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for Economic Affairs
and Energy

DIGITAL Economy Monitoring Report 2018

Germany as an ICT location
and its position in an international comparison

Compact

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Management Summary

This DIGITAL Economy Monitoring Report 2018 shows the importance of the ICT (information and communication technology) sector and the online economy for the German economy as a whole even more clearly than before. The digital economy is, as a provider of digital products and services, first of all an enabler of digitalisation in Germany and, secondly, it makes a significant contribution to overall economic development. Therefore, the German ICT sector was able to increase its gross value added to €108 bn - an increase of 4% compared to the previous year. This shows that ICT is leaving traditional industrial sectors, such as mechanical engineering or the chemical and pharmaceutical industry, trailing far behind.

With over 1.1 million employees and self-employed people making social security contributions, the number of people in employment in the ICT sector significantly increased again between 2016 and 2017. In total, almost 250,000 new jobs have been created since 2010. This means that the ICT sector is also proving to be an engine of growth in the jobs market in the long term.

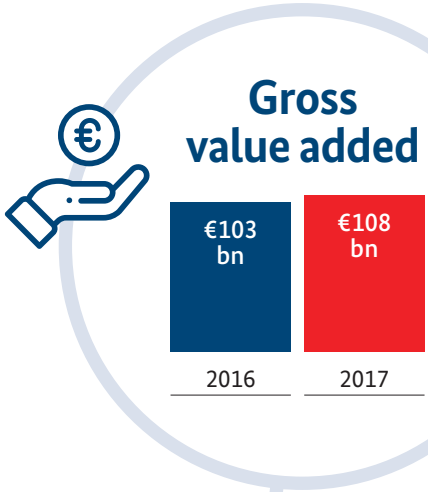
Furthermore, the DIGITAL Economy Monitoring Report is an indicator of Germany's performance as an ICT location. In a comparison of ten major global locations, Germany has improved one place to fifth. The USA remains the front runner, followed by South Korea and the United Kingdom. Germany scores particularly well in terms of infrastructure and other framework conditions, such as capacity for innovation. However, the report also makes clear where action is required: it concludes that there is still room for improvement in terms of the use of digital technologies and applications. In addition, companies still have potential to grow in terms of digital transformation. The extent to which Germany can benefit from the opportunities presented by digitalisation will also depend on the extent to which it succeeds in persuading people to actively help shape the changing working and living environments. Digitalisation must be anchored across the whole of the economy and society. To achieve this, we need an open and creative exchange of ideas at all levels and a lot of engaged participants.

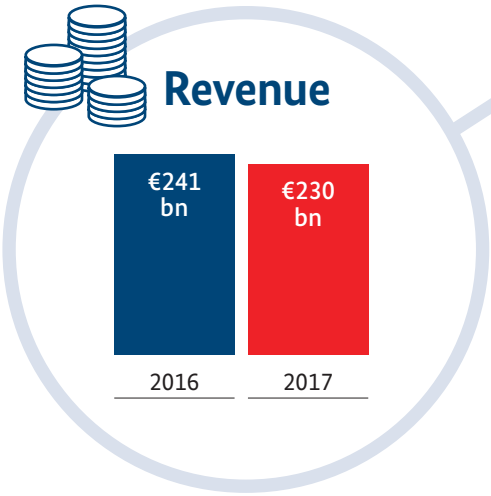
The future of Germany as a business location depends, to a not inconsiderable extent, on whether it takes advantage of the opportunities presented by new technologies and applications. The 2018 DIGITAL Monitoring Report contributes by showing how Germany can position itself as a digital location and position its digital economy, as well as where there is still potential to further improve its competitiveness at an international level.

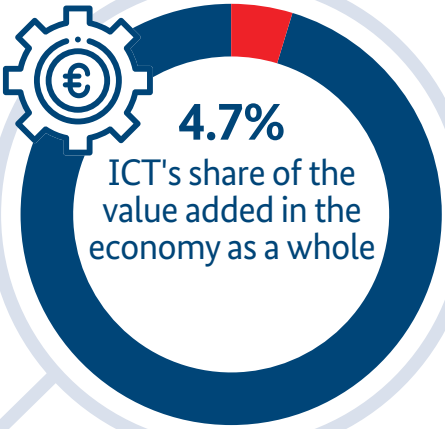
Contents

Digital Economy: Important Key Data at a Glance

More jobs, an increasing number of companies and a higher gross value added - this is a good summary of the ICT industry's track record for 2017. However, not all the indicators have improved since last year. ICT companies are investing less and their revenues are dropping. In contrast to the ICT sector, the online economy has grown significantly in the same period. An overview of economically relevant sector data:







1,176,324
Employees and self-employed people paying social security contributions

of which

Over 56,000
new jobs since 2016

Almost 250,000
new jobs since 2010

The online economy is growing

After the ICT sector, the online economy is the second largest sector of the digital economy. In 2017, the online economy increased its turnover to €119 bn - a significant increase of 9% compared to the previous year. These revenues include consumer, business, and federal and state spending on the following products and services: hardware, e-commerce, data services, internet-based applications and IT services, online advertising and online content (video games, video streaming and digital music). There are some overlaps between the online economy and the ICT sector.

Services Boost the ICT Sector

In terms of value added, ICT is ahead of mechanical engineering and the chemical/ pharmaceutical sectors

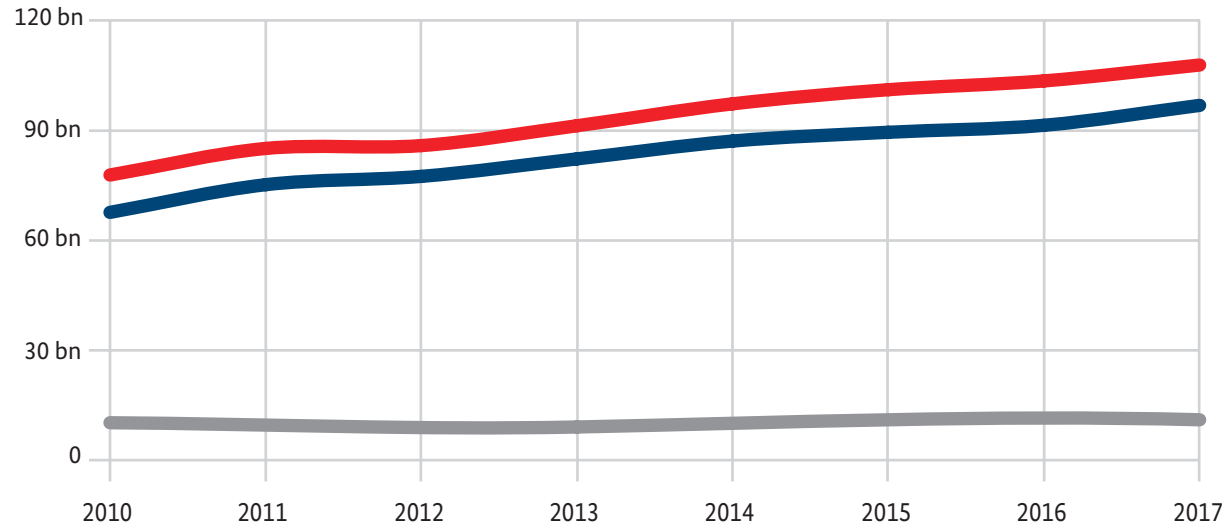
The ICT sector's gross value added increases significantly
The German ICT sector was able to increase its gross value added in 2017 to €108 bn - an increase of 4% compared to the previous year. Since 2010, gross value added - the value of the goods and services produced less intermediate consumption - has increased by a total of €30 bn. This shows that ICT is leaving traditional industrial sectors, such as mechanical engineering or the chemical and pharmaceutical industry, trailing far behind.
As in the previous year, the ICT sector accounted for around 5% of the total gross value added in the commercial sector in Germany. The significant increase in gross value added in the ICT sector, which also had to compensate for the decline in value added by ICT hardware manufacturers, is completely due to the increase in value added by ICT service providers.

ICT investment declines
However, not all the key economic data for the ICT sector is improving. After a record year in 2015, companies reduced their investments in production for the second year in succession in 2017 to €15 bn - a drop of 15% compared to the previous year. Nevertheless, the ICT sector still accounts for 3% of all gross fixed capital formation in the German commercial economy. This puts it in fourth place after transport and logistics, retail and vehicle construction.

Gross fixed capital formation - definition:

Gross fixed capital formation first and foremost includes the acquisition of durable means of production, but it also includes investments in real estate, other equipment and value-adding repairs. Spending on intangible assets, such as research and development and software, can also be allocated to gross fixed capital formation, provided these assets are used in the production process continuously for one year.

Growing value added for the ICT sector and ICT service providers (incl. software)



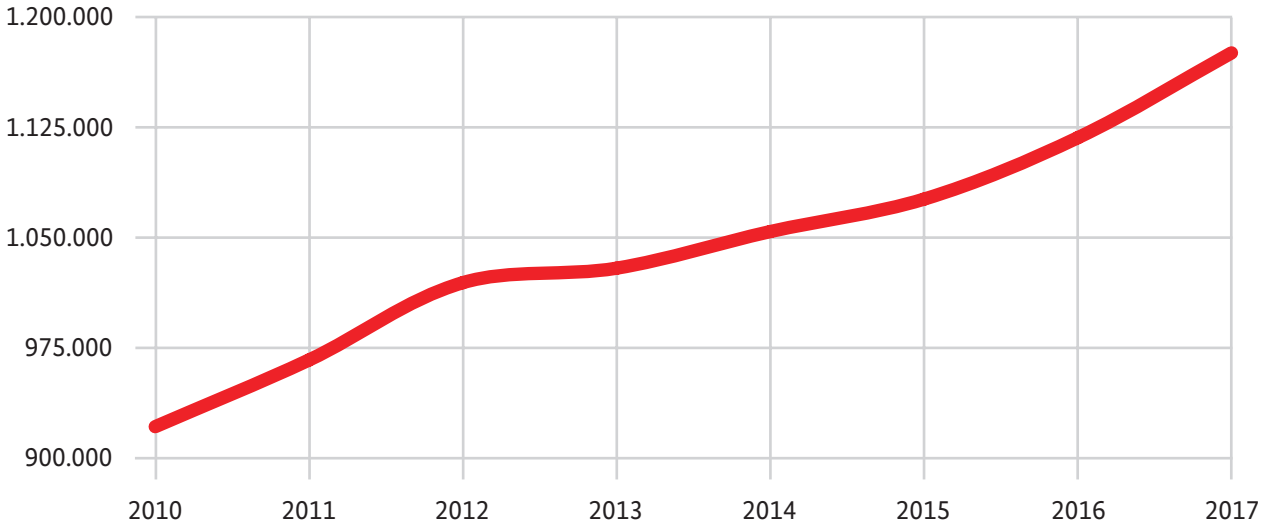
■ = ICT as a whole; ■ = ICT service providers; ■ = ICT - hardware; Gross value added growth in the ICT sector and its subdivisions. Source: Eurostat, Destatis and 2018 ZEW (Zentrum für Europäische Wirtschaftsforschung [Centre for European Economic Research]) calculations; figures for 2017 are estimates.

250,000 more ICT employees than in 2010
With 1,176,324 employees and self-employed people paying social security contributions in 2017, the number of people employed by the ICT sector again increased significantly. And it is not just the around 56,500 jobs created in the last year that are responsible for this growth: a long-term comparison also shows that the ICT sector is an engine of growth in the jobs market: In total, almost 250,000 new jobs have been created since 2010 (an increase of 27%). This means that, when compared to other sectors, ICT has had the highest growth rate since 2010 - followed by the transport and logistics sector (up 21%) and the automotive industry (up 18%). The number of people employed by financial and insurance service providers and energy and water suppliers actually fell.

Number of ICT companies on the rise
The number of ICT companies is approaching the one hundred thousand mark: in 2017, there were 97,700 companies in the ICT sector - an increase of 2%. On average, ICT companies generated almost €2.5 million in revenue and employed twelve people - which puts the sector above the average for the commercial sector in both respects.

Revenue losses for hardware manufacturers
The ICT sector in Germany generated revenue of just under €230 bn in 2017, which was a significant drop (down 5%) compared to the previous year. While ICT service providers were able to continue their long-term growth with a revenue increase of €2 bn, hardware manufacturers' revenues fell by more than €13 bn in the same period.
This trend has led to a shift in revenue towards ICT service providers: whereas hardware still accounted for 45% of ICT revenue in Germany in 2010, this figure had dropped to just over a third by 2017.

The number of employees in the ICT sector has been growing continuously since 2010



Growth in employment in the ICT sector (employees and self-employed people paying social security contributions). Source: Eurostat, Destatis and 2018 ZEW calculations.

The ICT sector generates revenue of €48 bn with new products and services

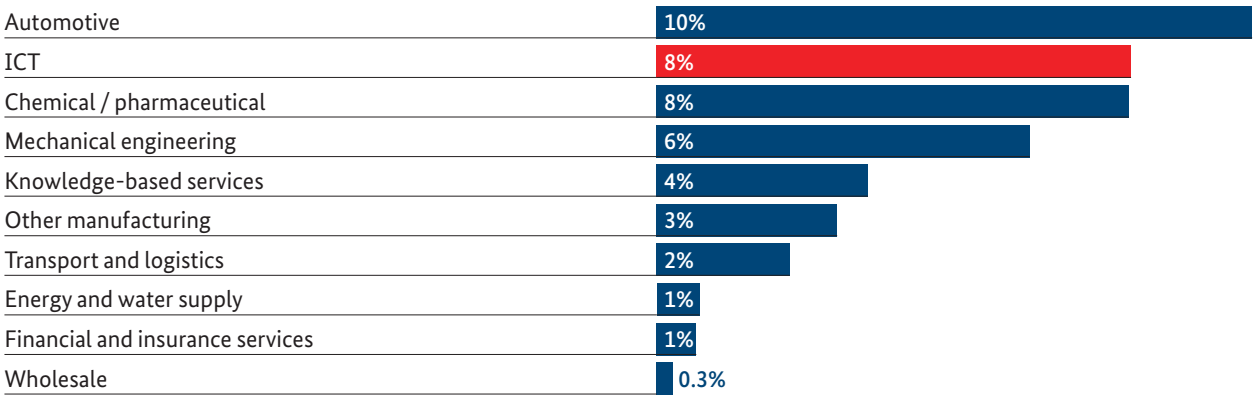
More investment in innovation

ICT sector amongst the leaders in innovation
The information and communication technology (ICT) sector in Germany is much more innovation-driven than other sectors. Only the automotive industry invests a higher percentage of its revenue in innovation than the ICT sector in Germany. In 2016, 8% of ICT revenue was spent on the development and launching of product or process innovations - the second highest value for "innovation intensity" after the automotive industry (10%).
Only chemical and pharmaceutical companies and the mechanical engineering industry also have a high level of innovation, with rates of 8% and 6% of revenue respectively.
In other comparable industries, the highest percentage of revenue spent on developments and new launches is 4%. The absolute figures also reflect the fact that the ICT sector is a leader in innovation.

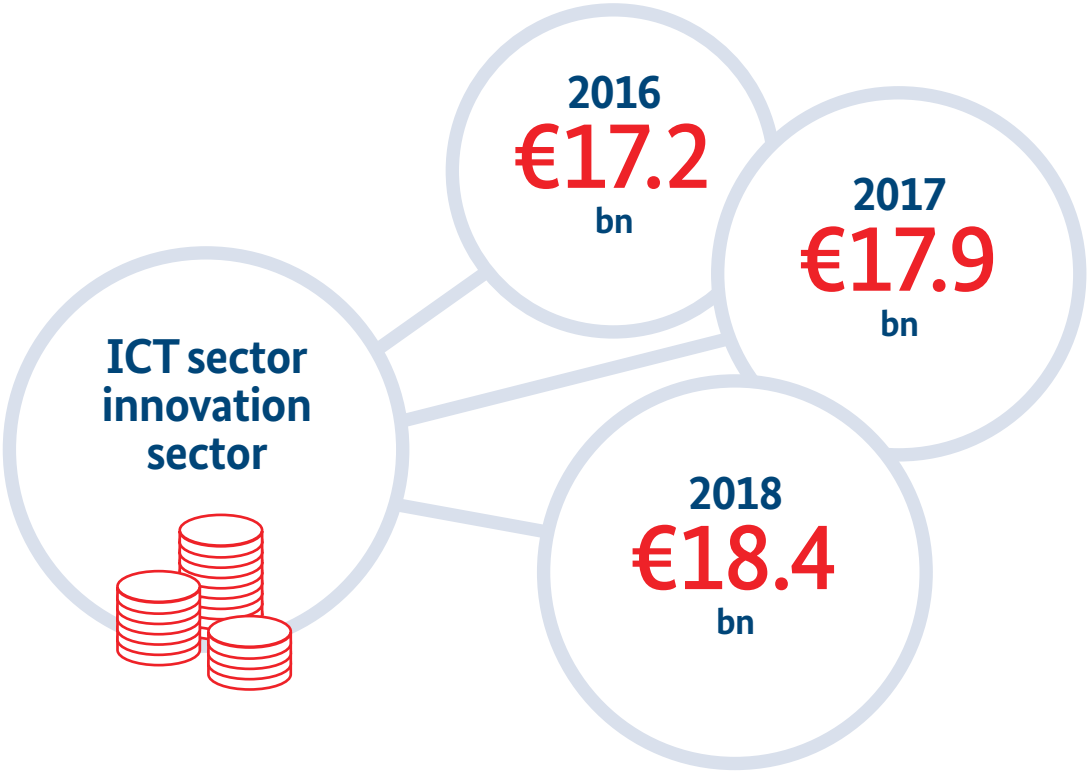
Innovation spending to rise steadily
In 2016, the sector's spending on innovation in Germany was €17.2 bn - with an upward trend: ICT companies planned an increase to €17.9 bn for 2017. For the current calendar year (2018), the sector forecast a further increase in innovation spending up to €18.4 bn (planned figures from Spring/Summer 2017).

New developments account for a fifth of revenues
The investment is paying off: in 2016, the ICT sector generated 20% of its revenues (€48 bn) through product innovations. A look at the two pillars of the ICT industry - hardware manufacturers and service providers - reveals clear differences: while new products and processes account for 40% of revenue in the hardware sector, new developments only account for 16% of revenue for ICT service providers.

The automotive industry and ICT invest the most in new developments



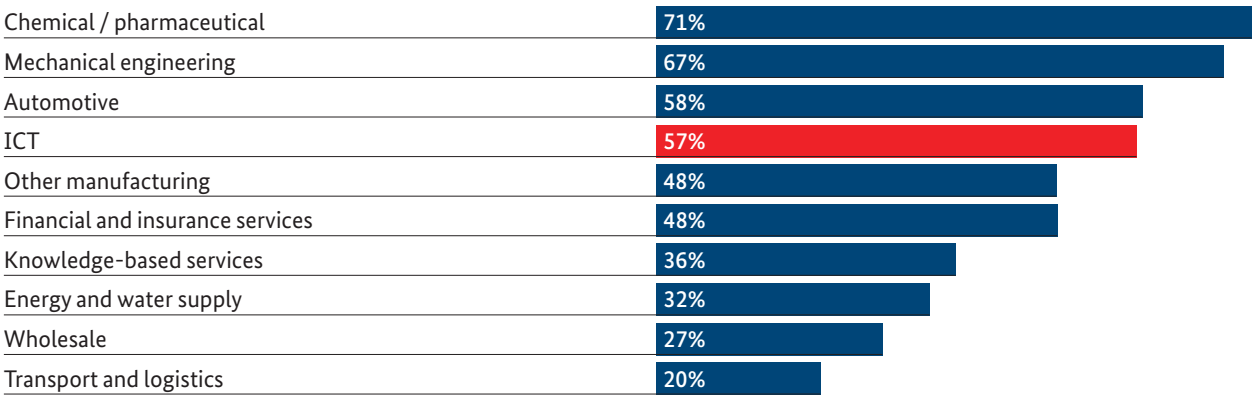
Innovation intensity: Percentage of revenue invested in the development and launch of product or process innovations (2016). Source: Mannheim Innovation Panel; 2018 ZEW calculations.



ICT profits from innovation
The aforementioned 20% of revenue from new products and services puts the ICT sector around 6 percentage points above the average for the German economy (14%). Only the automotive industry has a significantly higher percentage of revenue from new products (48%).
Amongst the comparable sectors, machine engineering at 20% has the same high level as the ICT sector.
The chemical and pharmaceutical industry, which generates 17% of its turnover from innovation, is next.

Share of innovative ICT companies slightly declining
The "innovator quota" - the percentage of companies that have introduced at least one new product or one new process in the last three years - has fallen by one percentage point. Nevertheless, more than half of ICT companies (57%) are innovators.
However, for this innovation indicator, both the chemical and pharmaceutical sectors (71%) and mechanical engineering (67%) sector are ahead of the ICT sector, which is on a par with the automotive industry.

More than half of ICT companies are innovators



Innovation rate: Percentage of companies in a sector who introduced at least one new product or process between 2014 and 2016. Source: Mannheim Innovation Panel; 2018 ZEW calculations.

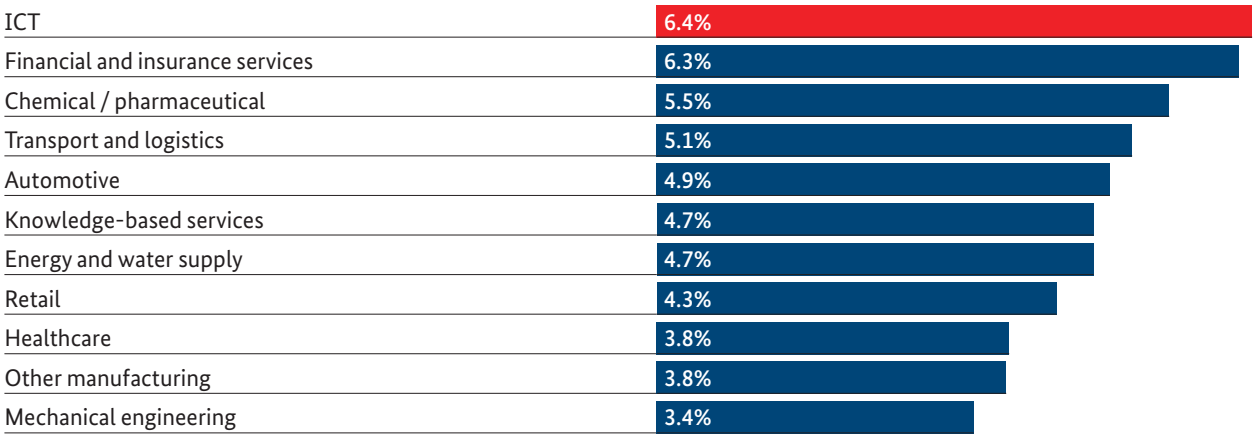
ICT start-up wave flattens out

ICT sector still has the highest start-up rate

6,000 new ICT companies in the market
The ICT sector currently accounts for almost 4% of all start-ups in Germany. Currently around 6,000 new companies are created here every year. This means that the number of market entrants is around 25% lower than in the boom period between 2009 and 2010. In that period, there were around 8,500 new ICT companies being created every year.

Highest start-up rate in an industry comparison
Nevertheless, the ICT sector still has the highest start-up rate of all the sectors that we have data for: 6.4% of ICT companies were only established in the last three years (2015 to 2017). Only the financial and insurance, and chemical and pharmaceutical sectors have similarly high levels in terms of the percentage of market entrants. For comparison: across the whole economy the start-up rate is 4.9%.
The service sector accounts for the lion's share (almost 97%) of start-ups within the ICT sector. Start-ups in the hardware sector are rare.

ICT leads the way on business start-ups



Start-ups (established 2015-2017) as a percentage of all companies in a sector. 6% of all ICT companies were established in the last three years. Source: Mannheim Innovation Panel; ZEW 2018 calculations.

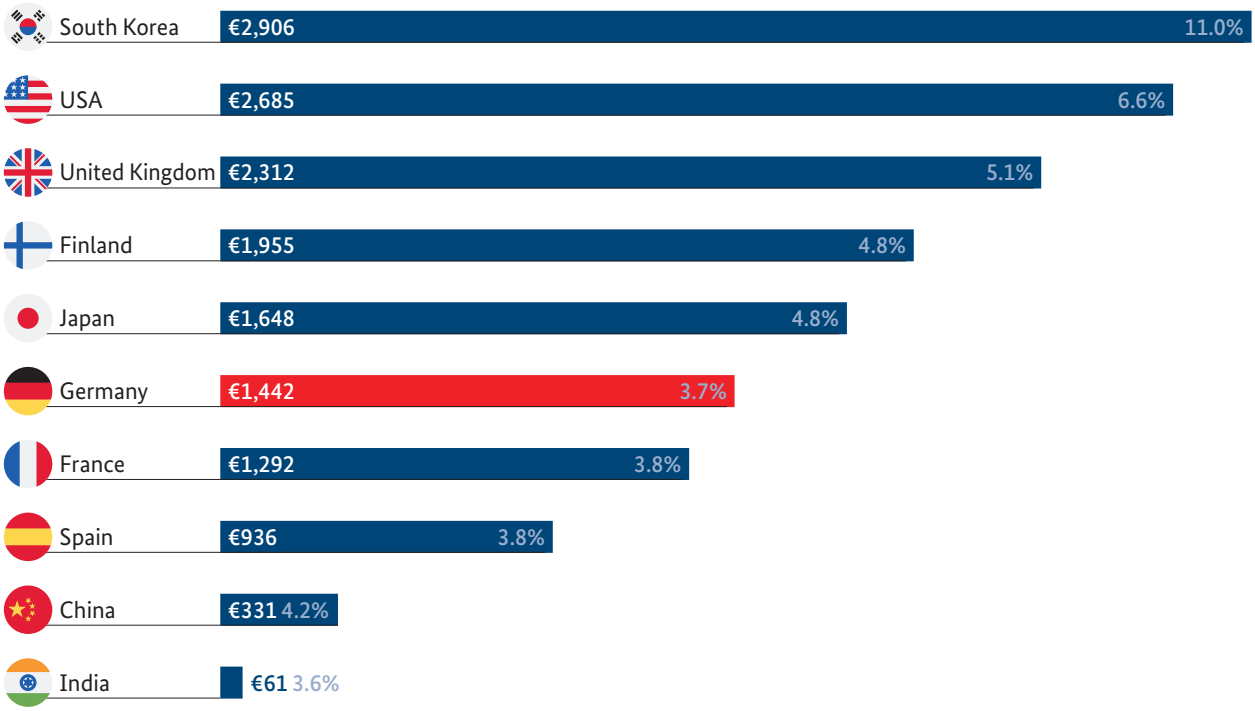
The online economy is growing - nationally and internationally

Online revenue has increased by €10 bn in Germany

The online economy is growing significantly
The online economy grew significantly in 2017 compared to the previous year and now has a turnover of €119 billion. That is around €10 billion more than in 2016. Measured in terms of gross domestic product (GDP), the revenue of the online economy accounts for 3.7% of all revenues in Germany.

South Korea leads the international comparison
The revenue generated via the internet - an indicator used in the DIGITAL Location Index (see page 12) - increased in 2017 in each of the 10 markets analysed. The country rankings remained unchanged from the previous year. South Korea is once again the undisputed leader with per capita revenue of €2,906, around 11% of the country's gross domestic product. Next come the USA (€2,685 in online sales per capita) and the United Kingdom (€2,312). Germany is in 6th place and is in the middle of the pack together with Japan and France. In Germany, €1,442 per capita is spent on internet-based goods and services - about half as much as in South Korea. China (€331) and - far behind - India (€61) are bringing up the rear in the country ranking. The figures calculated by ZEW Mannheim are based on spending on e-commerce hardware, data services, applications, IT services, online content and online advertising. In Germany, mobile and fixed internet access accounts for the largest share of per capita revenue (€518). This represents a slight decrease (down 4%). As all the other subdivisions of the online economy - in particular e-commerce - are growing, the German online economy has been able to compensate for the decline in revenue from internet access.

Germany's online economy is ranked sixth based on per capita revenue

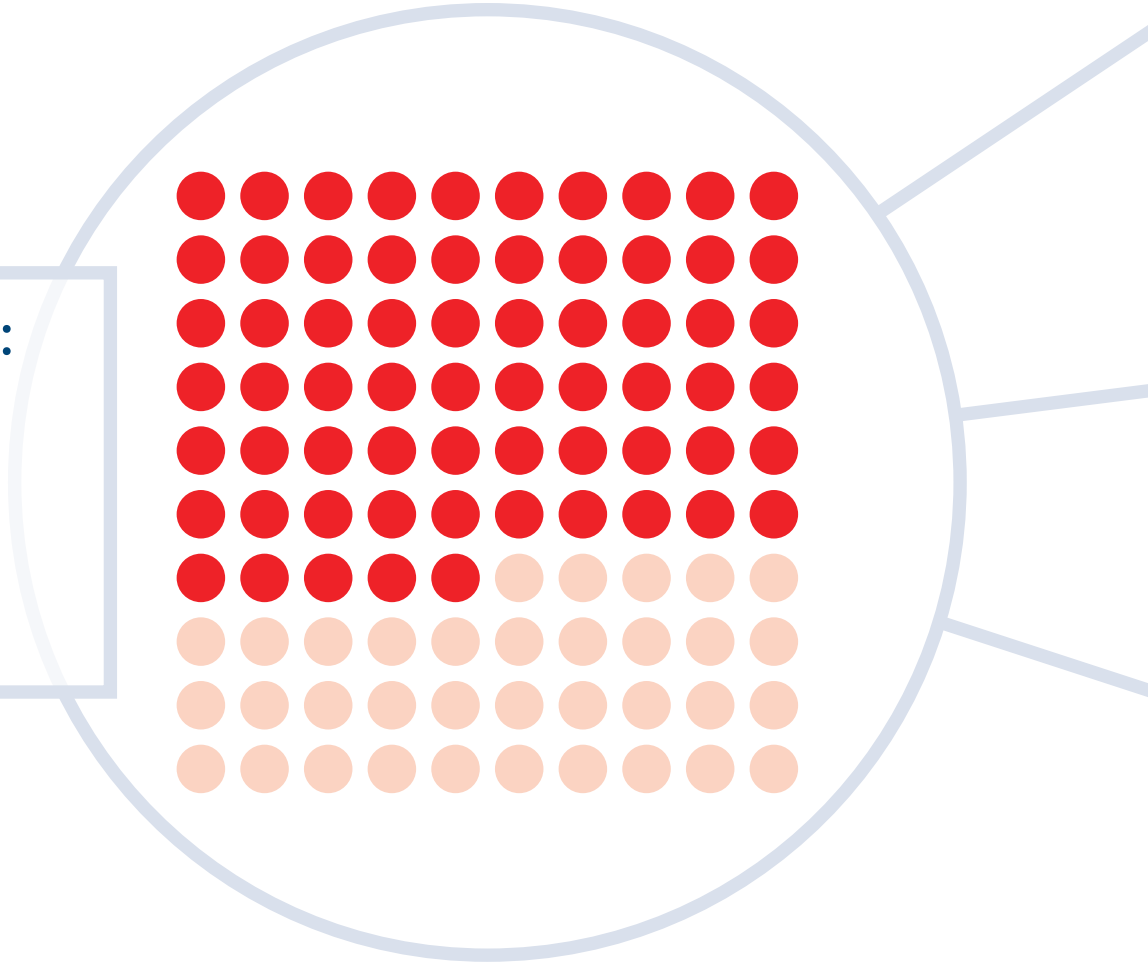


Online industry per capita revenue in 2017 and its percentage share of gross domestic product. In Germany, €1,442 per inhabitant was spent on internet-based goods and services in 2017, which is 3.7% of the country's gross domestic product. Source: 2018 ZEW calculations.

DIGITAL Location Index: Results for Germany at a glance

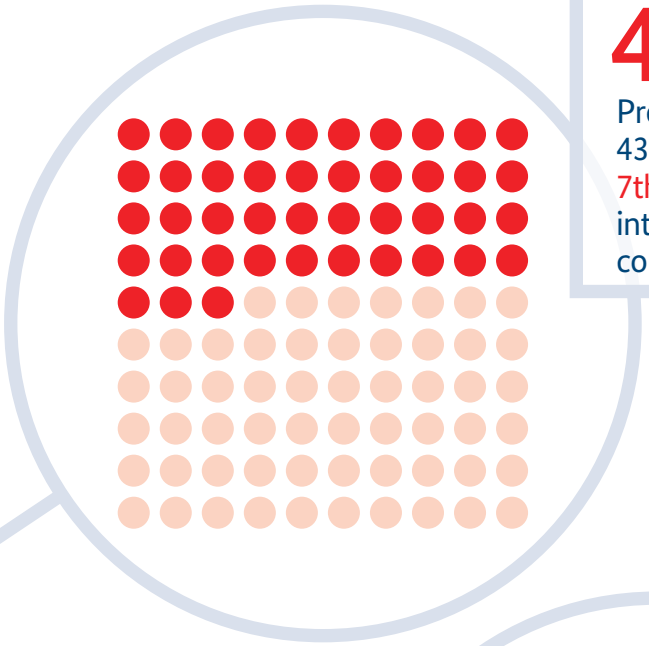
In 2017, Germany scored a total of 65 out of 100 possible index points in the DIGITAL Location Index. This means that Germany improved its overall performance by one place in comparison to the previous year, moving up to fifth place. The DIGITAL Location Index sums up, in an index score, the conditions available to a country's digital economy. These framework conditions are crucial for determining the potential for growth offered by the ICT and online sectors - both subdivisions of the digital economy - in each country.

The study looked at China, Germany, Finland, France, the United Kingdom, India, Japan, Spain, South Korea and the USA. For the DIGITAL Location Index, 45 core indicators are collected for each country and together these indicators give an overall picture of the performance of the digital location. It can be divided into three main areas: market strength (success and performance of the digital economy), infrastructure and other framework conditions, and the use of technologies and applications. The 45 core indicators in the long version of this report can also be compared individually.



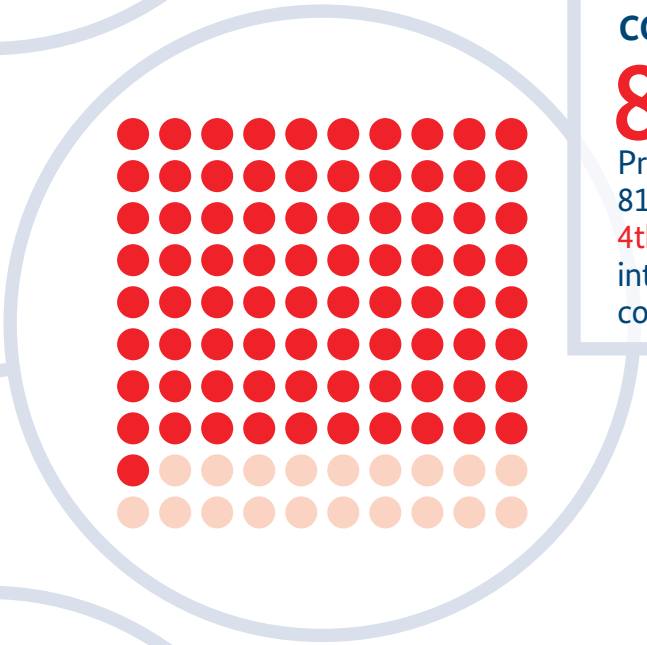
Index (total):
65 points

Previous year:
64 points,
5th place in the international comparison



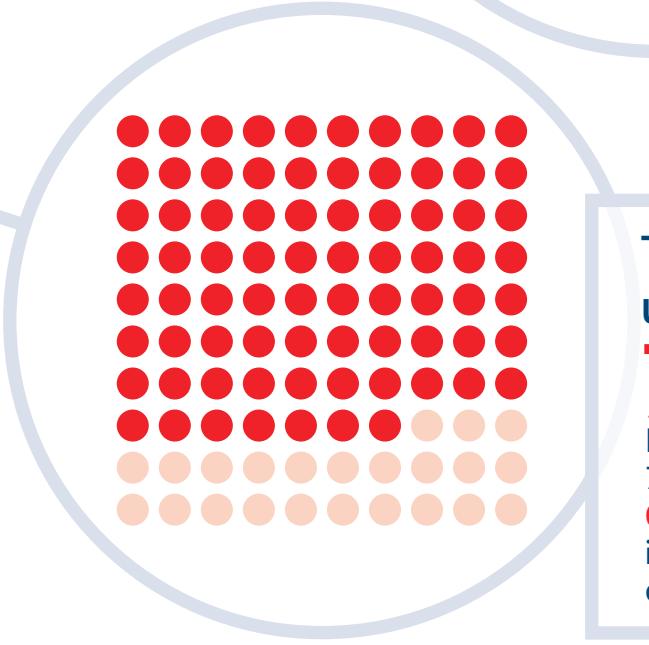
Market strength: 43 points

Previous year: 43 points, 7th place in the international comparison



Framework conditions: 81 points

Previous year: 81 points, 4th place in the international comparison



Technology use: 77 points

Previous year: 76 points, 6th place in the international comparison

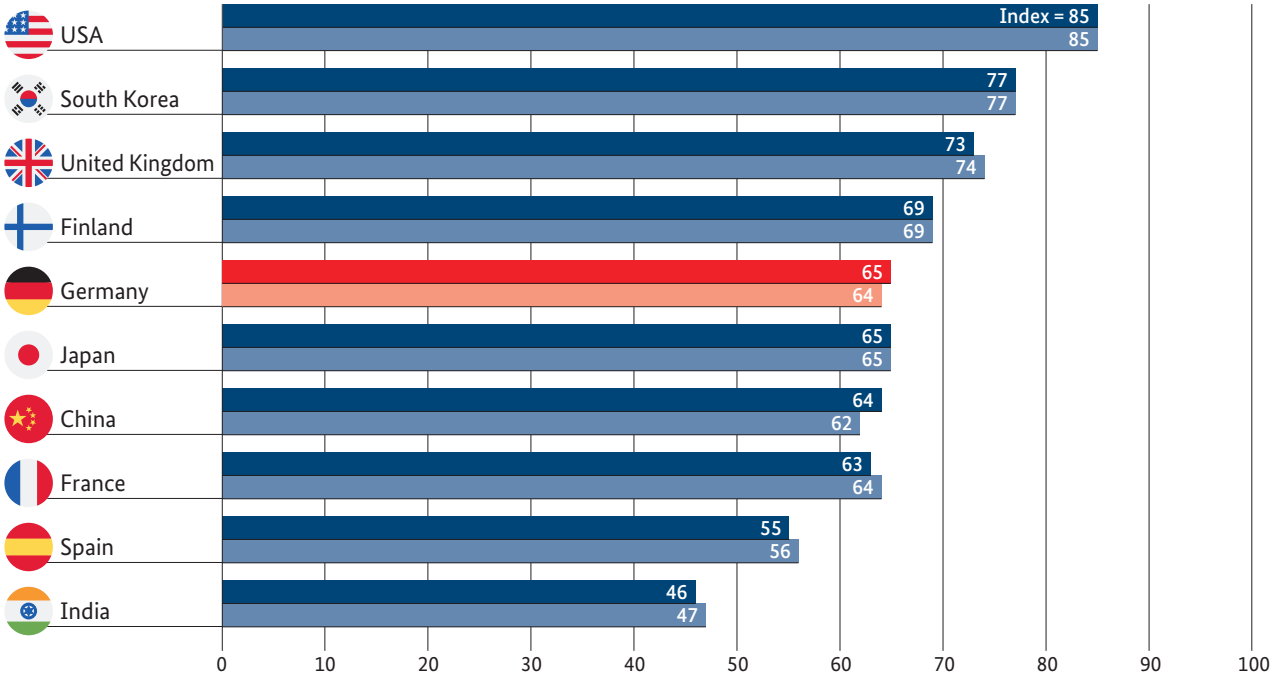
Improved Framework Conditions for the Digital Economy in Germany

Germany improves one place in the Digital Location Index

The size of a country's future digital growth opportunities depends largely on the conditions for companies in the country. The DIGITAL Location Index combines these framework conditions into a single score for global performance.
Forty-five core indicators from each of the ten countries considered - China, Germany, Finland, France, the United Kingdom, India, Japan, Spain, South Korea and the USA - were researched, analysed and calculated for the index. All the indicators can also be looked at individually.
To make it easier to compare the results, the best location in each ten-country comparison was awarded 100 index points. The other countries are then scored relative to this "best in class".

In 2017, Germany scored a total of 65 out of 100 possible index points in the DIGITAL Location Index. As a result, Germany did not just improve by one index point compared to the previous year, it also moved up a place in the country ranking.
The USA continues to lead the ten-country comparison with 85 points. South Korea has successfully defended its second place from the challenge of Great Britain, which is third, having lost a point compared to last year. China has improved by two index points and has leapfrogged France into eighth place. India is at the bottom of the ranking with 46 points.
The DIGITAL Location Index is essentially based on three pillars: market strength (see page 15), infrastructure and other framework conditions (see page 16), and the use of digital technologies and applications (see page 17).

Overall performance in the DIGITAL Location Index: Germany moves up to 5th place



Evaluation of countries with regard to the conditions they provide for the digital economy (in index points). The overall score is based on 45 indicators. Source: Kantar TNS. ■■ = 2017, ■■ = 2016.

The USA leads the ten-country ranking of market strength by a considerable distance

Market strength is a key factor for a location's success and performance. In the "market strength" category, the DIGITAL Location Index brings together indicators of supply and demand, revenues and exports in a country's digital economy (see box).

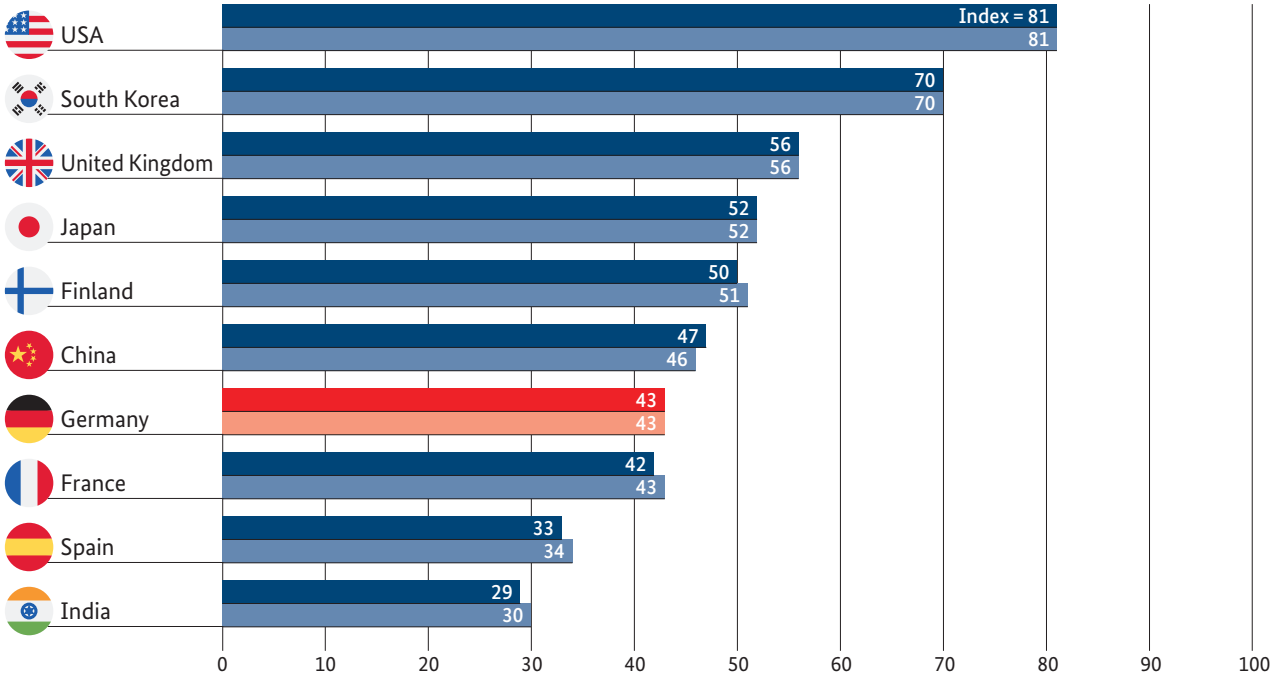
The USA continues to dominate here with a large lead over South Korea, which in turn has a clear lead over the United Kingdom.

Germany's market strength is stable compared to last year (43 index points), which gives it seventh place in the country ranking ahead of France and Spain. Germany performs below average in two key telecommunications (TC) areas. It can only manage ninth place for telecommunications revenue growth and telecommunications spending.

Market strength indicators (sources)

- IT revenues (EITO, European IT Observatory)
- TC revenues (EITO)
- IT revenue growth (EITO)
- TC revenue growth (EITO)
- ICT exports (World Bank)
- Online economy revenues (ZEW)
- Output (ZEW)
- Gross value added (ZEW)
- Internet service provider revenues (PwC/EITO)
- Share of online advertising (PwC)
- IT spending (EITO)
- TC spending (EITO)
- Gross fixed capital formation (ZEW)
- People employed (ZEW)
- Per capita ICT spending (EITO)
- E-commerce-spending (Euromonitor)
- Spending on online content (ITU International Telecommunication Union/PwC)

Market strength in the DIGITAL Location Index: USA and South Korea dominate



Evaluation of the individual countries' market strengths (in index points). Source: Kantar TNS. = 2017, = 2016.

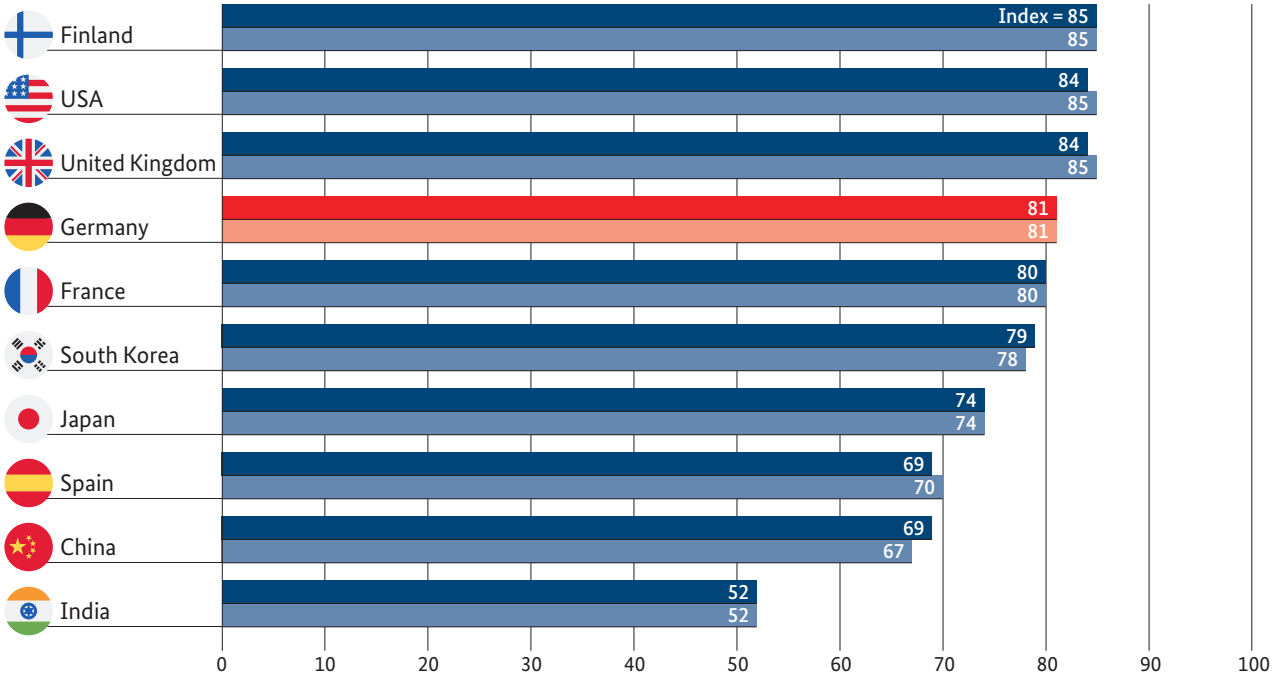
Infrastructure and other framework conditions: Germany is in fourth place

This section of the DIGITAL Location Index analyses how well developed each country's infrastructure is. The framework conditions for the digital economy are also recorded. In this aspect, Germany achieves a very creditable fourth place. Germany as an ICT location even takes first place for two infrastructure indicators. In terms of innovative capacity, the World Economic Forum (WEF) rates Germany as the best performer in an international comparison, ahead of the USA in second place and the United Kingdom in third. Germany is also the leader - together with Finland - in terms of computer penetration. When it comes to the availability of venture capital, Germany has improved to a very good second place. As expected, the USA is in first place. Finland has been replaced in second place by Germany and is now in third. In terms of the procurement of cutting-edge technologies by the public sector, Germany has had to give up its position at the top to the USA but is still in second place. According to an expert survey conducted by the World Economic Forum (WEF), Germany is below average when it comes to companies' willingness to undergo a digital transformation.

Indicators for infrastructure and other framework conditions

- Internet access (ITU)
- Broadband provision (ITU)
- Use of computers (ITU)
- Use of tablets (PwC)
- Mobile phone penetration (ITU)
- Smartphone penetration (PwC)
- ICT patents (EPO, European Patent Office)
- Innovative capacity (WEF, World Economic Forum)
- ICT start-ups (Bisnode business information)
- Readiness for digital transformation in companies (WEF)
- Science education (IMD, International Institute for Management Development)
- Digital and technological knowledge (WEF)
- Venture capital (WEF)
- Investment in telecommunications (IMD)
- Regulatory support for new technologies (IMD)
- Legislation promoting science (IMD)

Infrastructure/framework conditions: Germany in a good fourth place



Evaluation of countries with regard to the conditions they provide for the digital economy (in index points). Source: Kantar TNS. ■■ = 2017, ■■ = 2016.

Germany has traditionally been weak in terms of the percentage of ICT exports as a share of all exports. However, this is not due to low ICT exports, but rather to the fact that Germany's total exports are very high. Germany comes out better - it is in third place in each case - when it comes to mobile penetration and broadband coverage up to 10 Mbit/s - but is lagging behind when it comes to faster speeds. Germany also ranks third when it comes to the population's digital and technological knowledge.

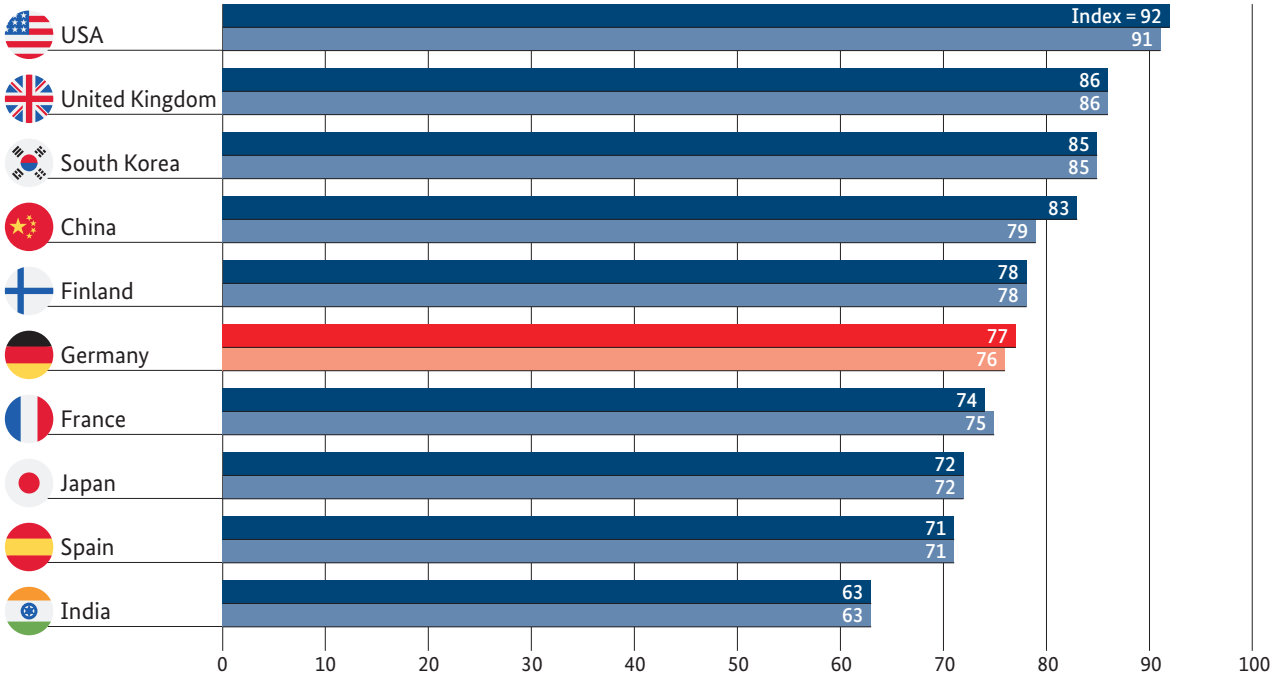
Anchoring new technologies is a prerequisite for the success of a digital location

The extent to which new applications and technologies are already widespread amongst the population, amongst businesses and amongst the public sector is the final significant factor influencing the DIGITAL Location Index. This factor provides an overview of the state of the digital transformation in society and shows the extent to which citizens are already benefiting from technological advances in the digital economy. Here, Germany is in the middle of the pack. The USA leads again. With regard to the use of technology, the developments in China are impressive. The country improved from 79 to 83 index points.

Indicators for technology use

- Internet use (ITU)
- Mobile internet use (PwC)
- E-commerce users (Kantar TNS)
- Music downloads (PwC)
- Use of social networks (Kantar TNS)
- Use of apps (PwC)
- Online videos (Kantar TNS)
- Use of online banking (Kantar TNS)
- Use of digital applications and technologies by companies (IMD)
- Use of big data and analytics by companies (IMD)
- E-government (UN)
- Procurement of cutting-edge technology by public administrations (WEF)

Technology use in the DIGITAL Location Index: Germany is in the middle of the pack



Evaluation of countries with regard to their use of new technologies and applications (in index points). Source: Kantar TNS. ■■ = 2017, ■■ = 2016.

About the study

Contents:
The 2018 DIGITAL Economy Monitoring Report looks at two key topics. Firstly, it describes the "importance of the digital economy", which includes the ICT sectors and online economy, in Germany. Secondly, the study allows us to measure the performance of the German digital economy in an international comparison by using the DIGITAL Location Index. The results of both parts of the study, based on numerous indicators, form an ideal basis for evaluating the current status quo and working out options for future action aimed at strengthening Germany as a digital location.

Institutes:
Kantar TNS
ZEW Mannheim

Data collection:
Kantar TNS carried out an international secondary analysis in Germany and nine other countries that are very relevant to Germany in terms of how it should act. The ZEW Mannheim performed an exclusive additional analysis based on its own studies as well as a sector profile with key figures for the ICT sector in Germany, and calculated revenues from the online economy in ten countries.

Economic Importance of the Digital Economy

In order to determine the importance of the digital economy for the economy as a whole in Germany, several official sources (such as Eurostat and Destatis) as well as private data (e.g. from the ZER's Mannheim Innovation Panel) were consulted and analysed. In addition to the classical key economic data (such as revenue or gross value added), factors such as innovative strength and the number of business start-ups were also important factors in this analysis. Results are available for both sub-sectors of the digital economy - the ICT sector and the online economy:

ICT sector
The information and communication technology sector consists of the ICT hardware and ICT services (including software development) sub-sectors. Its definition is based on the official OECD definition, which means that ICT retail trade and the repair of data processing and telecommunications equipment is not included.

Online sector
The online economy consists of the following areas: hardware, e-commerce, data services, internet-based applications and IT services, online advertising, and online content (video games, video streaming and digital music). Total revenues are calculated based on spending by private households, businesses and the public sector on these goods and services.

Innovation
The ICT sector's innovation performance is shown for the sector as a whole and for the two sub-sectors ICT hardware and ICT service (including software). The chemical and pharmaceutical industry, mechanical engineering, automotive industry, other manufacturing, energy and water supply, wholesale trade, transport and logistics, financial and insurance service providers, and knowledge-intensive service providers are used as comparison industries. The German innovation survey, a representative survey of approximately 35,000 companies, is used as the basis. A multi-indicator approach, which reflects the input and output of innovation processes and how widespread innovation activities are amongst ICT sector companies, has been used to describe the innovation performance of the ICT sector in Germany.

Start-ups
Start-ups are defined as all companies that represent the starting of a business activity that was not previously performed. Reorganisations or the establishment of holding commercial enterprises due to a relocation or commercial enterprises in secondary employment, registration of a fictitious business names and fictitious self-employment are not considered start-ups. The ZER's Mannheim Enterprise Panel (MUP) is used as the basis. The number of start-ups according to the MUP figures are slightly below the start-up figures according to the official commercial register.

DIGITAL Location Index

Definitions and bases
The DIGITAL Location Index gives each country a score based on the performance and economic importance of its digital economy. It analyses the performance of the German digital economy compared to other relevant international markets:

- Global market leaders: USA and South Korea
- European market leaders: United Kingdom and Finland
- Other comparable European markets: France and Spain
- Asian growth markets: China, India and Japan

The index includes 45 core indicators collected through secondary research. The indicators can be divided into three sub-sectors, namely market, framework conditions and technology use:

Subdivisions
Market: The performance of the digital economy in the market strength and attractiveness segments is evaluated in this sub-sector. Market strength (revenue, share of the global market and growth trend) is a key indicator of a location's success and performance. In order to be able to measure the digital economy, we have analysed the revenues of the online economy as well as those of the ICT sector. Amongst the criteria surveyed are: export strength compared to other industries, customer investment, and demand for digital economy services.
Framework conditions: The transmission and use of digital content, applications and services is only possible if there is suitable infrastructure. Technical infrastructure is a key requirement for the digital transformation of business processes and models. This subdivision analyses how well developed this infrastructure is, both in terms of hardware and in terms of the networks, in each country and how the security of investment in networks is assessed by experts. In addition, there are general framework conditions, such as: innovation. education and training, or the availability of a skilled workforce.
Technology use: This subdivision analyses the use of new applications and technologies by private individuals, companies and the public sector. The level to which people use these applications and technologies show how far advanced the digital transformation of society is. The use and exploitation of innovative applications and technologies by companies and their openness to digitisation processes are other factors critical to success. This also applies to the digital transformation of the public sector.
Calculation method
The data on the individual core indicators, which was researched or collected through surveys, is converted into index values. This makes it possible to compare and aggregate the data for the individual core indicators from different sources and with different units of measurement. In this way, the performance of the selected locations can be converted into a single score and, therefore, be compared. All the indicators are weighted to take account of the interdependencies between them when aggregating them into sub-indices and the overall index. This weighting enables the prioritisation of the sub-sectors that the location evaluation is based on. This weighting was determined through discussions and workshops with experts.

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