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Rapid prototyping
Adaptive capacity
Networks
Legal hurdles
Returns
Smart processes
Innovation partnerships
Cognition
Open innovation

Pathway of Digital Transformation in Logistics

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Best Practice Concepts and Future Developments

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Design Thinking
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Procurement
Leadership
Automatization
Segment of One
Tools

Frank Straube (Ed.)

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PATHWAY OF DIGITAL TRANSFORMATION IN LOGISTICS
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Impressum

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PREFACE

Dear reader,

Digital transformation is currently a winged word, but one that also translates into concrete applications, processes, and business models – changing the way we live, work, and interact. This evolution holds tremendous opportunities for logistics, as this discipline, with its integrating characteristics operating in global networks, is the playground par excellence for digital transformation. This is why we wanted to explore the ways in which companies can move forward on their path of digital transformation – evolving towards smart, autonomous logistics.

This research study sheds light on the often shadowy topic of digital transformation from four transdisciplinary key dimensions: technologies, and data-driven services; leadership and organization as well as open innovation. We have identified best practice concepts and future developments in logistics in an exploratory research design consisting of a questionnaire answered by international logistics experts and a Delphi panel. At this point we would especially thank our international colleagues from the World Bank (Jean-Francois Arvis and Christina Wiederer), ASLOG in France (Jean-Michel Guarneri and Valérie Macrez), Universidade Vila Velha (Dr. Juliana Kucht Campos) and the Institute of Logistics and Supply Chain (ILOS) in Brazil (Cesar Lavalle), as well as from the Türkisch-Deutsche Universität in Turkey (Dr. Yasanur
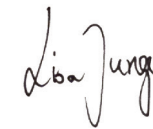
Kayikci) for supporting our work and inviting experts to participate in this research. Furthermore, we sincerely thank all the logistics managers participating in the survey, the Delphi panel and accompanying discussions. We greatly appreciate this contribution.

We wish you an insightful lecture and invite you to contact us to discuss and explore the topic of digital transformation in logistics further to foster and develop success strategies in the digital age!

With best regards,

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GLOSSARY

Best practice concepts	Concepts of best practice companies in the topics technologies, data-driven services, leadership & organization and open innovation
Dash-Buttons	Consumer goods ordering service which uses a proprietary device for ordering goods over the Internet
Design Thinking	Human-centric, iterative approach to innovation that focuses on prototyping solutions based on customer needs
Digital Transformation in Logistics	Transformation towards Smart Logistics by leveraging technologies, data-driven services, new leadership and organizational set-ups and open innovation to create customer value, efficiency improvements, sustainability and innovation
Hybrid product-service bundles	Offerings that combine both good(s) and service(s)
Idea contests	Events hosted by organizations that invite external developers, users, the public, or a specific group to address a task or issue on a specific topic
Innovation communities	(Often virtual) environments that allow developers and users of products and services, as well as third parties, to interact with each other
Innovation networks	Three or more legally independent companies that are loosely linked by a common goal and often operate in the same industry
Innovation partnerships	Partnerships between two or more companies, characterized by often close and long-term cooperation and common objectives
Open innovation	Paradigm of turning away from traditionally closed innovation management systems, offering companies the opportunity to secure their sustainable competitiveness through cooperative innovations
Segment of One	Generating individual customer profiles instead of comprehensive attributes for customer segments
Smart Logistics	Holistic, customer-oriented planning and control of highly integrated and automated, modular, self-steering flow of information and goods in the customer order and innovation process of value creation networks where relevant information and data is shared in real-time with stakeholders
Swarm Organization	Employees are (autonomously) connected for certain topics, and a peer-to-peer network replaces traditional hierarchy structures. This organizational form is based on the collective intelligence of humans, which means to use the abilities of individuals and the power of the masses to cope with demands and solve problems
Technology and innovation marketplaces	Various instruments that enable both the acquisition and sale of individual components of the innovation process, such as licensing of technologies or even entire organizational units from outside the company's boundaries

1. MOTIVATION AND FOCUS

Digital transformation is having important impacts on our lives – both private and in a business environment. It offers new opportunities for logistics as this integrative discipline, managing globally-distributed networks, is an enormously promising field for applying digital transformation tools and enablers.

We define smart logistics as the holistic, customer-oriented planning and control of highly integrated and automated, modular, self-steering flow of information and goods in the customer order and innovation process of value creation networks where relevant information and data are shared in real-time with stakeholders. To move forward on the pathway towards smart logistics, an end-to-end integrative logistics approach is a prerequisite.

Through the use of intelligent technologies, data analytics and the emergence of new actors and business models, smart logistics is evolving into flexible, low-interference, decentralized and real-time self-controlling processes with cognitive capabilities. The automation and integration of intelligent objects and their physical and organizational interfaces with the inclusion of semi-autonomous systems becomes possible. Logistics' goal of a transparent, synchronous, and coordinated cooperation of value creation partners from legally and economically independent companies and the internal organization to satisfy customer expectations becomes possible.

Logistics is gaining in strategic importance for companies and society. Potentially, new added value can be created by digital transformation of business models, meeting new customer expectations regarding the acquisition of benefits instead of products and the integrated marketing of products as systems with additional services. Order lot sizes in those systems are continuously decreasing in line with high-frequency planning of large order numbers and customer variants. Logistics is becoming an enabling factor for new forms of distribution and new business models. (Straube, 2017)

How, then, do companies move forward on their way to become "smarter" in logistics? What is the status quo and what are the main opportunities and hurdles associated with tackling digital transformation in logistics? Are there certain levers that distinguish high-performing companies from others? Those are the driving questions that motivated this research study. We intend to derive a pathway of digital transformation in logistics depicting different stages of moving forward towards intelligent (semi-) autonomous processes, decision making and execution of tasks in logistics networks.

Following the explanations above, for this research study we define digital transformation in logistics as *the transformation towards smart logistics by leveraging technologies including platforms, data-driven*

services, new leadership and organizational set-ups and open innovation to create customer value.

In our understanding of digital transformation, we suspect that the use of new technologies, data-driven services and the adaptation of organization, leadership, and innovation approaches will trigger changes of value creation in networks and, ultimately, will lead to paradigm shifts in logistics.

The aspects of digital transformation in logistics considered in this research study are by no means exhaustive. However, in our opinion it is important to move the discussion about digital transformation in logistics towards enablers that might be the adjusting screw determining success or failure of digital transformation endeavors. The two enablers in the focus of this study (leadership and organization, as well as open innovation) offer a range of possibilities for changing the approach to redefine the customer value logistics can offer – especially in combination with data-driven,

value-added services. This can increase logistics' strategic importance further and thereby the value that is inherently associated with logistics (Straube and Junge, 2017).

All of the four topics are closely interwoven and represent the interplay of organization, technologies and people, which is vital for successful digital transformation in logistics. The development of ever accelerating product lifecycles, increasing customer requirements, social responsibility and the need to constantly question and reinvent processes and service or product offerings calls for new concepts. These concepts need to be based on the latest technology and on data-driven services. Furthermore, the human aspects of leadership and organizational structures, as well as an environment where open innovation allowing for new solutions in forms such as minimum viable products is encouraged and promoted, are important enablers for the effective application of technologies and data-driven services.

Figure 1: Framework for digital transformation in logistics
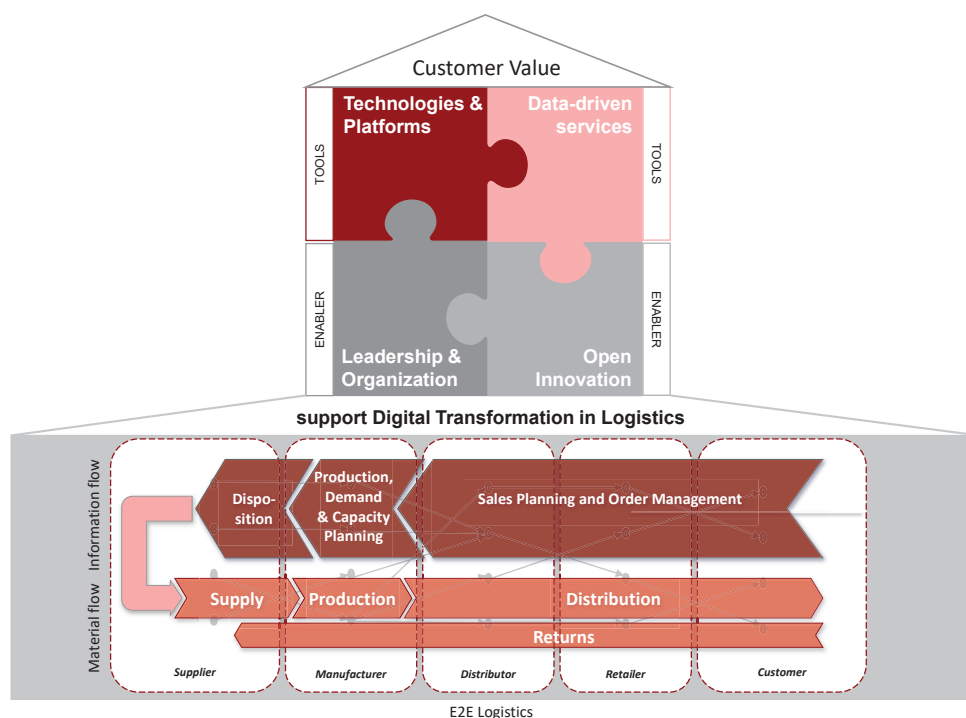
2. METHODOLOGY AND STRUCTURE OF THE STUDY

2.1 Structure and content

The structure of the study reflects the topics central to this investigation and the methodological approach. In the first step, an online questionnaire was implemented, followed by a Delphi panel to enrich and deepen the results. Please note that in the following figures possibly occuring deltas to 100% are due to rounding.

2.2 Online questionnaire

Based on the four topics, an online questionnaire covering technologies, data-driven services, leadership and organizational structures, as well as open innovation was designed. Apart from the questions about company-related data and the assessment of several key performance indicators, the structure of the questionnaire was organized as follows. The participating experts first had to assess different theses within the four topics on a five-point Likert scale. Subsequently, they had to state whether they already use certain technologies or concepts. This was rated on the dimensions of "already operational," "pilot phase," "planned for the upcoming two years," or "not planned." One hundred and twenty international participants with a broad knowledge in logistics answered the questionnaire, representing the following sectors: logistics service providers (LSP) (37%), industry (32%), retail (14%), IT and technology providers (9%), and others such as academia and consulting (8%).

Almost two thirds of the companies have a headcount

Figure 2: Aim, structure and methodical approach

Aim

Our study aims at
- Identifying **successful approaches in logistics** responding to new customer requirements and leveraging smart technologies
- Detecting the use of analytics for **services** and increasing **customer value** in logistics
- Understanding the shape of **leadership and organization** and future **social responsibility** in smart logistics networks
- Assessing logistics **innovation strategies**

Structure

- Technologies and platforms
- Data-driven services
- Leadership & organizational structures
- Open innovation

Methodical approach

I. Online questionnaire — N = 120

II. Delphi panel — N = 29 (1st round), N = 32 (2nd round)

Timetable

2017 Online questionnaire — **2018** Delphi panel — **2019** Publication

All sectors (n=120)

Other; 10; 8%

Technology Provider; 3; 3%

Industry; 39; 32%

IT Provider; 7; 6%

Retail; 17; 14%

LSP; 44; 37%

LSP (n=44)

3 PL; 15; 34%

4 PL; 7; 16%

Freight forwarder; 3; 7%

Transport provider; 10; 23%

Contract logistics; 6; 13%

Warehouse provider; 3; 7%

Retail (n=17)

Online; 1; 6%

Omni/Cross Channel; 8; 47%

Stationary; 8; 47%

Industry (n=39)

Electronics; 2; 5%

Machinery; 7; 18%

Automotive; 8; 21%

Consumer Goods; 15; 38%

Chemicals; 7; 18%

IT & Technology providers & others (n=20)

Other; 5; 25%

IT, Business process services; 3; 15%

IT, Application services; 3; 15%

Start-Up; 1; 5%

Consulting; 2; 10%

IT, Infrastrucure services; 1; 5%

University; 2; 10%

Technology provider; 3; 15%

Number of employees
(in % of all respondents)

Number of employees in % of respondents	%
1-49	15%
50-249	13%
250-1000	18%
>1000	53%

Revenue
(in % of all respondents)

Revenue in Mio € in % of respondents	%
< 2	16%
2-10	9%
10-50	17%
50-500	21%
> 500	37%

of more than 1,000 employees, while 34% belong to the category of micro-, small and medium-sized enterprises (according to the number of employees). The geographical distribution of the respondents' main business operations shows that they mainly conduct business Europe-wide or globally (19%), in Germany (22%), Turkey (22%), Brazil (19%), and France (6%). Other countries represent 14%. The divergent logistics performance indexes for Germany (4.2; rank 1), Turkey (3.15; rank 47), and Brazil (2.99; rank 58) reflect these countries' different logistical prerequisites (World Bank, 2018). However, the approaches of companies from Germany, Turkey, and Brazil investigated in this study do not show significant differences. Because of this and also due to the limited sample size, the study does not investigate country-to-country variation.

2.3 Key performance indicators for best practice evaluation

The online questionnaire surveyed five key performance indicators (KPIs), namely delivery time, reliability, flexibility, out-of-stock time, and orders returned. The assessed KPIs are the basis for the best practice analysis in chapter 3. We chose classical logistics KPIs as these are familiar to, and therefore assessable by, the participants who generously answered questions regarding them in the questionnaire. The hypothesis is that by linking them to the tools and methods companies apply in the four different topics, best practices can be identified. The results, implications, and limitations are discussed in chapter 3. The figures below depict the surveyed KPIs. It is noticeable that the KPIs include the whole sample as displayed in the previous figure. For example, the figures for industry include producers of automotive, chemicals, electronics, machinery, and consumer goods; LSP comprise 3PL, 4PL, contract logistics, warehouse providers, transport providers,

and freight forwarders; and retailers' KPIs represent online, stationary, and omni-channel retailers. The KPIs are defined as follows:

Delivery time:

Time from receipt of a customer order to the time of the delivery to the recipient (in days)

Delivery reliability:

Delivery at the correct time and in the correct quantity and quality (in %)

Delivery flexibility:

Period of time between last possible moment to change order and delivery date (in days)

Out-of-stock time:

Number of days that the main product was out of stock in 2015 (in days)

Orders returned:

Share of orders returned in percent of all orders (in %)

When comparing the KPIs to our previous assessments (Handfield at al., 2013) for industry and retail, only indicative comparisons are possible as the segmentation within industry and retail is not the same as in the earlier studies. However, delivery reliability for the best in class companies (1st quartile) seems to be stable, with numbers ≥98% for both industry and retail. Concerning delivery times, retail shows a mean of 9.25 days, which seems long but reflects the high percentage of stationary and onmi-/cross-channel retailers in this sample. Especially for omni- and cross-channel retailers, the integration of different order and distribution channels remains a challenge. For industry, the mean delivery reliability seems relatively low at 87.93%, which is an indicative of increasing risk in logistics due to increasing variant diversity and shorter product lifecycles. The figures for LSP, with a range of delivery times between one and 98 days, reflect the various types of service providers and services offered. Delivery reliability is high – greater

Table 1: KPI analysis

KPIs LSP	Delivery time (in days)	Delivery reliability (in %)	Delivery flexibility (in days)
Mean	12.12	93.3	2.66
Max	98.00	100.00	20.00
Min	1.00	30.00	<=1

	Delivery time (in days)	Delivery reliability (in %)	Delivery flexibility (in days)
1st quartile	1-1.5	>=99	<=1
2nd quartile	>1.5-2	>=98-<99	
3rd quartile	>2-9	>=95-<98	>1-<=2
4th quartile	>9-98	>=30-<95	>2-20

KPIs Industry	Delivery time (in days)	Delivery reliability (in %)	Delivery flexibility (in days)	Out-of-stock time (in days per year)
Mean	13.85	87.93	9.73	17.17
Max	60.00	100.00	98.00	50.00
Min	1.5	25	1	0.00

	Delivery time (in days)	Delivery reliability (in %)	Delivery flexibility (in days)	Out-of-stock time (in days per year)
1st quartile	1.5-3	>=98	<=1	0
2nd quartile	>3 -5	>=95-<98	>1-<=2	>0-<=2
3rd quartile	>5-25	>=89-<95	>2-<=5.5	>2->=14
4th quartile	>25-60	25-<89	>5.5-98	>14-50

KPIs Retail	Delivery time (in days)	Delivery reliability (in %)	Delivery flexibility (in days)	Out-of-stock time (in days per year)	Orders returned (in %)
Mean	9.25	94.58	6.77	16.62	6.85
Max.	90.00	100.00	30.00	102.00	35.00
Min.	1.00	80.00	1.00	0.00	0.00
1st quartile	1	>=98.375	<=1	0	<=1
2nd quartile	>1-2	>=97.5-<98.375	>1-<=2	1-9	>1-<=5
3rd quartile	>2-2.25	>=91.25-<97.5	>2-<=5	10-12	>5-<=10
4th quartile	>2.25-90	>=80-<91.25	>5-<=30	13-102	>10-<=35

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than 98% for the first and second quartiles. The mean delivery flexibility of 2.66 days indicates that the LSP sample mainly consists of participants organizing intra-national or short cross-border shipments.

The best practice analysis presented in chapter three rests upon these KPIs and is based on the following approach. The KPIs are equally weighted and the companies that form the top quintile of LSP, industry, and retail across all KPIs serve as the best practice sample. Subsequently, the study analyzes which of the surveyed concepts are applied by the best practice sample in contrast to the rest of the sample. This evaluation leads to the identification of best practice concepts, which are presented in chapter 3. The evaluation of the best practice concepts is indicative as, first, the choice of concepts is limited by the options presented in the questionnaire; second, the three sectors subsume different industries; and third, the assessed KPIs only serve as approximate values and are not necessarily correlated with the applied concepts.

2.4 Delphi Workshop

The Delphi technique is the product of studies of technological forecasting and transfer. The technique derives its name from the oracle of Delphi in Greek mythology. It was originally used for developing forecasts of future events and trends based on the collective opinion of knowledgeable experts. The Delphi technique is most useful for examining social and technological change.

The goal of the workshop is to elicit the differentiated opinions of the participating logistics experts to reveal what time horizons can be expected for specific future developments in logistics that relate to the four topics examined in this study. The panel comprised 32 experts with broad experience in logistics from LSP (53%), industry (44%), and retail (3%). The Delphi

workshop took place in October 2018. The first round was conducted online, the second one face-to-face. Two theses per topic were put forward. Their likelihood of occurrence on a temporal scale was assessed by experts online. In the second round, they discussed barriers and success factors for each thesis in groups and then rated the theses again.

Based on the findings from the online questionnaire and the Delphi workshop, the study derives a pathway for digital transformation in logistics, which we present and discuss in chapter 5.

3. STATUS QUO AND BEST PRACTICE CONCEPTS

This chapter is based on the online questionnaire and provides several insights into how the participants evaluate different aspects in the four topics. The majority of respondents agree about logistics not being sufficiently prepared to fulfill the requirements of digital transformation. This highlights the need to act.

In the next sections, status quo and best practice concepts in terms of the use of methods, tools, and technologies within the four topics (technologies, data-driven services, leadership and organization, and open innovation) are described and summarized.

3.1 Technologies

One important building block of digital transformation is the targeted use of technologies. In an earlier evaluation of technologies for logistics and SCM in

contract logistics, Siegmann et al. (2013) stated that top performing companies show higher engagement and greater propensity to invest in new technologies. Moreover, 95% of companies are yet to realize the full benefits of digital transformation technologies for their logistics networks (DHL, 2018). In order to capture the potential benefits of technology-related developments requires companies not only to acquire and use those technologies – it is also essential to take the steps of data capture and communication, data storage and analysis, and, finally, extracting value from the data in order to connect technologies as a tool to enable, for example, data-driven services. Survey participants across all sectors agreed that digital transformation requires aligned and scalable logistics structures. Technologies can help in fostering adaptable and aligned supply chain networks and

Figure 4: Flexible logistics structures as an enabler for digital transformation (in %)

Digital transformation requires flexible logistics structures enabled by scalable sub processes and quick decisions. As of today logistics is not sufficiently prepared for these requirements. (n=120)
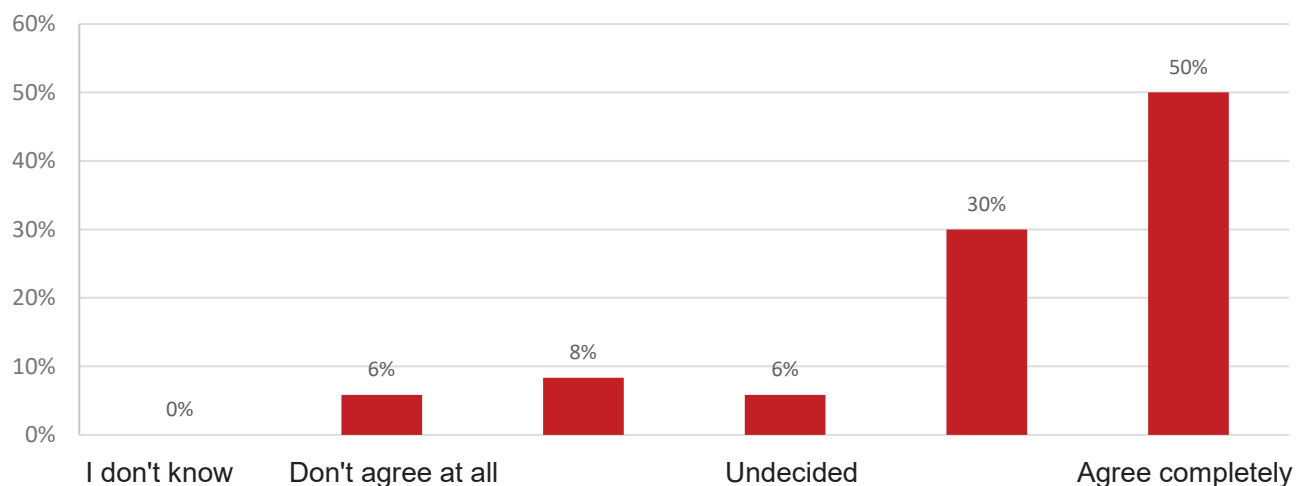
creating competitive advantage, but present certain requirements for the arrangement of those networks and also with regard to risk management (Kersten et al., 2017; Straube et al., 2016). The capabilities of digital transformation technologies can be described in terms of real-time visibility, cognition, automatization, and adaptive capacity.

Survey results reveal that almost three quarters (73%) of all survey participants have applications in place concerning real-time visibility (already operational or pilot-phase). Cognitive applications, such as machine learning, are largely insignificant concepts for industry, LSP, and the retail sector as of today. The following figure depicts the implementation and planning status of selected smart technology-enabled capabilities for retail, industry, and LSP. The question arising is, can the use of those technologies be linked with good logistics KPIs?

It is obvious that best practice companies across all sectors enable real-time visibility for their logistics processes. This is the basis for additional value-added services but only clearly distinguishes best practice companies in the retail sector from the rest. Concerning the use of artificial intelligence (cognition), retail and LSP best practice companies seem to benefit from the application with regard to the assessed logistics KPIs – in contrast to industry. Overall, the results from the best practice analysis suggest that it is not the acquisition and implementation of technologies that are the decisive factors, but the services and advanced processes enabled by the technologies that add concrete customer value. Data-driven services enabled by technology are discussed in section 3.2. Furthermore, the screening of the technology-enabled capabilities shows that the use of enablers of adaptive capacity, such as outsourced cloud services, distinguishes the high performers (best practice) from the others across all sectors. This supports the hypothesis that the use of digital transformation technologies supports adaptable, agile, and aligned networks, and hence creates more flexibility to gain competitive advantage. These advantages need to be transformed into tangible customer value added to explore the full potential of digital transformation in logistics and SCM.

Table 2: Capabilities of digital transformation technologies

Capability	Definition	Exemplary technologies/methods
Real-time visibility	The capability of real-time visibility is enabled by a valid master data source concerning all relevant data for the highly integrated and automated flow of information and goods in the customer order and innovation process of value creation networks.	Identification, information and communication technology (e. g. track & trace)
Cognition	Cognitive ability is enabled by artificial intelligence, which is defined as the theory and development of computer systems able to perform tasks normally requiring human intelligence.	Artificial intelligence (e. g. machine learning)
Automatization	Automatization is the transfer of functions of the customer order process, in particular process control and execution tasks from humans to artificial systems.	Autonomous vehicles, robotics
Adaptive capacity	Adaptive capacity is the capacity of a system to adapt if the environment where the system exists is changing.	Outsourced cloud services

- Enabling **real-time visibility** is established to lay the basis for analysis and optimization of logistics processes.
- Fostering cognitive capability (e. g., machine learning) is pursued to a lesser extent. Retail and LSP best practice companies seem to benefit from the application of machine

learning to enable **cognitive capabilities** with regard to the assessed logistics KPIs.
- The use of means for **adaptive capacity** such as outsourced cloud services distinguishes the high performers (best practice) from the rest across all sectors.

Figure 5: Implementation and planning status of smart technologies (in %)
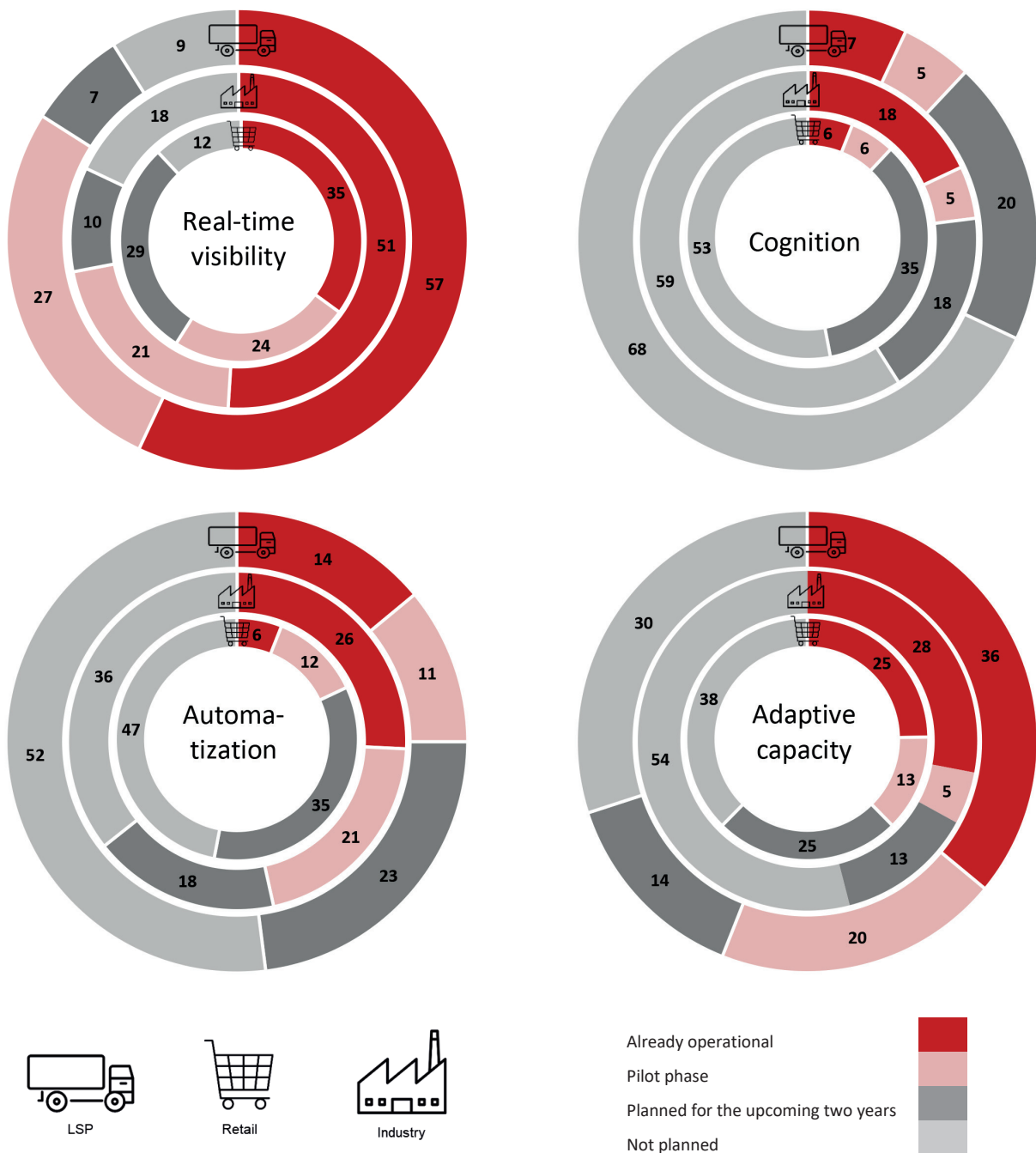
Figure 6: Best practice analysis: implementation status of technologies
(in % of answers, implementation includes the answer "already operational" and "pilot phase")

LSP

Adaptive capacity	Rest 56% / Best practice 63%	
Automatization	Rest 19% / Best practice 50%	Most differen-tiating concept
Cognition	Rest 8% / Best practice 25%	
Real-time visibility	Rest 83% / Best practice 88%	Most widely used concept

■ Rest ■ Best practice

Industry

Adaptive capacity	Rest 31% / Best practice 43%	Most differen-tiating concept
Automatization	Rest 50% / Best practice 29%	
Cognition	Rest 25% / Best practice 14%	
Real-time visibility	Rest 72% / Best practice 71%	Most widely used concept

■ Rest ■ Best practice

Retail

Adaptive capacity	Rest 31% / Best practice 50%	
Automatization	Rest 15% / Best practice 25%	
Cognition	Best practice 50%	Most differen-tiating concept
Real-time visibility	Rest 54% / Best practice 75%	Most widely used concept

■ Rest ■ Best practice

3.2 Data-driven services

Of the participants surveyed, 89% agree on the increasing relevance of logistics as a sales argument, since it can be utilized to generate perceptible services for customers that distinguish their companies from their competitors.

These value-added logistics services include setting ambitious standards for traditional logistics KPIs such as delivery time and flexibility (selectable time slots for delivery, same day/same hour delivery), hybrid product-service bundles (e. g., dash-buttons), and customer-centric reverse logistics (free returns).

The participants' opinions regarding mechanisms and concepts applied to enhance customer value by data-driven services are depicted in Figure 8.

As 84% of LSP already have real-time visibility applications in place, they meet the conditions to offer selectable time slots for deliveries and same-day or same-hour delivery. Concerning new hybrid bundles combining product and service, such as dash-buttons

(Consumer goods ordering service which uses a proprietary device for ordering goods over the Internet), LSP as well as industry and retail are hesitant to apply such a concept. Dash buttons were introduced by Amazon to offer a simple way of replenishing consumer goods (In January 2019 a court ruling prohibited the use of dash-buttons in Germany (Sontheimer, 2019). The mechanism can, however, be transferred to facilitate the replenishment of goods and thus automate the order process, representing a hybrid bundle that combines the product plus an associated service.

Eighty-two per cent of retailers already offer free returns, supporting the expectations of customers. They are also increasingly integrating faster and tailored delivery services for customers in their offerings; 31% have same-day or same-hour delivery in place and two thirds offer selectable time slots for delivery.

Industrial companies are focusing on offering adapted frozen zones, with 46% of the participants already using them to offer greater flexibility to their customers.

Figure 7: Logistics as a sales argument (in %)

Logistics increasingly becomes a sales argument because it generates perceptible services for the final customer.
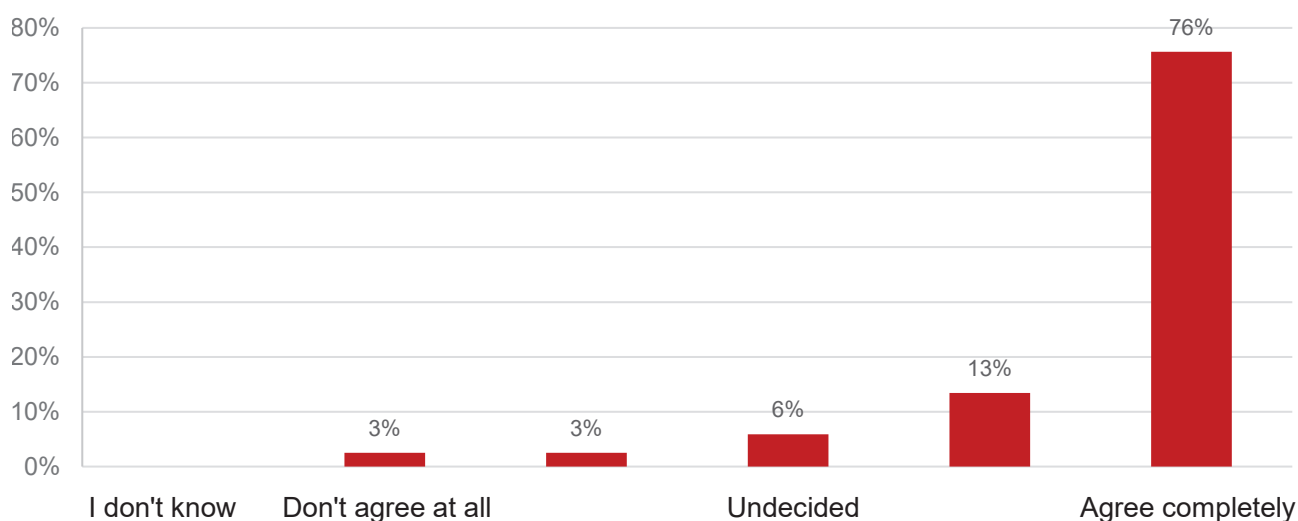
Figure 8: Implementation and planning status of value-added services (in %)

Selectable time-slots for delivery

LSP: 22, 47, 52, 58
Industry: 12, 40, 10, 10
Retail: 23, 18, 8, 0

Same day / same hour delivery

26, 26, 35, 52, 5, 12, 11, 24, 58, 29, 14, 7

Dash-buttons

5, 10, 10, 3, 0, 10, 7, 12, 12, 76, 77, 78

Free Returns

20, 12, 6, 0, 2, 5, 49, 49, 82, 73, 02

E-Commerce

29, 6, 6, 38, 46, 76, 39, 12, 5, 14, 19, 10

LSP	Retail	Industry

Already operational
Pilot phase
Planned for the upcoming two years
Not planned
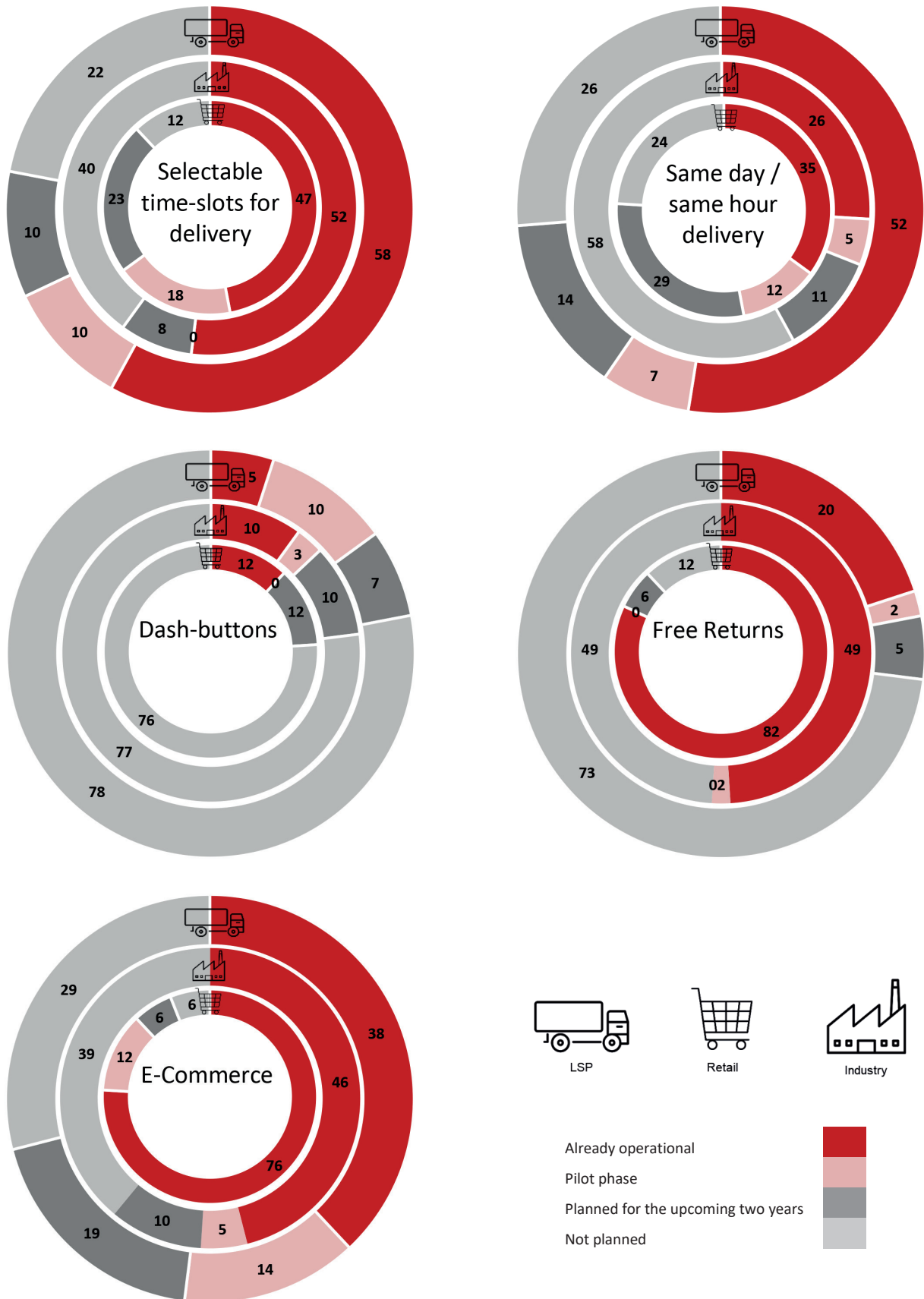
Concerning same day/same hour delivery, around one third operate with this concept, which is especially relevant for spare parts management.

The value-added services presented here are rather traditional, representing those on which participants could provide data. As logistics systems are becoming more service-oriented and customer-centric as well as globally connected, the participiants strongly agree on the statement that individual customer profiles (segment of one) enable new sales opportunities for logistics as well as new solutions for bundling and/or cooperation. In the future it will be very interesting to see how LSP, retailers, and industry will be able to offer tailored services to their customers based on data.

In many cases, a prerequisite for the implementation of such services is mastering supply chain analytics. The surveyed participants state that the increasing data availability is used to apply supply chain analytics for optimizing processes in procurement, demand planning, operations planning, and distribution, as well as reverse logistics. The application status of supply chain analytics among the surveyed participants is displayed in Figure 10.

Figure 9: Segment of one enables new opportunities for logistics (in %)

Segment of One enables new sales opportunities for logistics and new customer value requiring new solutions for bundling and/or cooperation.

Procurement

Procurement — Application status of supply chain analytics by sector

	Already operational	Pilot phase	Planned for 2 years	Not planned
Industry	62%	16%	14%	8%
LSP	39%	10%	10%	41%
Retail	47%	29%	6%	18%
IT Provider	50%	17%	33%	
Technology Provider	33%		67%	
Other	67%	11%		22%

Demand planning

Demand planning — Application status of supply chain analytics by sector

	Already operational	Pilot phase	Planned for 2 years	Not planned
Industry	58%	21%	13%	8%
LSP	45%	21%	14%	19%
Retail	65%	18%	6%	12%
IT Provider	43%	14%	14%	29%
Technology Provider	100%			
Other	56%	11%	22%	11%

Production/ Operations planning

Production/ Operations planning — Application status of supply chain analytics by sector

	Already operational	Pilot phase	Planned for 2 years	Not planned
Industry	61%	21%	8%	11%
LSP	29%	14%	24%	33%
Retail	25%	25%	13%	38%
IT Provider	50%		17%	33%
Technology Provider	33%		67%	
Other	60%	10%	10%	20%

Distribution

Industry: Already operational 61%, Pilot phase 8%, Planned for 2 years 13%, Not planned 18%
LSP: Already operational 48%, Pilot phase 17%, Planned for 2 years 12%, Not planned 24%
Retail: Already operational 53%, Pilot phase 24%, Planned for 2 years 12%, Not planned 12%
IT Provider: Already operational 57%, Pilot phase 14%, Not planned 29%
Technology Provider: Already operational 100%
Other: Already operational 70%, Pilot phase 10%, Planned for 2 years 10%, Not planned 10%

■ Already operational   ■ Pilot phase   ■ Planned for 2 years   ■ Not planned

Reverse logistics

Industry: Already operational 30%, Pilot phase 5%, Planned for 2 years 11%, Not planned 54%
LSP: Already operational 38%, Pilot phase 10%, Planned for 2 years 17%, Not planned 36%
Retail: Already operational 47%, Pilot phase 12%, Planned for 2 years 18%, Not planned 24%
IT Provider: Already operational 29%, Pilot phase 29%, Not planned 43%
Technology Provider: Already operational 100%
Other: Already operational 50%, Pilot phase 20%, Not planned 30%

■ Already operational   ■ Pilot phase   ■ Planned for 2 years   ■ Not planned

After-sales & maintenance

Industry: Already operational 32%, Pilot phase 24%, Planned for 2 years 14%, Not planned 30%
LSP: Already operational 25%, Pilot phase 15%, Planned for 2 years 8%, Not planned 53%
Retail: Already operational 24%, Pilot phase 29%, Planned for 2 years 18%, Not planned 29%
IT Provider: Already operational 29%, Pilot phase 29%, Planned for 2 years 14%, Not planned 29%
Technology Provider: Already operational 33%, Pilot phase 33%, Planned for 2 years 33%
Other: Already operational 25%, Pilot phase 13%, Not planned 63%

■ Already operational   ■ Pilot phase   ■ Planned for 2 years   ■ Not planned

PATHWAY OF DIGITAL TRANSFORMATION IN LOGISTICS - Best Practice Concepts and Future Developements

Figure 11: Best practice analysis: implementation status of technologies
(in % of answers, implementation includes the answers "already operational" and "pilot phase")

LSP

Concept	Rest	Best practice	
Dash buttons	8%	38%	Most differentiating concept
Same day/same hour delivery	53%	75%	
Selectable time slot for delivery	58%	88%	Most widely used concept

■ Rest ■ Best practice

Industry

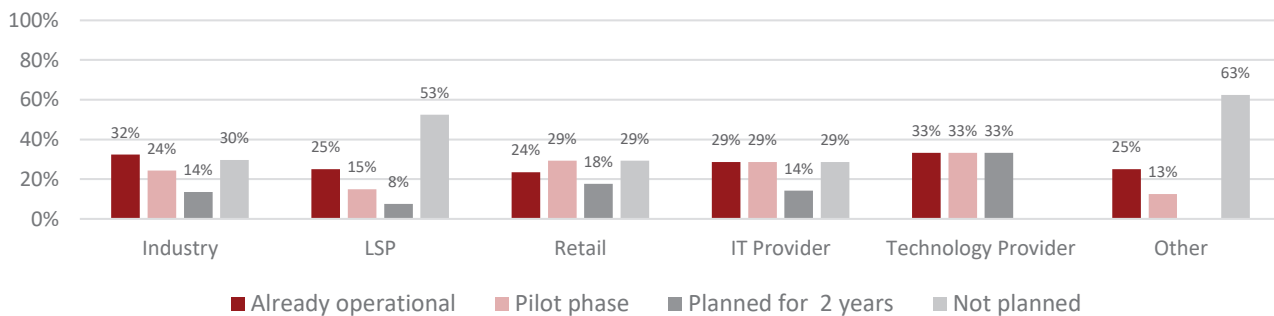| Concept	Rest	Best practice	
Same day/same hour delivery	31%	29%	
Adapted short frozen zones	44%	57%	
Free returns	50%	57%	Most widely used concept
Dash buttons	9%	29%	Most differentiating concept
E-Commerce	50%	57%	Most widely used concept

■ Rest ■ Best practice

Retail

Concept	Rest	Best practice	
Same day/same hour delivery	38%	75%	Most differentiating concept
Free returns	85%	75%	
E-Commerce	85%	100%	Most widely used concept

■ Rest ■ Best practice

3

Supply chain analytics functions as an enabler of value-added services – or, the other way around, value-added services can also trigger supply chain analytics innovation. For example, e-commerce was first designed to make shopping for final customers more convenient by delivering products to their door at a click. Now, however, the data collected by web-retailers has become a valuable resource helping companies to gain insights for supply chain analytics areas such as demand planning or after-sales services. These insights are used to generate individual product recommendations for customers based on their shopping history – some retailers even possess such a high level of customer insight that they can provide anticipatory package shipping (Spiegel et al., 2011). In this way, the best practice companies are able to create a closed loop of value-added services and supply chain analytics to continuously improve the value added of their products. This assumption is supported by the high implementation status of best-practice retail companies in both value-added logistics services and supply chain analytics application areas. Likewise, most of the best practice retail companies apply supply chain analytics for demand planning, distribution, procurement, and reverse logistics. Industry lays an emphasis on applying supply chain analytics to demand, procurement, operations planning, and distribution. Overall, participants from industry show a high application rate of supply chain analytics. However, in the best practice analysis it could not be confirmed that the use of supply chain analytics correlates with best practice logistics KPIs.

Hybrid product-service bundles such as dash buttons as surveyed here mainly play an insignificant role as of now. Hybrid product-service bundles will augment the value delivered to the customer in logistics networks. The combination of products and data to offer

tailored services is a pathway for increasing revenue and binding customers, especially in the regard, as the participants underlined, that the "segment of one" concept is an enabler for new sales opportunities and increased customer value.

Reverse logistics is a focus for supply chain analytics with rather untapped potential: only 49% of the surveyed companies do in fact use supply chain analytics in this area. In particular, manufacturing industry indicates great potential in this area and could learn from reverse logistics in retail. Even if this area might not be a major cost driver – unlike in the retail sector – a stronger focus on reverse logistics could spark new services or business models as well as reducing the environmental footprint of the companies. After-sales and maintenance-related services based on supply chain analytics also represent idle opportunities across all industries, since 48% of all companies do not use supply chain analytics in those areas. Even though the technological complexity of inter-organizational data sharing as well as data security concerns are barriers for the implementation of such services, the revenue and differentiation potential of after-sales services supported by advanced supply chain analytics shows potential (Breitschwerdt et. al., 2017).

Further findings concerning customer value indicate that transparency is very important, but that economically justifiable fields of applications for completely automated processes are still up in the air. More than half of all participants stated they are not planning to invest in cognitive intelligence such as machine learning in the following two years. However, the 89% approval rate for logistics increasingly becoming a sales argument, discussed above, underlines the fact that logistics is and will remain an important competitive factor. On the one hand, these findings show that

experts have realized that logistics plays an important role in distinguishing their companies from their competitors; on the other hand, advanced supply chain analytics is not on the investment agenda of many incumbents. This contradiction between perception and action of incumbents can become a threat for their traditional business models, since new, more supply chain analytics-aware players can disrupt their business models with innovative value-added logistics services that can be initiated by leveraging the potential of data availability and advanced analytics.

- The use of data to offer value-added services distinguishes best practice companies.
- **The retail sector is leading** concerning the application status of supply chain analytics along the customer order process. **Reverse logistics as well as after-sales and maintenance** represent idle opportunities to apply supply chain analytics for more sustainable and customer focused logistics services.
- **Hybrid product-service bundles** such as dash buttons represent opportunities with regard to offering tailored services for increasing revenue and binding customers.

## 3.3 Leadership and organizational structures

Many logistics managers still struggle to identify the right level of possible automated decision making, which is not yet generally in place on a tactical level. Automated decision making has major implications on organizational structures and skills management. This requires managers to adapt leadership to foster learning organizations that should support innovative and adaptable logistics networks to cope with the demands of interconnected sectors and individuals.

In order to examine potential logistics organization principles of the future, we asked whether participants think the "swarm organization" is the logistics organization of the future. A swarm organization is one in which employees are connected for certain topics, and a peer-to-peer network replaces traditional hierarchy structures. Employees work independently beyond department boundaries and are autonomously connected.

The results concerning the agreement for a swarm organization being the logistics organization of the

Figure 12: Swarm organization is the logistics organization of the future (in %)

Swarm organization is the logistics organization of the future
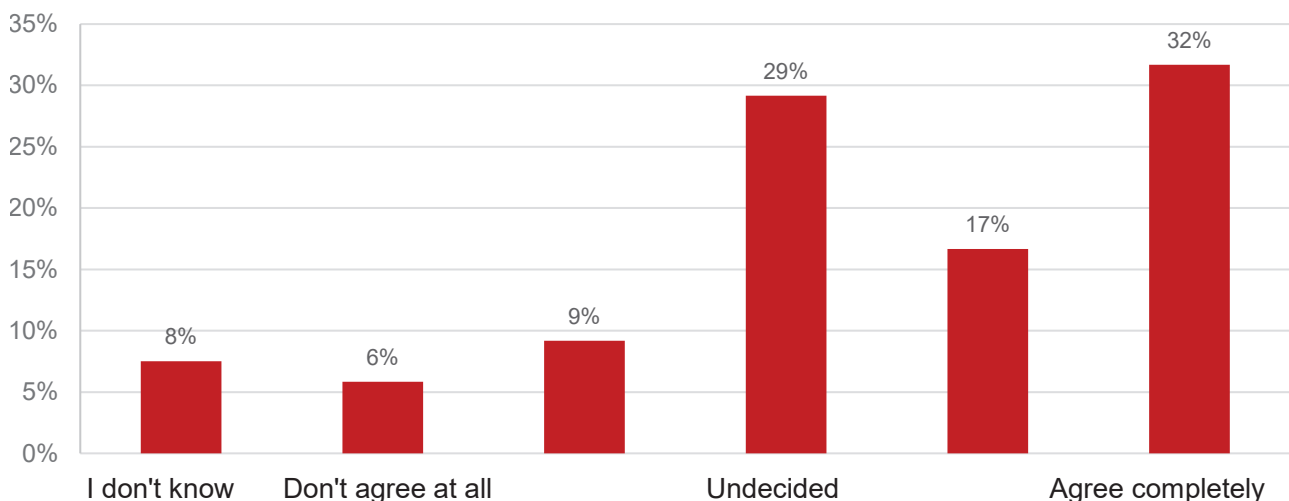
future show that a large number of participants are either undecided (29%) or agree completely (32%).

When thinking about the growing importance of logistics as a strategic management function and the increasing outsourcing or automation of operational activities, it is important to look at the significance of those operational processes. A supporting thread of opinion is that two thirds of participants did not confirm the statement that operational logistics activities lose significance through automation and outsourcing, allowing the presumption that logistics managers are aware of their future social responsibility.

As logistics systems and the corresponding environment become more complex and globally connected, strategic logistics managers increasingly become system managers. This is one of the topics agreed on by a majority of participants across sectors.

Nowadays, logistics managers are facing the complex task of managing and leading distributed networks as those networks become globally distributed. This global distribution also requires a focus on social responsibility. Networks and people working within those networks need be able to adapt to different working conditions in the countries that form parts of a particular supply chain. The participants agree with this topic to a high degree.

An important question concerning expected operational changes is automated decision making. Integrating gathered data for automated decision making on a tactical level shows disunity among the participants, 53% of whom agree with the statement while 47% disagree or are undecided whether data-driven decisions will replace human ones.

Humans are the capital for orchestrating future, partly automated logistics networks. We identified four main strategies and examined the participants' opinions regarding the implementation status of these strategies within their businesses.

The four strategies are:

1. ICT to enable decentralised working

Figure 13: Outsourcing and automation of operational logistics activities (in %)

Operational logistics activities are progressively outsourced or automated and therefore loose significance
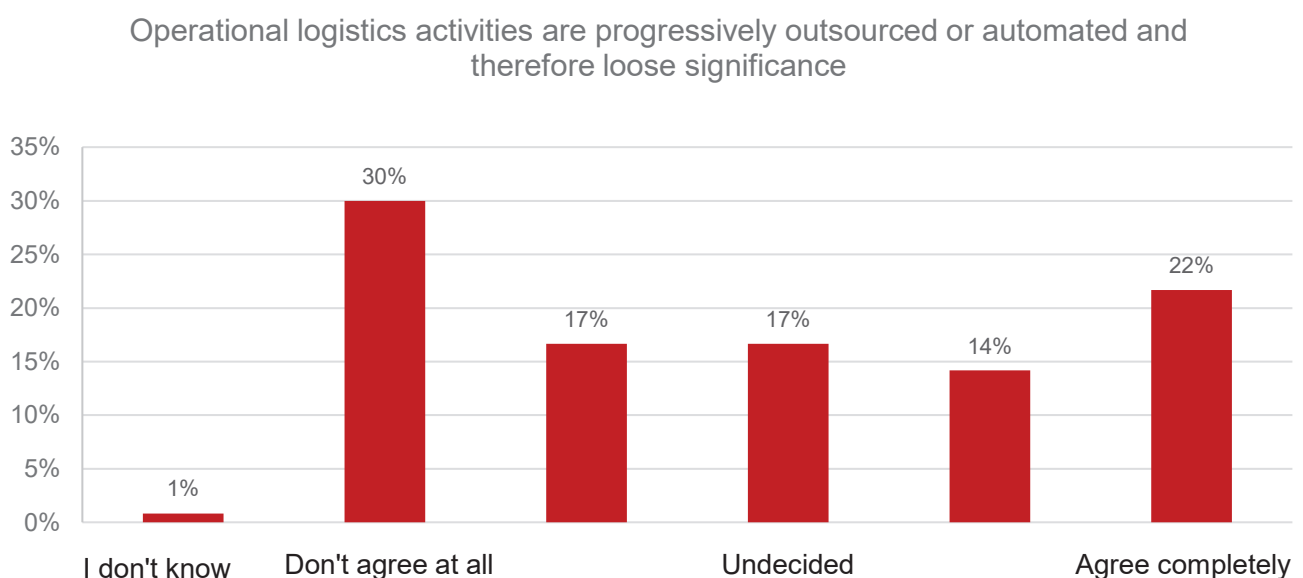
2. Strategy to promote agile and independent teams
3. Supply chain analytics to support and accelerate decidions
4. Freedom for employees to promote entrepreneurship in the company (e.g., FedEx Days at Google).

The results show that a large number of businesses have the first three strategies already operational or are developing a pilot project at the moment. For the fourth strategy, however (freedom for employees to promote entrepreneurship in the company), partici-pants' companies do not plan any measure in the near future. Four out of five managers take the human capital into consideration, stating that they have a clear

Figure 14: Leadership at a distance and social responsibility (in %)

Leadership at a distance and social responsibility concerning operational logistics activities get more important.
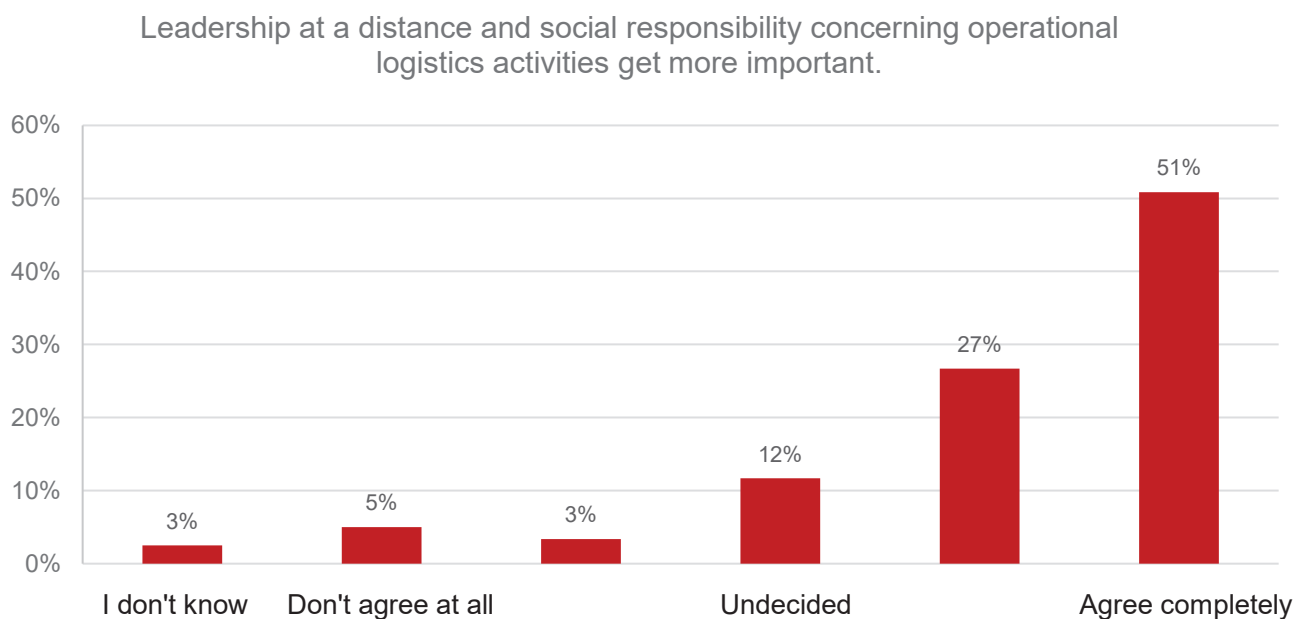
Figure 15: Data-driven decisions partly replace employees of the middle management

Data-driven decisions partly replace employees of the middle management
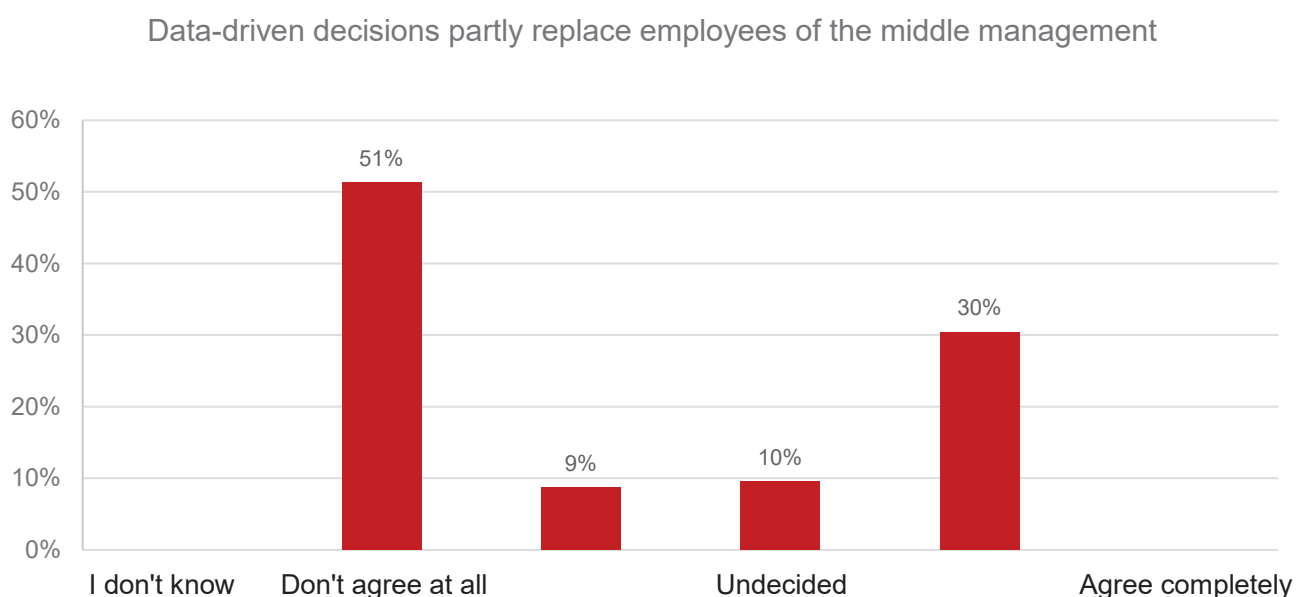
Figure 16: Implementation status of concepts for HR management for smart logistics (in %)

ICT to enable decentralized working

- LSP: 16, 28, 20, 15, 14
- Industry: 18, 29, 12, 21
- Retail: 36, 41, 50

Strategy to promote agile teams

- LSP: 20, 26, 11, 10, 20
- Industry: 18, 47, 18, 6
- Retail: 29, 46, 48

Supply chain analytics to support decisions

- LSP: 14, 21, 29, 23, 24
- Industry: 10, 6, 35, 46
- Retail: 12, 47, 33

Promotion of entrepreneurship

- LSP: 52, 24, 9, 11
- Industry: 55, 24, 3, 18
- Retail: 53, 6, 18, 27

Legend:
- LSP
- Retail
- Industry

- Already operational
- Pilot phase
- Planned for the upcoming two years
- Not planned

strategy in place to qualify employees for the digital age including the development of new skills. A part of that strategy is promoting agile and independent teams, which is already in place in almost half of the participants' companies (for industry and LSP). The promotion of entrepreneurial spirit is a concept that, for the time being, is less leveraged in the logistics context. The best practice analysis shows, however, that fostering entrepreneurial freedom distinguishes best practice companies from others. This can be especially important in combination with targeted open innovation strategies elaborated in the next chapter.

The best practice analysis shows different results in each of the sectors industry, LSP, and retail. In each sector, the best practice companies stand out when it comes to freedom for employees to promote entrepreneurship in the company. In addition, best practice retailers particularly stand out from the rest when it comes to agile teams, supply chain analytics,

and the implementation of IT and communication technology for decentralized working. For industrial companies the results are less unambiguous: entrepreneurial freedom, independent and agile teams as well as decentralized working seem to be in line with good logistics KPIs, whereas the use of supply chain analytics to support decisions was not found to be correlated.

- Best practice companies stand out when it comes to **promoting entrepreneurial freedom** for employees.
- Integrating gathered **data for automated decision making on a tactical level** shows disunity among participants: 60% disagree with the statement that data-driven decisions partly replace employees of the middle management while 40% are undecided or agree..
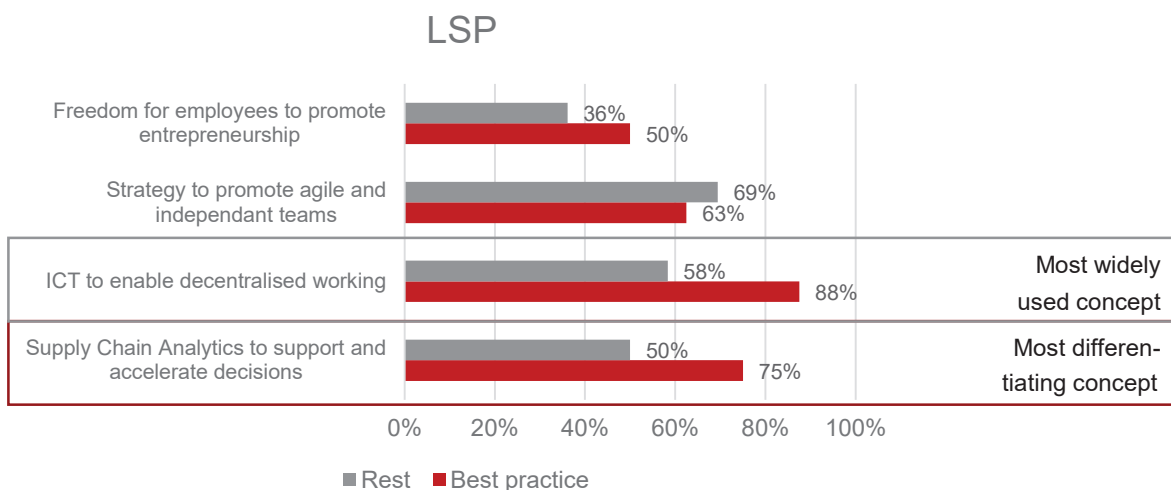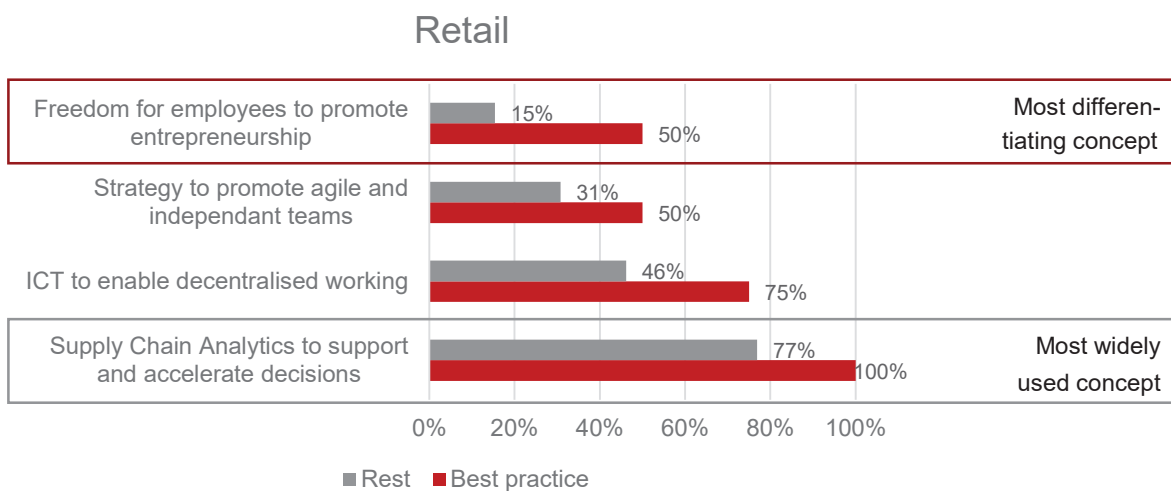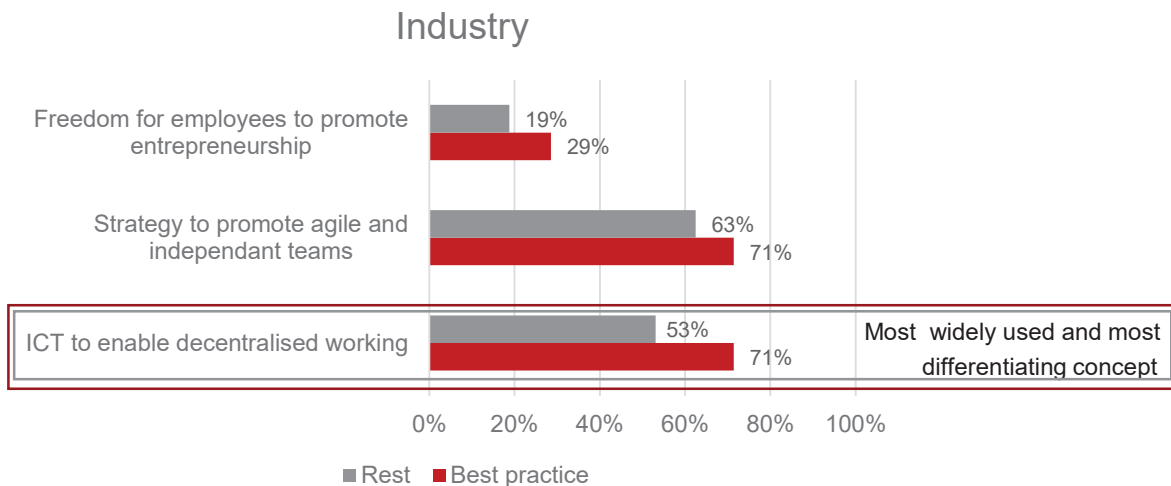- Enabling **flexible working modes** like decentralized working is applied more widely in best practice companies.

Figure 17: Best practice analysis: implementation of organization & leadership methods and strategies (in % of answers, implementation includes the answers "already operational" and "pilot phase")
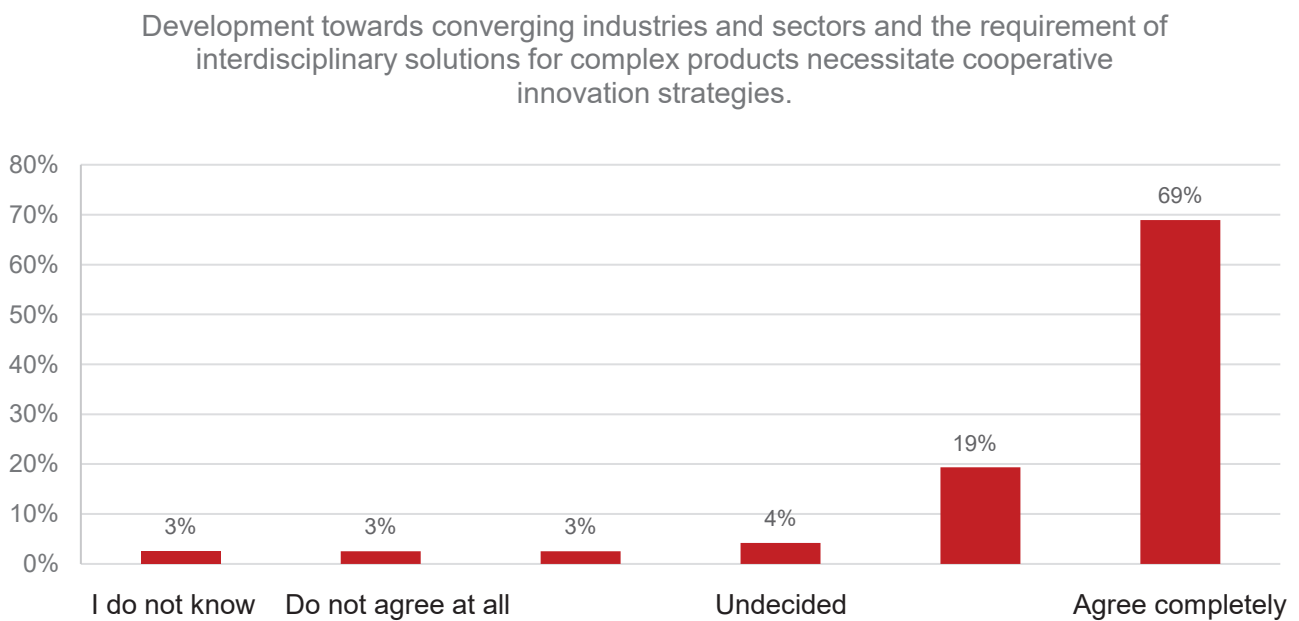
Industry

Concept	Rest	Best practice
Freedom for employees to promote entrepreneurship	19%	29%
Strategy to promote agile and independant teams	63%	71%
ICT to enable decentralised working	53%	71%

ICT to enable decentralised working — **Most widely used and most differentiating concept**

■ Rest ■ Best practice

Retail

Concept	Rest	Best practice
Freedom for employees to promote entrepreneurship	15%	50%
Strategy to promote agile and independant teams	31%	50%
ICT to enable decentralised working	46%	75%
Supply Chain Analytics to support and accelerate decisions	77%	100%

Freedom for employees to promote entrepreneurship — **Most differentiating concept**

Supply Chain Analytics to support and accelerate decisions — **Most widely used concept**

■ Rest ■ Best practice

3.4 Open innovation

Digital transformation is a major driver of the phenomenon of converging sectors. Studies show that the potential loss due to the market entry of new competitors or the absence of digitization in the automotive and logistics sectors amounts – in Germany alone – to €140 billion gross value added (Roland Berger, 2015). These new competitors are neither LSP nor automobile groups, but companies that demonstrate their core competencies in the fields of information and communication technologies. Google, for example, is working on an autonomous delivery system that aims to penetrate the CEP market with driverless minivans that act as mobile packing stations (Hennig and Bennühr, 2016). Amazon, originally a trading company, also wants to occupy the logistics service provider market with the help of technical innovations such as delivery robots and drones (Tönnesmann, 2016). This emergence of new competitors is a prime example of one of the significant effects of the digital transformation: the phenomenon of converging sectors. The traditional boundaries of individual industries and sectors are now blurring and overlapping significantly in terms of their target markets, technologies used, and their value propositions. Companies operating in such industries require expertise in a wide variety of knowledge areas in an increasingly competitive environment. Emerging problems are characterized by an ever-increasing interdisciplinarity.

Figure 18: Converging industries and sectors require interdisciplinary solutions and cooperative innovation (in%)

Development towards converging industries and sectors and the requirement of interdisciplinary solutions for complex products necessitate cooperative innovation strategies.

Almost 90% of the participants agree that this interdisciplinarity requires a change in innovation strategies and a more pronounced focus on cooperation. Interestingly, the sectors surveyed hardly differ in their response behavior. Sectors that are typically regarded as being less innovative (such as LSP) now recognize the need for cooperation as much as IT and technology providers. Other reinforcing factors include the increasing technological intensity of socio-technical systems, the availability and mobility of qualified employees, and constantly evolving information and communication technologies that allow knowledge to diffuse faster than ever before. This development, the paradigm of turning away from traditionally closed innovation management systems, was termed open innovation and offers companies the opportunity to secure their sustainable competitiveness through cooperative innovations (Chesbrough, 2003).

Open innovation consists of the basic principle that knowledge can enter and leave the innovation process at any point. Companies can therefore rely not only on their own internal knowledge base, but also on those of other companies. They can insource other technologies, invest in starts-ups, and even acquire new companies to do so. The external sources of knowledge are widespread and include customers, competitors, technology providers, IT-companies, academia, consultants, public institutions and administrations, sub-contractors or sub-suppliers, financial institutions, or even private persons willing to share their knowledge.

The study participants, with a few notable exceptions, agreed that basically no matter which type of knowledge source we look at, it will rise in importance regarding its value for the creation of innovative solutions, be it services or products.

Customers, already forming the number one source of innovations for most companies today, will keep their status in the eyes of the participants, while start-ups and tech companies, followed by academia, will experience the most growth. Comparing the answers from industrial companies, LSP, and retail companies, it is noticeable that LSP expect the least
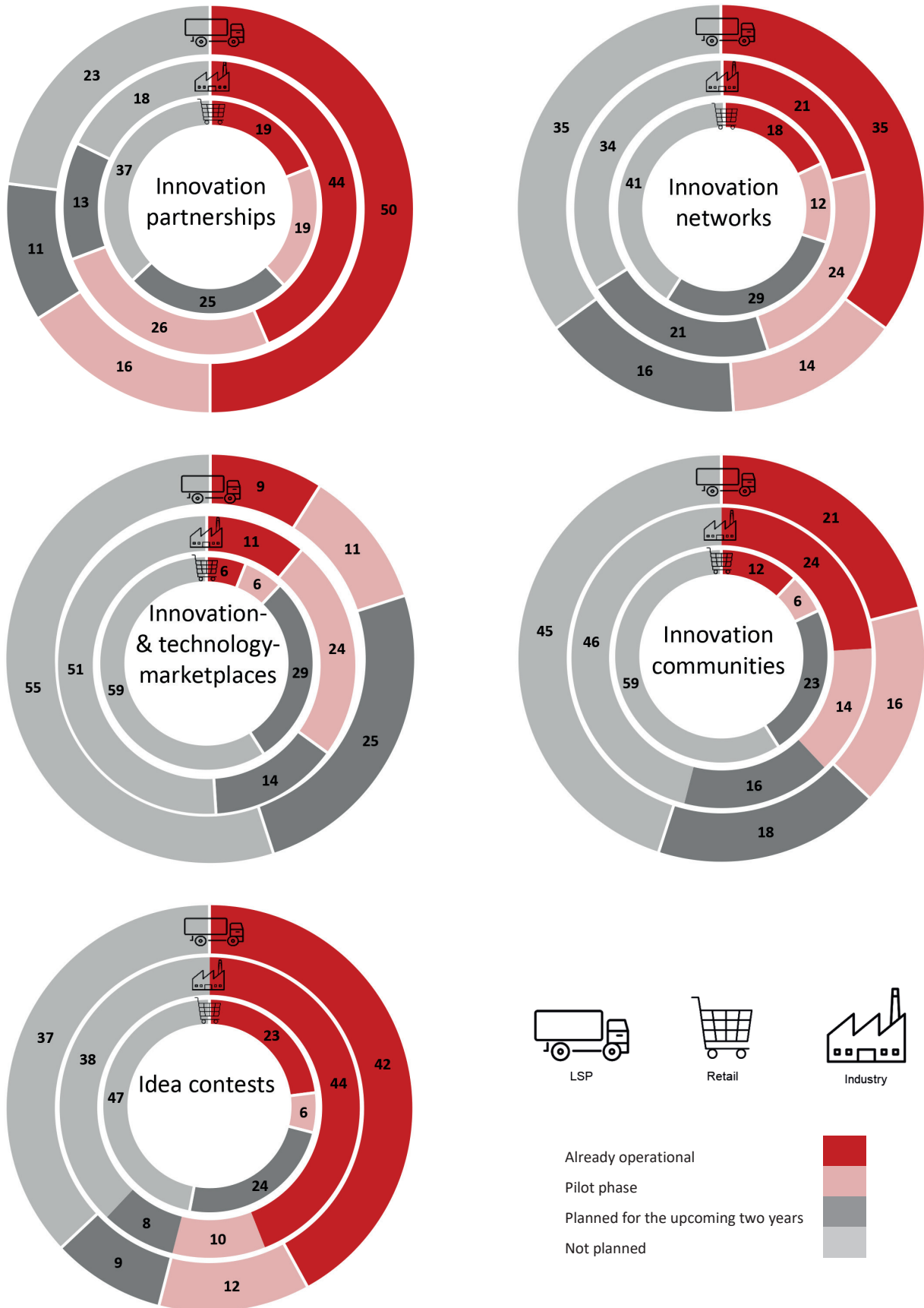
Please rate the following external sources regarding their importance for generating innovations. (All industries)
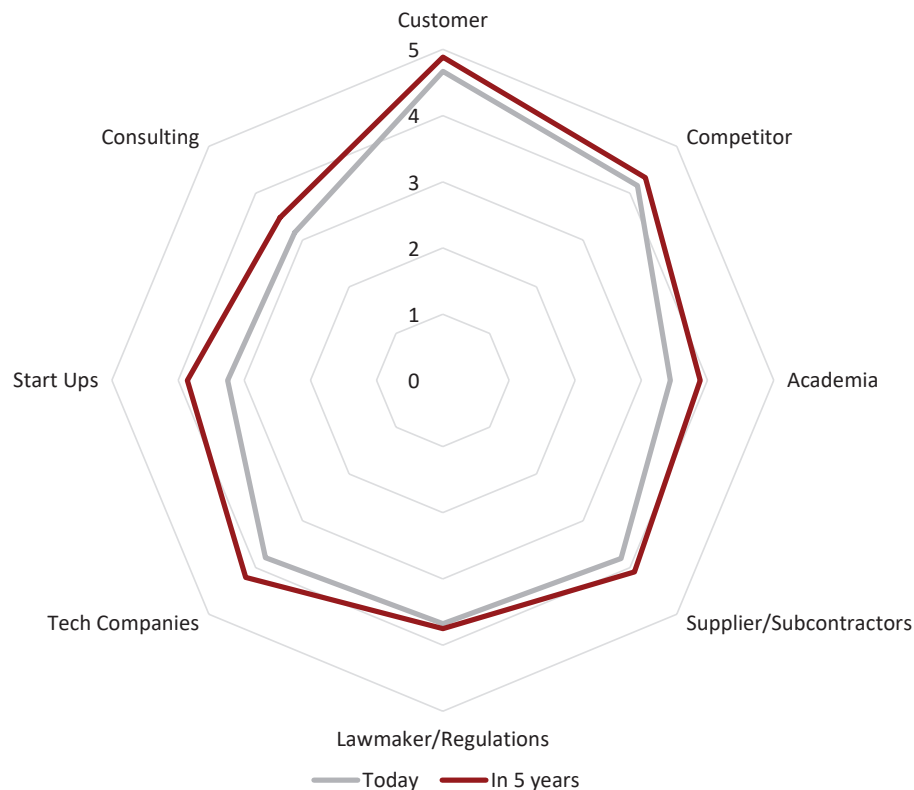
growth in importance across their stakeholders – a fact that may have to do with their often conservative stance regarding innovation in general (Wagner, 2008). It is also interesting to note that the industrial companies, compared to their peers, value competitors least as a source of innovation-related knowledge today, but expect a huge growth in importance in the future. The importance of academia as a source of innovation is considered surprisingly low today by participants across all sectors, on a par with start-ups and consulting companies, but expected to grow immensely in the next five years, only overshadowed by starts-ups. Cooperating with universities or research institutions can be a cost-efficient way for companies to gain access to "cutting-edge knowledge." This might explain why the cost-driven retail companies

in particular still see great potential in those collaborations. Lawmakers and regulations are, perhaps counter-intuitively, not seen as a growing source of innovation. While they might increase the pressure for companies to innovate and find new solutions (e. g., bans on diesel traffic in European cities and its influence on LSP), the companies do not consider them as an inspirational source for generating these solutions. Interestingly, it is the tech companies and IT-providers that are the only types of participants that actually expect a loss in importance for some stakeholders in the innovation process, namely customers, suppliers, and sub-contractors; lawmakers and regulators; and consultants.

Figure 20: Implementation and planning status of open innovation instruments (in %)

Innovation partnerships

Innovation networks

Innovation- & technology- marketplaces

Innovation communities

Idea contests

LSP

Retail

Industry

Already operational

Pilot phase

Planned for the upcoming two years

Not planned

The literature suggests the availability of a wide variety of different instruments to implement the core principles of open innovation and use different partners' knowledge, including:

- innovation partnerships: partnerships between two or more companies, characterized by often close and long-term cooperation and common objectives,
- innovation networks: three or more legally independent companies that are loosely linked by a common goal and often operate in the same industry,
- innovation communities: (often virtual) environments that allow developers and users of products and services, as well as third parties, to interact with each other,
- idea contests: events hosted by organizations that invite external developers, users, the public, or a specific group to address a task or issue on a specific topic,
- technology and innovation marketplaces: this term is intended to subsume various instruments that enable both the acquisition and sale of individual components of the innovation process,

such as licensing of technologies or even entire organizational units from outside the company's boundaries.

However, in reality, the instruments still differ considerably in their use. While almost 80% of all participants already use or plan to engage in innovation partnerships, more than 50% of the participants do not plan to engage in technology marketplaces. Moreover, a comparable number of companies do not plan to use innovation communities. This might have to do with the perceived cost and effort of these instruments. Idea contests, seen as very cost-efficient means to gain insight into users' needs and new perspectives on possible solutions, had already been conducted by almost half of the companies. There is also a considerable difference in take-up between the different types of participants, with retail being the most reluctant sector. Comparing, for example, the use of innovation partnerships (the most traditional form of cooperative innovation), only 39% of participants from the retail sector have experience in managing those partnerships.

Figure 21: Organizational structures and culture as success factors for innovation management (in %)

Organizational structure and culture are important success factors for innovation management. Hence, companies should promote venturesome and cross-functional cooperation and minimize inflexible structures and information channels.
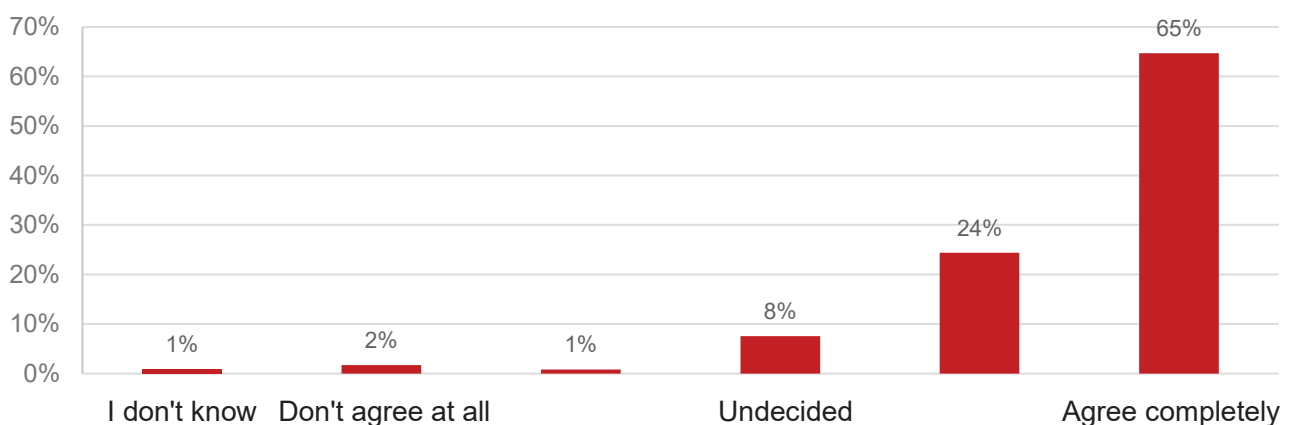
It is practically impossible today to separate the management of innovations from cultural and organizational aspects of a corporation. The participants agreed that success factors like inter- and intra-organizational cross-functional cooperation and organizational flexibility are of significant importance. Companies such as Google or Facebook are often highlighted as role models for a successful innovation culture. Start-ups also heavily influence how companies try to shape their own culture.

Google, for example, is known for its "moonshot" philosophy, describing solutions that are not only incremental improvements to existing alternatives but aim to improve solutions by a factor of 10. This way of thinking fosters creativity by eliminating traditional ways to solve the challenge in question. The "20% rule" allows every employee to dedicate 20% of her or his time to work on his or her own ideas and projects. Facebook is known for often physically mixing up employees' work spaces to break up routine and emphasizing the use of prototyping to "learn from results." Also, due to the increasing popularity of the Design Thinking approach, prototyping in particular has gained in importance in recent years. Design Thinking is a human-centric, iterative approach to innovation that focuses heavily on prototyping solutions based on customer needs.

The current experiences with those approaches vary greatly between the sectors under consideration. Not surprisingly, the IT and technology providers show the greatest amount of experience, with almost two thirds of the companies having experience with design thinking (71%/67%) and more than half of the companies having experience with prototyping (57%/67%). The industry and LSP show comparable experience regarding the use of design thinking (46%/48%) but significant differences when it comes to prototyping (53%/19%). This might be explained

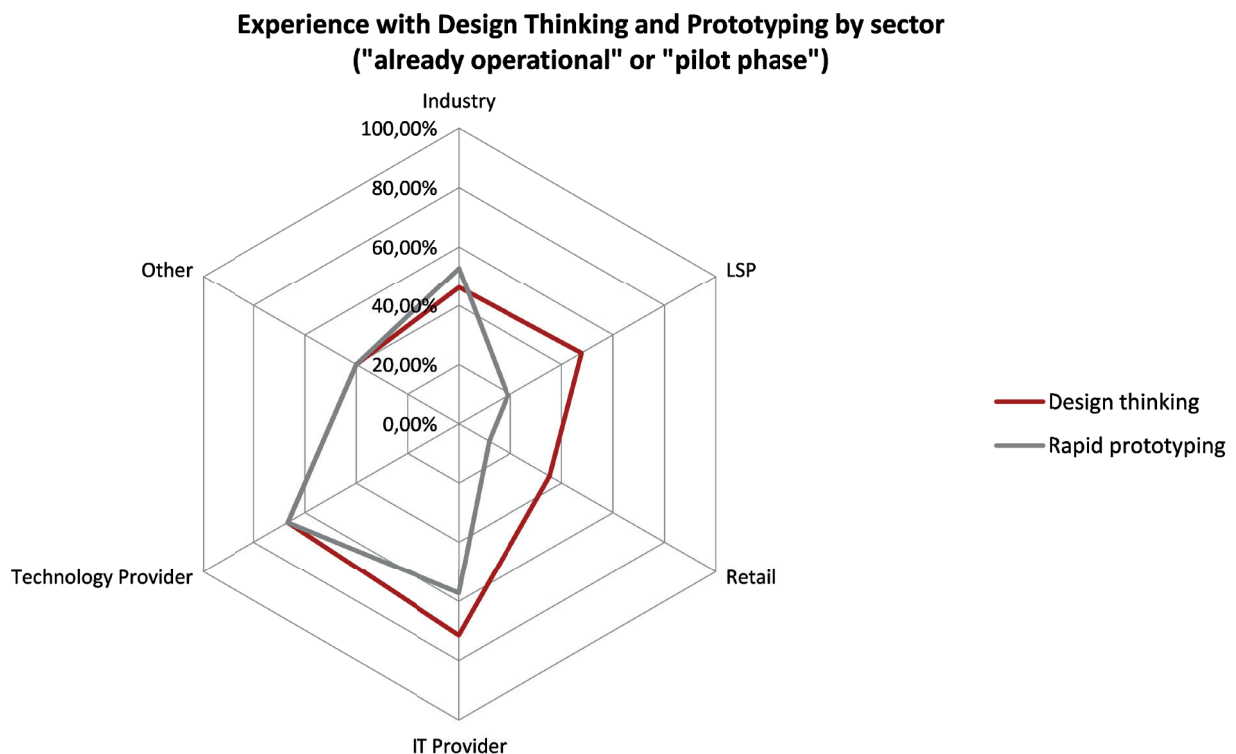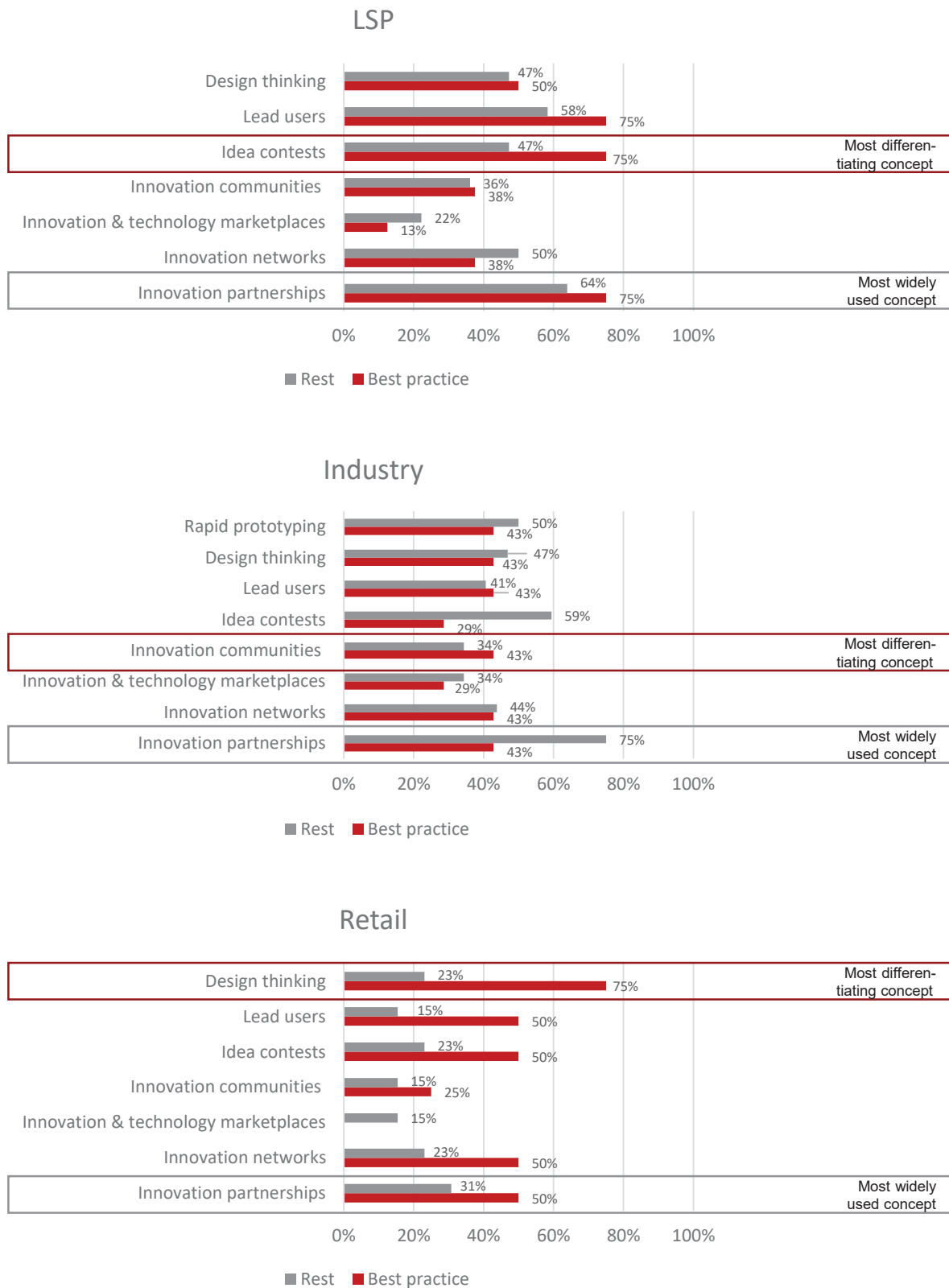Figure 22: Experience with Design Thinking and prototyping by sector (in %)

Experience with Design Thinking and Prototyping by sector ("already operational" or "pilot phase")

LSP

	Rest	Best practice
Design thinking	47%	50%
Lead users	58%	75%
Idea contests	47%	75%
Innovation communities	36%	38%
Innovation & technology marketplaces	22%	13%
Innovation networks	50%	38%
Innovation partnerships	64%	75%

Idea contests — Most differentiating concept
Innovation partnerships — Most widely used concept

Industry

	Rest	Best practice
Rapid prototyping	50%	43%
Design thinking	47%	43%
Lead users	41%	43%
Idea contests	59%	29%
Innovation communities	34%	43%
Innovation & technology marketplaces	34%	29%
Innovation networks	44%	43%
Innovation partnerships	75%	43%

Innovation communities — Most differentiating concept
Innovation partnerships — Most widely used concept

Retail

	Rest	Best practice
Design thinking	23%	75%
Lead users	15%	50%
Idea contests	23%	50%
Innovation communities	15%	25%
Innovation & technology marketplaces	15%	
Innovation networks	23%	50%
Innovation partnerships	31%	50%

Design thinking — Most differentiating concept
Innovation partnerships — Most widely used concept

by the perceived difficulty of prototyping services in general. Whereas physical products can be easily prototyped via 3D-printed models or less sophisticated techniques such as drawings or even paper models, the prototyping of services has to be done on a more abstract level. Still, methods like simulations, desktop walkthroughs (interactive mini-theater plays that simulate end-to-end customer experiences (Stickdorn et al., 2018) or service blueprints) visualizing organizational processes in order to optimize how a business delivers a user experience (Gibbons, 2017) can help with visualizing service ideas. The retail sector is the most reluctant when it comes to using new approaches.

However, the best practice analysis shows that, especially for the retail sector, the use of open innovation methods separates the best practice companies from others. For LSP, lead users and idea contests in particular seem to distinguish best practice companies from the others. The picture for industrial companies differs: here, the implementation of open innovation methods and tools does not seem to have a decisive impact when it comes to comparing companies with regard to the assessed KPIs.

In general, the participants agree that most companies need a paradigm shift concerning their innovation culture. In times of global competition and shortening product lifecycles, the speed of the innovation process is becoming more and more important. The prototyping discussed above is one way companies are trying to deal with this challenge. Methods like SCRUM or design sprints are gaining in popularity.

The openness of companies was discussed earlier. The participants agreed that basically every possible stakeholder will be more important in the future. Companies therefore need to find ways to integrate those stakeholders and their knowledge into their innovation processes. But that might not be enough – the innovation management of the future is not process- but rather culture-driven. Employees must be allowed to make mistakes and to take risks. The important thing is that companies need to encourage their employees not only to take risks but to learn from failure, which is an integral part of modern innovation management strategies.

3

Figure 24: Requirement of a paradigm shift in innovation culture (in %)

Traditional companies need a paradigm shift concerning their innovation culture (higher speed, more openness & failure tolerance) to remain competitive in the future.
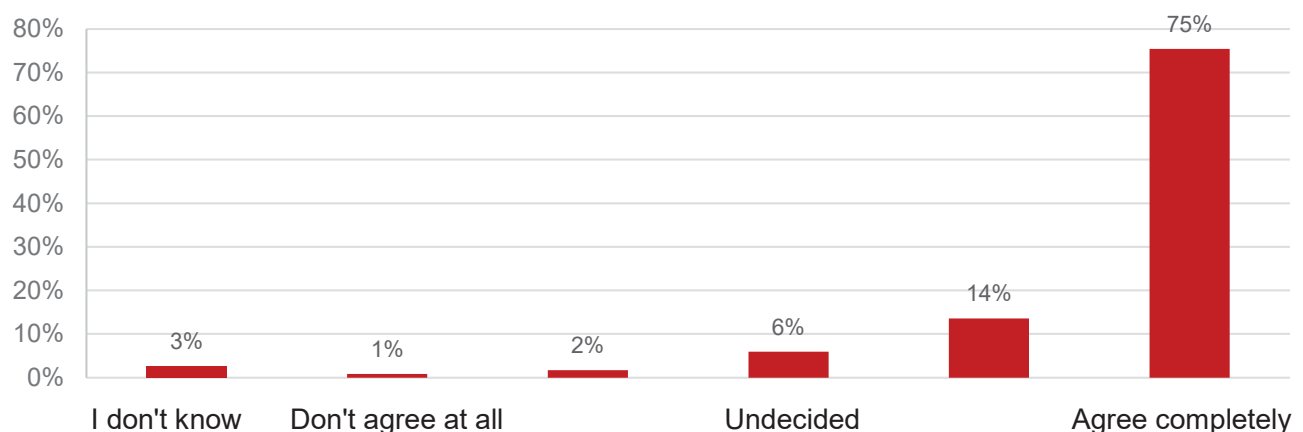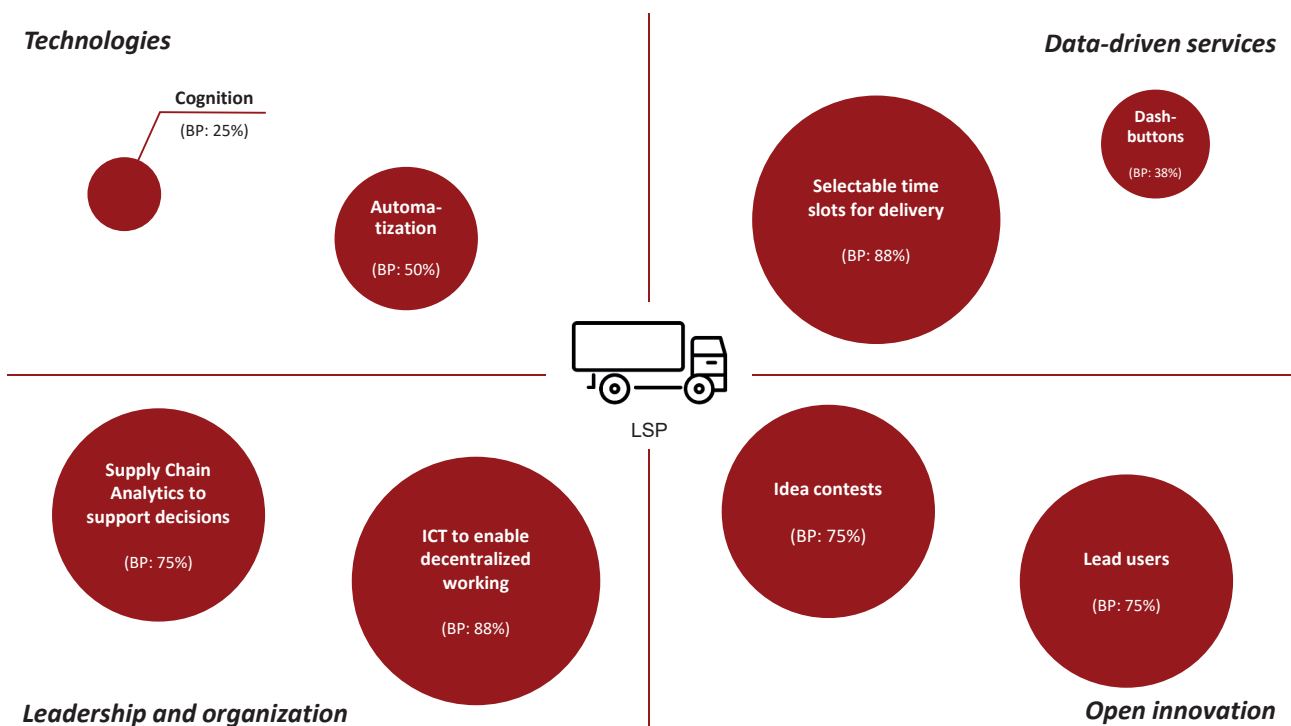
- **Customers are the number one source for generating innovations**, while start-ups and tech companies, followed by academia, will experience the most growth.
- **Although the retail sector** is the most reluctant when it comes to using new open innovation approaches, most of them are far more widely applied in best practice companies. This is also true for **LSP** concerning **lead users and idea contests**; for industry, the surveyed open innovation methods do not have an impact when it comes to identifying best practice.
- Speed of innovation is becoming more important – therefore companies need to foster a **culture-driven innovation management allowing risk-taking** and shaping an organization where **failure is seen as an important means to learn and progress.**
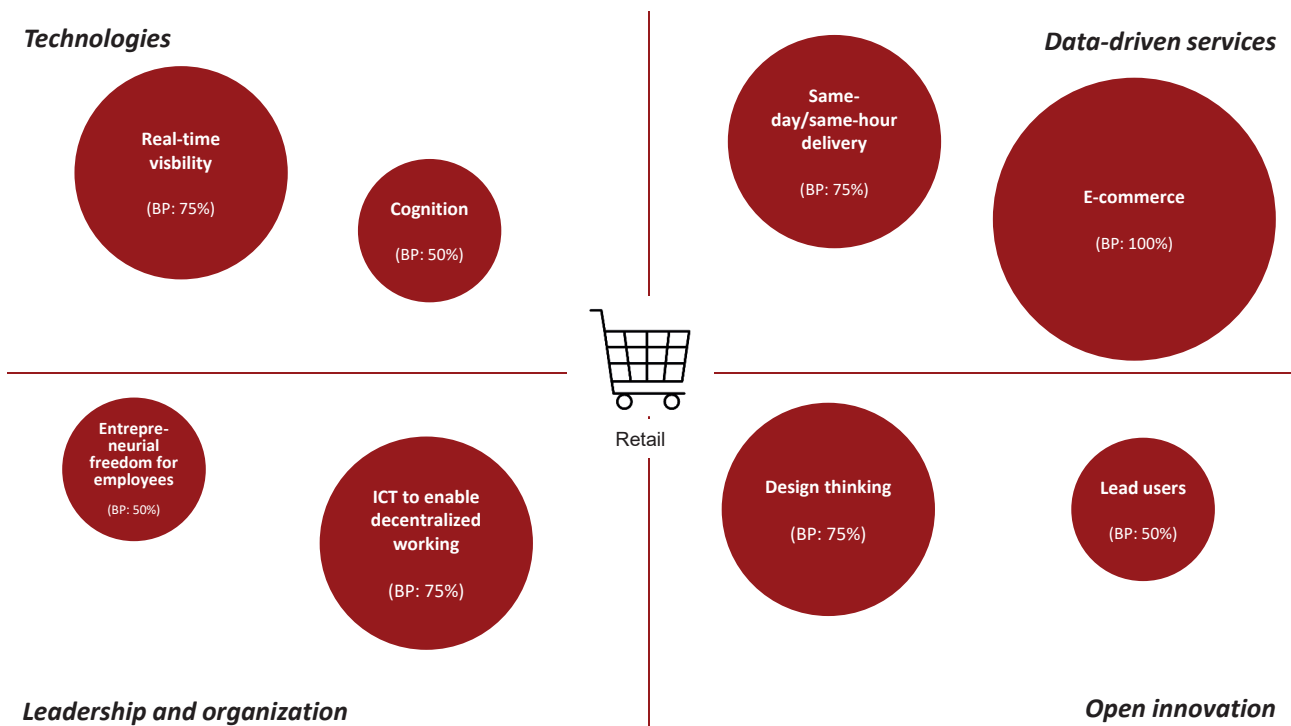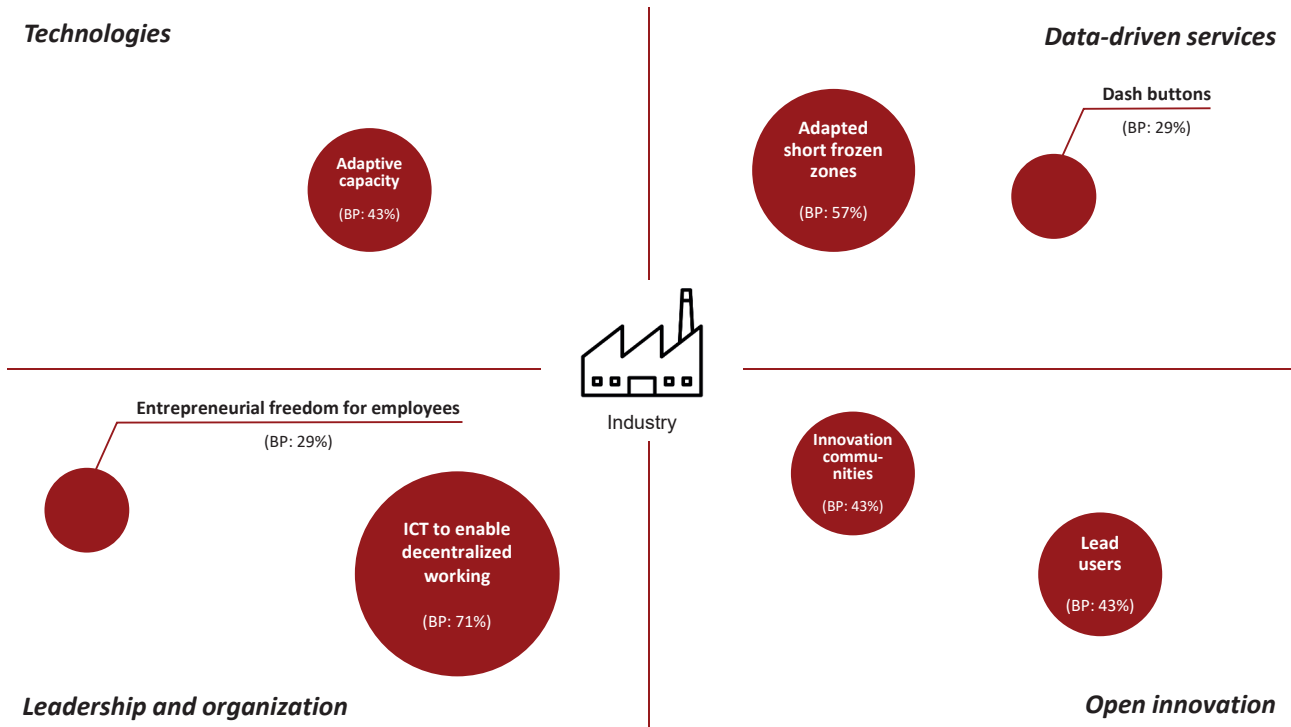
3.5 Summary

The investigation within the four topics of technologies, data-driven services, leadership and organization, as well as open innovation has revealed several insights. Most of the investigated concepts, tools, and strategies seem to be distinguishing for best practice companies to a certain extent. This, however, does not mean that the investigated KPIs are the ones directly influenced by the use and implementation of the methods and tools, or the other way around. The KPIs were used to identify best practice companies (top quintile for LSP, industry, and retail) and the study subsequently analyzed which methods and tools those best practice companies apply in the four different topics compared to the rest. The most distinguishing approaches (in terms of differentiating best practice companies from the others, but not in terms of overall diffusion) found in this survey are displayed in Figure 25.

Figure 25: Implemented best practice concepts of LSP, industry companies and retailers (BP - Best practice, numbers indicate best practice companies already having implemented the respective tool or method in %, size of the bubbles indicates diffusion among best practice companies)

Technologies

Cognition
(BP: 25%)

Automa-tization
(BP: 50%)

Data-driven services

Dash-buttons
(BP: 38%)

Selectable time slots for delivery
(BP: 88%)

LSP

Supply Chain Analytics to support decisions
(BP: 75%)

ICT to enable decentralized working
(BP: 88%)

Idea contests
(BP: 75%)

Lead users
(BP: 75%)

Leadership and organization

Open innovation

Technologies

Adaptive
capacity

(BP: 43%)

Data-driven services

Adapted
short frozen
zones

(BP: 57%)

Dash buttons

(BP: 29%)

Industry

Entrepreneurial freedom for employees

(BP: 29%)

ICT to enable
decentralized
working

(BP: 71%)

Innovation
commu-
nities

(BP: 43%)

Lead
users

(BP: 43%)

Leadership and organization

Open innovation

Technologies

Real-time
visbility

(BP: 75%)

Cognition

(BP: 50%)

Data-driven services

Same-
day/same-hour
delivery

(BP: 75%)

E-commerce

(BP: 100%)

Retail

Entrepre-
neurial
freedom for
employees

(BP: 50%)

ICT to enable
decentralized
working

(BP: 75%)

Design thinking

(BP: 75%)

Lead users

(BP: 50%)

Leadership and organization

Open innovation

- **Cognitive abilities**, although not implemented to a wide extent, distinguish best practice retailers and LSP.
- **Hybrid product-service bundles such as dash buttons** constitute an evolving concept that offers opportunities for customer value enhancing services. Furthermore, traditional value-added services (time slots for delivery for LSP, adapted frozen zones for industry, and e-commerce for retailers) are decisive and customer value-adding services that best practice companies offer. All those **services will be further adapted and tailored based on data to meet individual customer requirements** (segment of one).
- New leadership approaches should focus on promoting entrepreneurship in organizations and fostering a learning environment, where risk taking and associated failures are recognized as means to progress. **More flexible working modes** giving autonomy to employees and allowing decentralized working are success factors for LSP, industry, and retailers alike.
- **Design thinking** as a method to apply open innovation in organizations is used by 75% of best practice retailers. Across LSP, industry, and retail the not yet widely used **concept of lead users is a promising avenue for open innovation**, also paying tribute to the fact that customers are and will remain the most important source of generating innovation.

The interplay of successfully implementing organizational and technological changes while focusing on empowering employees distinguishes best practice companies from others. The results obtained were deepened in a Delphi workshop with the aim of assessing two theses per topic on a temporal scale (likelihood of occurrence) and identifying success factors and barriers for the respective subjects.

4. FUTURE DEVELOPMENTS IN LOGISTICS

The aim of the Delphi workshop was to deepen the insights gained and to evaluate barriers as well as success factors for future developments in logistics. Therefore, two theses per topic were investigated. The topic evaluation for the Delphi workshop is based on two pillars: first, expert conversations and current developments served as input for the determination of topics; and second, controversial and surprising findings from the online questionnaire and the best practice evaluation in chapter three were used to shape the theses.

Within the topic technologies, the current evolvement of logistics platforms opens the question of whether experts think that a main part of freight business will be handled via platforms, why they use those platforms, and what hinders further market saturation. The indication from the online questionnaire that experts are ambiguous concerning the implementation of data for operational and tactical decisions fed into two theses: first, the investigation of the partial use of data analytics on a tactical level; and second, whether, within the topic of data-driven services, fully autonomous handling of operational logistics activities will enable companies to reach a higher customer service level. A major prerequisite is intra-organizational data exchange, which is not yet happening in many cases and therefore remains under investigation along with the second thesis in the data-driven services topic. Concerning leadership and organization, first, the topic of swarm organization is put forward as the evaluation described in chapter 3.3 showed

disunity among participants. Second, the concept of promoting entrepreneurship within companies distinguishes best practice companies from others, although it is only used to a rather limited extent. Therefore, an examination of the success factors for and barriers to this concept is required. Under the umbrella of open innovation, it is necessary to investigate whether companies adapt their organization in order to maximize innovation capacity and therefore integrate in a structural way an innovation focus. The need for transdisciplinary innovation is confirmed (refer to section 3.4), but it is not yet clear whether this will result in open innovation becoming the dominant mode of innovation efforts. This led to the final thesis. To summarize, the eight theses put forward are as shown in Figure 26. In the following, the results per topic and thesis are presented and reflected upon. This leads to an indication of future developments in logistics, presented in section 4.5.
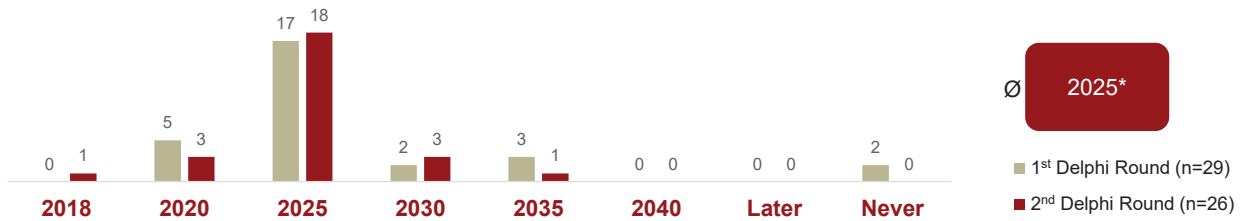
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Figure 26: Theses Delphi workshop

Technologies & Platforms	**Freight platforms**	• The freight business in logistics is largely handled via platforms.
	Technologies on a tactical level	• Technologies for automation, adaptive capacity and cognitive intelligence are implemented and used to support and execute logistics processes at the tactical level.
Data-driven services	**Technologies on an operational level**	• The fully autonomous handling of business processes in the most important operational logistics functions will enable companies to offer their customers a higher level of service.
	Data exchange	• Inter-organizational exchange of data and knowledge (i.e. across company boundaries) will be a crucial prerequisite for the majority of companies to offer new services and increase customer benefits.
Leadership and organization	**Swarm organization**	• Swarm organization will be established as a priority working method for logistics employees.
	Entrepreneurial freedom	• Targeted entrepreneurial freedom for employees is promoted by management and is an integral part of the corporate culture.
Open innovation	**Organization and innovation**	• Companies structure their organization to maximize innovation capability.
	Cooperative open innovation	• Cooperative Open Innovation will be the dominant mode of innovation effort.

4.1 Technologies and platforms

Thesis: Platforms

- The freight business in logistics is largely handled via platforms.

	2018	2020	2025	2030	2035	2040	Later	Never
1st Delphi Round (n=29)	0	5	17	2	3	0	0	2
2nd Delphi Round (n=26)	1	3	18	3	1	0	0	0

Ø **2025***

■ 1st Delphi Round (n=29)
■ 2nd Delphi Round (n=26)

Success Factors

- Transparency (e.g. for capacities)
- Cost efficiency
- Speed (e.g. processing)
- Better capacity/resource utilization
- IT interfaces, which are easy to integrate

Barriers

- Compliance (e.g. tender management)
- People (processes and mindset)
- Trust (no face to the customer)
- Cost intensive rework
- Process hurdles due to lacking standards

- Main parts of freight business will be handled via platforms by 2025.
- This will occur for standardized transports and operations, for special requirements (e.g. chemical industry) either niche solutions of platforms will appear or traditional business will prevail.

* Excluding later and never (also applicable for the following figures)
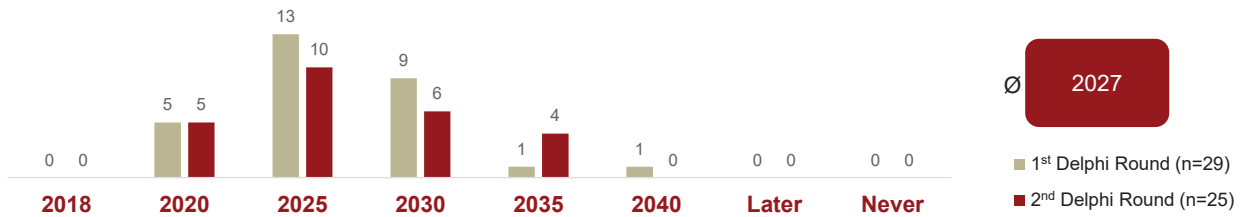
4

Platforms for freight transportation are emerging and have experienced increasing user numbers. As seen from the online questionnaire, they are also considered to increase comparability and hence strengthen cost pressure. This is also reflected by one of the experts participating in the Delphi workshop, who stated: "*Freight platforms create too much transparency.*" However, experts agreed in the workshop that freight business in logistics will largely be handled via platforms by 2025.

Supporting factors fostering the use of platforms are expectations to better use existing resources, speed of order processing, and a resulting improved cost efficiency. IT interfaces, which are easy to integrate, will be crucial for the acceptance and use of freight platform solutions. Hindering aspects are, on the one hand, human-centered points such as the mindset of people who might not be willing to apply the new processes and tools as well as a loss of trust because

of the lack of a face to present to the customer. On the other hand, the complexity of requirements in freight transport leads to process hurdles due to the lack of standards. Experts experienced cost- and time-intensive rework for order processing via platforms depending on the depth of detail of inquiries and depictability of specifications. As a conclusion, standardized transport inquiries for the short term will be processed via platforms. For more individualized requirements, either niche solutions will appear, or traditional business will prevail.

Thesis: Technologies

- Technologies for automation, adaptive capacity and cognitive intelligence are implemented and used to support and execute logistics processes at the tactical level.

	2018	2020	2025	2030	2035	2040	Later	Never
1st Delphi Round (n=29)	0	5	13	9	1	1	0	0
2nd Delphi Round (n=25)	0	5	10	6	4	0	0	0

Ø **2027**

Success Factors

- Better use of resources and capacities
- Increased flexibility (reduction of set-up times or empty runs, automatic steering)
- Planning accuracy and efficiency
- Transparency (increasing information level)

Barriers

- High investment (esp. for small companies)
- Skepticism of employees, acceptance of the solution (degree of transparency)
- Data quality and availability (master data) and data interfaces

- Technologies for autonomous logistics processes (e.g. machine learning) on a tactical level will be used by 60% of panel participants by 2025 (2nd Delphi round).
- Main concerns are investment efforts and skepticism of employees, which requires to foster a new culture towards more openness and including upskilling of employees.

Technologies to support and execute processes at a tactical level, such as machine learning, will be used by 60% of the panel experts by 2025. The scale and technology penetration are unclear, but the findings from the online questionnaire revealed that 46% of participants from industry and 70% from LSP are planning to use those technologies in the upcoming two years.
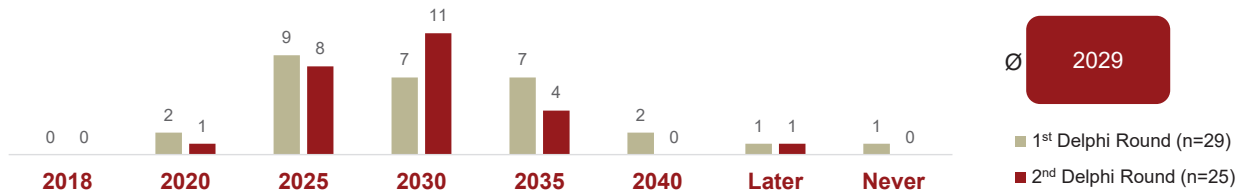
Delphi experts see success factors in a better use of resources through improved planning accuracy and efficiency. This is mainly based on increasing data availability for a better information level. As a result, more flexibility in terms of, for example, reduction of set-up times and empty runs is achieved. Concerning the people dimension, employees need to acquire new competences – but those technologies are also seen as a means to counteract skills shortages. Barriers are mainly associated with the high investment required (especially for small companies), data quality and availability, as well as a lack of openness among employees concerning new technologies. Furthermore, experts see problems in an unclear legal framework (e. g., working time act, General Data Protection Regulation) and mention concerns related to data protection and security. Summarizing, technologies for automation, adaptive capacity, and cognitive intelligence are attributed with potentials such as increased flexibility and better capacity utilization, but their successful implementation requires to foster a new culture moving towards more openness among employees and a clear qualification and upskilling strategy.

4.2 Data-driven services

Thesis: Technologies for operational logistics functions to increase the service level
- The fully autonomous handling of business processes in the most important operational logistics functions will enable companies to offer their customers a higher level of service.

| 2018 | 2020 | 2025 | 2030 | 2035 | 2040 | Later | Never |

Ø **2029**

■ 1st Delphi Round (n=29)
■ 2nd Delphi Round (n=25)

Success Factors
- Better capacity utilization (efficiency increases)
- For routine tasks
- Transparency about data flows
- Speed

Barriers
- Flexibility decreases
- Number of variants (services are constantly evolving)
- Investment
- Legal framework and liability

- Fully autonomous handling of the most important operational logistics functions will probably become true in a decade.
- Autonomous processes will redefine the customer interface and services offered, however issues such as legal and data hurdles as well as handling the variety of services for customer value added need to be solved.

4

Practitioners believe that the fully autonomous handling of business processes in the most important operational logistics functions will enable companies to offer their customers a higher level of service, beginning between the years 2025 and 2030.

Coupled with simplified customer interfaces and services, autonomous business processes promise to result in fewer errors, while being less labor-intensive. Furthermore, experts state that they expect increased efficiency and speed from the automation of routine and rudimentary tasks. Moreover, they believe that a higher degree of transparency can also help to ease decision making for management teams and consequently allow them to adjust their strategy faster in order to streamline their organization for increasing customer value.

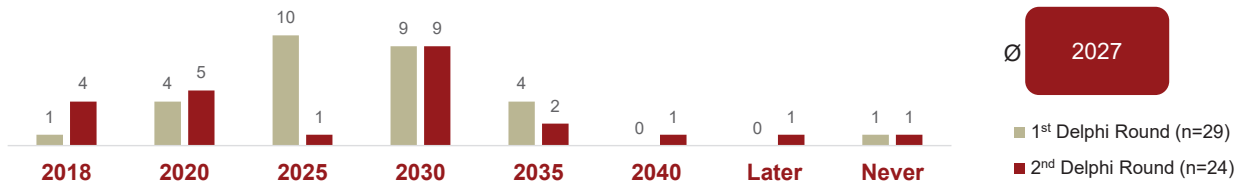However, the experts also mentioned that challenges will arise from the growing number of variants and

shorter product lifecycles, which lead to hurdles when it comes to automating processes – not to mention the high initial investments required and complex legal frameworks. If successfully handled, though, the benefits may be substantial.

- Inter-organizational exchange of data and knowledge (i.e. across company boundaries) will be a crucial prerequisite for the majority of companies to offer new services and increase customer benefits.

Ø 2027

	2018	2020	2025	2030	2035	2040	Later	Never
1st Delphi Round (n=29)	1	4	10	9	4	0	0	1
2nd Delphi Round (n=24)	4	5	1	9	2	1	1	1

Success Factors
- Service improvement and an efficient SC
- Minimization of errors
- E2E-optimization: holistic approach
- Clean slate which data is transmitted
- Speed of development of services

Barriers
- Trust
- Data security
- Loss/sharing of know-how and internal data (patents, copyright, code of conduct)
- Dependency

- Inter-organizational data-exchange as a crucial competitive factor is seen by most participants to be relevant towards 2030.
- Predominant fears such as lack of trust and loss of know-how need to be countered by a holistic E2E-approach and a sustainable legal framework (e.g. for contract management).
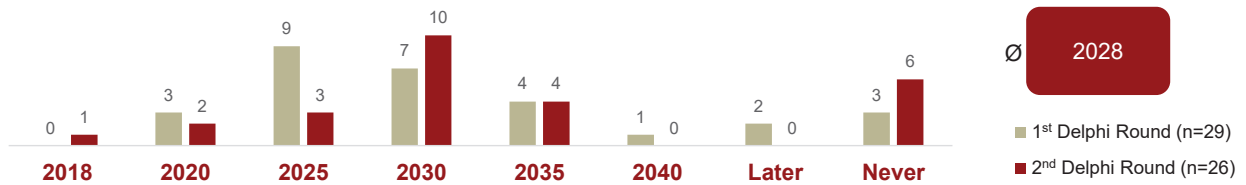
The surveyed experts agreed on the thesis that inter-organizational exchange of data and knowledge (i.e., across company boundaries) will be a crucial prerequisite for the majority of companies to offer new services and increase customer benefits by the end of the next decade or earlier. The expected benefits are service improvements and more efficient supply chains due to better data quality and faster transmission. This easily ties into E2E-optimization and offers a clear holistic approach to optimize processes and logistics.

Barriers to a successful implementation are questions of trust and data security along the supply chain, as well as issues regarding proprietary knowledge and data of individual agents. As inter-organizational data-exchange is seen as a crucial competitive factor by most experts, predominant fears such as lack of trust and loss of know-how need to be countered by a holistic E2E-approach and a sustainable legal framework (e. g., for contract management).

4.3 Leadership and organizational structures

Thesis: Swarm Organization
- Swarm organization will be established as a priority working method for logistics employees.

Ø **2028**

■ 1st Delphi Round (n=29)
■ 2nd Delphi Round (n=26)

Chart values by year:
- 2018: 0 / 1
- 2020: 3 / 2
- 2025: 9 / 3
- 2030: 7 / 10
- 2035: 4 / 4
- 2040: 1 / 0
- Later: 2 / 0
- Never: 3 / 6

Success Factors
- Leveraging know-how and specific competences (knowledge of details)
- Increased motivation and contentment of employees
- Steering via KPIs important (measurability)

Barriers
- Change management
- Organizational structures of companies
- Loss of power – no acceptance from the management level

- Almost 25% of experts state swarm organization will never be the priority working mode for logistics employees (2nd round).
- Swarm organization will more likely be applicable for white collar workers in logistics. The attitude of the management is seen as one of the major barriers for this new organizational form.

4

To establish swarm organization as a priority working method for logistics employees, certain barriers need to be overcome. One of the most hindering barriers is management acceptance, as swarm organization goes hand in hand with a loss of power in the corresponding hierarchy levels. On the other side, when looking at the employee level, the main barriers that need to be overcome are the organizational structures within the logistics department and the level of education, as there are great gaps between the different skill levels and task complexities. Furthermore, it will be a serious task to roll out the right change management program for this disrupting process of work re-organization.
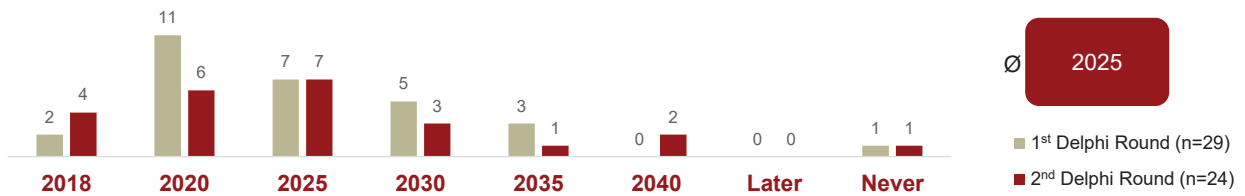
The critical success factors, on the other hand, that will support swarm organization in logistics are displayed as leveraging know-how and specific competences and steering employees and processes even more via KPIs. Finally, it is crucial to build trust towards employees and to rely on their competences. This will lead to increased motivation and contentment of employees.

The average expert opinion is that swarm organization will be established as a priority working method for white collar logistics employees by the year 2028.

Thesis: Entrepreneurial freedom

- Targeted entrepreneurial freedom for employees is promoted by management and is an integral part of the corporate culture.

	2018	2020	2025	2030	2035	2040	Later	Never
1st Delphi Round (n=29)	2	11	7	5	3	0	0	1
2nd Delphi Round (n=24)	4	6	7	3	1	2	0	1

Ø 2025

Success Factors

- Incentives, e.g. profit-sharing
- Trust in employees
- Target frame and steering of ambitions
- Increased motivation and identification with products and tasks

Barriers

- Management looses control and status
- Lack of failure culture
- Invest (time and resources) for improvement required

- On average experts expect entrepreneurial freedom to be an integral part of corporate culture by 2025.
- This will lead to increased employee motivation and contentment but requires the set-up of a clear and fair target framework and an environment, where failures are accepted as a way to move forward and improve.

As the best practice analysis has shown, successful companies tend to give free time and resources to their employees in order to develop and test new processes or products.

One of the main barriers to overcome when implementing this measure is to align the entrepreneurial freedom with the employee's daily operational tasks. Again, management needs to be deeply involved in the process as they are probably going to lose control and status when innovative and entrepreneurial ideas are created by the employees themselves. Such entrepreneurial freedom also comes with a high investment regarding time and resources for implementation.

Apart from that, experts envisage increased motivation for the employees as well as improved identification with the products and tasks performed. To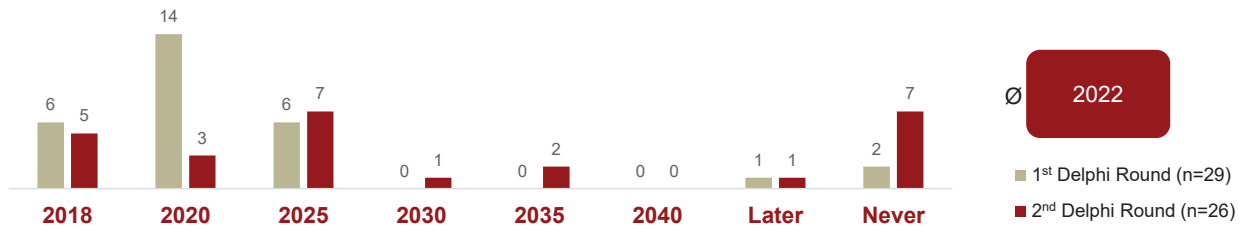 encourage employees to contribute even more to an entrepreneurial environment, incentives such as profit sharing will help. After all, targeted entrepreneurial freedom can create new revenue streams (e. g., development of new business models).

The average expert opinion is that targeted entrepreneurial freedom for employees will be promoted by management by the year 2025.

4.4 Open innovation

Thesis: Organization and innovation
- Companies structure their organization to maximize innovation capability.

Ø 2022

- 1st Delphi Round (n=29)
- 2nd Delphi Round (n=26)

	2018	2020	2025	2030	2035	2040	Later	Never
1st	6	14	6	0	0	0	1	2
2nd	5	3	7	1	2	0	1	7

Success Factors
- Use of know-how
- Market leadership and securing future viability
- Increased flexibility
- Holistic approach

Barriers
- Existing organization
- People (lack of acceptance, motivation etc.)
- Sector specifics
- Risk to only focus on innovation and neglect other value adding activities

- As a result of the 2nd round 27% of experts think, that companies will never structure their organization in order to maximize innovation capability. This represents a major shift from the first Delphi round.
- Although restructuring to meet innovation targets is seen as a way to secure future viability, the existing organizational structure, sector specifics, and innovation not being a priority represent barriers.
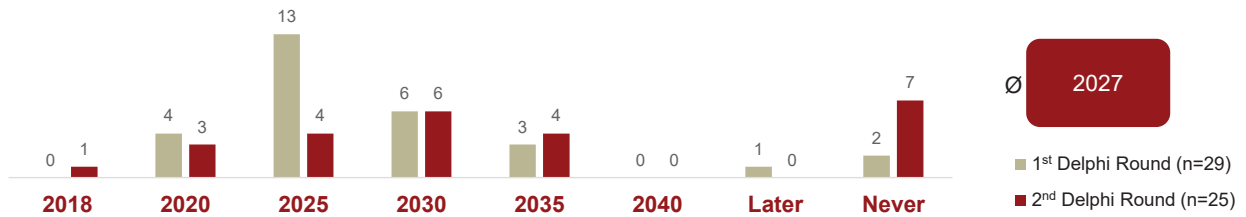
The answers to the question of at what point in time open innovation will be the dominant format in innovation management show a wide degree of dispersion and reflect one of the central dilemmas of the concept: balancing the advantages that opening the innovation management provides with the risks it can bring into a company. The experts agree that open innovation initiatives can help companies by providing cost-efficient and comparably faster ways to develop new product and/or services. One major success factor is identifying the right partners to cooperate with: companies must identify partners that are reliable, trustworthy, and provide a strategic fit.

Similar to the organizational structures discussed before, the main factors resisting the implementation of open innovation initiatives are psychological. Companies are afraid of losing intellectual property or revealing internal data, especially in competitive sectors like the logistics one. Cooperative innovation efforts also require additional legal effort, for example when it comes to defining who the owner of the innovation will be. While open innovation is mostly associated with decreasing both costs and time-to-market, the experts also raised concerns regarding the possibility of it having the opposite effect. Complex legal negotiations, a lack of trust, and additional coordination efforts can easily negate the possible advantages and require a holistic approach.

4

Thesis: Open Innovation

- Cooperative Open Innovation will be the dominant mode of innovation effort.

	2018	2020	2025	2030	2035	2040	Later	Never
1st Delphi Round (n=29)	0	4	13	6	3	0	1	2
2nd Delphi Round (n=25)	1	3	4	6	4	0	0	7

Ø 2027

Success Factors

- Common goals
- Standards and norms for overarching cooperation
- Better fulfillment of customer wishes
- Limited own resources, more innovation capacity

Barriers

- Loss of know-how/knowledge advantage
- Lack of trust
- Data protection
- Competitive disadvantage

- Converging industries and customers requiring interdisciplinary solutions force traditional companies to shift paradigms concerning their innovation culture.
- Cooperative open innovation is regarded as a means to enhance the own innovation capability, but knowledge transfer is still mainly associated with loss of know-how instead of leading to a competitive advantage.
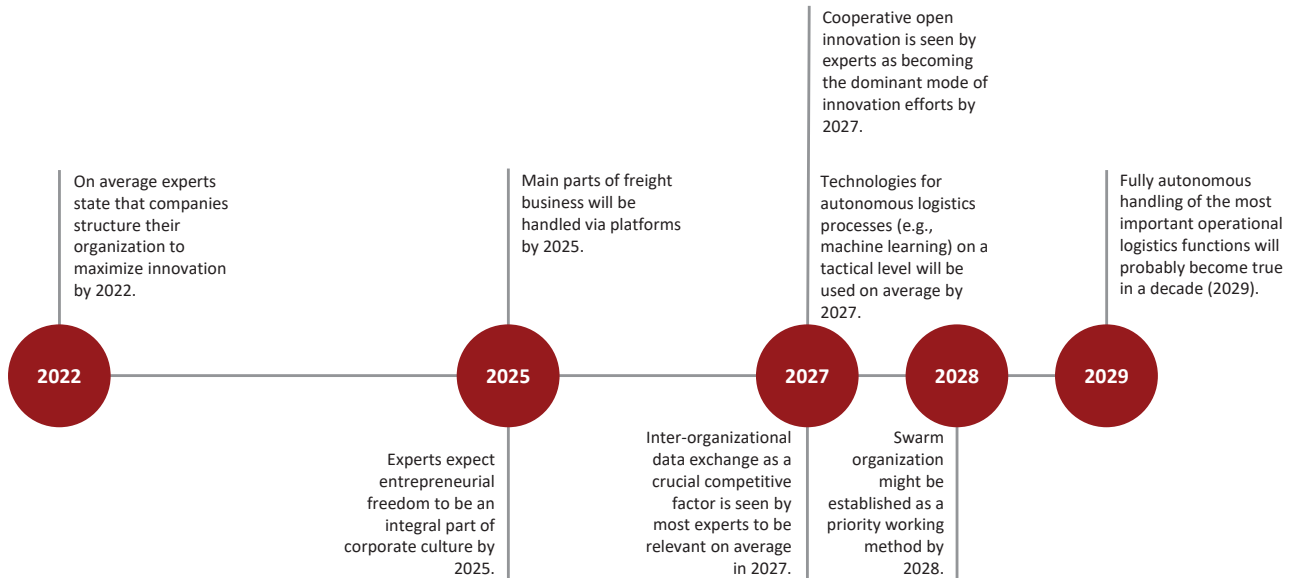
The results from the Delphi workshop reveal an interesting shift in the experts' expectations. While most experts expected companies to align their organization with their innovation strategy in the very near future in the first round, almost a quarter of experts expected this never to happen after the discussions in the second round. This shift perfectly characterizes the problem at hand: while at first sight an obvious objective, the many complex details necessary to consider make the alignment of organization and innovativeness a difficult task. Uniting the employees through a common vision and thus dissolving the often entrenched divisional thinking is one of the main success factors to achieve this. Companies need to take a holistic approach and implement elements of innovation management at every level and in every department. Heavily centralizing innovation management is therefore often counterproductive. Providing the necessary budget, be it financial or timewise, is crucial. Factors slowing down the adoption of innovation-promoting structures are both organizational and psychological. The characteristics of an industry or sector, for example, can have a significant influence on how the importance of innovation is perceived and thus institutionalized. Sectors with heavy cost pressure and fewer possibilities to differentiate from competition, like LSP, are therefore slower in developing innovation strategies and aligning those with their organizational structures. Another major barrier is the lack of acceptance from employees, especially those who have been in the company for a longer period. Implementing an organizational structure that promotes innovation is therefore only the frame within which companies must address the psychological barriers by also implementing an innovation-friendly culture which actively involves all types of employees.

4.5 Summary

Cooperative open innovation is seen by experts as becoming the dominant mode of innovation efforts by 2027.

On average experts state that companies structure their organization to maximize innovation by 2022.

Main parts of freight business will be handled via platforms by 2025.

Technologies for autonomous logistics processes (e.g., machine learning) on a tactical level will be used on average by 2027.

Fully autonomous handling of the most important operational logistics functions will probably become true in a decade (2029).

2022 — **2025** — **2027** — **2028** — **2029**

Experts expect entrepreneurial freedom to be an integral part of corporate culture by 2025.

Inter-organizational data exchange as a crucial competitive factor is seen by most experts to be relevant on average in 2027.

Swarm organization might be established as a priority working method by 2028.

4

The resulting summary from the Delphi workshops shows that all stated theses are expected to materialize within the next decade. As a first step, innovation capability will be enhanced by adapting the organizational structure and giving more entrepreneurial freedom to employees. However, it is remarkable that open innovation processes will tend to take longer due to skepticism about sharing data. This is also one of the main hindering reasons for the adoption of fully autonomous process on an operational level (2029) and partial automation of tasks on a tactical level (2027). It has to be considered that we asked experts about the use of autonomous processes on a tactical level as a support activity and about fully autonomous handling in terms of the most important operational logistics functions. Completely new organizational forms such as swarm organization may possibly be adopted towards 2028 for white collar workers in logistics, but one quarter of experts also perceived that it would never find its way into logistics departments.

5. CONCLUSION

The study presents a possible procedure for an exploratory research approach to get closer to the topic of digital transformation in logistics. Logistics managers can gain insights into how logistics experts from industry, while LSP and retailers can address digital transformation strategically along with how to position their own company. For finding solutions for adapting to dynamic economies and increasingly complex customer requirements, logistics practitioners are currently building the basis for optimizing their logistics by making data transparent and applying supply chain analytics to convert this data to perceivable (customer) value. Furthermore, they must shape their organization accordingly and develop human skills within it. Open innovation will be key to drawing on the full potential of external knowledge input. Organizations should allow a certain degree of autonomy for employees concerning work organization to account for the need for more flexible working environments.

5.1 Pathway of digital transformation in logistics

Based on the findings of this study, it can be stated that logistics will probably pass through different stages to move forward on the path of digital transformation. Currently, the status quo suggests that enabling (real-time) visibility is already quite established, laying the basis for analysis and optimization of logistics processes. Consistent vertical as well as inter- and intraorganizational integration (connectivity) is still prevented by media discontinuities and resistance, and uncertainty about sharing data. Completely autonomous processes in logistics networks are still up in the air, but best practice companies are moving forward by leveraging tools and enablers such as technologies, new leadership and organizational principles, as well as open innovation approaches. Connectivity across the supply chain will increase as this a prerequisite for, for example, applying the platform concept that experts agreed will be the main means to process requirements for freight business by 2025. Therefore, intra-organizational data exchange will probably be recognized as a decisive competitive factor by a majority of stakeholders along the supply chain. Data capture, analysis, and value-adding use will then lead to (semi-) autonomous processes on a tactical level, while completely autonomous processes for operational activities are to be expected towards 2030.

The research results presented offer indications of concepts that are currently being pursued, however, this study does not investigate how the links and interdependencies between the tools, technologies, and data-driven services and the enablers leadership, organization, and open innovation take shape. The identification and evaluation of additional tools and enablers of digital transformation in logistics as well as their interrelationships should be part of future research.

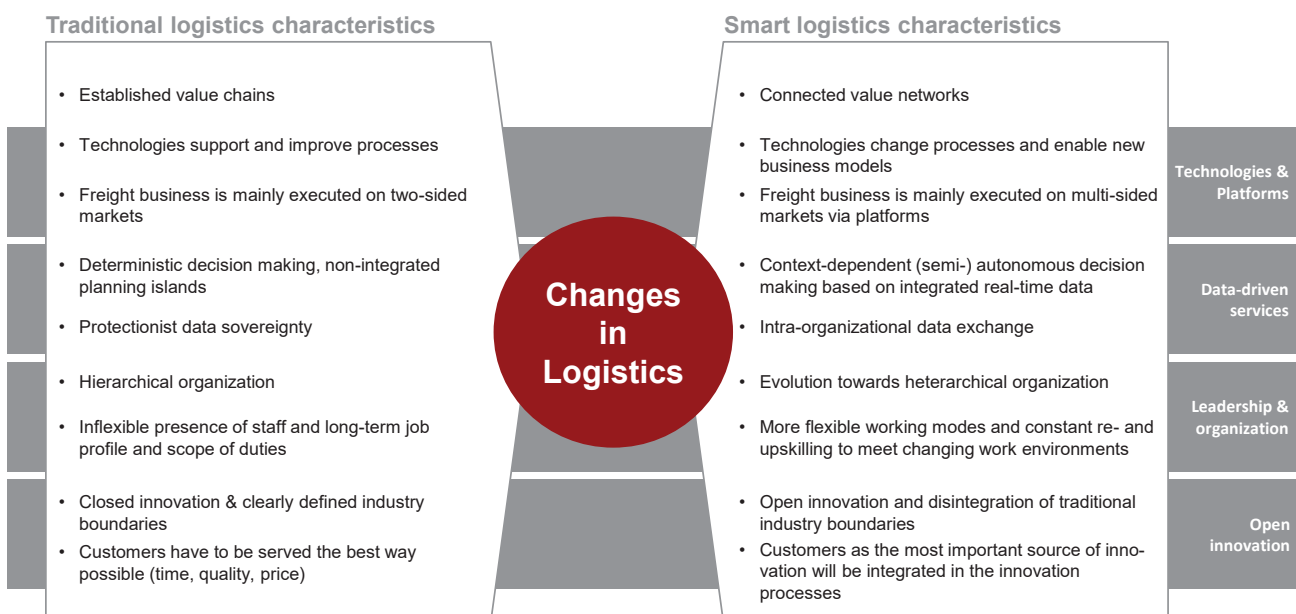Figure 28: Pathway of digital transformation in logistics
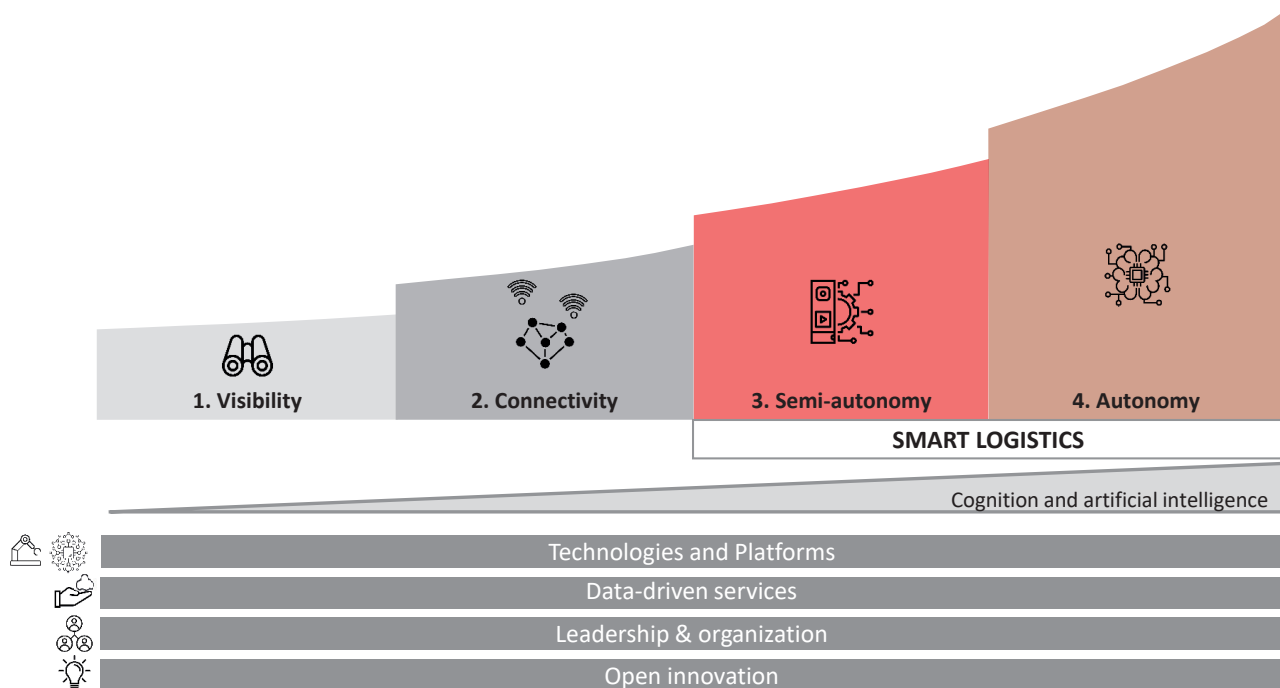
5.2 Implications for management and research

As the results from the best practice evaluation and the Delphi panel show, logistics is currently undergoing some fundamental changes. Those changes can be used in a very beneficial way, but a prerequisite is that the implementation of tools of new technologies and data-driven services, enabled through supportive organizational structures and progressive leadership as well as open innovation, is accompanied by a

Figure 29: Potential paradigm shifts in logistics

Traditional logistics characteristics

- Established value chains
- Technologies support and improve processes
- Freight business is mainly executed on two-sided markets
- Deterministic decision making, non-integrated planning islands
- Protectionist data sovereignty
- Hierarchical organization
- Inflexible presence of staff and long-term job profile and scope of duties
- Closed innovation & clearly defined industry boundaries
- Customers have to be served the best way possible (time, quality, price)

Changes in Logistics

Smart logistics characteristics

- Connected value networks
- Technologies change processes and enable new business models
- Freight business is mainly executed on multi-sided markets via platforms
- Context-dependent (semi-) autonomous decision making based on integrated real-time data
- Intra-organizational data exchange
- Evolution towards heterarchical organization
- More flexible working modes and constant re- and upskilling to meet changing work environments
- Open innovation and disintegration of traditional industry boundaries
- Customers as the most important source of innovation will be integrated in the innovation processes

Technologies & Platforms

Data-driven services

Leadership & organization

Open innovation

human-centered and holistic change management approach. Selected potential paradigm shifts that can probably be expected derived from the findings of our research study are depicted in Figure 29.

New actors such as start-ups, IT and technology providers, as well as the increasing numbers of platform providers are currently shaking up the logistics landscape. This evolution, in combination with the findings of the research study and the potential paradigm shifts, leads to certain implications. One important development is the further disintegration of traditional sector boundaries – as currently seen on the LSP market – calling for transdisciplinary innovation approaches. As the results show, the evolution towards greater autonomy in logistics networks is still hampered by media discontinuities, anxiety concerning data sharing, and also partly trust issues regarding digital offerings. This means that in the short and medium terms simple mobile solutions (e. g., app-based) are necessary to integrate new services and forms of collaboration in logistics networks and that people as important constituents of those networks need to adapt to new roles and skills, which requires innovative training and competence management.

The findings of this research study show that logistics managers recognize the possibilities new technologies, processes, and organizational settings provide. Wider application of those concepts is still hampered by people's mindset, missing standards and legal boundaries, and insecurity about the formation of new power structures in supply chains. Open questions that should be addressed by management and research alike concern the following areas:

- Role of people in (semi-) autonomous networks
- Coping with skills shortages and training
- Trust in digital services and technology

- Social responsibility in logistics networks
- Degree of distributed vs. centralized intelligence as well as the degree of autonomy (both human and technological)
- Robustness of systems
- Standardization
- Need for new KPIs
- Means to bridge different maturity levels (e. g., simple mobile solutions)
- Shift of power relations due to new data-driven business models and their impact on logistics networks
- Interrelation and dependencies of tools and enablers relevant for digital transformation in logistics.

Logistics, as an integrating discipline, will become increasingly connected. This requires stakeholders to become more venturesome while holding themselves ready to provide the groundwork for new forms of collaboration in order to fully explore the benefits digital transformation has to offer. In the short- and mid-term run, although it is desirable, logistics will not become totally integrated. Increasing visibility will be possible to a certain extent and will uncover potential as well as shortcomings in logistics networks that have not been tracked and visualized until now. The challenge will be to find the right degree of automatization and autonomy in those value creation networks, balancing economic, ecological, and social requirements with a special emphasis on change management to involve and empower humans as orchestrators and innovators of those networks.

6. SUMMARY

The research study "Pathway of Digital Transformation in Logistics" of the chair of Logistics at Technische Universität Berlin deals with today's logistics challenges, which are increasing speed, integrating real-time information, as well as finding approaches for cooperation with new actors such as start-ups or tech companies. Therefore, the study examined four thematic building blocks central to current developments in logistics: technologies, including platforms, and data-driven services such as tools and leadership and organization, as well as open innovation as enablers.

> I. Technologies and platforms
> II. Data-driven services
> III. Leadership and organizational structures
> IV. Open innovation

The approach of this research has been twofold. First, we investigated the four topics by means of an online questionnaire. The 120 international participants in different logistics functions who answered this questionnaire represented the following sectors: logistics service providers (LSP, 37%); industry (32%); retail (14%); IT and technology providers (9%); and others such as academia and consulting (8%).

Second, a Delphi workshop with 32 logistics experts from industry and LSP revealed further evaluations of **future developments** in logistics. The main results of the survey and the Delphi workshop are summarized in the following. Based on the findings, **best practice concepts** are identified and a **pathway of digital transformation** towards smart logistics is derived.

Technologies and platforms
To capture the benefits of digital transformation potential, the steps of data capture and communication, data storage and analysis, and finally converting data to value are essential. Participants across all sectors agree that digital transformation requires flexible logistics structures. The survey results reveal that three quarters (73%) of participants' companies have applications in place concerning **real-time visibility**. More than half of all participants stated they **are not planning to invest in cognitive intelligence** such as machine learning in the following two years.

Freight platforms	• Main parts of freight business will be handled via platforms by 2025. • This will occur for standardized transports and operations, for special requirements (e.g. chemical industry) either niche solutions of platforms will appear or traditional business will prevail.
Technologies on a tactical level	• Technologies for autonomous logistics processes (e.g. machine learning) on a tactical level will be used by 60% of panel participants by 2025 (2nd Delphi round). • Main concerns are investment efforts and skepticism of employees, which requires to foster a new culture towards more openness and including upskilling of employees.

Data-driven services

The approval rate of 89% for logistics increasingly becoming a sales argument underlines the fact that logistics is and will remain an important competitive factor. Higher data availability is used to **apply supply chain analytics** for optimizing processes in procurement, demand planning, operations planning, and distribution, whereas reverse logistics is a focus for supply chain analytics with rather untapped potential: only 49% currently use supply chain analytics in this area. Further findings imply that transparency is very important but that **economical fields of applications for completely automated processes are still up in the air.**

Technologies on an operational level	• Fully autonomous handling of the most important operational logistics functions will probably become true in a decade. • Autonomous processes will redefine the customer interface and services offered, however issues such as legal and data hurdles as well as handling the variety of services for customer value added need to be solved.
Data exchange	• Inter-organizational data-exchange as a crucial competitive factor is seen by most participants to be relevant towards 2030. • Predominant fears such as lack of trust and loss of know-how need to be countered by a holistic E2E-approach and a sustainable legal framework (e.g. for contract management).

Leadership and organizational structures

Integrating gathered data for automated decision-making on a tactical level revealed disunity among survey participants, with 60% disagree with the statement that data-driven decisions partly replace employees of the middle management while 40% are undecided or agree. A supporting thread of opinion is that two thirds of participants do not confirm the statement that operational logistics activities lose significance by automation and outsourcing, allowing the presumption that logistics managers are aware of their future social responsibility. Humans are the capital for orchestrating future, partly automated logistics networks. Four out of five managers indicated their awareness of this, stating that they have a clear strategy in place to qualify employees for the digital age. One element of that strategy is to promote agile and independent teams and to foster entrepreneurial spirit, which leads to new organizational structures.

Swarm organization	• Almost 25% of experts state swarm organization will never be the priority working mode for logistics employees (2nd round). • Swarm organization will more likely be applicable for white collar workers in logistics. The attitude of the management is seen as one of the major barriers for this new organizational form.
Entrepreneurial freedom	• On average experts expect entrepreneurial freedom to be an integral part of corporate culture by 2025. • This will lead to increased employee motivation and contentment but requires the set-up of a clear and fair target framework and an environment, where failures are accepted as a way to move forward and improve.

Open innovation

The convergence of sectors and customers requiring interdisciplinary solutions is forcing traditional companies to **shift paradigms concerning their innovation culture**. The final customer is still the most important external source for generating innovation, whereas **start-ups and tech companies** will experience the most important growth concerning their significance for generating logistics innovation over the next five years.

Organization and innovation	• As a result of the 2nd round 27% of experts think, that companies will never structure their organization in order to maximize innovation capability. This represents a major shift from the first Delphi round. • Although restructuring to meet innovation targets is seen as a way to secure future viability, the existing organizational structure, sector specifics, and innovation not being a priority represent barriers.
Cooperative open innovation	• Converging industries and customers requiring interdisciplinary solutions force traditional companies to shift paradigms concerning their innovation culture. • Cooperative open innovation is regarded as a means to enhance the own innovation capability, but knowledge transfer is still mainly associated with loss of know-how instead of leading to a competitive advantage.

To find answers to dynamic economies and increasingly complex customer requirements, logistics practitioners are currently building the basis for optimizing their logistics networks by making data transparent and shaping their organizations accordingly. The question of the right degree of autonomy for organizations and logistics networks plays an important role for future strategic orientation in logistics. Logistics will probably pass through several stages indicating a **pathway for digital transformation in logistics**. The first stage, creating visibility, is already quite mature. The second stage, increased connectivity, is still hindered by data protectionism, no standardized data interfaces, and non-integrated planning islands. However, best practice companies are already moving forward on the pathway towards the third stage of semi-autonomous processes in logistics, including by applying innovative leadership and innovation concepts. Completely autonomous processes across the E2E supply chain characterizing the fourth stage are still up in the air. From our insights, logistics managers recognize the need for increased collaboration in a data-driven environment, but hurdles such as the lack of standards on the process and legal sides, insufficient technological support (e. g., existing media discontinuities), and resistance from both management and employees need to be overcome in order to successfully manage the digital transformation in logistics.

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Pathway of Digital Transformation in Logistics

The present study deals with today's logistics challenges, which are increasing speed and the integration of real-time information for data-driven services, implementing new organizational and leadership structures as well as the need for finding approaches for cooperation with new actors such as start-ups or tech companies. Therefore, the study examines four thematic building blocks central to current developments in logistics: technologies, including platforms, and data-driven services as tools and leadership and organization, as well as open innovation as enablers.

The research approach is twofold. First, we investigate the four topics by means of an online questionnaire answered by 120 international participants. Second, a Delphi workshop with 32 logistics experts from industry and LSP reveals further evaluations of success factors and barriers for future developments in logistics. The study describes findings how companies move forward on the path of digital transformation towards smart logistics by presenting and discussing best practice concepts and future developments in logistics.