be achieved if the companies concerned use innovations and 4.0 applications. These objectives admittedly also include conventional objectives that become more important when considered against the background of digitalisation (for example optimising processes and increasing efficiency). Over half of the respondents whose companies are already pursuing a corresponding digitalisation strategy stated that their company has also already firmly established digitalisation in its procurement strategy. The positioning of a corresponding digitalisation plan solely in the strategy pursued by the procurement department could also be identified at a few companies.

About one fifth of the companies that participated in the study have already intensively explored the fourth industrial revolution and its impacts on their organisation. Virtually all of the respondents from these companies referred to the „digital transformation" of their organisations. These companies have all recognised that digitalisation is an important benchmark for the upcoming years and have included it in clear objectives that are above all firmly established in their corporate strategy, but also in their procurement strategy. The year 2020 seems to play an essential role as the deadline by which most of the companies want to achieve the goals specified in their strategies. Another common characteristic among these companies is the fact that their management teams act as the driving force behind digitalisation.

2.1.3 Coordination of Measures and Activities Concerning Industry 4.0 at Companies

All of the respondents involved in the study were asked whether and if so, how the topic of „Industry 4.0" is coordinated and managed at their companies. This question aims to ascertain whether companies or their procurement departments conduct targeted activities in order to implement the „4.0 Topics". The respondents were specifically asked about the type of organisation and incorporation of these topics at their companies. Figure 6 shows the percentage distribution of the responses to the question of whether companies have a central unit that manages activities for the entire organisation or uses decentralised activities that are centrally recorded.

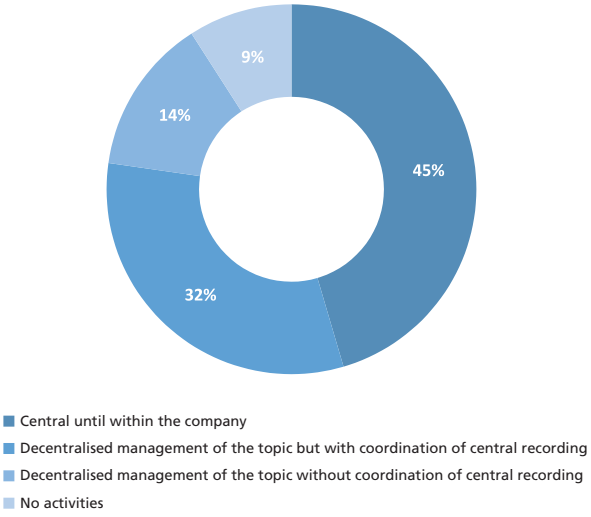

Figure 6: Coordination of measures and activities concerning Industry 4.0 at companies

45% of the companies involved in the survey have a central unit that is responsible for coordinating the topic of „Industry 4.0". The central teams are often comprised of representatives from several different areas of operation. This unit identifies the most important developments for the company and manages the implementation of measures and innovations within the group or organisation. The unit is normally established directly on a management or executive level and/or reports to this top management level. Concrete examples of the use of such units in practice include the creation of new departments or divisions („Digitalisation", „Research & Innovation" or „Big Data"), the introduction of new functions within the company (the Chief Digital Officer, CDO) or the establishment of operation boards.

32% of the respondents state that the topic is managed on a decentralised level at their company but that activities are recorded centrally in order to avoid duplication of work and to reveal interfaces. This approach involves several project teams working together in individual areas of operation. Although activities take place in several different areas of the company, these activities are coordinated and the individual groups exchange their knowledge and experiences.

At 14% of the companies, activities also take place on a decentralised level but are not recorded in one place. The companies are therefore often lacking the required

transparency as to what is going on in other areas and units.

9% of the participants in the study stated that their company conducts no activities whatsoever when it comes to the coordination and management of Industry 4.0.

The results of chapters 2.1.2 and 2.1.3 can be summarised as follows:

A general connection can be identified between the incorporation of digitalisation in corporate and procurement strategies and its coordination and management within a company. The stronger and more defined the incorporation of „Industry and Procurement 4.0" into the strategy, the more likely the activities within the company are to be coordinated by a central unit. Weaker incorporation into the strategy, on the other hand, goes hand-in-hand with more uncoordinated activities within the company.

The incorporation of digitalisation into a company strategy alone is not, however, sufficient and companies need to produce a roadmap containing concrete tasks, action plans, activities and responsibilities. This roadmap should additionally specify the time frame in which these objectives should be achieved.

In order to position the topic of „Industry 4.0", digitalisation needs to be THE predominant topic at a company and should not be treated as a side issue.

Industrie 4.0 in procurement in 4 dimensions

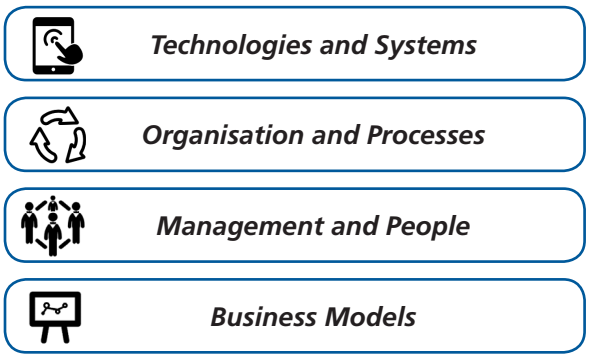

Figure 7:
Industry 4.0 in procurement in four dimensions

2.2 A Presentation of Procurement 4.0

After the current status of Industry 4.0 was revealed in chapter 2.1, chapter 2.2 now takes a look into the future and presents the objectives and visions arising from Industry 4.0 that are expected to form part of the range of tasks carried out by purchasers in the future.

2.2.1 Objectives in Procurements as a Result of Industry 4.0

Respondents were asked about the objectives of procurement departments with regard to Industry 4.0 in four different dimensions in order to establish systematic transparency and identify focal points. These are the dimensions of Technologies and Systems, Organisation and Processes, Management and People and Business Models (see figure 7). The participants in the pilot study expect Industry 4.0 in the field of procurement to enable them to achieve objectives that are above all connected to the availability of new data and information. Further objectives mentioned by the respondents mainly concern the optimisation of processes by means of digitalisation, developing autonomy and internal and external networking. The respondents also expect to be able to tap into new products and markets.

Technologies and Systems:

- Real-time availability of data and information (e.g. for early error detection, for avoiding risks and on the quality of parts from suppliers)
- Improved data quality (higher significance due to information and not only data)
- Better data availability (more data available)
- Data access from all locations
- A fully automated flow of information
- Simplified and improved communication (vertical and horizontal)
- Communication without any media disruptions
- Increased transparency of data and information
- More transparency in the supply chain (e.g. supplier risk management)
- Improved management options and a better decision-making basis
- Improved evaluation of customer data (more targeted customer approaches, development of more individualised needs-based products, etc.)

- A quick response to changes (e.g. innovations in the market)
- Obtaining trend statements

Organisation and Processes:

- Faster processes
- Digitalisation of processes and procedures
- Standardisation of processes
- Continuous processes
- Lower process costs
- Simpler and improved workflows
- More stable processes
- Developing autonomy
- Increased efficiency
- More flexibility
- Quick reaction times
- Closer connections to and involvement and integration of suppliers
- Better global networking (across different value creation levels)

Management and People:

- Improved human resources planning
- Workload on staff reduced by the digitalisation of processes
- Combining activities
- Strategic placement of procurement within the company
- Developing strategic products
- Tapping into strategic markets
- Bigger savings
- Achieving better purchase prices
- Creating synergies

Business Models:

- Preserving competitiveness
- Easier communication with customers and suppliers
- More customer-oriented business models
- Stronger development into a service provider (alongside core industrial services)
- Creation of new networks

The results of chapter 2.2.1 can be summarised as follows:

Technologies and Systems: Although the question focused on technologies and systems in general, all of the objectives mentioned fit into the category of big data. The objectives developed in this area are already very concrete and indicate that a certain level of expertise is responsible for this.

Organisations and Processes: The objectives specified refer solely to processes. A comprehensive range of optimisation measures ranging from the simplification of processes through to the full development of autonomy were named by respondents.

Management and People: The (company) objectives specified with regard to this dimension are mainly strategic.

Business Models: The fact that the objectives relating to business models are still extremely vague supports the statement made at the beginning of the study that the significance and opportunities provided by Industry 4.0 in the field of procurement have not yet been fully recognised.

2.2.2 Visions of the Procurement Profile 4.0

In the future, the field of procurement will take on a completely different form. The role played by purchasers will change radically.

The experts involved in the survey all agree that procurement will change radically as a result of digitalisation and Industry 4.0. They are, however, of very different opinions when it comes to the future role that people will play in the field of procurement. How important will the human factor actually still be in the future? Will fewer employees be required in Procurement 4.0 in the future or will people continue to be the important factor in the field of procurement?

1. Operative procurement will no longer exist.

Operative procurement will become extinct. The complete operative and administrative area will be digitalised.

2. Procurement will shrink.

The number of employees involved in the field of procurement on both an operative and strategic level will decrease in the future, above all due to the fact that the role of operative purchasers will seemingly virtually disappear. Respondents also think that procurement may not exist at all in the future and that companies would instead procure procurement services from elsewhere if procurement is not one of their core areas of expertise. Even the outsourcing of existing areas of expertise to a service provider seems to be a realistic scenario given that digitalisation causes areas of expertise to shift.

3. Purchasers will become multi-talents.

In consideration of the multitude of descriptions of purchasers in the future, individuals in this role seem to require many new abilities.

- Procurement departments will work as coordinators, multi-talents, controllers and contract managers.
- Procurement departments will become consulting departments.
- The role of purchasers will also grow increasingly closer to that of product developers.
- Purchasers will become data analysts.
- Purchasers will become managers of framework conditions.
- The role of purchasers will grow increasingly closer to that of interface managers.

4. Strategic procurement demands a higher level of qualification.

Given the theory proposed above, this statement comes as no surprise. In future, there will be fewer purchasers but they will have a higher level of qualification. Procurement departments will instead be small groups of powerful and strategically oriented employees and their activities will become more complex as time goes by.

5. People continue to play a central role in the field of procurement.

Personal contact continues to be an important factor. People still play an essential role in negotiations and supplier relationships. Personal relationships are still extremely important – people are and remain the central factor in the world of procurement.

The results of chapter 2.2.2 can be summarised as follows:

It can be assumed that the expected disruptive changes are partly responsible for the fact that procurement is so reluctant when it comes to the development of Industry 4.0. It is therefore even more important to highlight the opportunities and advantages that Industry 4.0 offers companies by providing them with more information and clarification.

How important will the human factor be in Procurement 4.0? More important than ever? Or less important? When it comes to this question, the experts have yet to agree.

2.3 Hurdles and Requirements on the Journey towards Procurement 4.0

The hurdles involved in the journey towards Procurement 4.0 back up the previous results of the interviews and provide information on the reasons behind the status quo of all „4.0" developments. The hurdles connected to the requirements enquired about in the survey are also very helpful when it comes to being able to formulate specific initial measures and orientation tools (chapter 3) that can be used to actively promote and support these developments.

The hurdles and requirements were presented in the same way as the objectives, namely in the four dimensions of Technologies and Systems, Organisation and Processes, Management and People and Business Models.

2.3.1 Dimension: Technologies and Systems

2.3.1.1 Hurdles

Most of the hurdles listed below are connected to the handling of data. Uncertainty when handling data is

identified as a hurdle given the large amounts of data that can be generated. An inundation of data and information therefore poses a risk if users are unable to handle data correctly.

Data security is being questioned and suitable data protection is currently thought to be too limited and not trustworthy. The experts responsible for technologies and systems believe that current IT systems are only suitable for processing large amounts of data to a certain extent and identify both system failures and the high error-proneness of existing systems to pose a large risk. This in turn leads to the danger of increased dependency on systems.

The actual availability of data in the present day is also identified as a hurdle given that the final implementation of big data is still considered to be a long way away and users are often not yet able to benefit from the advantages.

The experts view the introduction of new systems with criticism and question not only their actual suitability and ability but also their compatibility with existing systems. An unclear and non-transparent supplier market for new technologies is also considered to be yet another obstacle alongside force majeure events such as large-scale power cuts.

2.3.1.2 Requirements

When labelling the most important requirements, the experts above all refer to sufficient data protection and IT security and improved security standards. Nevertheless, each company must ultimately make its own decision when it comes to how to correctly handle data security and should not wait until other stakeholders such as the world of politics create the statutory framework.

In order to progress towards their digitalisation target and keep up with the current state of technology, companies need to invest in systems that are both further developed and simpler and can be networked with the largest possible number of interfaces.

New technological standards, stable interfaces and the easy handling of new solutions were also labelled as requirements.

2.3.2 Dimension: Organisation and Processes

2.3.2.1 Hurdles

Both the organisation and the adaptation of processes and procedures in the field of procurement are currently lagging behind technical further developments to a large extent. There are too many classic process patterns. Workflows are characterised by classic process organisation structures and processes do not cover several different areas of operation. As a result, observations only focus on sub-processes and opportunistic behaviour is supported.

2.3.2.2 Requirements

Companies need to step away from classic organisational models. They need to focus on establishing a new approach oriented towards the comprehensive observation of processes so that they can achieve the horizontal and vertical networking of process steps rather than only digitalising sub-processes.

In the future, organisational activities and processes need to be further developed and adjusted in accordance with new technologies and systems.

2.3.3 Dimension: Management and People

2.3.3.1 Hurdles

The main factor labelled as an obstacle in this dimension is the lack of transparency. At present, there is no uniform understanding of the definition and classification of the terms Industry 4.0 and Procurement 4.0, neither within the respondents' own companies or beyond the boundaries of individual companies. The non-transparent information situation (a high information density with little significance and no precise points of reference) is also identified as a barrier. The fact that it is more difficult to build up a base of knowledge means that companies do not have any concrete perceptions of the opportunities available to them thanks to digitalisation.

The second most frequently mentioned hurdle is fear connected to cultural change. - How can staff be properly involved? At present, there is no clear information as to

how companies adapt to new circumstances and above all how they deal with the necessary cultural change. A lack of qualification measures for staff with regard to future challenges (e.g. establishing a base of technical knowledge) is also causing concern.

Many companies are currently lacking in willingness when it comes to investing in new technologies or are unable to do so because they do not have the required investment funds. On top of this, they are not prepared to take risks. This is above all due to the fact that the advantages and therefore also the cost-effectiveness of new technologies are being questioned. There are also no existing business cases that prove the cost-effectiveness of new technologies.

At the moment, there are not enough factors to drive development within companies. Companies generally act passively rather than taking action and shaping their future, and the decision-making process is too slow. The older age structure of management staff supports this current situation because managers are not open enough to new technologies. Companies are also lacking in resources for the placement and management of the necessary measures.

2.3.3.2 Requirements

The requirements in the dimension of management and people are diverse.

Management teams need to act as initiators that provide suitable ideas and impetus (shaping a Vision 4.0 and firmly establishing Industry 4.0 / digitalisation in the corporate strategy) so that the staff at their companies can act accordingly. They need to break free from their passive and observing role within this context and start to explore Industry 4.0 / Procurement 4.0. Management teams and therefore also management staff need to be active because the largest risk can be found in doing nothing. Having the courage to fail (and to accept failure!) and establishing a positive error culture can support this action. Being more open to new technologies and the changes that they bring (e.g. new organisational forms and „new people“) is another example of a necessary requirement that needs to be met in order to firmly establish a new approach within a company. The positive aspects that Industry 4.0 can bring to a company need to be recognised and suitably presented within the company in order to achieve an open approach and motivation to change. Resources that help to draw attention to the topic within a company need to be provided (e.g. creating a central company unit or several organisational units). In order to do so, companies may first need to find the right people to take on these new tasks (e.g. digital natives).

New cooperation models (e.g. with start-ups, market experts, subcontractors, users and programmers) need to be established and the exchange of information needs to be strengthened given that external perspectives will determine a company's success in the future. („We need an outside-in perspective“.)

The staff of a company need to be attuned to the new era at an early stage. In order to do so, companies need to create structures that enable them to fully implement the digital transformation, for example by involving employee representatives in order to minimise fears of job losses. Employees need to be trained in a timely manner and new qualification and further education measures, including those supported by external organisations, need to be developed in order to support and promote the expansion of technological expertise. Training and qualification need to be high on the agenda of every CPO.

2.3.4 Dimension: Business Models

2.3.4.1 Hurdles

New business models based on new technical opportunities are currently being identified and developed at too late a stage and the role played by procurement when it comes to supporting new business models tends to be underestimated.

Higher demands are being placed on procurement departments, for example the demand for services and hybrid additional products extending past a simple range of products.

2.3.4.2 Requirements

Procurement departments need to be able to quickly adapt to the changes in framework conditions caused by digitalisation. They should not only focus on individual products, but should instead aim to find complete solutions in the form of hybrid combinations of products and services.

Consistent questioning of well-established business models and a targeted search for and rapid development of new business models that are only made possible by digitalisation are considered to be important requirements.

Internal and external networking (e.g. with start-ups and technology companies) and a stronger integration of suppliers in the value creation network are needed for the creation of new business models.

The results of chapter 2.3 can be summarised as follows:

Technologies and Systems: The main focus in this dimension is placed on the handling of data. The hurdles identified predominantly concern the handling of huge amounts of data and a lack of data protection.

Organisations and Processes: Only a few hurdles and requirements were mentioned in this dimension. In comparison, a number of concrete objectives already exist with regard to processes.

Management and People: The objectives in this dimension tend to be rather vague whereas the hurdles and requirements are considerably higher. The reason as to why procurement currently seems to be holding back in this area is therefore clear and there is a risk that procurement may not make the most of the opportunity to reposition itself within the company in sufficient time.

The largest hurdles are

- a lack of transparency and knowledge
- no active attempts to explore Industry 4.0
- the shaping of cultural change and the ‚involvement' and qualification of staff are already a burden in the minds of those responsible
- a lack of willingness to take risks / a lack of willingness to invest

Business Models:

- New business models also lead to increased demands being placed on procurement departments.
- New business models based on new technologies need to be identified at an early stage.

2.4 The Role Played by Procurement in the Implementation of Industry 4.0

As could already be observed in the previous results, there are also a number of different perceptions of the role of procurement when it comes to the implementation of solutions for digitalisation and Industry 4.0. When examining the role of procurement, it is particularly important to ascertain how active the involvement of procurement departments should be when it comes to creating the necessary conditions for and implementing Industry 4.0. The results of this question additionally provide the first points of reference with regard to the initial hypothesis put forward, namely the idea that the fourth industrial revolution offers the unique opportunity for procurement to meet the demand that it plays a strategic role.

The opinions of the experts differ in response to this hypothesis. While some claim that procurement is a pioneer of and driving force behind Industry 4.0 at companies, others state that although procurement plays an active role, it is not responsible for and does not drive the entire development within a company. This group of experts prefers to assign procurement the role of an „active influencer" or „enabler" within the framework of its naturally advantageous position as an interface to all internal and external partners in the supply chain. Procurement needs to build on this foundation by becoming actively involved as a „network designer" and „bringing innovations to the company at an early stage".

The majority of the respondents believe this is the role played by procurement. All of the respondents rejected the idea that procurement plays the role of a follower. The relative distribution of opinions on the role played by procurement can be seen in figure 8. There is no doubt that procurement is a significant factor when it comes to digitalisation. The respondents who believe that procurement is an „active influencer" nevertheless believe that the overall responsibility for digitalisation lies with a company's management team and not its procurement department.

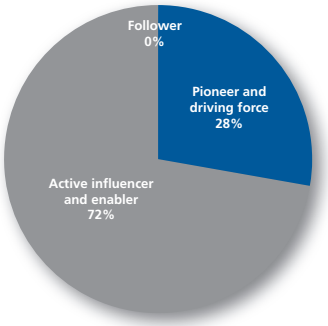

Figure 8: The relative distribution of opinions on the positioning of procurement

The various opinions are also summarised in figure 9 using the example of strong statements regarding Procurement 4.0.

„Procurement is currently missing out on its historic opportunity to prove its strategic importance."

„It is essential that procurement is an enabler or a pioneer. Under no circumstances should it be allowed to act as a follower."

„Procurement needs to play a much stronger role as a network manager."

„Procurement definitely needs to be a driving force, otherwise it will be forced back into its old performing role."

„Procurement needs to be a listening post to the field of technology."

„Procurement paves the way and acts as an enabler."

„Procurement needs to keep up with digitalisation: it is essential that it doesn't fall behind."

„Procurement plays a key role within the company: it understands processes and can generate value contributions."

„It is essential that procurement plays a pioneering role. This needs to be stipulated and demanded by the top management figures."

„A pioneering role would be too much. Procurement needs to be an active enabler."

„Procurement needs to be an active supporter that provides a company with innovative ideas."

„Procurement needs to be an enabler. It is the first port of call for the interface with suppliers. This interface needs to be better managed in the future."

„Procurement needs to be a gatekeeper and partner."

„Procurement is a key function that can be optimally used if it is approached in the right way."

„At the moment, procurement does not play a role and in the future, it will also tend to be a follower."

Figure 9: Opinions on the role played by procurement

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3 The Journey from Procurement to Procurement 4.0

The interview results presented have shown that there are many different perceptions of Industry 4.0 and the consequences that it may bring for the world of procurement. They also, however, show that the topic is having an impact on procurement and is increasingly leading to the realisation that action needs to be taken. In chapter 3, the central conclusions drawn from the results of the study are summarised against this background in the form of perspectives from which Procurement 4.0 can be viewed. The chapter also introduces initial fields of activity and orientation tools that show how the results of the pilot study should be further processed in the future.

3.1 Conclusions Resulting from the Pilot Study

This chapter presents three central perspectives from which Procurement 4.0 can be viewed according to the results of study. Figure 10 provides a clear overview of the perspectives, which form a basis for the fields of activity examined in chapter 3.2.

The digitalisation of procurement

The digitalisation of the procurement portfolio

From a functional perspective to a process-basedperspective: the operationalisation of digitalisation

Figure 10: The three perspectives from which procurement can be viewed

3.1.1 Perspective 1: The Digitalisation of Procurement

The digitalisation of procurement

This perspective solely focuses on the digitalisation of all processes and actions in the area of operation of procurement. This development is essential in order to ensure that procurement departments can optimally perform their main value-adding tasks. The more digital and above all autonomous procurement processes are, the more able procurement departments are to concentrate on their strategic tasks. One expert involved in the study described the digitalisation of procurement as a type of homework for procurement that seems to have a hygienic impact.

Against this background, the fact that procurement departments already have a certain understanding when it comes to big data can be viewed even more positively given that big data play a key role in procurement. The fact that companies already have a certain amount of expertise and have already implemented some measures when it comes to data is a good prerequisite for further development in this area. Data are, however, only really useful when viewed in an extended context, namely when data are summarised to produce information that can be used as a basis for decision-making processes.

Existing fears based on the changes expected seem to be resulting in a passive approach. Even the very consideration of the immense changes that we may face as a result of Industry 4.0 is creating a sense of paralysis. An example of this situation is the fact that there is currently no response as to how cultural change needs to be managed and how staff can be successfully ‚involved'. The question as to how the impending qualification requirements for employees (new training content and the time and scope of training) should be tackled is also leading to more questions than answers and causing companies to choose to observe the situation rather than take action.

Although the interview specifically asked respondents about the impacts on business models, the responses to this question and the information provided were rather limited. Many of the respondents have no concrete perspectives when it comes to these impacts on business models and their significance for procurement departments and companies. The experts also disagree as to whether new business models are a consequence of the achievement of all targets connected to Industry 4.0 or whether new business models are superior targets that precede all efforts and activities concerning Industry 4.0.

Companies are currently lacking a concrete roadmap as to how the targets that they set can be achieved and as a result, the implementation of Industry 4.0 is still unclear.

3.1.2 Perspective 2: The Digitalisation of the procurement portfolio

The digitalisation of the procurement portfolio

Two major changes are influencing the world of procurement. Alongside the digitalisation of procurement itself, the second major challenge is the digitalisation of the procurement portfolio. Perspective 2 refers to the core task of procurement, namely procurement and value creation. The value contribution made by procurement can be directly measured in this area. The demand for digital products and solutions already exists in the present day and procurement departments need to respond to it now. One of the changes in the portfolio is the addition of new products and components that will later be processed in the company's own production activities. Elements such as new raw materials, devices and equipment (for example a 3D printer) and tools required for the processing and finishing of the new products also belong to the new procurement portfolio. This involves the following challenges for the field of procurement:

- Expertise is required so that the right products and technologies can be procured and can in turn facilitate the creation of new business models.
- Procurement therefore first and foremost depends on internal (vertical) networking with other departments so that it can acquire the appropriate specialist knowledge and obtain relevant information.
- Secondly, procurement can then use its concentrated expertise to contact suitable suppliers (horizontal networking) and procure the new products.
- Expertise in procurement is above all required with regard to technology and systems in order to ensure that procurement departments can be an equal partner when working together with their internal and external partners. This means that further qualification measures for the field of procurement are becoming essential.
- New products additionally require procurement departments to expand their supplier portfolio. As a result, Industry 4.0 is causing horizontal networking to become even more significant.
- Innovation sourcing also gains new significance against the background of Industry 4.0. More and more innovations are being purchased and no longer produced by companies themselves for a wide variety of different reasons. The reduction of the „time to market" (being the first on the market), a lack of appropriate expertise in a company's own research and development department and quick access to state-of-the-art technologies are just some of the reasons that favour the decision to purchase technologies and reduce companies' own vertical range of manufacture. Nevertheless, this only increases the pressure placed on procurement departments and yet again emphasises how important technological expertise and also internal and external networking will become in the future.

3.1.3 Perspective 3: From a functional Perspective to a Process-Based Perspective: the Operationalisation of Digitalisation

From a functional perspective to a process-based perspective: the operationalisation of digitalisation

In serious terms, the digitalisation of procurement and the procurement portfolio is only possible if department and company boundaries standing in the way of an exchange of information occurring in as close as possible to real time become more and more open and all actors work together. This, in turn, can only succeed if departments cease to work within their set departmental boundaries (a functional perspective) and instead network with other departments and form a common entity (process-based perspective). The same applies for networking that goes beyond company boundaries and in which procurement above all establishes stronger links with its suppliers. The digitalisation of procurement and the procurement portfolio is only possible if companies adopt a process-based perspective that observes procurement as a process (the act of procurement) and not just a function (the purchase).

Strong vertical and horizontal networking is the be-all and end-all for the successful development of Industry 4.0. While vertical networking within a company affects all departments in equal measure, horizontal networking places special demands on procurement departments in particular.

The use of technologies and systems can play an important role in making a vertical and horizontal process-based perspective easier to adopt, for example by aligning the different systems of different departments and reducing interfaces in order to facilitate an exchange of data between these departments. Technologies and systems used for data processing and big data are particularly important in networking and when it comes to a process-based perspective. The better and stronger the use of big data technologies, the easier it is for companies to focus on processes.

Procurement departments and companies now already need to respond to a changed procurement portfolio. The digitalisation of internal processes (perspective 1) favours the response to a new procurement portfolio (perspective 2). Both perspectives therefore need to be advanced in parallel. This additionally means that networking should not only be initiated by means of technologies, but also by people themselves.

The process-based perspective needs to be fully integrated and the silo mentality between departments and companies needs to be eradicated for once and for all. Only once departments have become familiar with the new tasks and responsibilities and the transformation of the organisation has been successfully completed can the targets connected to Industry 4.0 be fully achieved and the advantages of new 4.0 business models used.

3.2 Fields of Activity and Orientation Tools

This chapter aims to provide initial orientation as to how Industry 4.0 should be implemented within companies and the most important components involved in this process. It highlights the special fields of activity for procurement departments.

1. Management teams need to take on full responsibility for Industry 4.0.

- The overall responsibility for all developments caused by Industry 4.0 must lie with a company's management team. Industry 4.0 will radically change the way in which companies currently go about their work. These changes affect the entire company and not just individual areas of operation. A process-based perspective can only be achieved if it is adopted throughout an entire company and on all of its hierarchical levels. Full responsibility for this approach can therefore only lie in the hands of the company's Management Board.
- Industry 4.0 and its associated targets need to be incorporated into a company's strategy. Areas of operation then have the opportunity to develop their own more decidedly departmental strategy based on this corporate strategy. Companies also need to develop a concrete roadmap that records their journey towards becoming a Company 4.0 in the form of specific activities and is coordinated with their strategy.
- Industry 4.0 needs to be clearly defined as a company's core topic
- Management teams are additionally responsible for identifying new business models on the basis of the new opportunities provided by Industry 4.0 and integrating these into their company strategy to the best possible extent. New business models need to be continuously questioned every step along the way.
- In order to initiate activities and send a signal to the employees, companies need to create one central or several decentralised teams that are substantially responsible for the implementation and promotion of Industry 4.0 and report directly to the management board.

2. Creating transparency and generating knowledge

This task is also the responsibility of a company's management team and its designated teams given the task of supporting and implementing Industry 4.0. Providing a clear insight into Industry 4.0 will help to minimise hurdles.

- Enterprises at the start of their Industry 4.0 experience need to reach a consensus on Industry 4.0 within their company. The topic needs to be introduced via different channels and staff need to be given the opportunity to find out more and access platforms that support an exchange of ideas and experiences (company wikis, forums, information events, etc.). Companies should also go beyond the provision of information on an internal level by working with other actors to develop further informative measures.
- Given the fact that there are many fears and reservations concerning Industry 4.0, companies need to highlight and explain the significance of and opportunities provided by Industry 4.0.
- They also need to qualify their staff at an early stage, namely by developing further education and training programmes for existing employees and initiating and helping to design new qualification measures.

3. Initiating change management at an early stage

Companies' management boards and upper management teams are also responsible for this measure.

- Given that there are many fears concerning potential problems such as job losses or changes in tasks and activities, staff need to be prepared for the upcoming changes right from the start. Employees therefore need to be provided with information as early as possible (before concrete changes are made) and need to be actively involved in the implementation of Industry 4.0. By doing so, companies can enable their employees to ‚be a part of it'. Staff who are able to participate in and help to shape the transformation within their company are more likely to accept it.

- Another sensible idea is to employ new members of staff (e.g. so-called „digital natives“) who bring a different approach to a company and can have a positive influence on the transformation taking place.

4. Networking horizontally and vertically

- The key to achieving a process-based perspective is networking itself, namely vertical and horizontal networking using technologies and systems and vertical and horizontal networking between people. Both of these networking approaches are interdependent and mutually reinforce each other.
- To start with, the different areas of operation within a company should communicate (internal networking between people). This should lead to the decision as to which technologies and systems are sensible options for the digitalisation of the company and should be used to support networking and an exchange of data.
- It will help to increasingly break down the boundaries between departments and divisions because everyone is provided with the same information and processes become simpler. This in turn helps to strengthen networking between people.
- The same level of interdependency also applies to horizontal networking, which is, however, also supported by vertical networking. Procurement departments need to make a special effort in this area.
- When implementing networking activities, companies need to be more open and willing to divulge more data and information on an internal and external level in the future. In order to achieve this, companies need to adopt a new approach and also need to develop new mechanisms and rules that allow them to protect their intellectual property. This step is an important requirement when it comes to remaining competitive both within a company and within a supply chain.

5. Procurement needs to do justice to its strategic role, preferably as a pioneer.

- Regardless of whether it acts as an active influencer or a driving force, the role played by procurement departments will definitely differ from company to company in the future. They can, however, underline their strategic relevance in both of these roles. The greatest risk tends to lie in ‚doing nothing‘ and ‚sitting back and waiting‘, which automatically causes procurement to become a follower. Be it as a driving force behind Industry 4.0 within a company or as an active influencer, procurement departments can use this change as an opportunity to reposition themselves, increase their value contribution towards their company and do justice to their strategic importance.
- Procurement above all plays an essential role when it comes to horizontal networking. Vertical networking within a company is the responsibility of its management board and of all other departments that need to accept procurement and its significance for the implementation of Industry 4.0 in equal measure.
- Procurement departments are responsible for networking activities that go beyond the boundaries of their company. As ‚innovation scouts‘, it is their job to bring innovations to their company and make them available as quickly as possible. Speed will play an essential role when it comes to determining the competitiveness of a company in the future.

6. Identifying new business models at an early stage

- Industry 4.0 presents companies with a huge opportunity to offer new products and above all new services in a much more diversified manner than ever before. New business models needs to be identified at an early stage on the basis of new technologies. All efforts made in connection with Industry 4.0 need to be oriented towards successfully implementing the business model behind the new technology.
- Big data in particular play a significant role when it comes to new business models, with the linking and evaluation of data offering huge potential, above all in the field of procurement.

3.3 Outlook

The first perspectives and fields of activity developed within the scope of this pilot study now need to be firmed up so that they can be converted into a roadmap and a plan of action for Procurement 4.0. This is an important prerequisite for the successful implementation of Industry 4.0 in companies in general and in procurement departments in particular.

3.3.1 Possible Further Developments Linked to the Topic of Procurement 4.0

The fourth industrial revolution is a reality, regardless of how we ultimately choose to label the development. This transformation will radically change the way we work

and is therefore already forcing us to take action at an early stage. On top of this, the current developments are occurring so rapidly that waiting to see what happens could quickly pose a threat to the very existence of a company. Nevertheless, taking action without proper planning is not the correct approach to pursue. Companies instead need to focus on drawing the right conclusions and introducing suitable measures.

The prediction that operative procurement will soon be a thing of the past is one of five visions for Procurement 4.0. It is clear that this vision can quickly become a reality. In consideration of the new opportunities provided by technologies and systems, we can now already predict that operative and administrative processes will soon be able to be fully digitalised and even made autonomous.

The vision that purchasers will transform into multi-talents and require a much higher level of qualification also seems realistic. The demand placed on procurement departments, which are responsible for strategic processes, will increase. These departments therefore need to become more digital themselves and provide their companies with a partly new product portfolio. Departments are involved in new supply chains and networks to a certain extent and therefore also require more detailed knowledge and a higher level of technical understanding. As a result, the topic of procurement engineering will become increasingly important.

In contrast to these predictions, it is not yet possible to clearly state precisely how the role of people in Procurement 4.0 will develop and the extent to which procurement will shrink in the future. On the one hand, it is highly likely that procurement will shrink because operative processes will become autonomous, thus causing the role of people to become less important. On the other hand, so many demands will be placed on strategic procurement in the form of new tasks and responsibilities that additional staff may be required in this area where applicable. This is joined by the fact that personal contact cannot be replaced by technology. A conclusive answer as to whether the field of procurement as a whole will actually shrink and the role that the human factor will ultimately play in Procurement 4.0 is not yet possible. It can, however, be said that people should most definitely form the focus when it comes to further digitalisation efforts in the future.

3.3.2 Our further Activities – the Think Tank for Procurement 4.0

The „Think Tank for Procurement 4.0" initiated by BME e.V. and the Fraunhofer IML is a group of experts that has been set the task of checking and further developing the findings and conclusions produced within the scope of the pilot study. The experts from the fields of industry and science should work together to develop an application-oriented plan of action and concrete measures and helpful tools based on the fields of activity for procurement identified in the study.

The Think Tank plays an important role in the digital professionalisation of procurement. It is one of the first working groups to explicitly investigate the impact that Industry 4.0 has on the field of procurement. The Think Tank will make the topic of the digitalisation of procurement more transparent and therefore have a direct influence on one of the most important fields of activity. It is responsible for providing procurement departments with suitable ideas and incentives that will enable them to play an important strategic role in the future.

From a technological point of view, there are plenty of different options. It currently seems to be the case that technology is setting the pace and determining the path that will be taken by revealing new opportunities for value creation that have never been considered before. The next step that needs to be taken is to establish links between the pure use of the clear advantages provided by technologies and the right way to apply them, namely by optimally connecting people and company processes. Technology needs to be used in a way that meets the targets set by a company and optimally supports processes. Companies that want to make the most of the advantages of the new technologies need to intensively explore Industry 4.0, play an active and influential role and set standards. Companies need to pave the way and play a pioneering role. Although technology itself is the enabler, it cannot be the driving force.

As a result, procurement departments need to quickly prepare themselves for the digitalisation era given that they are responsible for bringing the right technologies to their company. They need to establish a base of technological expertise and form strong networks on an internal and external level in order to know which technologies can help them to achieve the company objectives and how they can ultimately support the processes. Procurement departments also need to know which new products and solutions their customers demand. By doing so, they can support the development from a highly functional perspective to a process-based perspective.

These requirements show that on the whole, procurement will take on a special role in the course of the fourth industrial revolution. Although procurement departments are not fully responsible for the implementation of Industry 4.0 at their company, they can, however, have a significant influence on further development in this area within the scope of their key role in the value chain and their responsibility in their company's value creation process.

Appendix 1: Interview Questions: Pilot Study on „Procurement 4.0“ - Expert Interview

Question 1

In your opinion, what influence do the developments taking place in connection with digitalisation (namely the Internet of Things, big data and Industry 4.0) have on your company on the whole / on your purchasing department?

Question 2

Can you name some examples of measures contributing towards the implementation of Industry 4.0 in your company that have been completed / are planned?

Question 3

When it comes to the measures specified in your response to question 2, which changes/consequences have you already experienced / will you experience (with regard to the dimensions of technology/systems, organisation/processes, people/management, business models and other factors)?

Question 4

How would you rate the progress when it comes to implementing Industry 4.0 applications (technologies) in your company as a whole and in your purchasing department?

Question 5

In your opinion, what are the biggest opportunities (e.g. real-time availability, networking, etc.) and risks (e.g. data security) of Industry 4.0 from a purchasing perspective?

Question 6

What are the reasons behind the low degree of implementation of Industry 4.0 applications at your company and/or what are the largest hurdles currently standing in the way of the implementation of these applications?

Question 7

In your opinion, what are the important requirements/criteria for success for the successful implementation of Industry 4.0 applications in the field of purchasing (with regard to the dimensions of technology/systems, organisation/processes, people/management, business models or other factors)?

Question 8

How intensive is the current involvement of your suppliers in the further development of products/services/processes etc.?

Question 9

In your opinion, how relevant will the shared development of Industry 4.0 applications with your suppliers be in the future and why?

Question 10

Is Industry 4.0 firmly established in your corporate strategy and can the topic also be found in your purchasing strategy? Is your purchasing department responsible for the implementation of this strategy?

Question 11

Is Industry 4.0 (measures and applications) centrally coordinated and advanced in your company?

Question 12

What role does purchasing need to play when it comes to the implementation of Industry 4.0 at a company (e.g. pioneer, enabler or follower)?

Question 13

In your experience, which tasks involved in the field of purchasing are experiencing the largest changes?

Question 14

What do you think Purchasing 4.0 will be like in a few years‘ time? What is your vision for Purchasing 4.0 in 2025?

Question 15

In conclusion, what are your recommended actions for the successful implementation of Purchasing 4.0 (for your own company, the industry, the world of politics and other areas)?

Notes

Fraunhofer IML

Fraunhofer Institute for Material Flow and Logistics IML
Joseph-von-Fraunhofer-Straße 2-4
44227 Dortmund

BME verband
Bundesverband Materialwirtschaft, Einkauf und Logistik e.V.

Bundesverband Materialwirtschaft, Einkauf und Logistik e. V. (BME e.V.)
Bolongarostraße 82
65929 Frankfurt