

A close-up of an astronaut's helmet in space. The helmet's visor reflects a digital landscape with binary code (0s and 1s) and a network of nodes. A small satellite or drone is visible in the reflection. The background is a starry space with a blue and orange gradient.

Traveling to Digital Worlds

Germany Blasts Off toward the Technological Future

A trend study by Tata Consultancy Services (TCS)
and Bitkom Research

www.studie-digitalisierung.de/en

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Foreword

How far has digitization come in Germany? Although German companies were hesitant for a long while, the time for waiting finally seems to be over. The third annual trend study conducted by TCS and Bitkom Research is proof of this – and the latest findings provide reason to be optimistic. German enterprises have hit the ignition and are starting their innovative journey to the future business world.

Almost all indicators show an upward trend. On average, 4.9 percent of annual revenue is invested in digitization, compared to 4.6 percent in the previous year. There was a significant increase in the fundamental openness to transformation, which rose by 5 percentage points to reach 75 percent. Moreover, the majority of companies have embedded transformation into their strategy, organizational structure, and workforce. Three out of four organizations have a digital strategy, and one in three have a dedicated digital business unit. The chief digital officer (CDO) has also become an established role, driving digitization initiatives at 17 percent of the surveyed companies – almost three times as many as the previous year.

One of the most striking findings is the unchanged innovation gap between large enterprises and SMEs. Big data analytics is a prime example: 59 percent of large companies analyze big data, compared to just 37 percent of smaller companies. A similar trend can be seen with artificial intelligence (AI). Although only 7 percent of all companies surveyed use AI, the proportion of large companies with the technology is 17 percent. In contrast, cloud computing is already more or less standard at companies

of all sizes with 76 percent using the technology. The Internet of Things, 3D printing, and virtual/augmented reality are all becoming more prevalent – each up 5 percentage points on last year.

This shows that, in terms of technology, companies are generally on the right track. But what about processes and employees? There has been much progress in these areas, too. Half of the surveyed companies recognize the far-reaching effects of digitization on employees and on the working world, up from 37 percent in 2016. In addition, around half of the companies are using structured change management to prepare their employees for the culture shift that comes with digitization. On the other hand, only 18 percent regularly use agile methods to accelerate development projects and make their organization more adaptive.

At the same time, the competitive labor market for IT experts is becoming more differentiated. Many companies are searching for cloud experts, data scientists, digital marketing specialists, and virtual reality designers. The need for IT security experts remains the most urgent demand. As a key requirement for successful digitization, IT security plays a particularly important role.

On the following pages, you will see these findings and many more in full detail. I hope you will find inspiration in the results. If you have any questions, please do not hesitate to contact us. Digital transformation is a journey – and the best and most reliable way to complete it is with a strong partner at your side.



Sapthagiri Chapalapalli
Managing Director – Central Europe
Tata Consultancy Services

1. Methodology

This study by TCS and Bitkom Research builds on previous studies carried out in 2016 and 2017 to measure the progress of digital transformation in German businesses. The methodology of the study remains largely unchanged. This allows meaningful comparisons to be made and forms a clearer picture of the various digital strategies pursued by companies of different sizes and in different industries.

The latest survey took place in May and June 2018 via computer-assisted telephone interviewing (CATI). In total, the sample size consists of 954 companies based in Germany with at least 100 employees, representing a selection of businesses of different sizes and from different industries. The survey was directed at executives who are responsible for digitization within their companies. This includes managing directors, board members, and decision makers in IT and finance departments, digital technology, and business operations.

Using stratified random sampling ensures that companies of specific industries and sizes are represented in a sufficient number to allow a valid evaluation. The responses were weighted in the analysis.

The study therefore provides a representative picture of companies in Germany with 100 employees or more in different industries and of different sizes.

The survey focuses on four main topics:

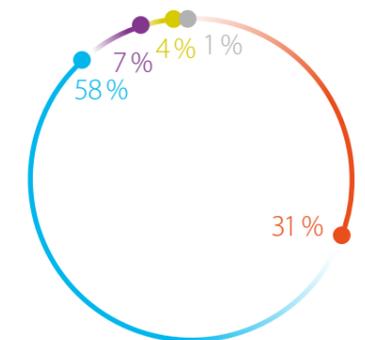
- Significance of digitization in the companies
- Use of key digital technologies
- Impact of digital transformation on business areas
- Investment areas, potential, and obstacles

Sample Composition 2018 by Company Size
(unweighted)



- 100 to 199 employees
- 200 to 499 employees
- 500 to 1,999 employees
- 2,000 employees or more

Sample Composition 2018 by Title of Respondent
(unweighted)



- CEO or board member
- Chief information officer (CIO)
- Chief operating officer (COO)
- Chief digital officer (CDO)
- Chief financial officer (CFO)

2. Key Findings



Germany's Digitization Is Taking Off



Large Enterprises Are Digital Pioneers – the Lead over SMEs Is Growing

Overarching digital strategy



Altered products and services



Big data analysis

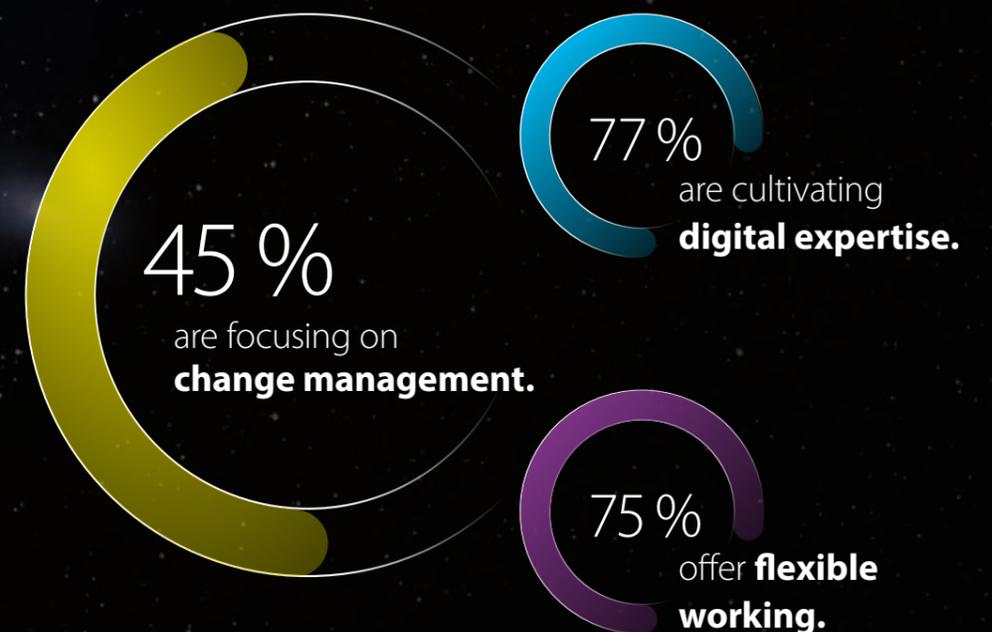


*employees

Companies Are Putting Customers First



Companies Are Making Long-Term Investments in Employees

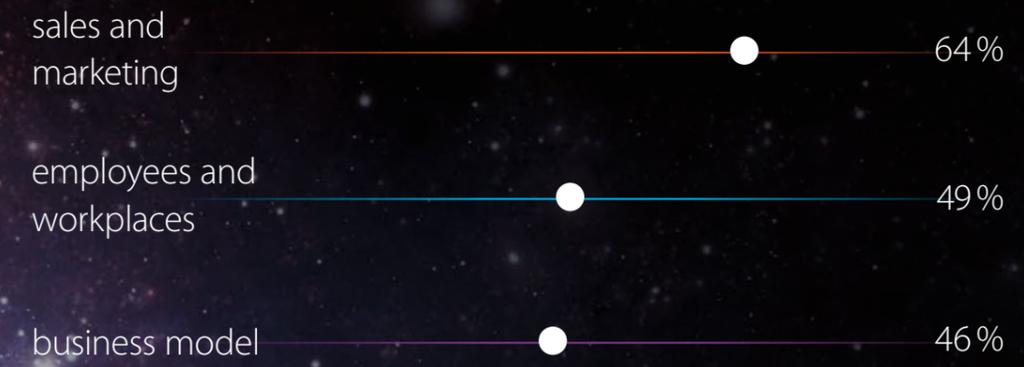


Which Job Profiles Are Employers Currently Searching For?



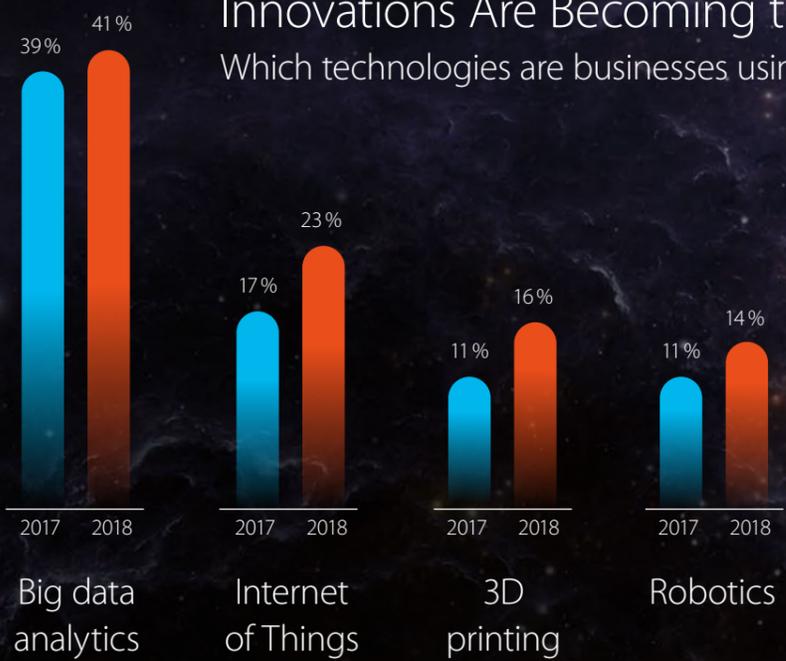
People Are at the Center of Digital Transformation

Which areas are most affected by digitization in companies?



Innovations Are Becoming the Norm

Which technologies are businesses using?



Digitization Is More Firmly Established

How are companies structured in terms of organization and personnel?



Security Comes Before Innovation

In which technologies do companies invest most heavily?



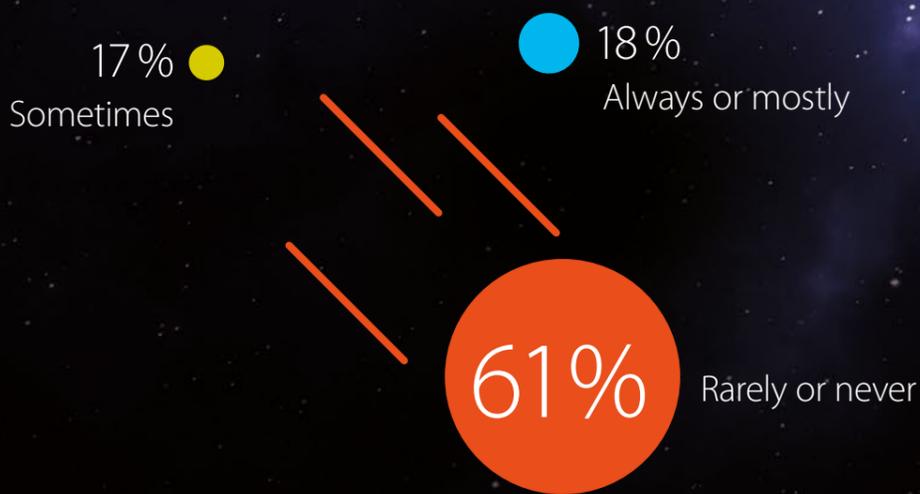
Data Protection Is a Bigger Obstacle than Costs

What do companies view as obstacles to digitization?



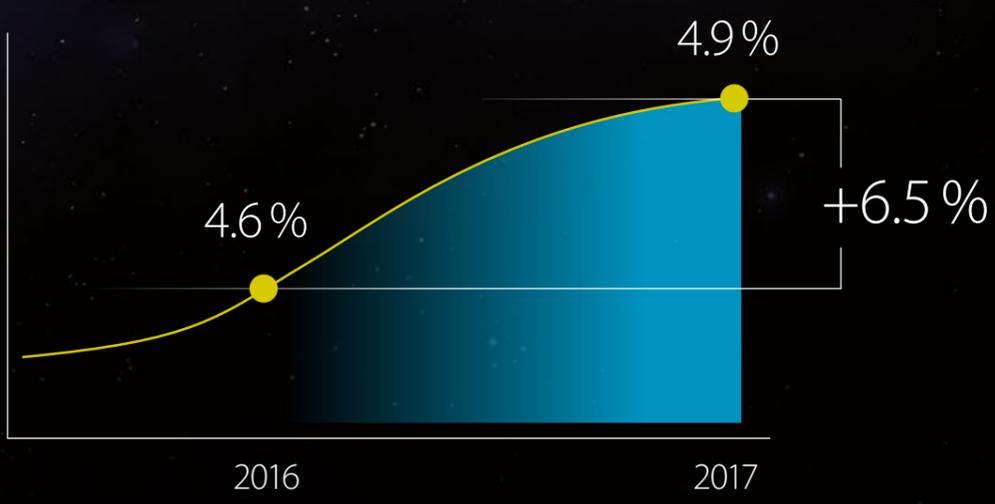
There Is Still Great Potential for Digital Projects

How often do companies use agile methodology?



Investment Is Growing Rapidly

What percentage of annual revenue have companies invested in digitization in previous years?



3. Significance of Digitization in Companies



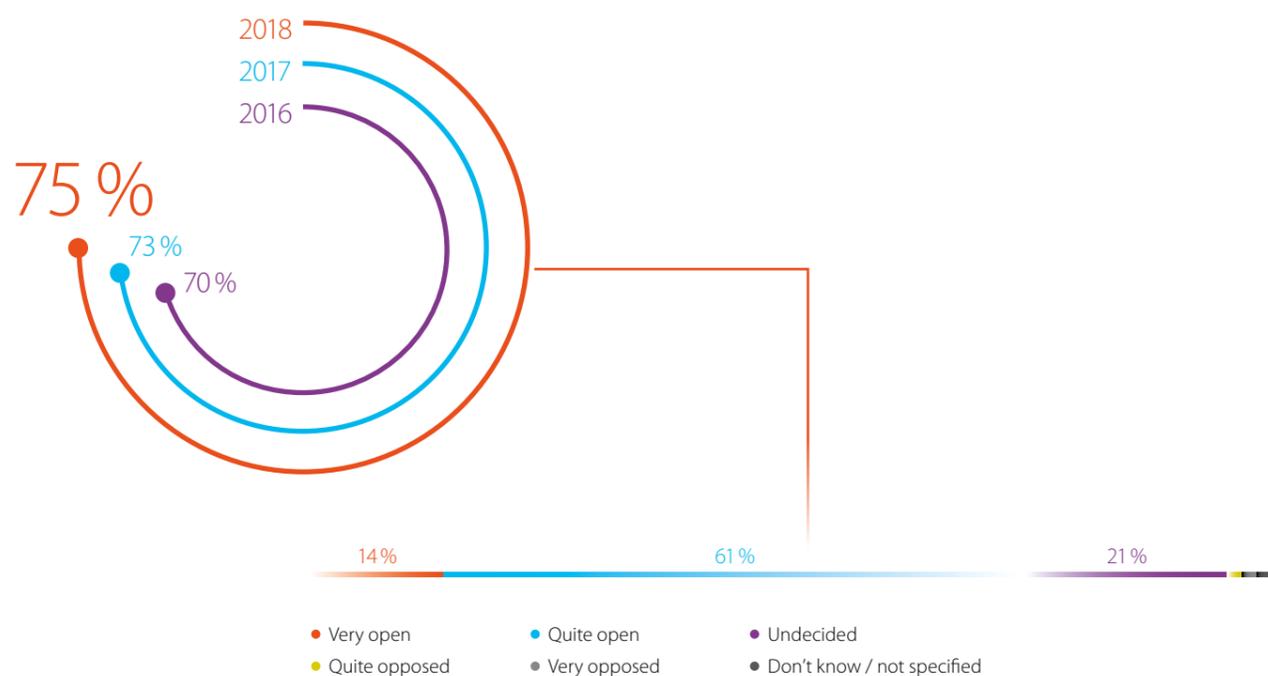
The Majority of Companies Are Ready for Digitization

In Germany, three in four companies with 100 employees or more (75 percent) now have a positive view of digitization. This marks another slight increase (2 percentage points) compared to the previous year. The percentage of "very open" companies has even risen from 6 percent in 2016 and 10 percent in 2017 to 14 percent in 2018. As in previous years, one in five companies (21 percent) are still undecided. Only 2 percent of companies are opposed to digitization.

It can be assumed that companies that are open to digitization take a more active approach to the challenges of digital transformation than the sceptics do. Their positive attitude gives them better chances to compete in the mid to long term.

Attitudes toward Digitization – Companies Are Very Open

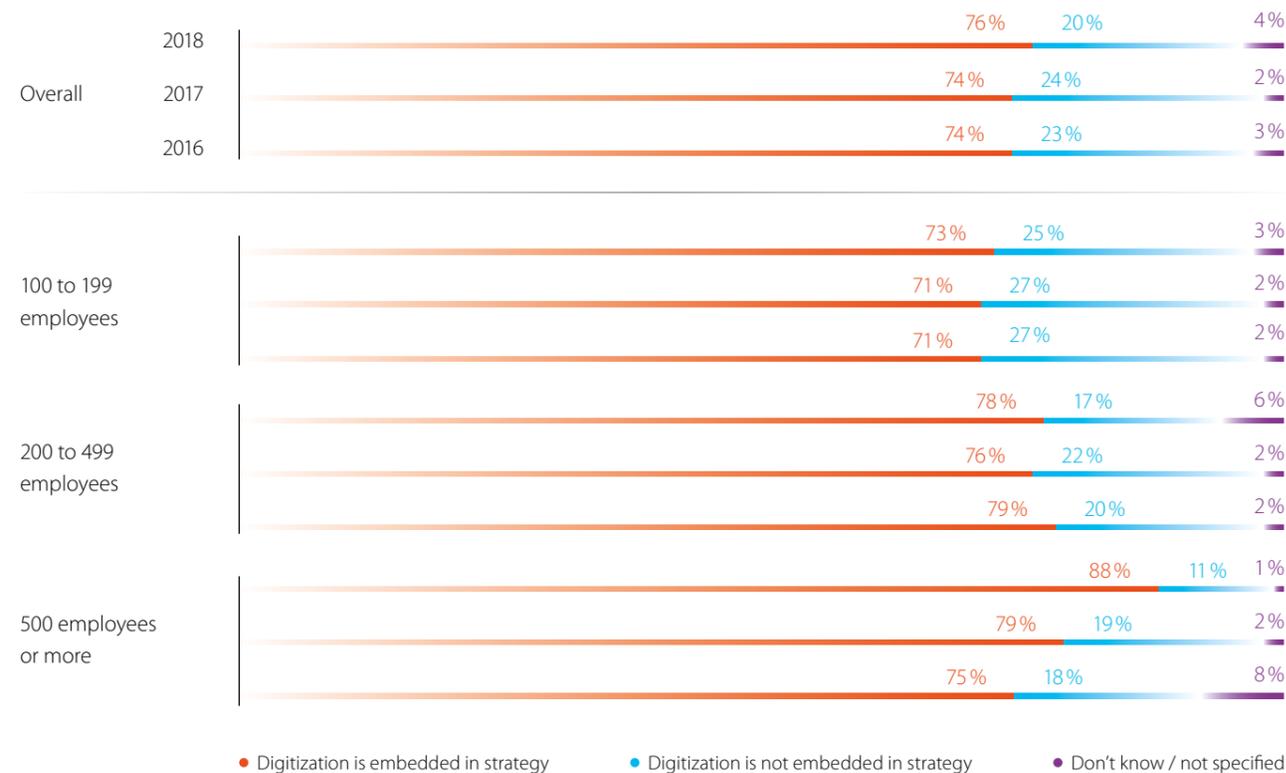
75 percent of companies are open to digitization. Only 2 percent are opposed to it.



Question: "What is your company's general stance on digitization?"; Sample: All surveyed companies (2016: n=805; 2017: n=905; 2018: n=954); Top two boxes ("Very open" and "Quite open") in percent; Due to rounding, percentages may not total 100%.

Three Quarters of the Companies Surveyed Are Taking a Strategic Approach to Digitization

Three out of four companies have embedded digitization in their strategies. For companies with 500 employees or more, the proportion is even higher at 88 percent.



Question: "Does your company follow a strategy for digital transformation?"; Sample: All surveyed companies (2016: n=805; 2017: n=905; 2018: n=954); Due to rounding, percentages may not total 100%.

Three quarters (76 percent) of the companies surveyed already have digitization embedded in their strategy. In a digital strategy, the management team defines the company's digital objectives and the actions to be taken to achieve them in the mid to long term. These could include improving process efficiency, initiating and expanding sales and marketing activities, and developing new products and services.

One in five companies (20 percent) still lack a digital strategy. These enterprises have less flexibility to react to changes in their respective market environment or to respond to the growing significance of digital technologies for their business. They risk being at a competitive disadvantage.

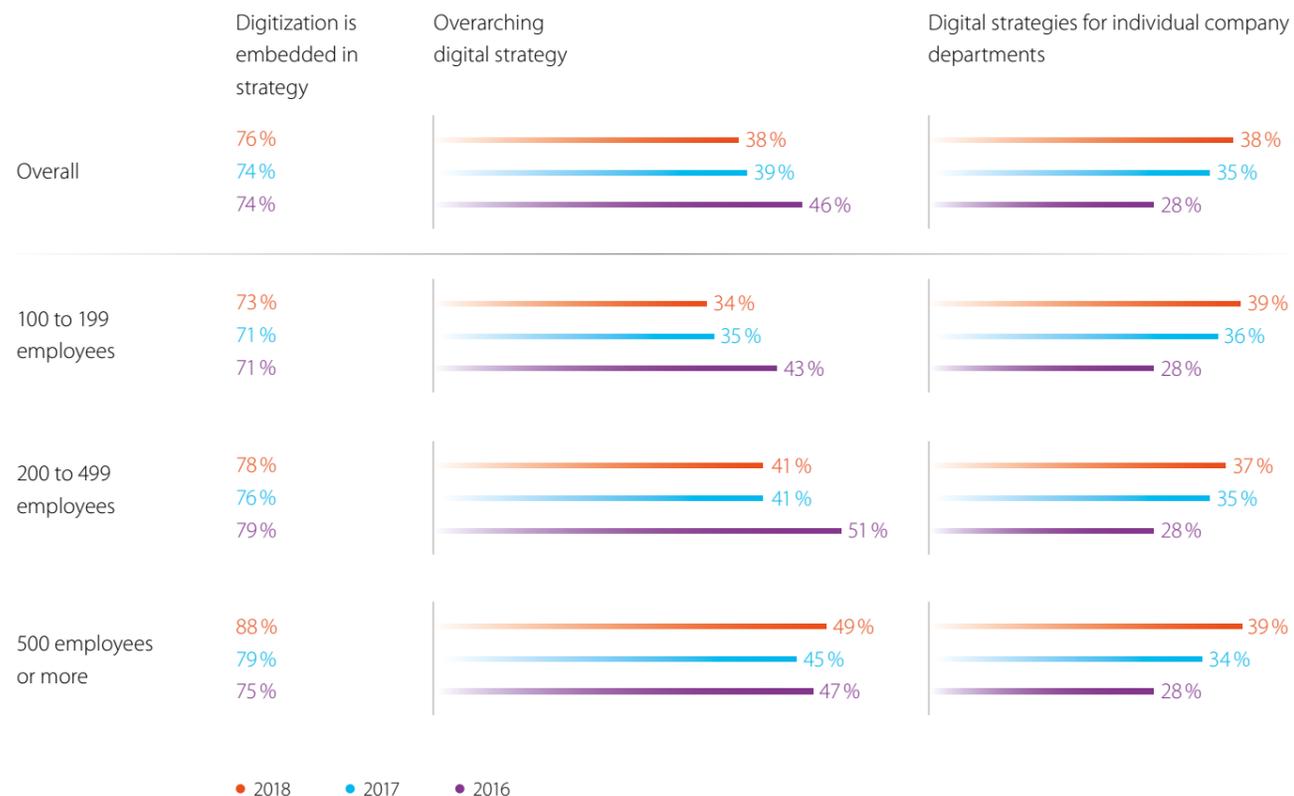


"76 percent of companies are taking on digital transformation with a clear strategy. In doing so, they are placing more focus on their customers. Additionally, more and more companies are using new technologies like big data analytics. In this respect, large enterprises are still leading the way – and they are increasing their lead over SMEs."

Sapthagiri Chapalapalli, Managing Director – Central Europe, TCS

The Trend toward Department-Specific Digital Strategies

Over the past few years, department-specific strategies have grown in importance. Large enterprises are more likely to have an overarching strategy than smaller companies.



Question: "Does your company follow a strategy for digital transformation?"; Sample: All surveyed companies (2016: n=805; 2017: n=905; 2018: n=954).

The trend toward department-specific digital strategies has become more firmly established. 38 percent of companies follow strategies for deploying innovative technologies in individual areas of their organization. Two years ago, this figure was only 28 percent. The share of companies that have an overarching strategy for various aspects of digitization is also 38 percent (down from 46 percent in 2016).

While department-specific digital strategies are useful, they should be enhanced and supported by an overarching strategy. To this end, the executive board should formulate a digital vision for the enterprise, set clear strategic guidelines for digitization in specific areas, and maintain an overview of all initiatives.

IT Departments and CIOs Drive Digitization Projects

The role of Chief Digital Officer (CDO) is rapidly increasing in importance. Executive boards are initiating projects less frequently than in the past.



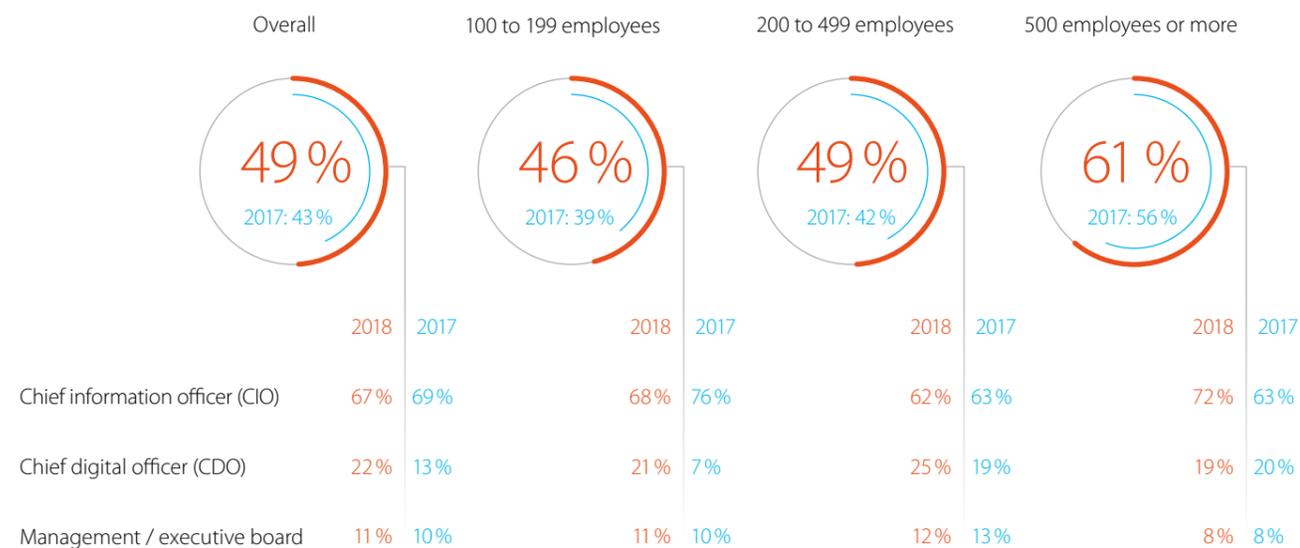
Question: "Who initiates digitization projects in your company?"; Top two boxes ("Always" and "Very often") in percent; Sample: All surveyed companies (2016: n=805; 2017: n=905; 2018: n=954).

At nine out of ten companies (89 percent), the IT department or the chief information officer (CIO) "always" or "very often" initiates digitization projects. At 44 percent of companies, the executive board usually starts the initiative. Digitization projects are launched by other departments at one third (34 percent) of the surveyed companies. That is a significantly higher proportion than in the previous year (26 percent). The chief digital officer

(CDO) is playing an increasingly significant role. Compared to last year, the proportion rose from 6 to 17 percent. This indicates that the position of CDO has become established at many companies. At some companies, it is external stakeholders who drive the transformation process. The impetus for digital innovations comes from third-party providers at 15 percent of those surveyed and from customers at 13 percent.

Individuals Responsible for Coordinating Digitization across Departments

At one in two of the companies surveyed, one person is responsible for digitization across departments. Centralized coordination is significantly more common at large enterprises.



Question: "Is there a person at your company who coordinates digitization across departments?"; Answer "yes"; Sample: All surveyed companies (2017: n=905; 2018: n=954) When yes, question: "Who coordinates digitization across departments at your company?"; Sample: Companies with coordination across departments (2017: n=388; 2018: n=471) Due to rounding, percentages may not total 100%.

At one in two of the companies surveyed (49 percent), one single person is responsible for digitization and coordinating it across departments – a significant increase compared to 2017 (43 percent). Large enterprises are still much more likely to centrally govern activities than smaller companies, with 61 percent and 46 percent respectively. At companies with a central function, the CIO or

head of IT is usually responsible for coordination (67 percent). However, it is becoming increasingly common for the chief digital officer to take on this task (22 percent compared to just 13 percent in the previous year). The executive board coordinates digital transformation at one in ten companies (11 percent).

Dedicated Business Units for Digitization at Almost One Third of Companies

It is common for companies to create business units dedicated to driving digitization.



Question: "Is there a team or an organizational unit at your company exclusively dedicated to digitization?"; Sample: All surveyed companies (2017: n=905; 2018: n=954); Due to rounding, percentages may not total 100%.

Digital transformation is not only ingrained in the workforce of companies, but also in the organizational structure. Almost a third of the companies surveyed (29 percent) have teams solely dedicated to digitization. At large enterprises, the proportion is 40 percent, compared to 25 percent at smaller companies. In most cases (73 percent), the unit is part of the IT department. On the other hand, 21 percent of the teams work mainly independently of the IT department. The remaining 6 percent of companies

have digital teams both inside and outside of the IT department.

Dedicated business units have the advantage that they can carry out digitization projects independently of daily business and existing structures. However, companies should not just "delegate" digitization to these teams. Digital transformation affects all departments and, ultimately, all employees.

Change Management Supports Transformation

Close to half of the surveyed companies use change management methods to accomplish digital transformation.



Question: "Does your company use change management methods to deal with digital transformation?"; Sample: All surveyed companies (2017: n=905; 2018: n=954).

Digital transformation impacts much more than just the existing technologies in companies. Processes change, new tools and methods of working are utilized, and innovative products and services are introduced. When combined, this frequently leads to organizational changes, too.

Furthermore, demands on employees change. This could unsettle some employees and obstruct the transformation. Companies would be well advised to take these

concerns seriously and take a structured approach to preparing employees for the new challenges. To this end, almost half of the surveyed companies (45 percent) use change management methods to accomplish digital transformation. That is an increase of 9 percentage points on the previous year.

Agile Methods Still Not Used Enough

It is mainly large enterprises that are beginning to take advantage of agile methodology. However, they are still only standard practice at just 8 percent of the large companies surveyed.



Question: "How often does your company use agile methods in projects (e.g. for development, operation, production, support, project management, etc.)?"; Sample: All surveyed companies (2018: n=954); Due to rounding, percentages may not total 100%.

Over two thirds of the companies surveyed (69 percent) use agile development methods such as scrum, Kanban, and design thinking in projects. However, agile methods are still by no means standard practice. Just 18 percent use them "mostly" or "always". In contrast, around half (52 percent) use agile methods "sometimes" or "rarely".

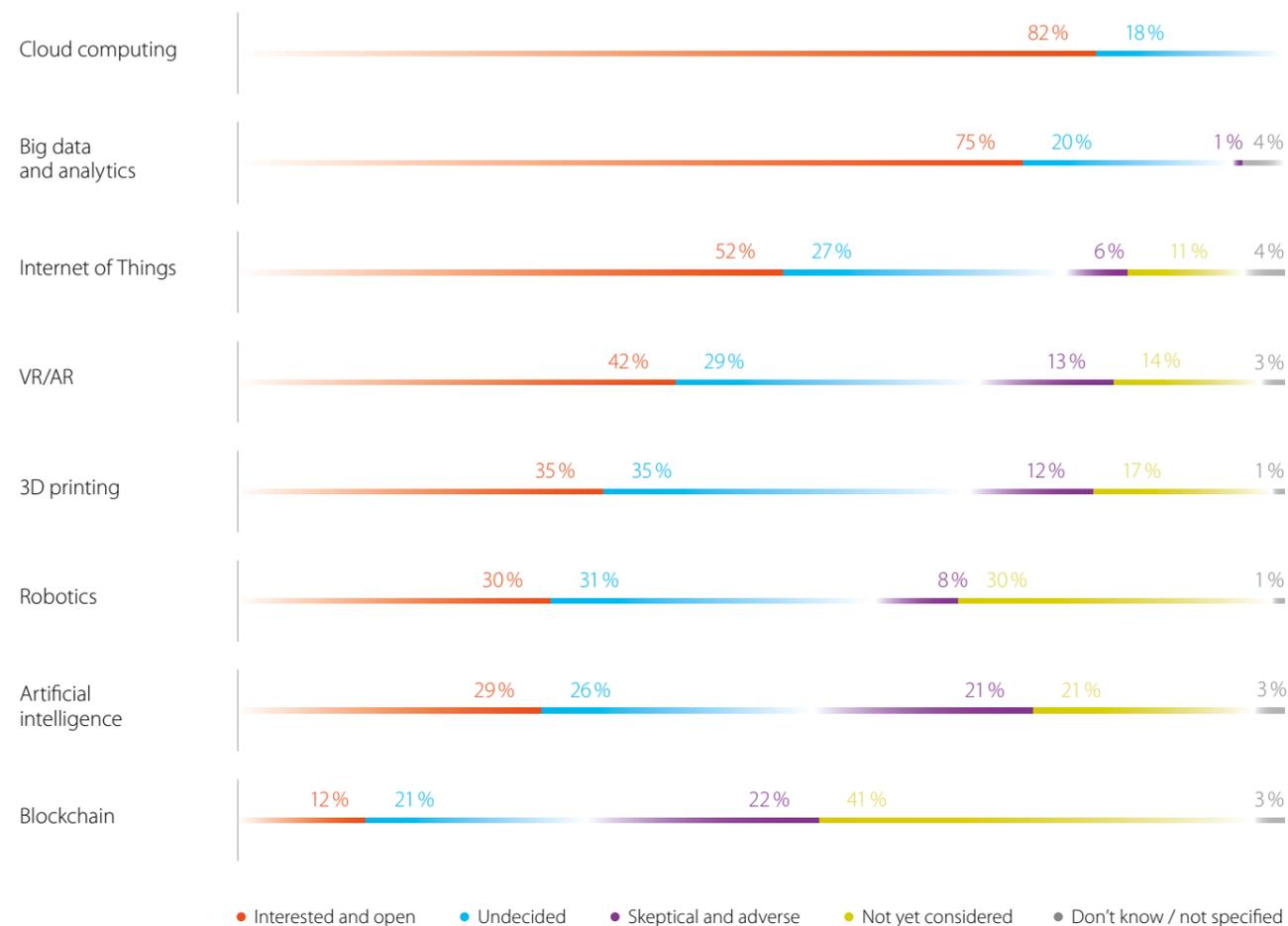
Agile methods and structures are key to digital transformation. The aim is to maximize the ability to respond to changes in structures, processes, and management principles, as well as corporate culture and strategy. At an operational level, agile methods increase pace, creativity, and customer centricity in projects.

4. Key Digital Technologies



The Majority of Companies Are Interested in Cloud Computing and Big Data Analytics

Companies are showing strong interest in cloud computing and big data analytics. The blockchain trend is slower to take off.



Question: "What is your company's stance on the following technologies?"; Sample: All surveyed companies (2018: n=954); Due to rounding, percentages may not total 100%.

A key indicator in the progress of digital transformation is how open companies are to digital technologies. Interest in almost all innovations has risen in comparison to the previous year. 3D printing and robotics are the only technologies where interest has stagnated.

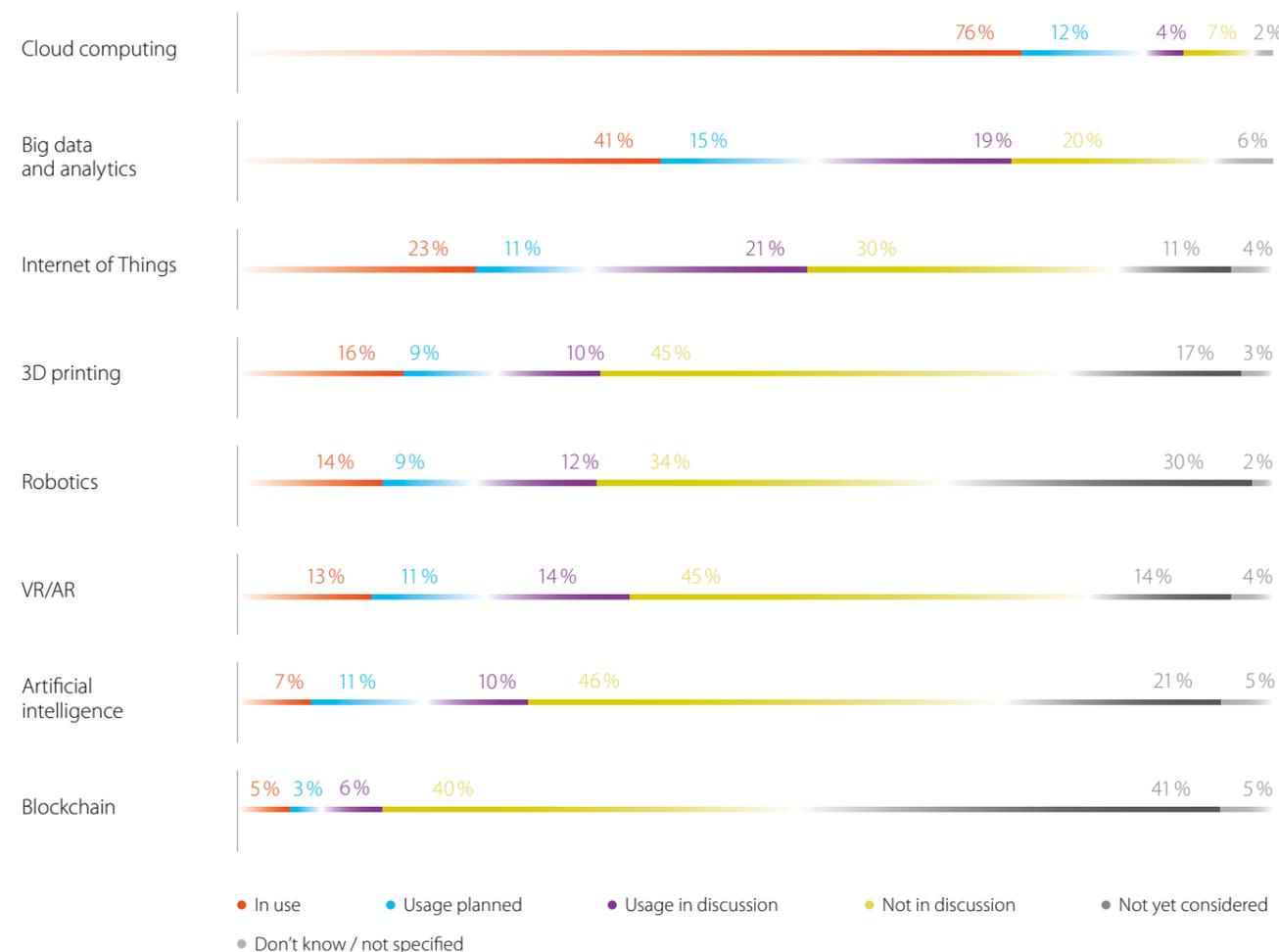
The vast majority of companies are interested in cloud computing (82 percent) and big data analytics (75 percent). Over half (52 percent) are showing interest in the Internet of Things. Virtual/augmented reality follows in

fourth place with 42 percent. Roughly a third of companies are interested in 3D printing, robotics, and artificial intelligence. These technologies are increasingly being tailored to the demands of specific industries and companies.

One in eight companies show an interest in the relatively new blockchain technology. An above-average proportion of large enterprises are interested in robotics, artificial intelligence, and blockchain.

AI and Blockchain Are Still Rare

Three quarters of the companies surveyed use cloud computing, and around 40 percent use big data analytics. Blockchain and artificial intelligence are not yet widespread.



Question: "Which of the following 'digital solutions' is your company already using, planning to use, or discussing for future use?"; Sample: All surveyed companies (2018: n=954); Due to rounding, percentages may not total 100%.

76 percent of all companies with 100 employees or more already use cloud computing. This key technology is used by companies to obtain and utilize various products and services, such as software, storage space, and computing power via data networks from external providers. 41 percent use big data analytics, with large enterprises (59 percent) significantly more likely to analyze big data than smaller companies (37 percent). One in four companies (23 percent) uses the Internet of Things to connect devices, machines, and objects. 16 percent use 3D printing, 14 percent use robotics, and 13 percent use virtual/augmented reality.

Artificial intelligence (7 percent) and blockchain (5 percent) are much less widespread. However, among enterprises

with 500 employees or more, the proportion using artificial intelligence and blockchain is 17 percent and 13 percent respectively. Here, there are considerable differences between industries (see Chapter 6).

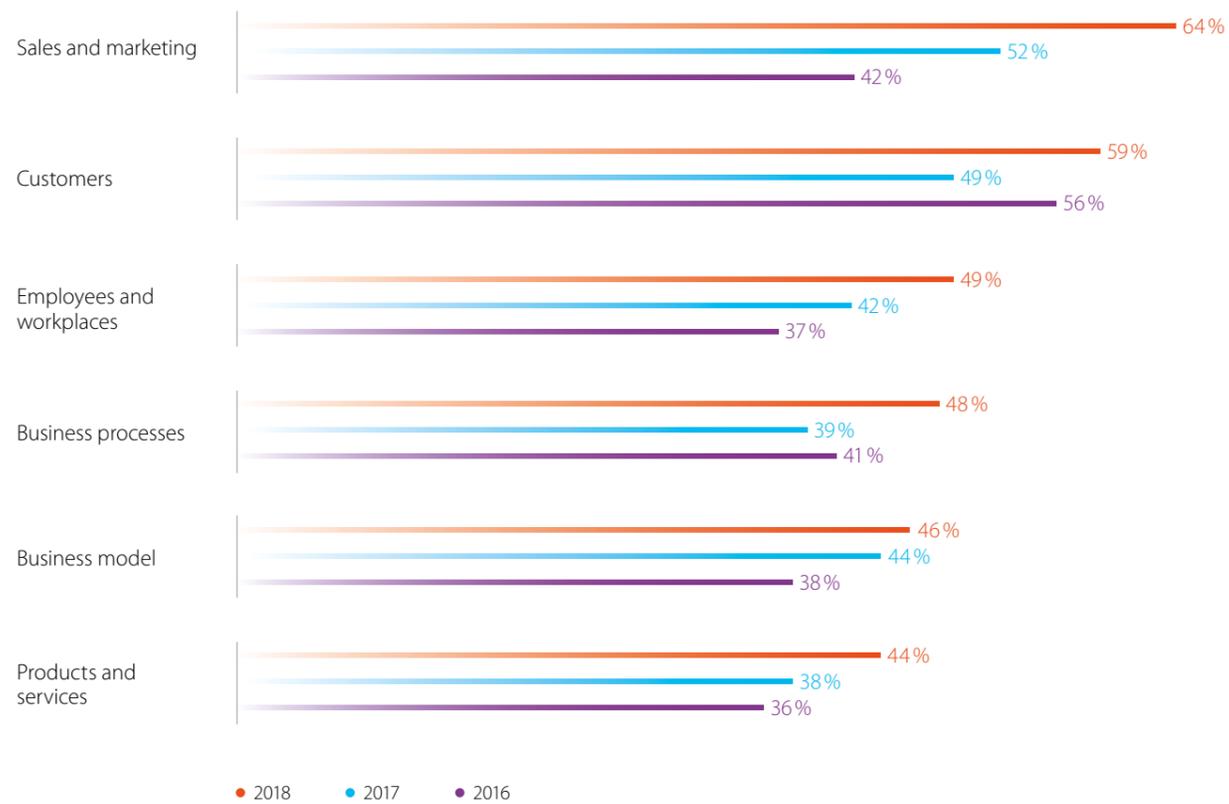
A double-figure percentage of companies is planning or discussing all of the technologies – with the exception of blockchain. A particularly high proportion of companies are planning or discussing the implementation of big data analytics (34 percent) and the Internet of Things (32 percent). In comparison to the previous year, companies are significantly more likely to be using all kinds of key technologies, with the Internet of Things, 3D printing, and virtual/augmented reality each seeing an increase of 5 percentage points in popularity.

5. The Effects of Digitization on Business Areas



More and More Companies Are Feeling the Impact of Digitization

Companies are feeling the effects of digital transformation significantly more than they were one or two years ago. Areas of the business that work closely with customers are transforming at the fastest pace.



Question: "How much is digitization affecting different area of your company?"; Top two boxes ("Very large impact" and "Quite large impact") in percent; Sample: All surveyed companies (2016: n=805; 2017: n=905; 2018: n=954).

Significantly more companies are feeling the impact of digital transformation compared to previous years. A clear trend can be seen in the effects on key areas of business. With 64 percent, the majority of companies see a "very large" or "quite large" impact in sales and marketing (compared to 52 percent in 2017). One in two companies (49 percent) notice a considerable effect on employees and workplaces as new job profiles emerge in this area. In the previous year, this figure was 42 percent.

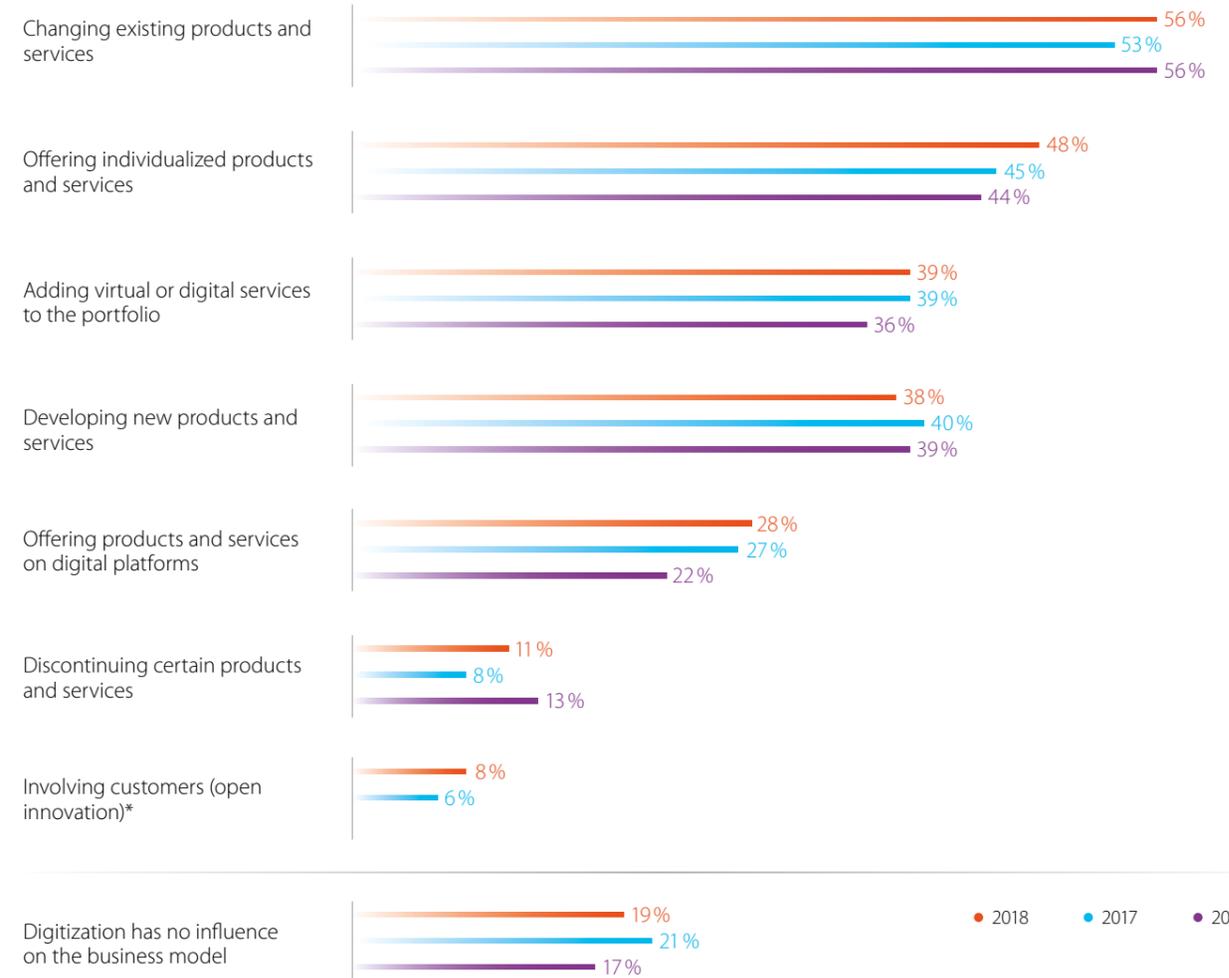
48 percent see an impact on their existing business processes (2017: 39 percent).

At 46 percent, business models, i.e., the way in which revenue and profit are generated, are being affected more than in previous years (2017: 44 percent). Closely linked to this is the growing impact on products and services, with 44 percent noticing greater effects in this area (up from 38 percent in 2017).

5.1 Transforming Business Models

More Than One in Two Companies Are Developing New Products and Services

As part of digitization, around half of the companies surveyed are altering their portfolio (56 percent) and are offering customers individualized products and services more frequently (48 percent).



Question: "How much of an effect is digitization having on your company's business model? Which of these statements apply to your company?"; Statements have been shortened; * New in 2017; Sample: All surveyed companies (2016: n=805; 2017: n=905; 2018: n=954); Multiple answers possible.

To ensure that a business model functions, it is important to select the right target markets and sales channels, be able to access necessary resources, and collaborate with partners. The products and services offered are an especially important success factor.

Over half of the companies surveyed (56 percent) state that their existing products and services are changing as a result of digitization. Almost one in two companies (48 percent) have increased the number of individualized products and services in their portfolio. This is partly due to connected manufacturing making it possible to manufacture custom products at similar costs to mass-produced goods.

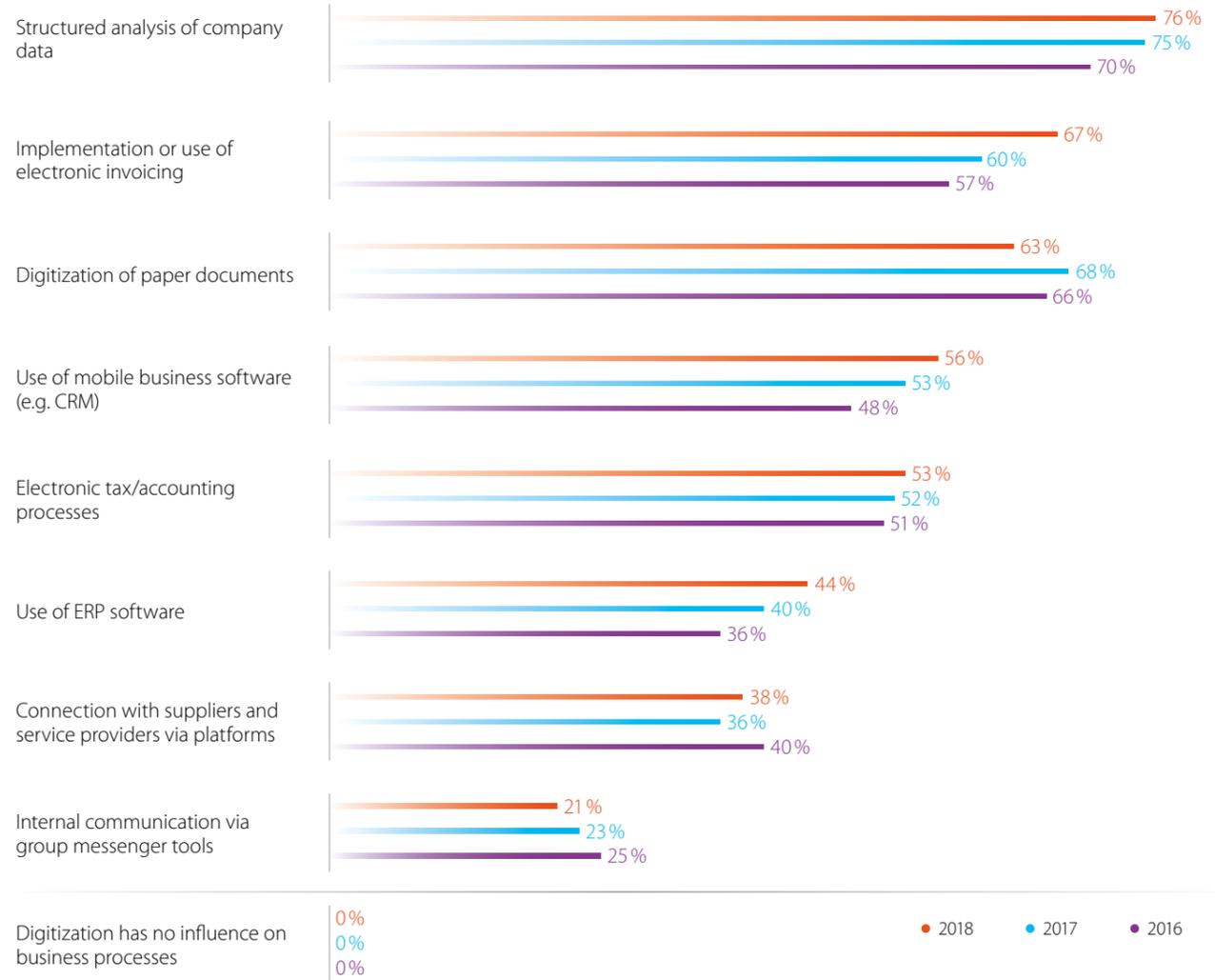
39 percent of the companies surveyed are adding digital services to their portfolio, and 38 percent are developing brand-new products and services in response to digital transformation.

28 percent are now offering products or services via digital platforms. "Digital platform" here refers to an online marketplace where various market players sell their services. The operator of the platform receives a fee or commission. Similar to the previous year, one in five companies (19 percent) do not believe that digitization is having an effect on their business model.

5.2 Influence of Digitization on Business Processes

Business Processes Are Increasingly Digitized

Three out of four companies (76 percent) analyze data in a structured way. Electronic invoicing and ERP software are gaining popularity.



Question: "How much of an effect is digitization having on your company's business processes? Which of these statements apply to your company?"; Statements have been shortened; Sample: All surveyed companies (2016: n=805; 2017: n=905; 2018: n=954); Multiple answers possible.

Above all, organizations digitize their business processes to improve efficiency and reduce costs. Another aim is to use digital technologies to increase flexibility and adaptability in a dynamic market environment. The most important key for this is the structured analysis of company data. Three in four companies (76 percent) take this approach to analysis in order to make business-relevant decisions based on clear and up-to-date data.

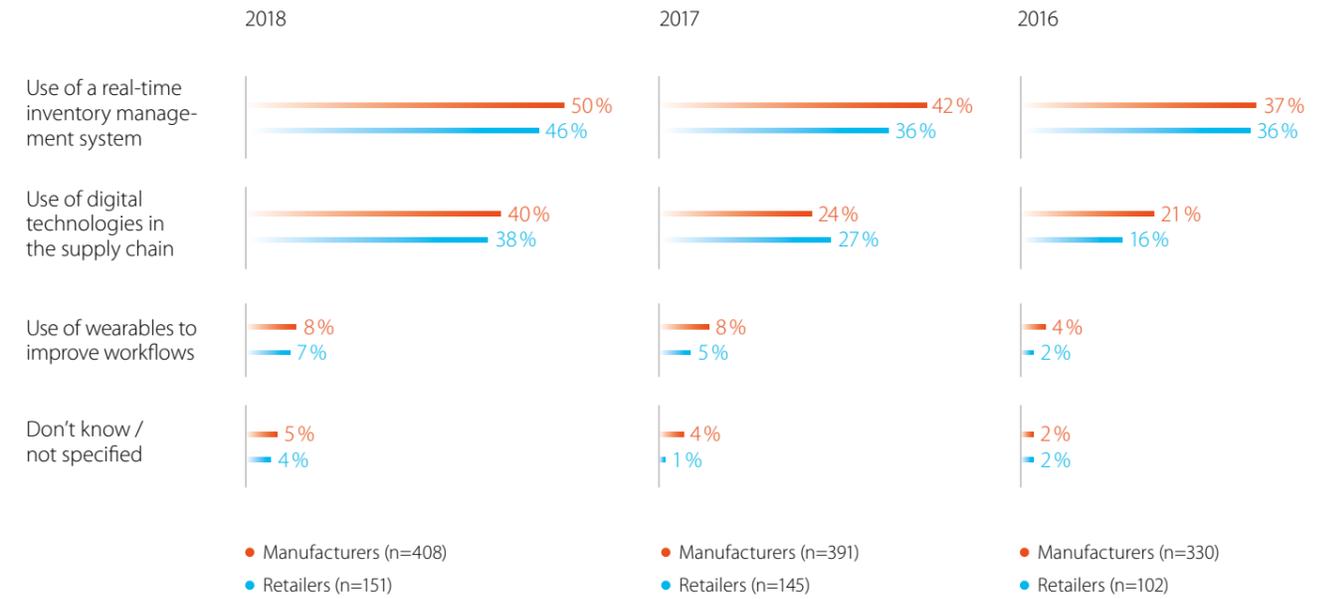
Electronic invoicing, mobile business software, and enterprise resource planning (ERP) software all experienced strong growth in recent years. ERP solutions comprise a set of applications that support numer-

ous business processes in areas such as accounting, human resources, manufacturing, and marketing.

More than half of the companies surveyed (53 percent) perform tax and accounting processes digitally. 38 percent are already connected to suppliers and external service providers via digital platforms. Not a single company stated that digitization had no influence on its business processes.

Manufacturing and Retail Use Digitized Supply Chains and Inventory Management

Manufacturing and retail companies are more likely to deploy digital technologies in the supply chain and use real-time inventory management systems. More and more retailers are using wearables.



Question: "How much of an effect is digitization having on your company's business processes? Which of these statements apply to your company?"; Statements have been shortened; Sample: All surveyed manufacturing and retail companies (2016: n=432; 2017: n=536; 2018: n=559); Multiple answers possible.

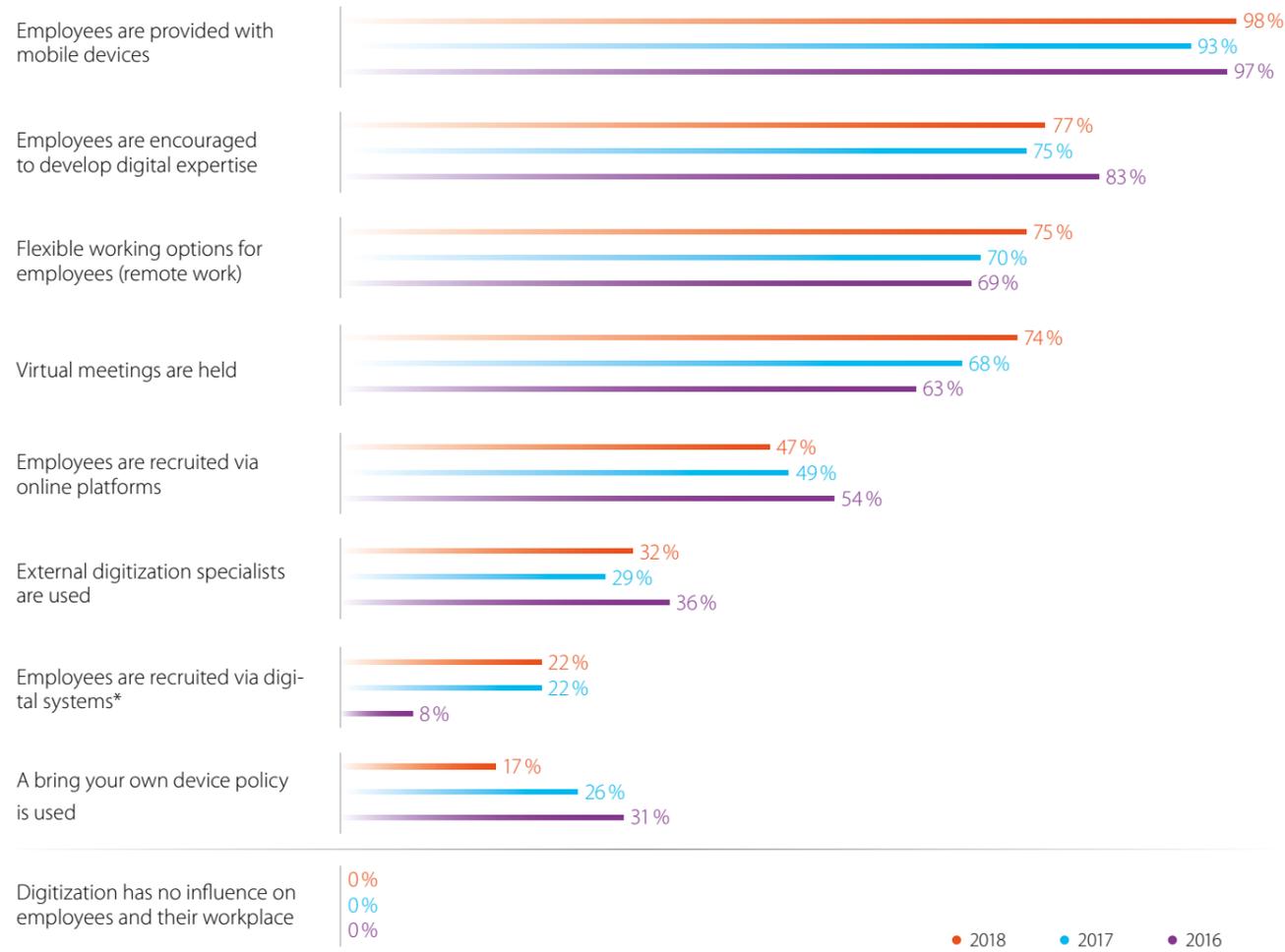
German manufacturers and retailers are deploying digital technologies, particularly in inventory and supply chain management. One in two companies use an inventory management system to track inventory levels, order status, payments received, and much more in real time. In the previous year, it was only 42 percent. Among retailers, the figure rose 10 percentage points to reach 46 percent.

The use of digital technologies in the supply chain experienced even stronger growth. 40 percent of manufacturers (+16 percentage points) and 38 percent of retailers (+11 percentage points) are digitizing their supply chain. In contrast, in the manufacturing industry, the use of wearables such as smartwatches, smart glasses, and special handhelds remains at 8 percent as in 2017. In retail, this figure rose by 2 percentage points to reach 7 percent.

5.3 The Working World and New Job Profiles

Mobile Devices for Employees Are Now the Norm

Nearly all companies provide their employees with mobile devices. Consequently, 'bring your own device' policies are becoming less common.



Question: "How much of an effect is digitization having on your company's employees and their workplace? Which of these statements apply to your company?"; Statements have been shortened; *Changed in 2017; Sample: All surveyed companies (2016: n=805; 2017: n=905; 2018: n=954); Multiple answers possible.

The digitization of businesses is affecting the working environment at all surveyed companies – drastically, in some cases. Jobs, tools, and the way work is organized are all transforming at a rapid pace. Almost every company surveyed now provides smartphones, notebooks, and tablet devices to its employees. Consequently, the 'bring your own device' (BYOD) concept is declining. Only 17 percent of companies still use it, down from 26 percent in 2017.

Almost three quarters of companies (74 percent) use virtual meeting tools (2017: 68 percent). Employees communicate via video conferencing tools and instant messaging, and work together on documents simultaneously. In combination with mobile devices, these collaboration tools enable a more flexible way of working. 75 percent of

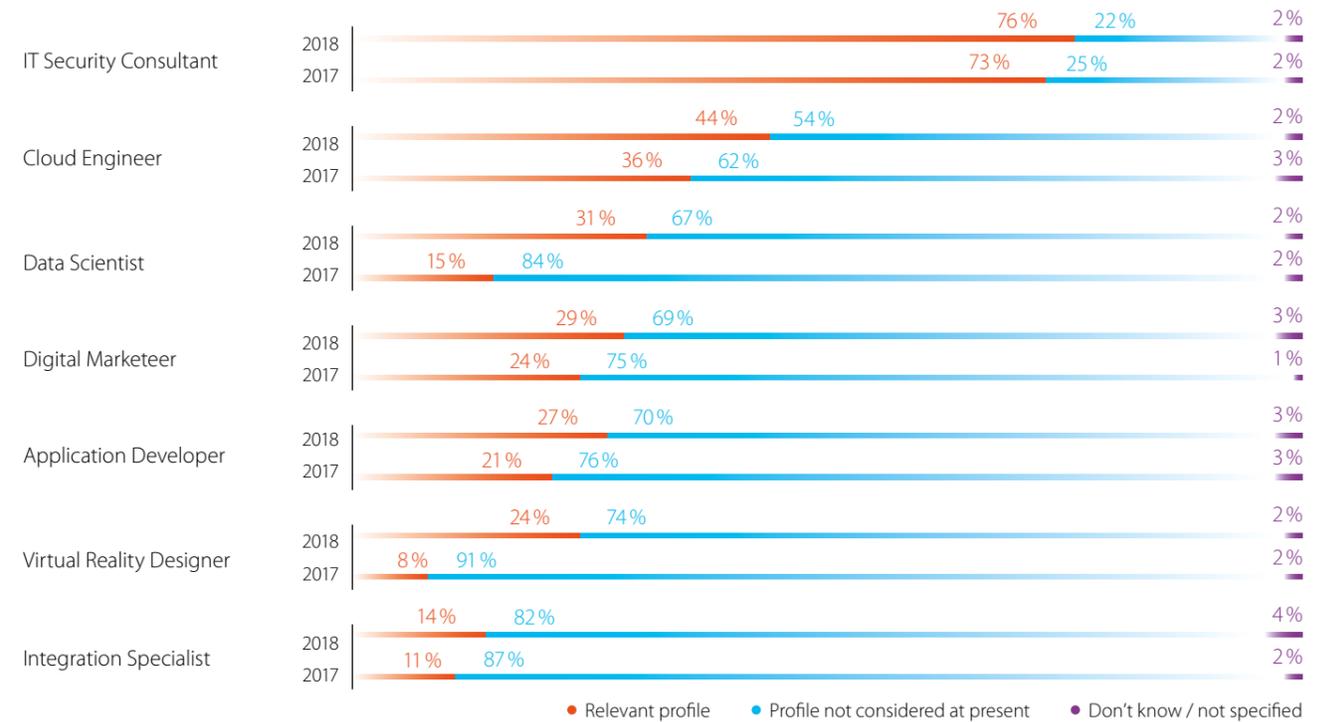
companies offer their employees flexible working hours or the opportunity to work from home – an increase of 5 percentage points.

Digitization is changing human resource management, too. 77 percent of companies encourage their employees to learn digital skills through training activities. One in two companies (47 percent) uses online platforms such as XING* and LinkedIn to recruit employees. However, this trend remains on the decline for the second year running. 22 percent of companies state that they use digital systems to recruit new employees. Smart recruiting apps support HR and other departments in narrowing down a multitude of job applications to make the selection process more efficient.

*One of Germany's largest business networking platforms

IT Security Experts Are in the Highest Demand

More than three quarters of companies surveyed are looking for IT security experts. There is growing demand for cloud engineers, data scientists, and virtual reality designers.



Question: "Has your company created a position for the following roles, does it use an external provider for this, or is it planning to do so in the future?"; Sample: All surveyed companies (2017: n=905; 2018: n=954); Due to rounding, percentages may not total 100%; Multiple answers possible.

Digital technologies are changing the profiles of employees and the demands made of external service providers. This survey indicates a trend toward specialization, particularly in IT.

At present, IT security experts are the most sought after. Similar to the previous year, three in four companies (76 percent) have either created a position for IT security consultants, outsource this function to an external service provider, or are planning to use one of these two options.

44 percent of the companies surveyed are looking for cloud engineers, up from 36 in the previous year. These specialists in cloud computing plan, develop, maintain, and safeguard cloud infrastructures within their organization. In line with the increased use of advanced data analysis, the demand for data scientists has risen drastically. Almost one third of companies (31 percent) are searching for professionals in this field, up from just 15 percent in the previous year. The demand for virtual reality designers has tripled to reach 24 percent. 29 percent of companies are looking for experts in digital marketing, while application developers are required at 27 percent.

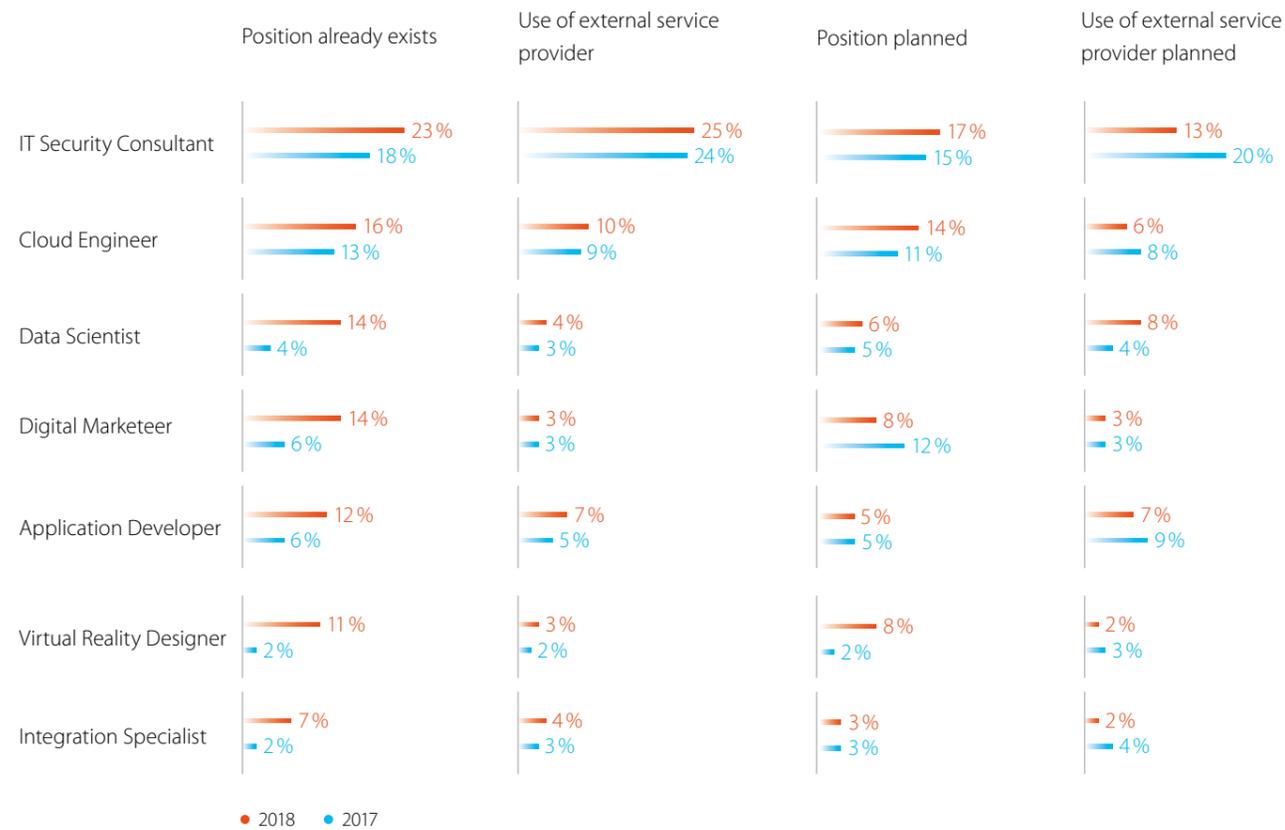


"Job profiles are changing drastically due to digitization, and entirely new job descriptions are emerging. Companies should therefore offer their employees appropriate training and education at an early stage. At the same time, they need to fulfill the rising expectations for a digital-friendly work environment."

Frank Karcher, Head of HR & Administration – Central Europe, TCS

New Positions for IT Experts

One in four companies are seeking additional personnel for IT security. 14 percent have created positions for data scientists – an increase of 10 percentage points.



Question: "Has your company created a position for the following roles, does it use an external provider for them, or is it planning to do so in the future?"; Sample: All surveyed companies (2017: n=905; 2018: n=954); Multiple answers possible.

The rising demand for specialist digital expertise is reflected in the growing number of jobs. 23 percent of the companies surveyed have created a position for IT security experts, and an additional 17 percent are planning to do so. One quarter use external service providers for this function, and 13 percent plan to do so. 16 percent of

companies have one or more positions for cloud experts, 14 percent for data scientists and digital marketing experts, and 11 percent for virtual reality designers. The proportion of companies that rely on external service providers for these functions remains the same as in the previous year.



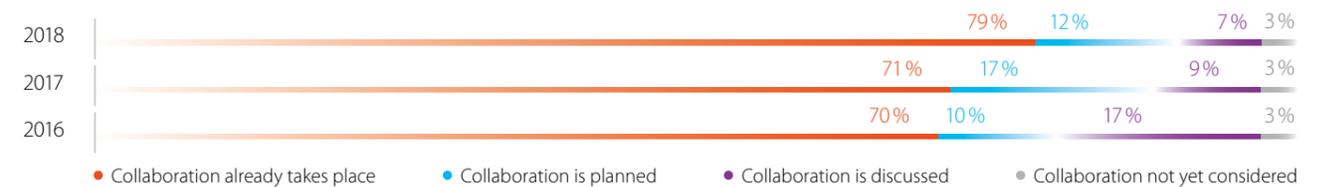
"The digital technologies are available – and more and more companies are using them. However, the success of digital transformation crucially depends on employees. It is necessary to use structured change management to prepare the workforce for the changes that come with the digital working world."

Dr. Kay Müller-Jones, Head of Consulting & Services Integration – Central Europe, TCS

5.4 Collaboration with External Partners

External Partners Often Support Companies with Digitization

Due to digitization, companies are more frequently working with partners: Eight out of ten companies draw on external expertise.



Question: "Has your company already collaborated with external partners on digitization-related matters, or is it planning or discussing the possibility of doing so?"; Sample: All surveyed companies (2016: n=805; 2017: n=905; 2018: n=954); Due to rounding, percentages may not total 100%.

As part of their digital transformation, 79 percent of companies are working with external partners. This is an increase of 8 percentage points compared to the previous year. An additional 12 percent already have solid plans to collaborate with partners. More than a third of companies (37 percent) collaborate with industry associations and interest groups. Associations typically offer their members industry-specific information and services related to digitization. Almost a third (32 percent) work with IT consultancy firms, compared to just 27 percent in the previous year. Another 14 percent are planning to do so.

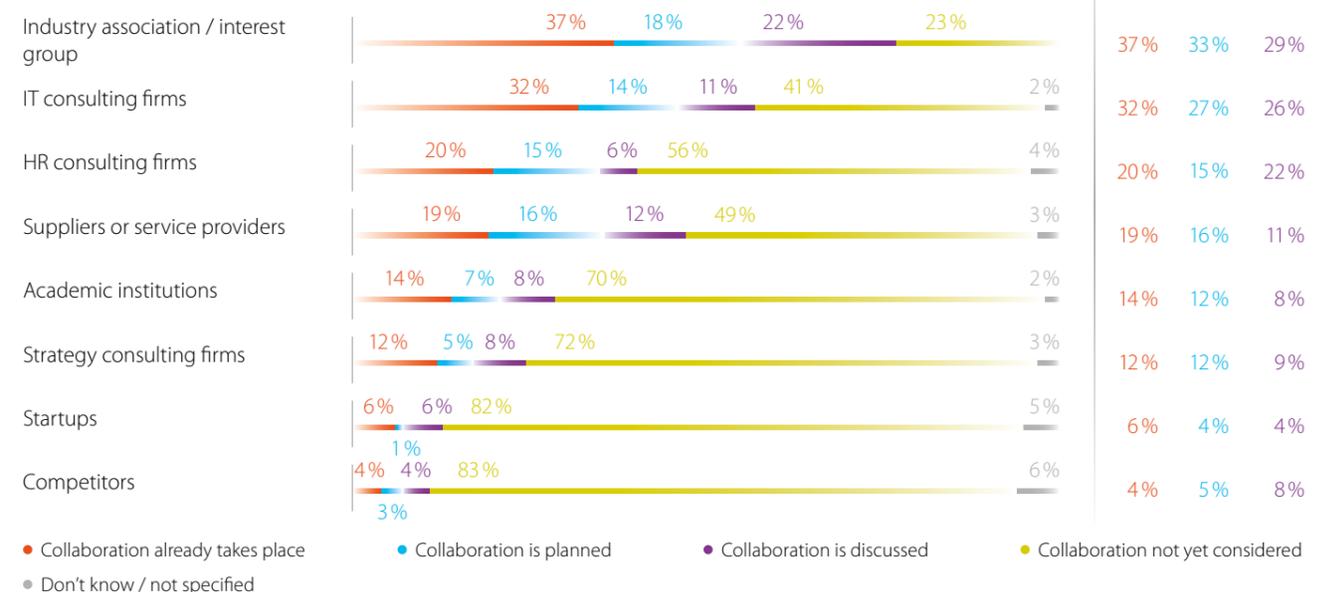
The functions of IT consultancy firms include providing support in the implementation and operation of hardware and software, the deployment of specific digital technologies, and the development of

digital business models. One in five companies use the services of personnel consultants to fill vacancies for specialists and executives, for example. 19 percent of the surveyed companies collaborate with suppliers or other service providers. 14 percent work with academic institutions, and 12 percent work with strategy consultants.

In contrast, just 6 percent of the companies surveyed collaborate with startups. That is an increase of only 2 percentage points. Startups can give established companies inspiration for using digital technologies in an innovative way, developing new business models, or making the organization more flexible and agile. Large enterprises recognize this opportunity more than smaller companies and collaborate with startups significantly more often (13 percent).

Few Companies Work with Startups

Knowledge from industry associations, interest groups, and IT and HR consultants is in increasing demand. On the other hand, only 6 percent of companies collaborate with startups.



Question: "Has your company already collaborated with the following external partners on digitization-related matters, or is it planning or discussing the possibility of doing so?"; Sample: All surveyed companies (2016: n=805; 2017: n=905; 2018: n=954); Due to rounding, percentages may not total 100%.

6. Investment Areas, Potential, and Obstacles

Customer Service

Profit

Investment

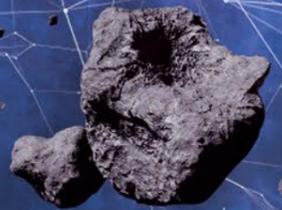


Technology



69°
49t

3998.91
j763
t-48.33



Data Protection



IT Security

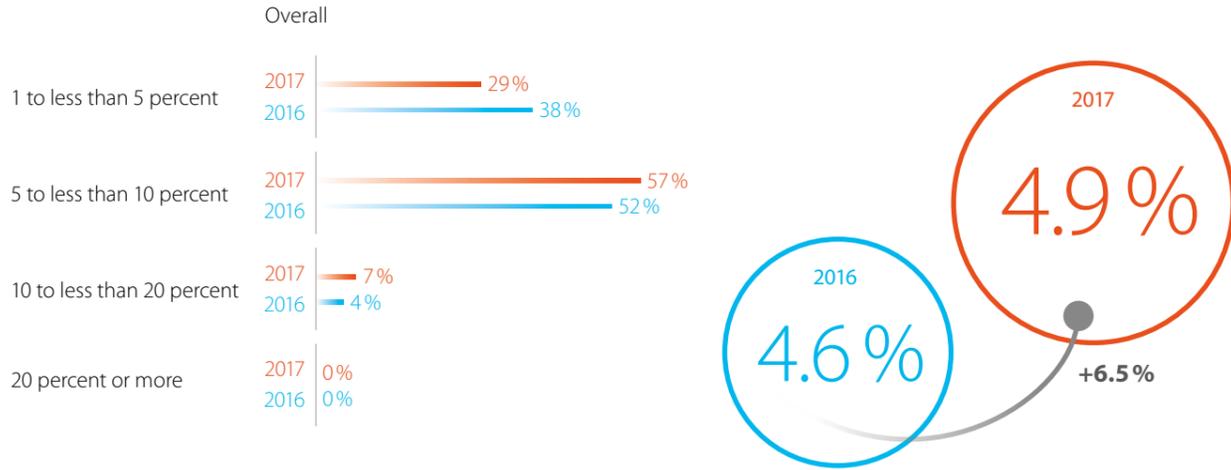
Employee Retention

63241 au



Investment Is Growing

German companies are increasing investment in the digitization of their businesses. In 2017, expenditure rose to 4.9 percent of annual revenue on average.



Question: "What percentage of its total annual revenue did your company invest in digitization in 2017 and 2016?" Sample: All surveyed companies (2017: n=905; 2018: n=954); Due to rounding, percentages may not total 100%.

In 2017, companies in Germany invested an average of 4.9 percent of their annual revenue in the digital transformation of their business. That represents a 6.5 percent increase in comparison to the previous year. These values are based on estimates made by executives and decision makers who work in IT, digital technologies, business operations, and finance.

With 57 percent, the majority of survey respondents stated that their company invests between 5 and 10 percent of its annual revenue in digitization. 7 percent invest between 10 and 20 percent of annual revenue. 29 percent of companies invest less than 5 percent in digitization.

Digitization Is Seen as an Ongoing Process

84 percent of companies view digital transformation as an ongoing process.



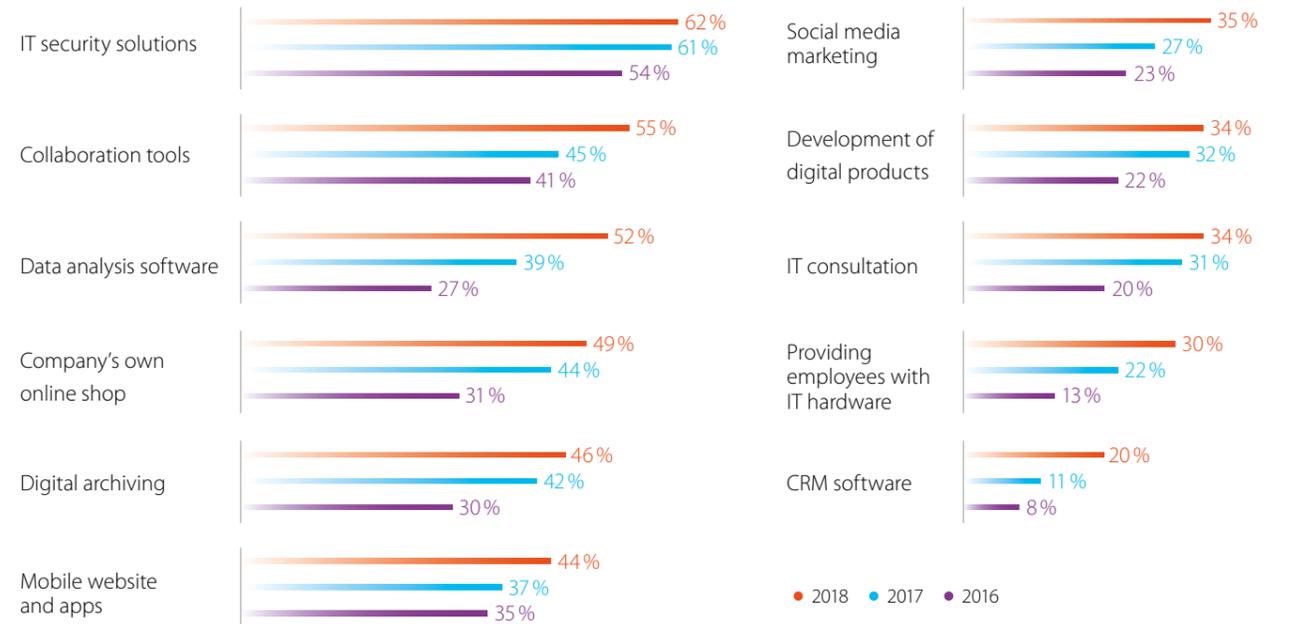
Question: "By when do you believe your company's digital transformation will be completed?"; Sample: All surveyed companies (2017: n=905; 2018: n=954); Percentages do not total 100% due to responses "Don't know / not specified".

Only 14 percent of the companies surveyed believe they will have completed their digital transformation in five, ten, or more than ten years. In contrast, 84 percent are of the opinion that digitization is a continuous and ongoing process.

While companies will have digitized almost all processes in the next few years, innovations are constantly emerging, giving companies new opportunities to gain a competitive edge. For this reason, the digital transformation of business will continue for an unforeseeable period of time.

Security Technology Benefits Most of All from Rising Investment

Companies are ramping up their budgets for all areas of digital innovation. They invest especially in IT security solutions, data analysis software, and collaboration tools.



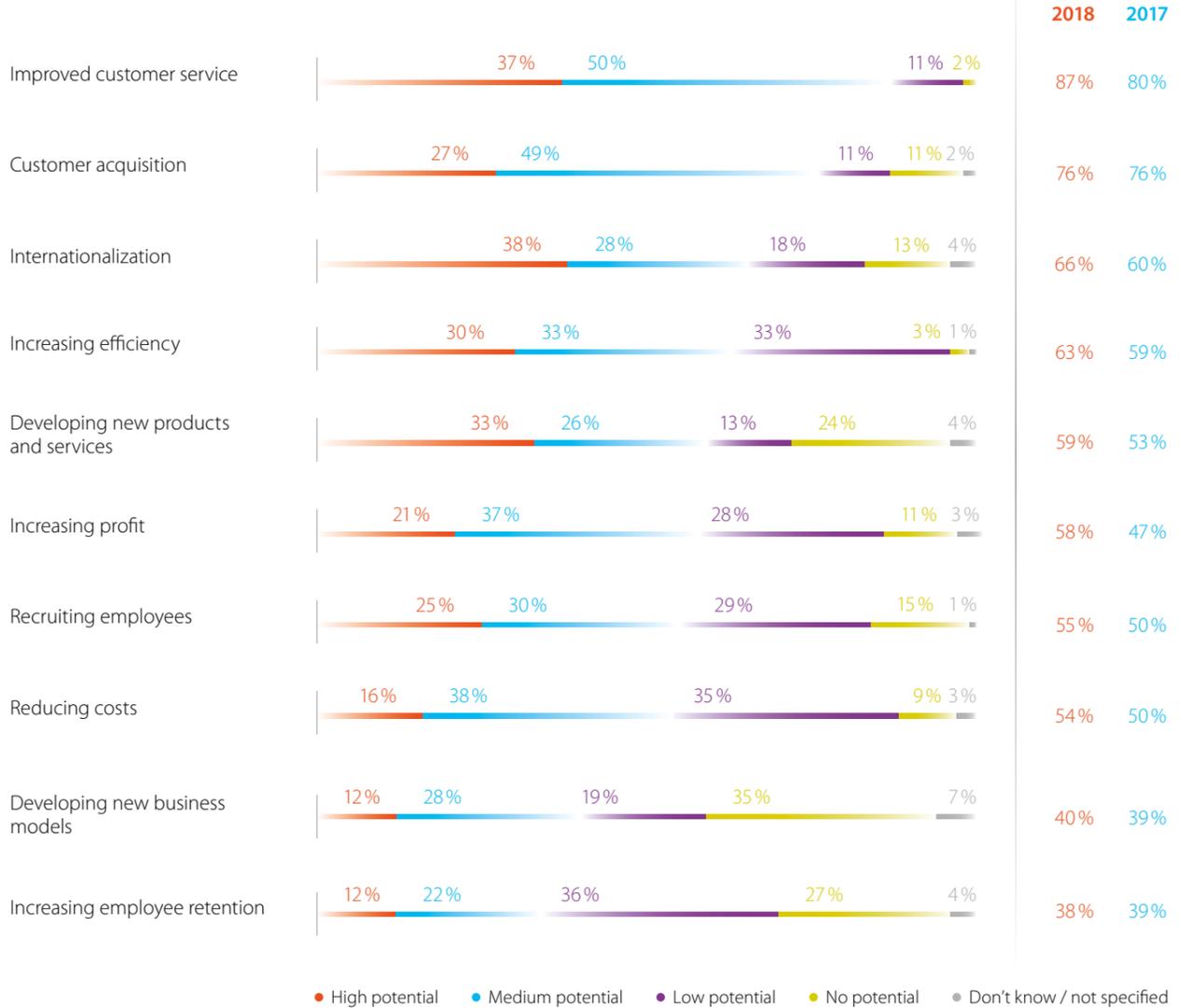
Question: "How do you predict your company's investment in the following areas will develop this year in comparison to the previous year?"; Top two boxes "Will increase significantly" and "Will increase slightly" in percent; Sample: All surveyed companies (2016: n=805; 2017: n=905; 2018: n=954).

Investments in hardware, software, and IT services continue to rise in 2018. With a proportion of 62 percent, the majority of companies want to invest more in IT security solutions. Collaboration tools have grown in popularity, with 55 percent of companies intending to invest more in this area compared to 45 percent in 2017. The greatest increase can be seen in data analysis software at 52 percent – up 13 percentage points from the previous year. In particular, companies with fewer than 200 employees want to use data analysis software more. 53 percent plan to invest more in this area – an increase of 17 percentage points compared to 2017.

As in the previous year, the will to invest is growing in all areas. One in two companies (49 percent) intend to invest more in establishing and developing their own online shops. 46 percent want to increase investment in digital archiving, 44 percent in developing mobile websites and apps, and 35 percent in social media marketing. One in three companies (34 percent) are planning to increase investment in developing digital products and services. For large companies, the proportion is even higher at 41 percent.

Digitization Should Improve Customer Service

Companies believe digitization holds the greatest potential in improving customer service and customer acquisition.



● High potential ● Medium potential ● Low potential ● No potential ● Don't know / not specified

Question: "In your opinion, does digitization have a high, medium, low, or no potential for the following company objectives?"; Sample: All surveyed companies (2017: n=905; 2018: n=954); Due to rounding, percentages may not total 100%.

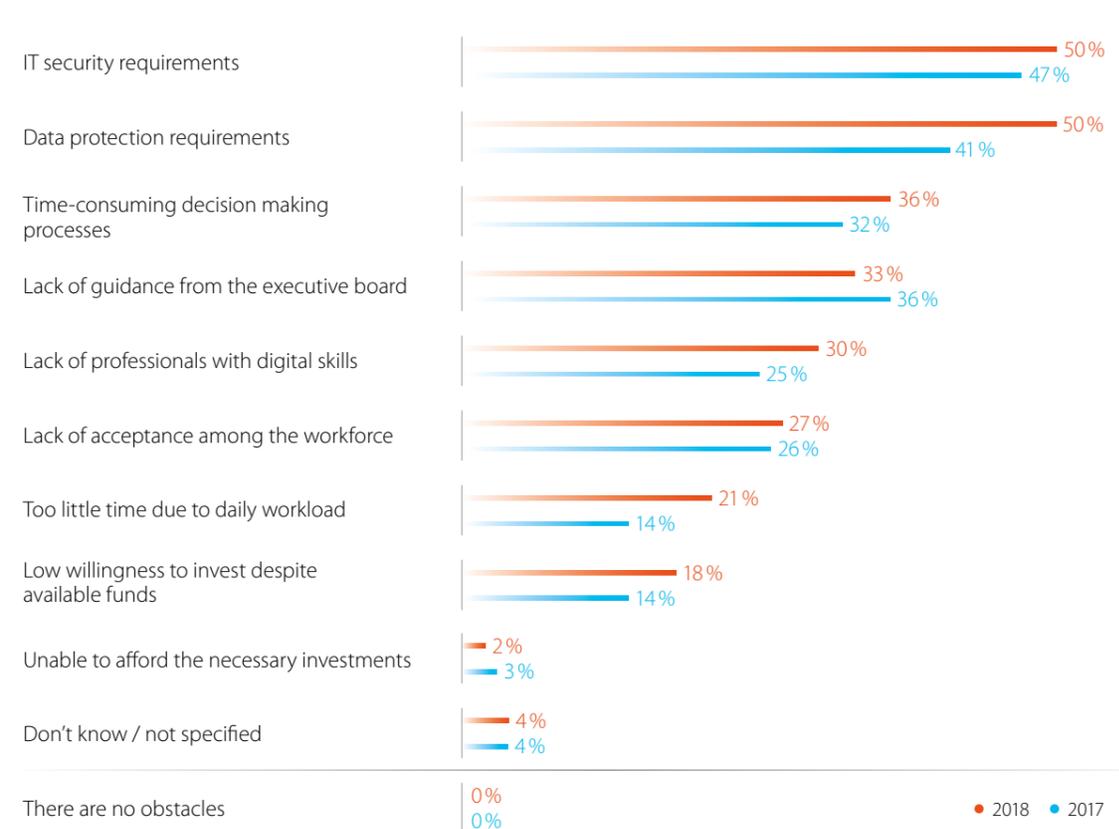
Companies pursue a variety of goals through digitization. The largest potential is seen in improving customer service and optimizing the customer acquisition process. Faster internationalization of business follows in third place.

Many organizations use digital technologies with the intention of increasing efficiency and reducing costs by simplifying and accelerating business processes, as well as making them more flexible.

Companies see high potential in developing new products and services. Digital open innovation platforms for accelerated development of products and ideas are trending. What's more, digital technologies can be used to extend the existing product and service portfolio. This goes hand in hand with the development of new business models. Last but not least, digitization holds great potential for recruitment and employee retention.

IT Security Is One of the Largest Obstacles

IT security and data protection are hindering one in two companies in digital transformation. In contrast, costs play much less of a role.

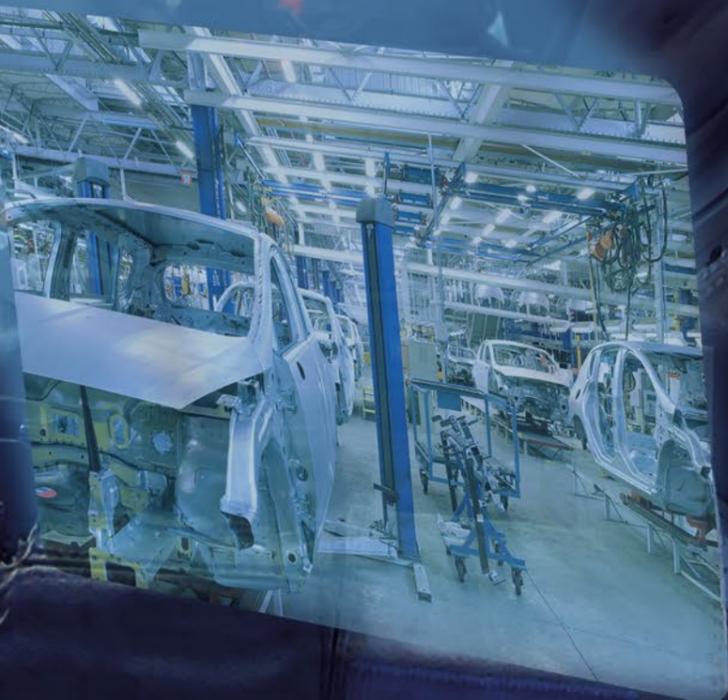


Question: "In your opinion, which of the following are obstacles to digital transformation at your company?"; Statements have been shortened; Sample: All surveyed companies (2017: n=905; 2018: n=954); Multiple answers possible.

The main obstacles to digitization are IT security and data protection requirements (each 50 percent). In comparison to the previous year, there has been a significant increase in the number of companies listing data protection as a challenge (+9 percentage points). This sharp increase should be considered in conjunction with the period during which the survey took place: May 2018. In the weeks leading up to the EU General Data Protection Regulation (GDPR) entering into force, there were many negative reports about the potential effects on businesses and consumers.

Additional obstacles to digital transformation are time-consuming decision making processes (36 percent) and a lack of guidance from company management (33 percent). Many companies also listed a lack of professionals with digital skills (30 percent) and a lack of acceptance among the workforce (27 percent). Money is rarely an issue in digitization. However, despite the funds being available, almost a fifth of survey respondents (18 percent) complained of a lack of willingness to invest.

7. Results by Industry



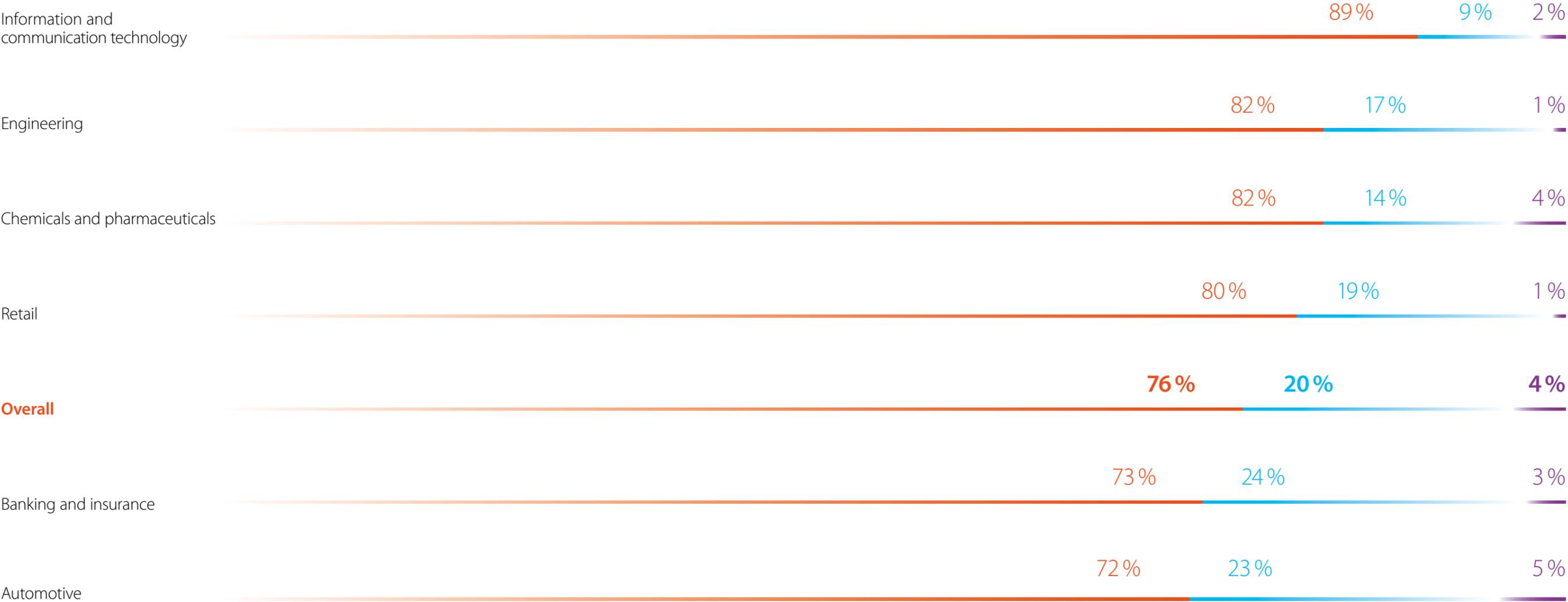
Digital transformation affects the entire German economy. However, digitization is progressing at a different pace in each industry. This study shows the current situation in six selected key industries: automotive, banking and insurance, chemicals and pharmaceuticals, retail, information and communication technology, and mechanical engineering.

The IT industry is leading the way (89 percent), followed by engineering and chemicals/pharmaceuticals (each with 82 percent) and retail (80 percent). In contrast, just 73 percent of companies in the banking and insurance sector and 72 percent of automotive manufacturers have a digital strategy.

An initial indicator of digital progress is the question of whether digital transformation is embedded in company strategy in different industries.

Strategic Approach to Digitization by Industry

IT companies are the most likely to take a strategic approach to digitization. The automotive industry trails in last place.



Question: "Does your company follow a strategy for digital transformation?"; Sample: All surveyed companies (2018: n=954); Due to rounding, percentages may not total 100%.

● Digitization is embedded in strategy ● Digitization is not embedded in strategy ● Don't know / not specified

7.1 Information and Communication Technology

The predominantly small and medium-sized companies in the IT industry face similar challenges in digitization as other sectors.

IT companies are constantly required to adapt their products and services to their customers' needs and utilize digital technologies such as cloud computing, big data analytics, the Internet of Things, and artificial intelligence. This is one of the reasons for the above-average proportion of IT companies that take a strategic approach to digitization (89 percent). 64 percent coordinate their transformation across departments (average: 49 percent) and 43 percent have their own digital business unit (average: 29 percent).

IT companies are naturally well attuned to new technologies. However, they are generally no more likely to use them than other companies. The

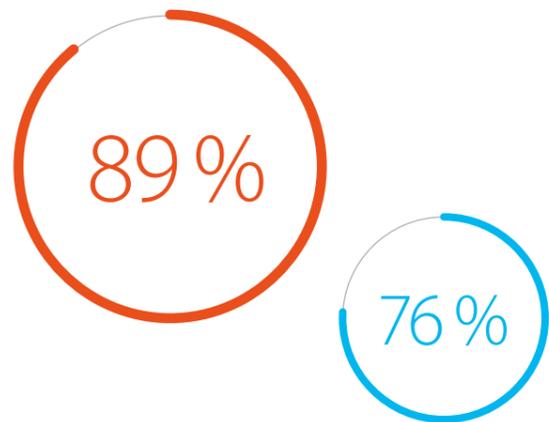
exceptions are big data analytics at 50 percent (average: 41 percent) and the Internet of Things at 26 percent (average: 23 percent).

The use of other technologies is actually below average. This is most surprising with pervasive technologies such as cloud computing and artificial intelligence.

However, at 44 percent, an above-average proportion of IT companies are developing new products and services as part of digitization. An additional 31 percent already offer their products and services via digital platforms.

Survey Results for IT Companies

Digitization Is Embedded in Company Strategy

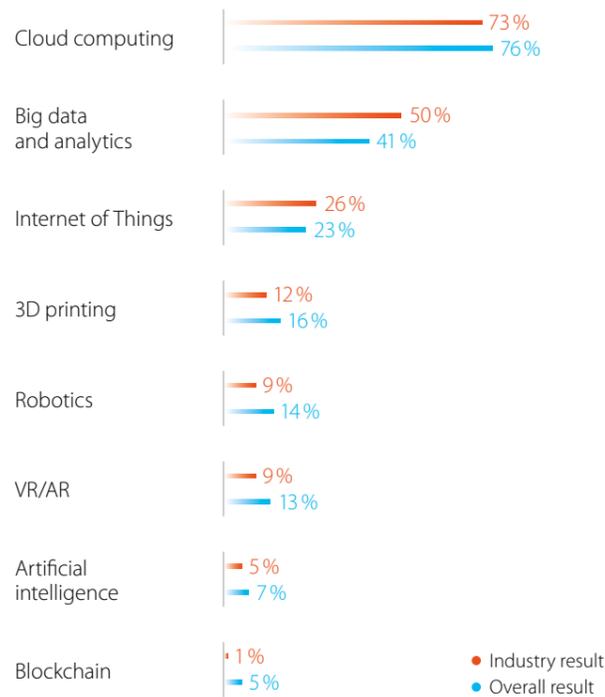


Influence/Potential of Digitization in Detail

(Multiple answers possible)



New Technologies in Use



IT companies believe in the potential of digitization and have a clear strategy. However, in terms of actual use of technologies, they often trail behind companies in other industries.

7.2 Mechanical Engineering

With 82 percent, engineering companies are much more likely to embed digitization in their business strategy than the average. The industry is far ahead when it comes to using new technologies: 37 percent use robotics and 29 percent use 3D printing techniques in manufacturing environments, for example. One in two companies uses big data analytics to analyze data from devices such as sensors in systems and machinery.

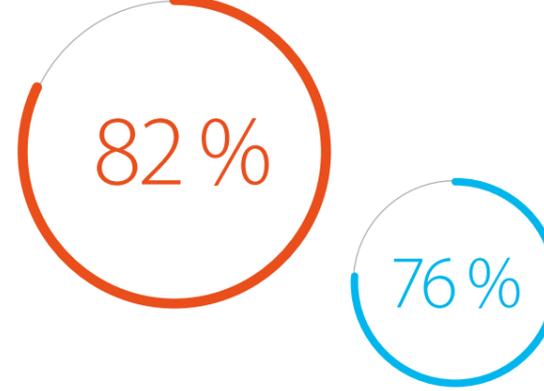
One in five mechanical engineering companies (22 percent) uses artificial intelligence. This is higher than in any other surveyed industry – the overall average is just 7 percent. One of the reasons for this is that artificial intelligence is often used in conjunction with advanced data analysis and robotics. At the same time, 17 percent use virtual reality

technology. One of the ways that VR systems support employees is by helping them perform the right tasks in the right order in situations such as operating machinery or installing complex components.

A particularly high number of engineering companies state that they are making changes to existing products and services during the course of digitization (61 percent). The industry attaches much importance to encouraging employees to develop digital skills (80 percent). One in three companies (35 percent) use digital systems to recruit new employees. Engineering companies are more likely to require specific job profiles than other industries: 56 percent are looking for cloud experts, 38 percent for application developers, and 34 percent for virtual reality designers.

Survey Results for Engineering Companies

Digitization Is Embedded in Company Strategy

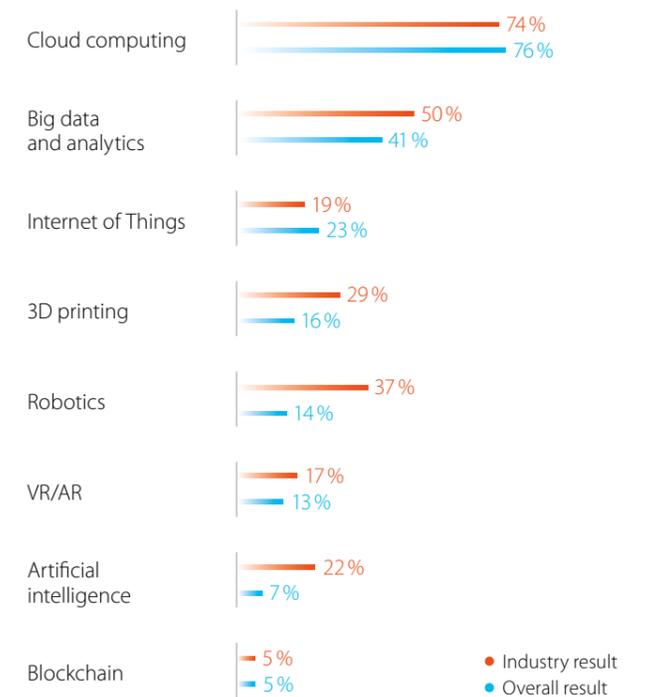


Influence/Potential of Digitization in Detail

(Multiple answers possible)



New Technologies in Use



Even in the digital age, mechanical engineering companies remain Germany's main driving force in innovation. The industry is more technologically advanced than any other.

7.3 Chemicals and Pharmaceuticals

Just two thirds (65 percent) of the chemical and pharmaceutical companies surveyed claim to be very open or quite open to digitization. This is 10 percentage points below the overall average. However, this apparent skepticism is contradicted by the industry's open attitude toward digital technologies: 82 percent of chemical and pharmaceutical companies have a digital strategy in place – more than the overall average. Similar to other industrial sectors, manufacturing-relevant technologies are particularly common in chemicals and pharmaceuticals. 40 percent of companies use robotics, 28 percent use 3D printing, and 20 percent use artificial intelligence. The industry's use of cloud computing, big data analytics, and the Internet of Things roughly matches the average.

More so than other industries, chemical and pharmaceutical companies see great potential for digitization to increase efficiency and reduce costs. 40 percent of survey respondents expect an increase

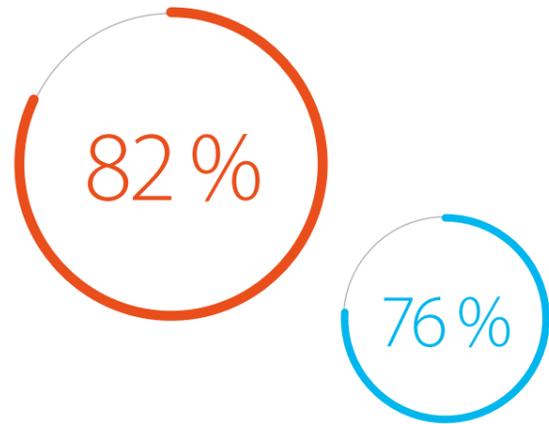
in efficiency (average: 30 percent) and 22 percent hope to cut costs (average: 16 percent). In addition, 43 percent see high potential to develop new products and services, while this figure is just 34 percent across all industries.

At 61 percent, chemical and pharmaceutical companies are more likely to view IT security requirements as an obstacle to digital transformation (average: 50 percent). This wariness comes as little surprise, as cyber-attacks on chemical plants or production facilities for medication could endanger human lives.

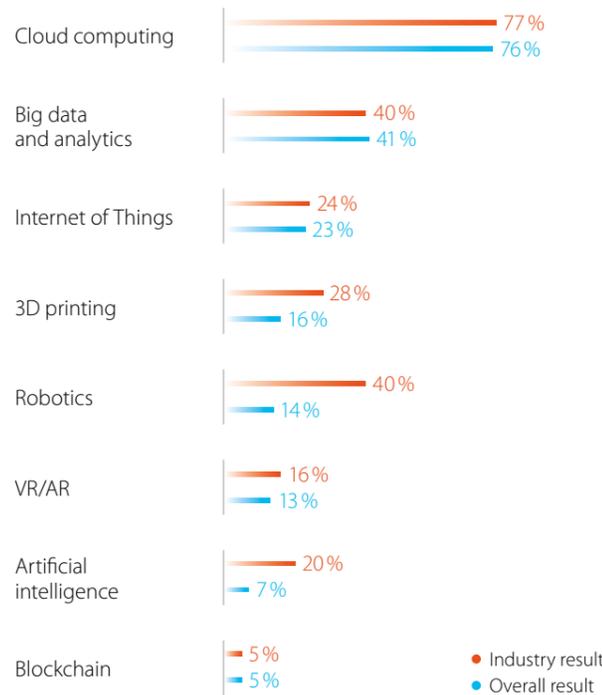
An above-average number of companies in the industry are seeking digital experts. 77 percent of survey respondents need IT security experts, 50 percent need cloud specialists, 38 percent need data scientists, and 41 percent need application developers.

Survey Results for Chemical and Pharmaceutical Companies

Digitization Is Embedded in Company Strategy

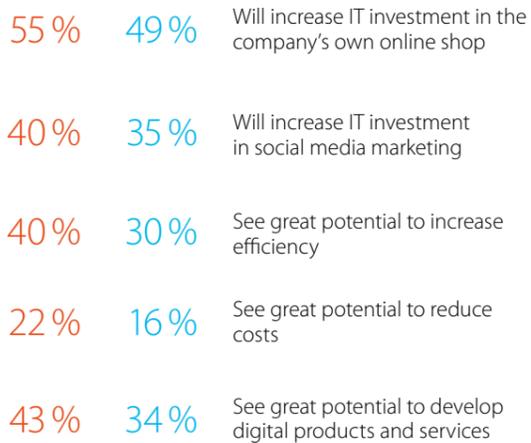


New Technologies in Use



Influence/Potential of Digitization in Detail

(Multiple answers possible)



Chemical and pharmaceutical companies have an ambivalent relationship with digitization. While they view it with skepticism, they take a structured and systematic approach to technological innovation.

7.4 Retail

Four in five retailers have developed a digital strategy. However, when it comes to using technology, the industry is still hesitant. With the exception of cloud computing and blockchain, retailers are less likely to use the innovations referred to in this study.

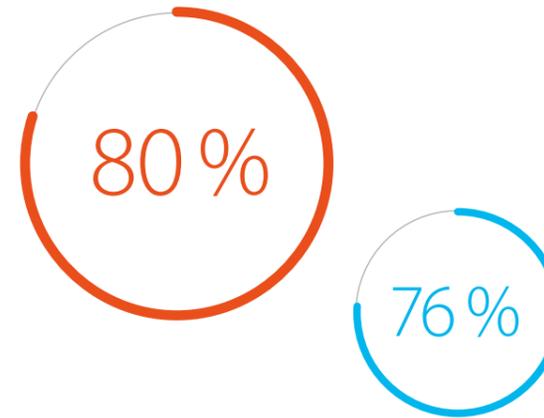
As part of digital transformation, retail's main focus is to acquire and retain customers. Two thirds of companies (67 percent) state that digitization is having a big impact on sales and marketing. 53 percent of all surveyed retailers want to increase investment in their online shops, and 51 percent want to invest in mobile websites and smart-

phone apps. These aims are reflected in the industry's recruitment strategy: 37 percent of retailers are searching for digital marketing experts to market their products online more effectively. In comparison, the average across other industries is just 27 percent.

At 49 percent, almost half the surveyed retailers notice the effects of digitization on their business model, compared to an average of 44 percent in other industries. 55 percent are anticipating a major impact on employees and workplaces (average: 49 percent).

Survey Results for Retailers

Digitization Is Embedded in Company Strategy

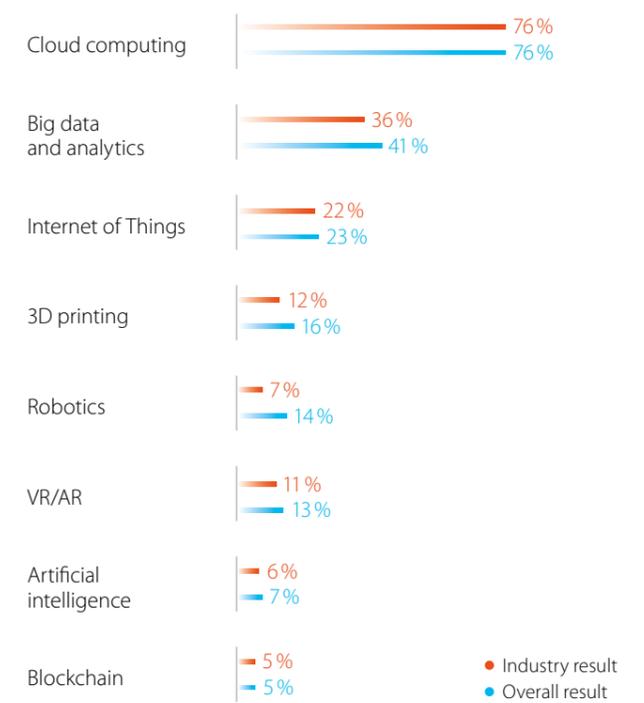


Influence/Potential of Digitization in Detail

(Multiple answers possible)



New Technologies in Use



Retailers take a careful approach to digitization and tend to hold back. The industry recognizes the great potential of digital transformation, but is not exploiting it enough.

7.5 Banking and Insurance

Digital technologies are fundamentally changing the structure of the finance sector. However, in comparison to other industries, banks and insurance companies are less open to change and innovation and are also less likely to make digitization part of their strategy. That also fits with the fact that only 4 percent of all banks and insurance companies collaborate with startups. While that is not much lower than the 6 percent cross-industry average, the finance sector is home to a lively fintech and insurtech scene, which is developing digital innovations at a rapid pace. Working with startups would provide an opportunity to learn from one another and develop new business models together. This would in turn guide the finance sector into the future.

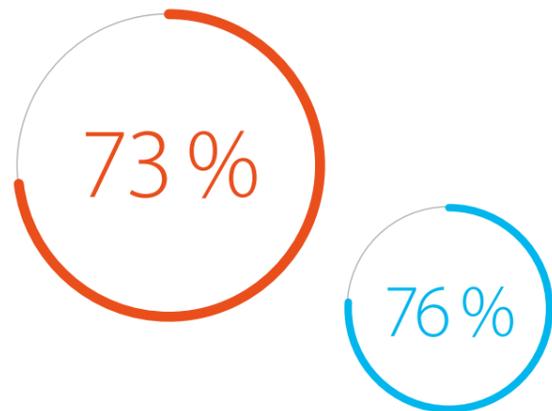
Increased use of digital technologies is typical in service industries. The finance sector's use of cloud computing and the Internet of Things is in line with the cross-industry average. As can be expected, technologies like robotics, 3D printing, and virtual reality are much less likely to be used than in manufacturing industries. The banking and insurance sector is the top user of big data analytics, with

44 percent of companies using the technology. One in five finance companies (21 percent) possess artificial intelligence capabilities.

Considering the rise of cryptocurrencies, experts predict that blockchain holds particularly high potential in the finance sector. However, only one in eight companies (12 percent) are experimenting with blockchain. At a proportion of 76 percent, banks and insurance companies are much more likely to make changes to customer relationships as a consequence of digitization. The cross-industry average is just 59 percent. One in two financial service providers (51 percent) offer their customers individualized services, and 12 percent involve customers in the product development process (average: 8 percent).

37 percent of finance and insurance companies are lacking professionals with digital expertise, while the total average is just 30 percent. 80 percent of companies in the finance sector are looking for IT security experts, 45 percent need cloud computing specialists, and 18 percent need system integrators.

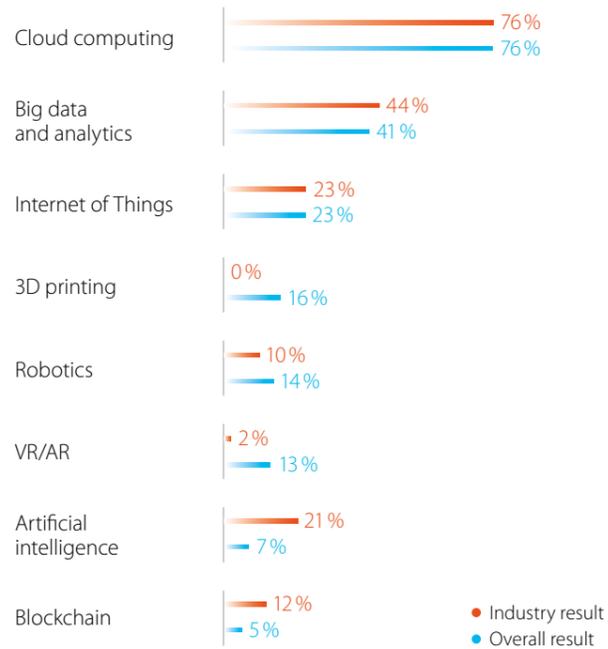
Survey Results for Banks and Insurance Companies
Digitization Is Embedded in Company Strategy



Influence/Potential of Digitization in Detail
(Multiple answers possible)



New Technologies in Use



Fintechs and insurtechs are flooding the market with innovations, and blockchain is galvanizing businesses and investors around the world. However, German banks and insurance companies seem to be taking barely any notice of this digital upheaval.

7.6 Automotive

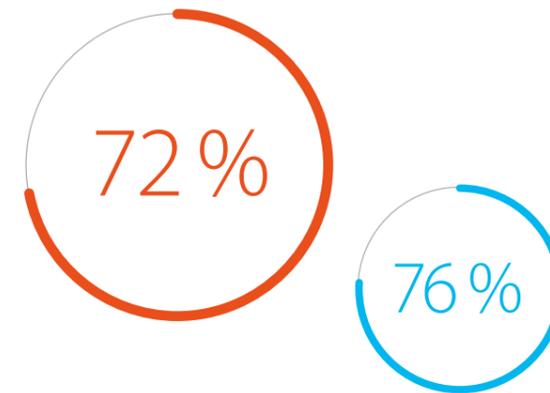
72 percent of automotive manufacturers have made digitization part of their strategy. Three quarters are fundamentally open to digital transformation. And when it comes to using digital innovations, the automotive industry is one of the best. It occupies the top spot for five out of the eight technologies referred to in this study: 78 percent of automotive companies use cloud computing, 58 percent use big data analytics, 27 percent use the Internet of Things, and 22 percent use virtual or augmented reality. In terms of 3D printing techniques, automakers share first place with engineering companies (29 percent). In addition, an above-average number of automotive manufacturers use artificial intelligence (18 percent) and robotics (39 percent).

The automotive industry is experiencing radical changes due to digitization more than other industries – and in all areas of business. 74 percent are noticing an impact on sales and marketing (average: 64 percent), 61 percent on employees and workplaces (average:

49 percent), and 57 percent on business processes (average: 48 percent). What stands out, at 55 percent, is the high proportion of companies experiencing a direct impact on their business model (average: 46 percent). Furthermore, 57 percent are altering their products and services as a result of digitization, compared to the cross-industry average of 44 percent. The influence of digital transformation is also evident from the fact that 64 percent of companies have modified their existing products and services and 57 percent offer individualized products and services.

Automotive companies are significantly more likely to collaborate with external partners such as suppliers, academic institutions, strategy consultants, and startups. With 14 percent of companies collaborating with startups, the automotive industry is the only industry significantly above the overall average of 6 percent. Automakers plan to build on these partnerships in the future.

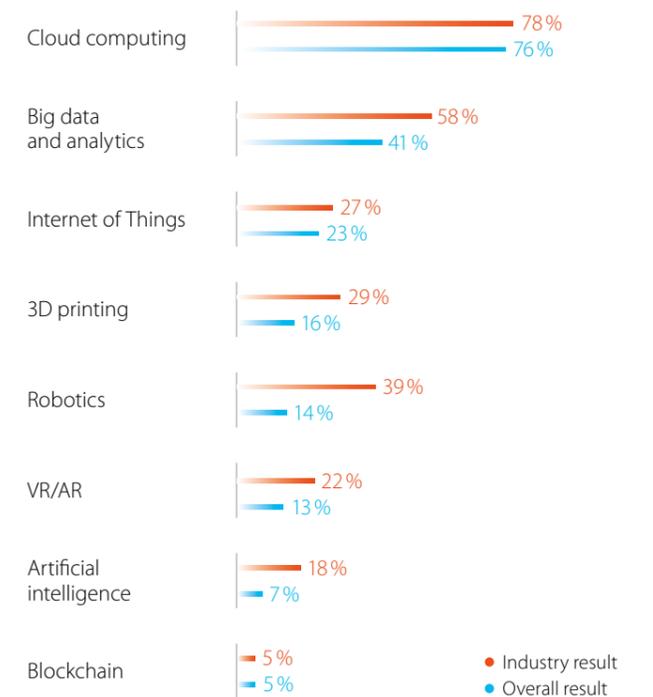
Survey Results for Automotive Companies
Digitization Is Embedded in Company Strategy



Influence/Potential of Digitization in Detail
(Multiple answers possible)

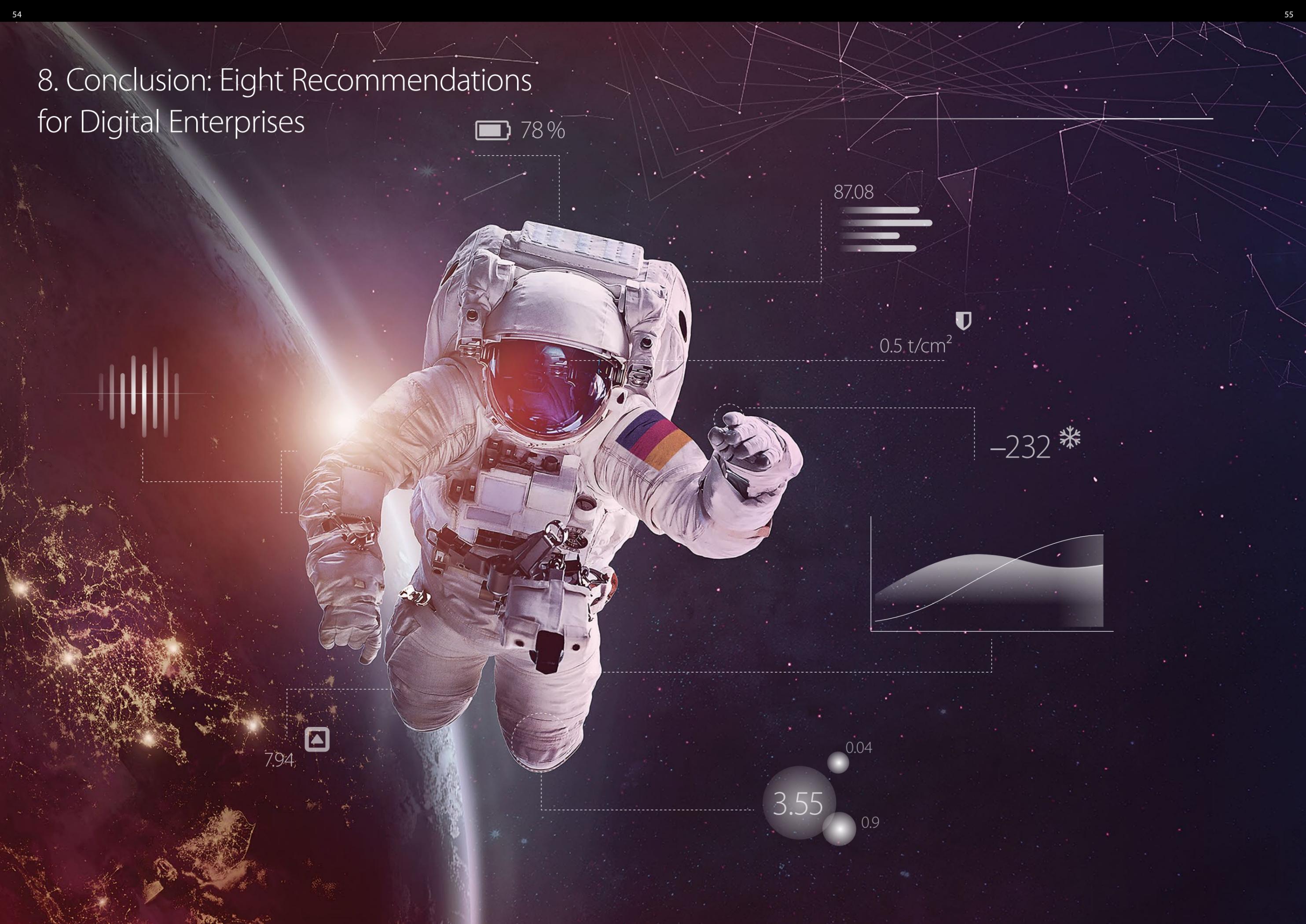


New Technologies in Use



Automotive companies are experiencing a particularly profound impact from digital transformation. Germany's flagship industry is responding by investing in new technologies, innovative products and services, and an increased number of partnerships with startups.

8. Conclusion: Eight Recommendations for Digital Enterprises



78%

87.08



0.5 t/cm²

-232 °



7.94



3.55

0.04

0.9

1. Take a Strategic Approach to Digitization

More than three quarters of the companies surveyed have embedded digital transformation in their strategy. In other words, the senior management has defined goals and actions to be taken in order to achieve the full potential of digital technologies in the future. A central digital strategy and department-specific approaches can be useful additions to this. However, the executive board should fully back an overarching strategy. A strategy is a crucial aid to orientation for employees in digitization projects.

2. Establish New Business Units

Nearly a third of companies has an organizational unit dedicated to digitization. These digital units are beneficial as they can help drive innovations within a protected space outside of day-to-day business and independent of existing structures. However, digital transformation is a task that always involves the whole business. That means it should not be delegated to the digital unit alone, but executed by employees from all areas of the business.

3. Define Central Responsibilities

As part of their organizational efforts, companies should define employee responsibilities. In comparison to previous years, there has been a significant increase in the number of companies with a chief digital officer (CDO), who initiates, coordinates, and oversees projects. In addition to technical skills, a CDO should be business-minded and a strategic thinker. These qualities are necessary as the CDO collaborates with a variety of business areas to develop successful digitization projects. Last but not least, the CDO should maintain an overview of all initiatives, serve as a connection between internal and external stakeholders, and review project results.

4. Implement Ongoing Change Management

As part of digital transformation, companies make changes to their structures, business models, and processes, as well as launching new products. These complex changes demand a willingness to innovate and a high degree of adaptability. Structured change management supports and drives the transformation by actively involving and preparing employees. Open communication between all people involved is pivotal to the success of digitization. In this context, managers should also assess the benefits of agile methodologies to ingrain a willingness to change into the corporate culture and to accelerate development projects and make them more customer-centric. The study shows that although agile development methodologies are widespread, they have not yet become standard practice in many companies.

5. Develop Digital Skills

Companies are noticing that digitization is having a greater impact on employees and job profiles compared to previous years. New technologies demand new skills and even completely new job descriptions. Many companies are seeking cloud experts, data analysts, and virtual reality designers. IT security experts are still in the highest

demand. However, in light of the shortage of skilled IT professionals, HR departments face major challenges. The demand for digital experts is rising drastically in all industries, and companies need to find new ways to recruit new talent while nurturing the digital skills of their existing workforce.

6. Think in Terms of Digital Business Models

Companies should make a clear distinction between the digitization of their business processes and the digital transformation of their business model. Digitizing processes primarily serves to increase productivity while reducing costs – in other words, achieving greater efficiency. In contrast, innovating business models is about leaving the beaten track and developing brand-new products and services in order to ensure the future success of the company. Only in this way can established businesses maintain a link to their customers and defend their unique position in the value chain against new competitors. This can only be achieved through careful management of the internal innovation process – and with the courage to take business risks.

7. Connect Digital Technologies

After the triumph of cloud computing, big data analytics arrived on the scene as the next major technology. The Internet of Things has also established itself in the meantime. 3D printing and robotics have experienced strong growth, especially in the manufacturing industry. Manufacturing is also one of the top users of artificial intelligence – and this pervasive technology is continuing to gain traction in a diverse range of industries. In addition, blockchain is another technology with the potential to revolutionize numerous areas of business – from finance to logistics to the energy sector. However, many technologies do not reveal their full potential until they are combined with others. Companies should therefore assess potentially beneficial combinations and the resulting applications.

8. Understand Digital Markets

Digital transformation is changing the market conditions in numerous industries. In many areas, digital platforms play a key role. These are online marketplaces where different market players offer their services. Platform operators receive a fee or commission. Prominent examples of platforms, including Airbnb, Uber, Facebook, and Amazon, are all targeted at private customers. However, digital platforms are taking over numerous B2B markets. In addition to simply selling products, this requires smart analysis of data. In view of global value chains, companies should assess which digital platforms are relevant to them. In some cases, it can be beneficial for companies to develop their own platform strategy to enable more efficient collaboration with suppliers and partners within an ecosystem.

9. Contacts

This study was conducted by Bitkom Research GmbH on behalf of Tata Consultancy Services.

Tata Consultancy Services Deutschland GmbH

Tata Consultancy Services (TCS) has been supporting companies globally for over 50 years with IT services, consulting, and business solutions. TCS offers a consulting-led, cognitive powered, integrated portfolio of IT, business & technology services, and engineering. This is delivered through its unique Location Independent Agile delivery model, recognized as a benchmark of excellence in software development.

TCS is part of the Tata Group, India's largest industrial conglomerate, and employs around 400,000 highly skilled IT consultants in 46 countries. In the previous fiscal year (ending March 31, 2018), TCS generated a total revenue of \$19.1 billion. The company is listed on the National Stock Exchange and the Bombay Stock Exchange in India. For more information, visit: www.tcs.com

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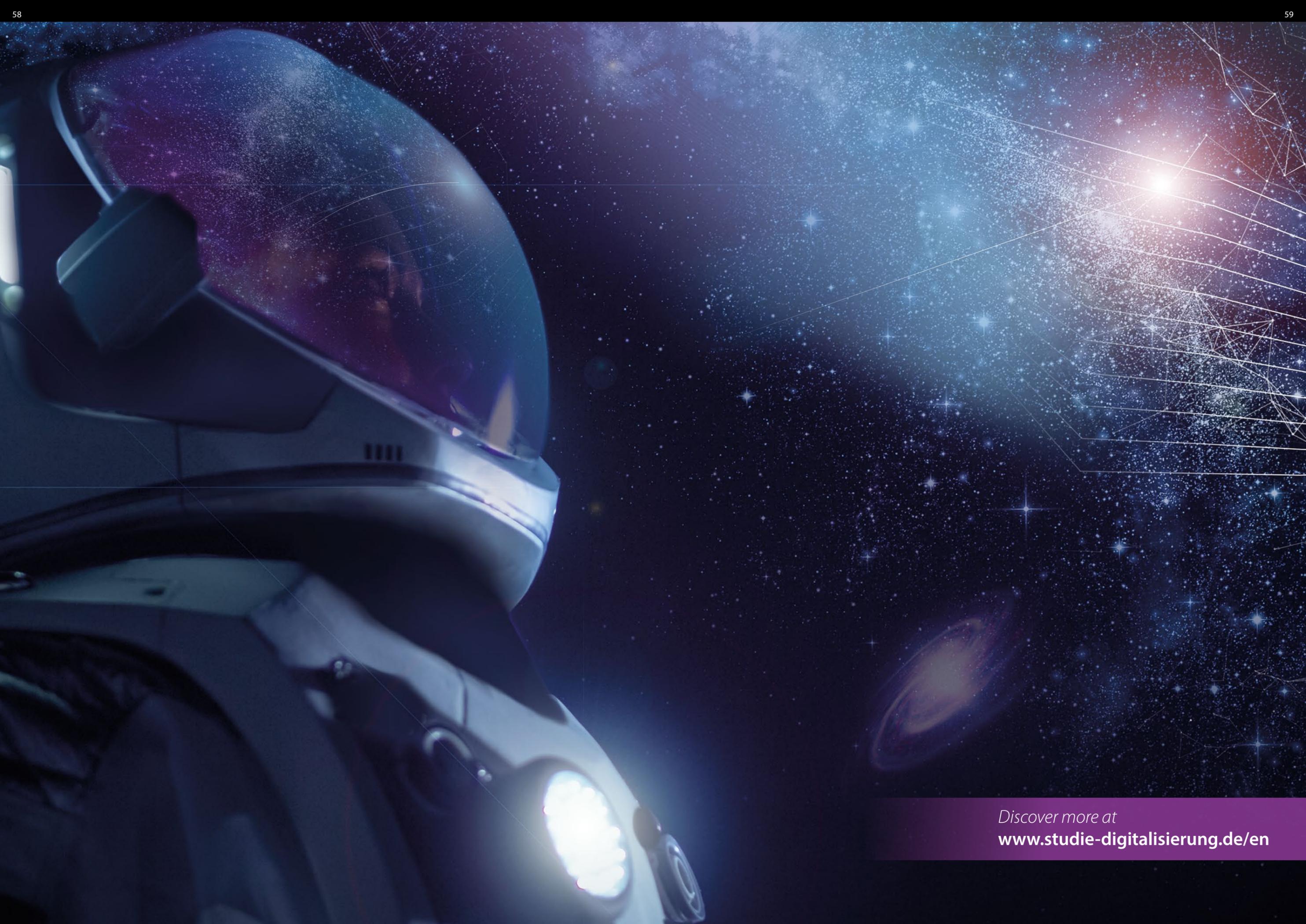
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