

# Global.

# Innovative.

# Fair.

*We are creating  
a digital future.*

**Fast  
networks**

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4.0**

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Education**

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# Preface

**Dear readers,**



the Digital Revolution takes place everywhere. Technology is developing rapidly, changing how we communicate, work, learn and live. It is opening up new opportunities for better quality of life, more efficient economic management and new business models.

Both professionally and in personal use, computers, tablets and smartphones accompany us around the clock and connect us to the entire globe. Even today more than 20 billion devices and machines are interconnected – and by 2030 this number will increase to one-half trillion.

Digitalisation drives innovation and participation, and provides enormous opportunities to society and business. However, it is also one of the biggest challenges of our time – and we must tackle it globally.

For this reason, the German Federal Government has put digitalisation at the focus of its G20 presidency. The Group of 20 – a partnership of the 19 most important industrialized and emerging market economies and the EU – is the appropriate forum for paving the way to making digital progress available to as many people as possible. We must have the right framework to be able to do this: strong infrastructure, digital education, harmonisation of norms and standards – for Industrie 4.0, for example – fair competition in the market, support for startups and SMEs, and guidelines for transparency and security.

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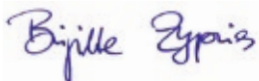
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Germany has the presidency this year, and in addition to the G20 summit of heads of state and government in Hamburg in July, there will also be a meeting of the G20 Digital Ministers. This will take place on April 6<sup>th</sup> and 7<sup>th</sup> in Düsseldorf, on the topic “Digitalisation: Policies for a Digital Future”. We aim to agree on a mutual work program, important digital development strategies and specific steps on how to achieve this. Three major topics will be the focus of discussions and consultations:

- Using the opportunities offered by digitalisation to enhance growth and employment.
- Connecting industrial value-added to digital networks
- Strengthening confidence and enhancing transparency in the digital world.

The digitalisation process must include everyone, in order to become a successful global model – across all age groups and social levels, from small craft businesses to corporations, from developing countries to industrialized economies. This publication demonstrates how the digital transformation will specifically take shape in our daily lives, what opportunities it offers and how we can successfully implement it – that is, where we need to take action.

Yours sincerely,



**Brigitte Zypries**  
Federal Minister for Economic Affairs and Energy

# Fast Networks Pave the Way to a Gigabit Society

There can be no digital progress without fast Internet. That is why Germany is working hard on expanded broadband access. However, digitalisation must also be put in a global context and implemented globally. A weak digital infrastructure is a barrier to growth, development and social participation in progress.

Streaming videos, doing banking transactions online, shopping on the web – this has become very commonplace for many people, especially urban residents. However, streaming a television show or making a bank transfer online in rural areas can be a frustrating experience: instead of a favorite series, news program or account update, often the only thing visible on the screen is the loading icon.

## Digital rutty roads in the country, Motorways in the city

A nuisance at home, such inconveniences can become a very real business disadvantage. Small and medium-sized businesses in rural areas are cut off from progress if they do not have access to fast Internet. For example, they cannot conduct video conferences with business partners or access data in the Cloud. What's more, downloading large volumes of data takes hours instead of a few seconds.

The situation in the cities is much better. Speeds of at least 50MBit/s have become standard. Urban data highways and rural digital ruts together achieve an average data rate of only 13.7MBit/s – putting Germany in 26<sup>th</sup> place internationally.

Obviously, there is much room for improvement, and the Federal Government has created a package to fill this gap: it has provided 4 billion euro for broadband expansion since the end of 2015. The goal is to enable all of Germany to surf the Internet at speeds of at least

50MBit/s by 2018. This could succeed: more than 70% of all households already have access to a fast broadband connection, and supplying the remaining 30% is a high-priority project.

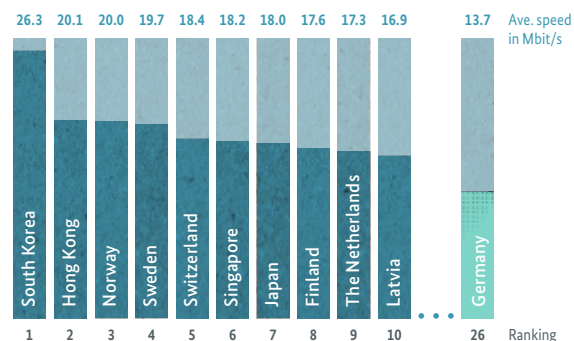
## Broadband networks today, gigabit networks tomorrow

Broadband connections can only be an interim step. Even today it is obvious that we will need much higher speeds in the future in order to take advantage all of the new digital services being offered. In particular, the Internet of Things relies on fast and absolutely reliable networks – both on the ground and mobile.

For example, autonomous driving: even the best sensors and cameras on the vehicles cannot predict an accident beyond the next curve in the highway. However, if all vehicles were connected to strong mobile

## Internet in Germany: still not fast enough.

In a ranking of countries with the fastest Internet, Germany is currently only No. 26. South Korea is number one. But even in Europe, many countries surf faster than Germany (Status: Q3 2016).



Source: <https://de.statista.com/infografik/1064/top-10-laender-mit-dem-schnellsten-internetzugang/>

networks, they could inform each other in fractions of a second about the accident and brake in time. Or, to provide an example from e-health: in the future, patients will be able to consult with their doctor by video for follow-up care or monitoring. This saves travel time and unnecessary waiting in doctors' offices. Stroke patients in rural areas can also profit from specialist doctors who join the team in the emergency room of a hospital by videoconference to assist the on-site doctor. Within minutes the best possible treatment can begin – provided there are powerful networks that assure disruption-free communication.

This and many other applications are made possible by gigabit networks with speeds of over 1,000MBit/s – using fiberglass cables underground, and mobile networks equipped with the future standard 5G. The Federal Ministry for Economic Affairs and Energy (BMWi) actively supports measures to create such gigabit networks nationwide in Germany by 2025. It is not enough to have good networks in Germany – they must be top-notch. This is the only way for our economy to remain competitive. And it also provides people the opportunity to benefit from digitalisation.

### Once around the entire globe

A national approach is much too limited. Not only are private persons often in contact with friends around the world, but also companies, who increasingly collaborate on an international level. To make the digitalisation of the economy and society a global success, the German G20 presidency has set a clear goal: all G20 countries should agree to connect all of their households and companies to fast Internet by 2025. This will require additional public and private investment.

Together with the other G20 countries, we must therefore ensure that global economic growth and social participation are not hindered by a lack of fast networks or access to the Internet.

In addition to fast networks, the new Internet protocol IPv6 must be introduced globally to create a powerful digital infrastructure. We want to make IPv6 a priority in the G20 digitalisation process.

It takes  
18 minutes to upload  
**200MB** of  
photos at 1.5Mbit/s,  
but less than  
one minute at  
**40MBit/s.**

Source: PC-Welt: "Benötigte Bandbreite fürs Video-Streaming und für Uploads" (Required bandwidth for video-streaming and uploads), July 2016



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### What actually is IPv6?

In order for billions of devices – from refrigerators to cars to 3D printers – to communicate with each other in the Internet of Things in the near future, new Internet protocols are necessary: so-called IPv6 protocols. To put it simply, these are addresses used for sending “digital mail” to any user and any object in the Internet. IPv6 makes 600 quadrillion IP addresses accessible to every square millimeter of the earth.

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# Ensuring Fair Competition

**The digital transformation is opening up a multitude of new products, services and business models. This enhances competition, but also turns traditional market mechanisms upside down.**

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## **SMS and messaging services – still not a level playing field.**

More and more people are using messaging apps instead of SMS text messages to communicate. Almost 700 million messages are sent per day in Germany using WhatsApp, whereas in 2015 only about 40 million SMS messages were sent. The problem is that the market leader WhatsApp expressly does not want to play by European rules, according to its terms and conditions. Accordingly, anyone using WhatsApp accepts the conditions of use, which means the user allows their data to be transmitted to the USA, and accepts Californian law as governing law. On the other hand, the SMS providers – the telephone companies – are subject to the respective national laws. However, a level playing field means that the same rules should apply for customer protection, data protection and security, regardless of which is used – SMS or a messaging app.

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New glasses? Only a few clicks away: with virtual screen mirrors and a selection of trial glasses by mail, online opticians provide services similar to the comprehensive services of specialty stores. Comparison portals filter out the largest selection of models, the most reasonable conditions, the quickest delivery times and the various ratings. The advantage for the consumer: from a number of offers, he or she selects the most suitable offer. This works equally well for new glasses, insurance, vacation trips, repair work and innumerable other products and services.

No question, digitalisation has had an enormous effect worldwide on competition – to the benefit of consumers. They have a nearly unlimited selection of products and services from all over the world – tailored to individual taste and reasonable in price. Finally, digitalisation allows for innovative technologies, products, services and business models. Using the Internet, young startups and established companies alike can open up new markets, both domestically and internationally, without being physically present in those markets. This in turn has a positive effect on productivity, efficiency and economic success.

## **Data and users – it's in the numbers**

At the same time, digitalisation has given rise to offers and business models that follow their own market logic. Platforms are places like local market places in towns used to be. These global online market places provide a place for people and companies to meet, both from the neighboring areas, but also from opposite ends of the earth, to exchange goods, services and information. Anyone can offer and order services and products on these types of platform, cheaply and without effort. This is the basis for the sharing economy, as evidenced by Uber and Airbnb. Yet even social networks, online retailers and search engines – such as Facebook, Amazon and Google – are also digital platforms.

The basic maxim of the digital platform economy is: the bigger the platform, the more information it can provide, and the more attractive it is for customers and vendors. So-called network effects play a decisive role: that is, the benefits increase with each additional user. In other words, just as a telephone only makes sense when many people can use it to communicate with one another, a social network becomes more interesting when a growing number of people use it for networking. The consequence is that large platforms almost automatically become even larger. This can be beneficial for users. The more his or her contacts use the same instant messaging service, the simpler communication becomes. On the other hand, this kind of market concentration leads to users – both consumers and businesses – becoming more and more dependent upon large players. Smaller competitors of these large, dominant platforms usually remain small or disappear altogether, according to the principle “The winner takes it all”.

### Government policies must create a fair environment

The Federal Government has already responded to the new economic situation in digital markets and has modernized the Act against Restraints of Competition. This amendment aims to provide greater protection from abuses by dominant market players and effective merger control.

However, unilateral national initiatives are not sufficient in the age of the digital platform economy. Our goal is to achieve a consensus among the G20 countries regarding applicable regulatory frameworks that will allow all companies a fair opportunity to participate in the market. Companies need a level playing field on which the same rules apply for all participants, just like in sports, enabling fair play.

On the other hand, too much in-depth regulation could bear the risk of slowing down the fast pace of technological progress. Decisive for the global digital economy is a framework that provides legal certainty and yet is flexible and innovation-friendly.



Currently,  
**six** of the **ten**  
most valuable companies in the world are digital platforms.

Source: Bloomberg, Roland Berger



# Industry 4.0: The Digital Revolution in Manufacturing

**Digitalisation is fundamentally changing industrial production: machines communicate with one another, processes organize themselves, individual customer preferences can be implemented in the manufacturing process. Industry 4.0 is shaping and changing our economy.**

Windows close automatically before it starts raining, heating units adjust room temperatures to the daily rhythms of occupants, automobiles automatically reduce their speed near schools and garbage containers send signals to municipal authorities that they are full – this is the Internet of Things. This is the capability of each device to communicate with the Internet and other devices using modern information and communications technology. A digital revolution with substantial implications – for our personal lives, our daily work, and also for the way in which companies communicate, now and especially in the future. The Internet of Things is also the basis for Industry 4.0 and smart manufacturing.

Industry 4.0, the Industrial Revolution and Digitalisation of Industry are catchwords for this development. What they mean is the melding of the physical world of machines and plants with the digital world of bits and bytes. Production is integrated with information and communication technology: working conditions improve, and new jobs and innovative business models are created.

## **Mass production with high quality standards**

Musli with quinoa instead of oatmeal, cranberries instead of raisins, and absolutely no nuts? Up until recently consumers had to look long and hard for the right product, or buy the individual ingredients and mix them by themselves, in order to satisfy their special wishes. Today the consumer can order their favorite cereal combinations online and cheaply at home at their computers – the same goes for configuring jogging shoes, customizing furniture or ordering sports articles manufactured by 3D printers. Industry 4.0 combines the advantages of mass production with the special requirements of custom manufacturing. This has an enormous impact on productivity, customer loyalty and competitiveness.



**€153 bn.**

in economic  
growth attributable

to Industry 4.0

by **2020.**

Source: BMWi study: Industrie 4.0. Volks- und betriebswirtschaftliche Faktoren für den Standort Deutschland (Industry 4.0. Economic and Business Factors for Germany as an Industrial Location), 2015



German companies are in the lead internationally in this regard and are very competitive. They are familiar with customer demand and are leading in Industry 4.0 technologies. The Federal Ministry for Economic Affairs and Energy provides a significant contribution to digital transformation of manufacturing with its Platform Industry 4.0, one of the world's largest networks of companies, government, trade unions and research institutes.

### Important prerequisites: norms, standards and interoperability

In order for individual components such as machines and sensors to communicate with each other in the Internet of Things, reliable interfaces are absolutely necessary. This interoperability – that is, independent systems and technologies are capable of working together seamlessly – requires us to introduce uniform international norms and standards. Machines must be able to communicate cross-border, so that companies can manufacture globally.

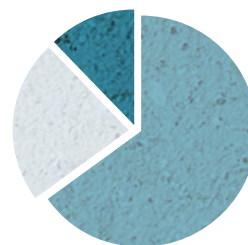
For this reason, Germany is using its G20 presidency to forge an international consensus on norms and standards for four central topics: Industry 4.0, IT security, smart cities and smart mobility. This also includes involving the G20 countries in defining important principles of international standardisation, such as interoperability and transparency. The global Internet of Things can only function if everyone agrees on uniform international frameworks and interoperable solutions.

### What is a smart factory?

In a factory 4.0 machines autonomously coordinate manufacturing processes, service robots work together with humans in smart assembly steps, driverless transportation vehicles handle logistics tasks. In addition, tools, machines or transportation means are outfitted with digital “eyes and ears” (sensors) as well as “hands and feet” (actuators) and controlled using central IT systems. In this manner, smart transportation containers can transmit by radio link information regarding their contents and their current location in the factory. This relieves the workload for production and logistics.

### Industry 4.0 in German companies

Everyone is talking about Industry 4.0 – but what does it look like in practice? A survey showed that 56% of those surveyed already use or plan to use specific Industry 4.0 applications.



■ Use or plan to implement special applications (65%)

■ Could imagine using such applications (23%)

■ Not applicable (12%)

Source: Statista, according to Bitkom Research



# Protecting Personal Data in the Free Internet

In the digital age, data has become more valuable than ever before. New business models are continuously being created that use personal data to provide customized services and to simplify our lives. However, data protection and informational self-determination may not be left by the wayside. That is why we need rules that provide security to users, especially in the Internet.

Many online platforms and apps make our lives easier. For example, WhatsApp: instead of communicating with friends individually, you can communicate with all of your friends at the same time. And quickly arrange to meet at a restaurant in the evening for a glass of wine. Such communication creates an enormous amount of data that is collected by messaging services and processed. What happens to the data afterwards is not always traceable by the user. There is only one choice: accept it or not use the service at all.

The guiding principle of informational autonomy should therefore become a greater priority. This means that all users should have more control over when and where they disclose their data. Users could then make their own decisions on the level of protection for their data. And, they will gain a new understanding for the fact that online platforms and apps use their personal data for advertising purposes – as a kind of payment for use of these services, which are usually free of charge.

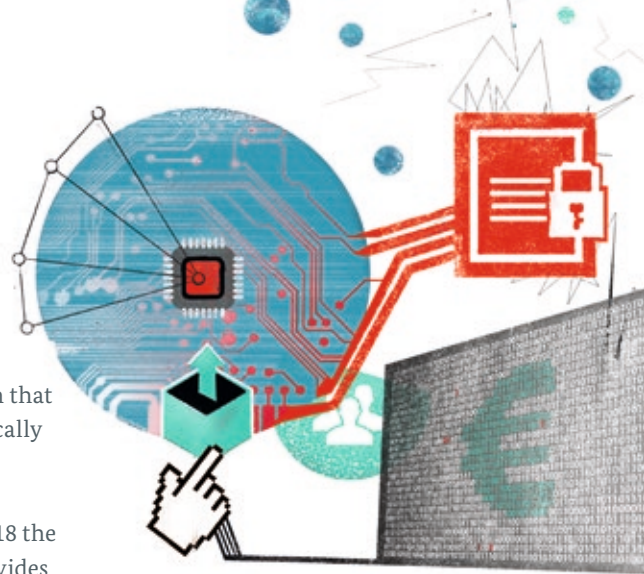
## How can greater informational autonomy be achieved?

To provide greater informational autonomy, both sides must be involved. On the one hand, users must learn to exercise competence and autonomy regarding their data. Digital education is an important building block. On the other hand, companies could offer new forms of consent so that users are even given the opportunity to decide how much of their data they



Each minute  
all over the globe,  
**400** hours  
of videos are uploaded  
on YouTube,  
**216,000**  
photos on  
Facebook,  
and users like  
**2.4 million**  
posts on Instagram.

Source: <https://www.domo.com>



want to reveal. Online platforms and apps can also be designed such that they guarantee the greatest degree of data protection, either technically (“by design”) or using default data privacy settings (“by default”).

Legislators are also involved in informational autonomy. In May 2018 the new EU General Data Protection Regulation will become law. It provides for various improvements that will strengthen the individual’s informational autonomy. This includes the “right to be forgotten”, which has for the first time been expressly written into law: it will become easier for users to delete personal information that has been stored by a company. If a user wishes to “move” from one platform to another, he or she can also exercise the “right to transferability of data” – that is, data portability. Users can for example switch more easily from one music streaming service to another.

### What can the Group of 20 do?

We also want to achieve better data protection standards outside the EU. The public should be able to depend on the fact that its personal data is safe with companies. For this reason, the German G20 presidency will aim to bring about global agreements on protection of privacy and data protection, data security and consumer protection.

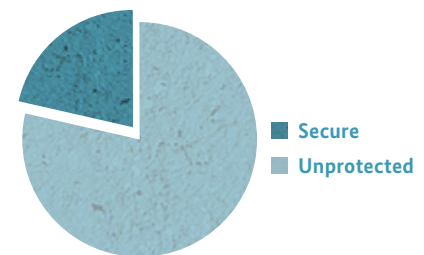
Apart from all of this, the principle of net neutrality must be observed. The Internet may not be censored by any country, turned off or misused for government purposes. Net neutrality creates the foundation for unhindered flow of knowledge, plurality of opinion and a successful digital economy. Each user can express himself or herself freely and gather information at any time, and each company can provide its services worldwide without restriction.

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### Very little trust in data security

Almost 80 percent of Internet users believe that their personal data is not protected in the Internet.

Question: “In general, how secure do you think your personal data is in the Internet?”



Source: <https://de.statista.com/statistik/daten/studie/217842/umfrage/sicherheit-von-persoeneichen-daten-im-internet/>

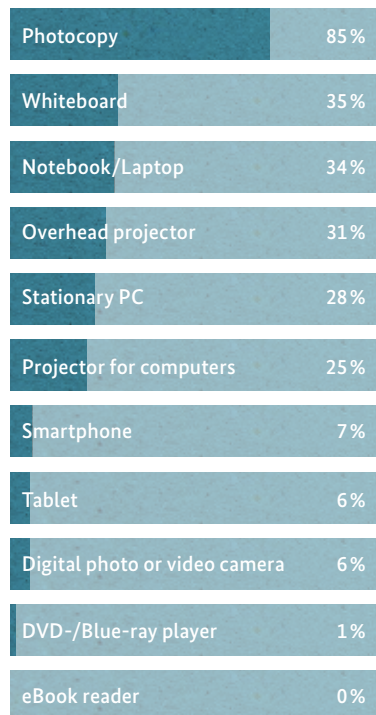
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# New Learning Methods for New Jobs

## Photocopies instead of ebook readers

Digital media is apparently used only infrequently in schools. According to a survey of pupils in Germany, paper copies are used almost daily, tablets only very rarely – and eBooks not at all.

Question:  
"What devices and media are used daily in your classes?"



Source: Bitkom, Study: "Digital school – networked learning", 2015

Digitalisation makes learning opportunities much easier and globally accessible, be it a lecture at a top US university, the latest online tool for app development or an online language class for the next vacation trip. This means greater educational opportunities for people all over the globe – thanks to digitalisation.

It is possible that people of school age today have not yet heard of a job they might take in the future. In only five years there will be jobs that we haven't heard of yet. This makes skills for a successful life in a digital world more important. Knowing how to use social media platforms, video and design programs, create digital content, develop networks, conduct big Data analyses and such complex tasks as software programming and knowledge of robotics: these are skills that will become more and more important in order to be successful in the job market of the future. The foundation for these skills can be learning at play in pre-school, then strengthening these skills in school, and later acquiring in-depth knowledge and specific competency by means of higher education classes, continuing education and on-the-job training.

## Learning about – and with the help of – digitalisation

Digitalisation is making life-long learning possible for all levels of society – and a necessity. However, new teaching content and better equipment in schools and in training is required. There is a lot to be done in this respect. In an international comparison on use of digital devices in schools, Germany ranges in the lowest third. The Federal Ministry for Economic Affairs and Energy (BMWi) has worked out a whole number of recommendations and proposals on digital education. One very important aspect is training for teachers. Often, pupils know more about the latest digital technology than their teachers. According to a current D21 special study, teachers themselves have a similar perception of the situation. Sixty-two percent feel that their own deficiencies in IT skills pose the largest hurdle to digital dissemination of knowledge to pupils – who, as "digital natives" grew up with such things. Vocational schools also need improvement: 40% of the schools have no access to wireless LAN. We therefore see an urgent need to equip vocational schools digitally so that the pupils can receive proper instruction on Industry 4.0.



**3.5 million**

IT experts will be needed in Europe by 2020.

Source: BMWi, Digital Strategy 2025

## Education for all

Digitalisation is pushing a democratic evolution in education. Never before have so many people had access to knowledge. Digitalisation changes the way we learn. Already nowadays millions of people are taking continuing education classes online. They take advantage of YouTube tutorials and online language courses, but also MOOCs (Massive Open Online Courses) at online universities. For example, the Coursera platform has 15 million students. The Khan Academy in the US – free of charge – has already registered more than 500 million video views on YouTube globally.

## Special sponsoring for girls

To increase participation in digitalisation worldwide, we want to use the G20 presidency to create an initiative for supporting digital skills during apprenticeship. It will build on a G20 initiative already under way for improving the quality of teaching. A particular focus is on closing the gap between the sexes in education. Currently, only 24% of all jobs in the field of technology are held by women. The synergies offered by the initiative “eSkills4girls” aims to improve job opportunities in developing countries for girls and women in the digital and technology fields by providing funding for digital education and IT skills.

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## Minicomputer Calliope – Digital training for primary schools

It is barely as large as a hand: the star-shaped minicomputer Calliope mini helps teach primary school pupils how to program. With just a few clicks, children can even write their first programs. Calliope mini can be used for controlling a robot, for example. Children learn at play how circuits, software, sensors and computers work in general. Calliope mini was developed with the support of the BMWi, and is distributed free of charge to third-graders – initially in the Federal state Saarland, where all children in the third grade are given access to a Calliope mini, free of charge. By the end of 2017, pilot schools in all of the German Laender should be equipped with Calliope mini. The goal is to introduce 100,000 of these microcontrollers into the schools by the end of 2017. For more information please see <http://bit.ly/2lul047> and [www.calliope.cc](http://www.calliope.cc).

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# Innovative, Digital, Successful: What is Helpful to Startups and SMEs

## Fast, faster, digital!

Digitalisation is fundamentally changing our economy, and at incredible speed. This affects everyone: the trades, SMEs, startups and industry. The rapid expansion of digital innovation also has an impact.

## This is how long it takes to acquire 100 million users.



Source: OECD, "Key Issues for Digital Transformation in the G20", 2017-03-01

Digitalisation is massively changing our economic structure. Innovative and quick startups drive this trend with new business models. Digitalisation also provides many opportunities for crafts and trade businesses and small and medium-sized companies. This requires assistance and funding so that startups can grow and the small and medium-sized sector is not left behind on the path to the digital era.

Pizza, pasta, Pad Thai-delivery services in the food sector are booming in the Internet age. New business models are continually arising, for example a comprehensive package for amateur cooks: they choose a recipe online, assemble a shopping list with one click and shortly thereafter receive their purchases from the supermarket around the corner.

Even planning construction in the craft trades is done digitally: for example, a plumber can create various designs with a tablet, using special software. The customer gets a realistic picture of his or her future bathroom, and the workman can order the parts from the wholesaler with one click.

New software solutions, Industry 4.0 applications, standardized e-business processes and digital connectivity provide huge opportunities to businesses: enhanced efficiency, better customer service, greater cost savings and entirely new business models.

## Networks and capital for startups

What young companies often lack is capital, especially during their growth phase. This is a task to be addressed by politicians. To assist startups, BMWi provides investment incentives to business angels with programs such as INVEST. It is also important to founders to test new technologies and business areas and to deal with regulatory issues. So-called Real Laboratories with temporary experimentation rooms for limited periods of time and shifting locations would be very helpful.

Digital Hubs such as those currently initiated in Germany bring together German and international startups, scientists, investors and established

companies. In this digital ecosystem, founders benefit from the knowledge and networks of established companies, and they in turn learn about digital innovation first-hand.

### “Hands-on Digitalisation” for SMEs

Whereas startups have recognized the opportunities offered by digitalisation, medium and small business is still reluctant. For more than half of SMEs, digitalisation is not currently part of their business strategy. The reasons are, among other things, lack of technical and digital expertise in the company, or misgivings regarding the cost.

However, technologies such as cloud computing provide many middle-sized companies the possibility of sourcing IT solutions from the Internet. Data memory and applications do not need to be operated by the company or not to the full extent, and only the volume and programs actually used is charged. This saves money and encourages innovative potential and flexibility – if companies know how to tap this potential. Innovative technologies such as 3D printing used for producing replacement parts are often still future dreams.

For this reason BMWi has set up eleven Mittelstand 4.0 Competency Centers throughout Germany that provide “Hands-on Digitalisation” to SMEs. In demonstrations and learning factories small and medium-sized enterprises can gather information on digital applications and innovative technologies, and try out their own new technologies before making any investments.

### How does everyone else do it?

Learning from each other – that is the approach taken by the G20 countries in their global digitalisation initiative. Having individual countries present their best practices and sharing experiences with one another should provide assistance for startups and SMEs and help the G20 countries to start their own national initiatives.

**13.9%**  
of German startups  
were initiated by  
female entrepreneurs,  
a continuation of a  
positive trend in the  
past few years.

Source:  
German Startups Association e.V.,  
Fourth German Startup Monitor, 2016



### Customised furniture

Using your own ideas to design shelves or a bed and having them custom-made? Digital manufacturing makes this possible. Customers design their own furniture on a screen and then the manufacturing data is sent to a furniture manufacturer near the customer. Using digital CNC drills in automated manufacturing processes, the custom piece is produced. This is a win-win situation: the customer gets customised furniture at a good price, and local businesses get commissions that help them finance their expensive machines.



Federal Ministry  
for Economic Affairs  
and Energy



G20 GERMANY 2017

g20-future.digital

*For current  
information on  
the G20 process on  
digitalisation,  
see [de.digital](http://de.digital).*

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