



# Digital Strategy 2025

The diagram illustrates the pillars of the Digital Strategy 2025. The central text 'Digital Strategy 2025' is surrounded by ten interconnected concepts, each represented by a blue banner:

- gigabit optical fibre network
- New Start-up Era
- innovations
- smart networks
- informational autonomy
- data security
- new business models
- digital technologies
- research
- Industry 4.0
- Digital Single Market
- regulatory framework
- Digital Agency
- Digitisation Campaign for SMEs
- digital education

These concepts are interconnected by lines, forming a network around the central text.



# Digital Strategy 2025





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# I. The digital society in 2016 – A Digital Strategy 2025

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Technological progress is the driving force of our society. The innovation and new and continually improving methods and principles that come with it are the foundations of coexistence in modern society. These elements form and shape our communication, our economies, our working environments and our interactions – in the little things and on a wide scale. Technological advances are therefore always accompanied by changes in our world – improvement and steps forward.

Today we are witnesses, participants and designers of these technological advances. Digitisation is already creating an intelligent, information-based, highly productive and interconnected world that only a few years ago was more a remote futuristic vision than a realistic scenario. In recent years, this process has driven creative transformation at a pace never seen before. Previously, technological change was a process spanning generations, and its overall impact was apparent only in retrospect. Today the development of digital technologies and innovations starting from interesting, but still diffuse experiments up to marketable mass products – or even global brands – is a matter of only years or maybe even months.

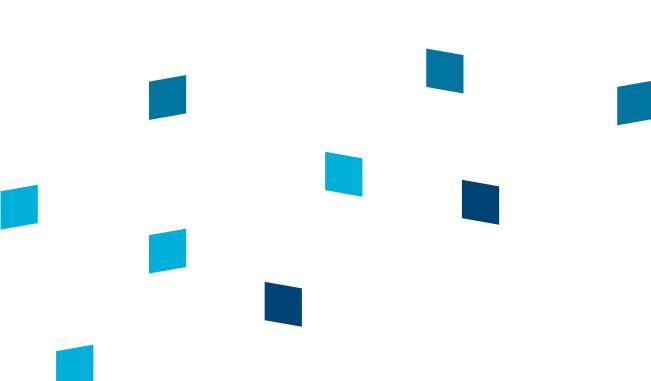
The basic raw material of this digital transformation is data. How data is handled is a decisive factor in the success of modern business. Big Data is one of many buzzwords – a catch-all phrase for today's unprecedented magnitude of data. Data can capture more and more aspects of our everyday lives with increasingly greater precision. Data is more and more frequently a decisive factor for success, for example for product developments of mid-size service providers or in Germany's 7:1 upset in Belo Horizonte, Brazil, on its path to the soccer world championship. In the long run, the key competencies of successful companies will revolve around collecting, processing, linking and protecting data – and the specific measures and

methods these companies develop to carry out these tasks.

The possibilities provided by the digital transformation are not however simply the stuff of economic prophecies and optimistic soccer fans' fantasies of victory, but can rather be expressed in concrete numbers. Germany's GDP could rise by an additional €82 billion if digital technologies and German companies' ability to use them are aggressively pursued. The Internet of Things, that is, the smart connectivity of the myriad of sensors present in physical objects, is slated to provide economic growth of up to US\$11 billion, with the largest share in the area of industrial production.

In the services industry in particular, digital technologies and the accompanying methods have made massive productivity improvements and entirely novel business models possible in recent years. Many sectors, for example music and entertainment or the creative industry, but also areas such as banking and tourism, have all taken more than just initial steps – they have developed new processes and products, have entered new markets and forged new partnerships. A busy German start-up community is embracing digital principles and creating technological and conceptual innovations that can provide substantial advantages to established companies and are open to new ideas. This includes for example customer-orientation of all business processes while at the same time optimising the use of resources, rapid prototyping of innovative concepts, more financial freedom and more generous time frames for investments.

Technological progress that we today consider to be the driver of these developments is far from reaching a final plateau or even slowing down. Today's status quo is the basis for a constant flow of new concepts and methods that will influence entire



sectors of the economy. For this reason, it is important to open up new markets early on, set our own standards and provide an answer to urgent social issues in order to keep up internationally, but also to be at the forefront of this development.

Let's work together to make this possible!

The Digital Strategy 2025 programme demonstrates how the Federal Ministry for Economic Affairs and Energy (BMWi) has been setting priorities in recent years, developing capabilities and using new tools to make a digitised Germany possible. We want to show which areas require immediate action. Our recommendations are intended not only to enable the German economy to respond to new challenges but also to ensure its leading position both in quality and technology for years to come, by combining traditional competitive advantages with the newest technology, modern methods and specific support programmes.

In particular, however, we want to demonstrate that the era of isolated solutions must come to an end. Only by working across organisations, in a network, and in a concerted effort as a community and society, will we be able to find and implement answers to questions arising in the immediate future. Businesses, unions, the scientific community, the government and a motivated public are already developing approaches and projects for the digital transformation in Germany – for DE.DIGITAL. However, regarding digital infrastructure, future work opportunities, data security, future-oriented education and the legal framework, it is high time we all address these aspects together and with goals in mind. We consider this to be the decisive imperative of a digital society – and the logical consequence is to create a connected, intergovernmental organisation – a Digital Agency.

If technological progress is the motor of our society, we should see to it that we have a smart, competent and long-term design for our digital future. Building on the progress already made, we will discuss in the following our goals and options, all of which will certainly extend beyond the current legislative term – as will the digital transformation.

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## **II. Introduction**

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Digitisation is changing the rules. It is causing enormous shifts in business and society, the working environment, consumption, cooperation and communication. And, in digitisation, more than in any previous transformation, the fastest will win. Those who open up new markets early and quickly set new standards will be successful. We must see the digital transformation as a high priority area for political and economic action and develop new answers to the following new urgent issues:

- *How can we create the necessary infrastructures required to even release the potential provided by digitisation and use it? New distribution channels and logistics processes, the Internet of Things, autonomous driving and Industry 4.0 – all of this requires broadband real-time communication in the gigabit range. We must therefore quickly start building an optical fibre network with wide availability in Germany.*
- *How can we continue to develop a regulatory framework based on competition, administrative and cartel law such that digitisation can be a creative and far-reaching process for business, while at the same time ensuring fair competition and strengthening rights of the individual data subject? Regulation must make investment and innovation possible, prevent abuse of dominant market positions, ensure informational autonomy of consumers and guarantee an open Internet. Special services must be made possible, accompanied however by creation of additional network capacities.*
- *How can we encourage and enable entrepreneurial capability and creativity that will fully maximize the possibilities of digital technologies, create new companies and realign established small and medium-sized businesses without hesitation?*
- *How can manufacturing companies, production and value creation processes be radically reorganised and improved so that they can compete with new market players that are not manufacturers themselves, rather have control of customer interfaces and are pushing to the forefront with superior data know-how – such as large IT companies and platforms? Access to customers is becoming increasingly important, even in industrial sectors.*
- *How can we make direct access to customers possible, even in our very heterogeneous service economy where companies are frequently very small? We must avoid creating dependency on online platforms with huge network effects.*

- How can we create an environment in Germany and Europe that will ensure capabilities in information and communications technologies and in software development that will make us less dependent and more competitive? We need our own digital ecosystems comprised of hardware and software. We should not have to be dependent on external digital components, nor should we have to turn our data over to strangers.
- How do we manage training and skill development such that digital evaluation and application capabilities reach a level that can satisfy the quickly shifting requirements of an economy that is driven by information and communication technology and data collection? Jobs and entire professional profiles are affected by digitisation – new qualifications and, correspondingly, new training content are needed. We must react to this challenge with new policies and instruments, especially regarding informal learning in all phases of our working lives.
- How can we finance the necessary technological innovations and the development of new business models? All government research and development expenditures must be at least at the level of the most innovative regions on the globe. Start-ups must be in a position to be able to mobilise the resources needed to successfully introduce new products and services to a global market.
- How can we create an effective management system for the digital transformation in Germany? A task this complex and extensive requires not only a broad-based strategy, but also an independent center of expertise for all issues related to digitisation. A think tank that provides service and advice, coordinates the communication of participants in this process and creates expertise for functioning market structures.
- How do we provide for qualified jobs with good working conditions and codetermination, even as job structures become more and more hybrid? Work 4.0 provides opportunities for more spatial and temporal flexibility. At the same time, there is a danger that the boundaries between work and family or personal life become blurred. Rules on compensation and conditions of employment as well as social insurance systems must be rewritten.

- The German federal government has already implemented a number of important projects and measures in the context of the Digital Agenda. The Federal Ministry for Economic Affairs and Energy has expanded the scope of future areas of involvement.<sup>1</sup> Among other things, the government has successfully auctioned off mobile broadband radio frequencies. In addition, the federal programme for promoting broadband deployment has been set up, over one hundred specific practical examples of Industry 4.0 were introduced at the 2015 National IT Summit, the interministerial programme Smart Networks Strategy (Strategie Intelligente Vernetzung) was initiated, and the funding programme Digital Technologies for Business (Digitale Technologien für die Wirtschaft PAiCE: Platforms | Additive Manufacturing | Imaging | Communication | Engineering) was started. In addition, we assist small and medium-sized businesses in the digitisation process by setting up Mittelstand 4.0 Centres of Excellence.

Meanwhile, the pace of technological change is picking up, and data traffic is rapidly expanding. One of the main reasons for this is the increasing connectivity of devices, machines and people through the Internet. In 2015 approximately 20 billion devices and machines were linked via the Internet. It is estimated that this number will increase to one-half trillion by 2030. In order to benefit from this trend, we hereby propose our Digital Strategy 2025, which describes our goals in the major areas of focus and specifies measures to be implemented.

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<sup>1</sup> BMWi publication: Industrie 4.0 und Digitale Wirtschaft (Industry 4.0 and the Digital Economy), April 2015.  
BMWi publication: Impulse für die Digitalisierung der deutschen Wirtschaft (Going digital: driving the digital economy in Germany), September 2015.

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### *III. 10 steps toward the future*

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**“Building powerful optic fibre networks with direct access for offices and production sites is absolutely necessary for preparing the way into the gigabit era.”**

Ralph Dommermuth, CEO of United Internet AG



# 1. Creating a gigabit optical fibre network for Germany by 2025

High-performance broadband networks are the foundation and driver of digitisation and are therefore indispensable for Germany's digital future. Without sufficient information highways, Germany cannot successfully accomplish the process of digitisation that is progressing at an ever increasing speed. For this reason that we must create a viable digital infrastructure that can support the triple requirements of high capacity, broad availability and low latency.

- **Capacity:** *The volume of data transmitted in the Internet per minute is growing at an exorbitant rate on all network levels. The global data volume on the landline network is doubling every 40 months, and in the mobile radio networks, every 18 months. Whereas global IP traffic is around 718 exabytes (718 billion gigabytes), this volume will most likely approximately triple to 2 trillion gigabytes as early as 2019.<sup>2</sup>*
- **Availability:** *Germany's Internet is not fast. Currently, 96% of households have access to LTE networks with at least 2 Mbps, however only 6% have access to 16 Mbps.<sup>3</sup> The average data signalling rate in Germany in the second quarter of 2015 was around 10.7 Mbps, with peak rates ranging at 46.8 Mbps.<sup>4</sup> Only about 15% of Internet access points used in Germany achieved data signalling rates exceeding 15 Mbps.<sup>5</sup> Only 7% of households have access to optical fibre cable, and only a little over 1% of broadband customers use this type of connection.<sup>6</sup> Adequate offers for commercial customers, in particular affordable gigabit connections for small and medium-sized businesses, are often not even available. Only large companies can afford their own optical fibre connection. Other countries are significantly ahead of us in this regard.<sup>7</sup>*

<sup>2</sup> Source: Cisco Visual Networking Index (VNI) 2015, [http://www.cisco.com/c/en/us/solutions/collateral/service-provider/ip-ngn-ip-next-generation-network/white\\_paper\\_c11-481360.html](http://www.cisco.com/c/en/us/solutions/collateral/service-provider/ip-ngn-ip-next-generation-network/white_paper_c11-481360.html)

<sup>3</sup> Source: Breitbandatlas (an atlas of broadband connections published by the BMWi).

<sup>4</sup> Based on the Akamai Content Delivery Network (Source: Akamai State of the Internet Q2 2015 Report).

<sup>5</sup> In the USA, this figure is 21%, UK 23%, the Netherlands 32%, Switzerland 34%, Japan 38% and in South Korea 53% (*ibid.*).

<sup>6</sup> In the USA, this figure was 9%, Netherlands 10%, Switzerland approx. 12%, Denmark well over 21%, Spain 12%, Sweden 44%, South Korea 68% and Japan around 73% (source: OECD broadband portal, status: 12/2014; also the 17th Telecommunications Market Study by VATM/Dialog Consult).

<sup>7</sup> South Korea: 23.1 resp. 83.3 Mbps; Japan 16.4 resp. 75.1 Mbps; the Netherlands 15.2 resp. 60.9 Mbps; Switzerland 15.5 resp. 59.4 Mbps;

Singapore 12.7 resp. 108.3 Mbps (*ibid.*).

- **Latency:** Uninterrupted data transmission (low latency) is also essential for many applications, for example for extensive use of the cloud and interconnected commercial software. Studies on e-commerce show that even a delay of only one second in page loading leads to around 10% less revenue, and customer satisfaction drops by 16%.<sup>8</sup> Then again, delays in the millisecond range, currently still the rule, render certain process applications impossible.

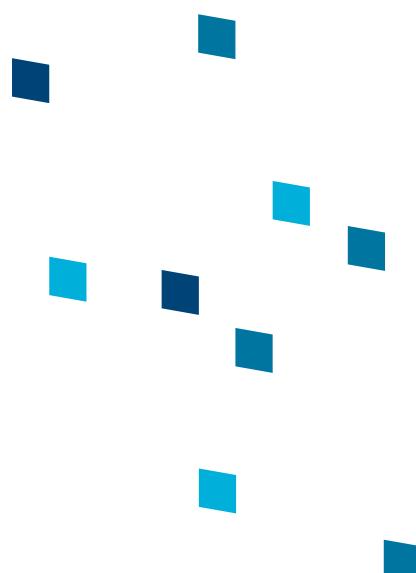
In order to accomplish this triple task we must construct a gigabit optical fibre network in Germany by 2025. Classic telephone lines or metal TV coaxial cable can lead to signal interference if more than one signal is being transmitted at once. Optical transmission of data over glass fibre cables is largely immune to such problems. In addition, glass fibre infrastructure exhibits significantly less energy consumption for transmission to end customers than high-performance copper wire networks.<sup>9</sup> With the growing importance of information and communications technology, energy and resource efficiency (Green IT) should be given more consideration. This also applies to the telecommunication network.

Broadband connections with speeds in the range of several gigabits per second symmetrically are essential, both in download and upload in order to ensure reliable real-time transmission capabilities and high-quality Internet service. To achieve this, the present broadband strategy in Germany, largely aimed at providing asymmetric connections for private customers, must already be adjusted now to include optical fibre technology extending beyond the year 2018.

A nationwide Fibre to the Home (FTTH) network expansion in Germany will require investments of up to €100 billion.<sup>10</sup> Around three-fourths of the population of the Federal Republic of Germany live in metropolitan areas<sup>11</sup>, where the German broadband market is very competitive and where we can expect the market to drive an expansion of gigabit networks. Even in rural areas there are certainly investment activities that take advantage of cost-savings possibilities and cross-sectoral synergies. In some regions, however, networks are not being expanded because it is not economical.

In order to establish a powerful and competitive digital infrastructure, the following measures must be implemented:

- An investment fund for the future for gigabit networks in rural areas. A fund volume of around €10 billion is expected to lead to additional investments in the period to 2025. Financing sources for this fund could include the proceeds from the next spectrum auction (the UMTS frequencies will expire in 2020) as well as funds from the Digital Dividend II which have not yet been utilised for broadband deployment. Beyond that, new financial instruments will be necessary.



<sup>8</sup> Arthur D. Little: The future of the Internet, ill. 9 and the references there.

<sup>9</sup> Also see MICUS: "Nachhaltiger NGA-Netzausbau als Chance für Nordrhein-Westfalen", Studie im Auftrag der NRW.BANK (Sustainable NGA network rollout provides opportunities for North-Rhine Westphalia), May 2015.

<sup>10</sup> TÜV Rheinland Consulting, Scenarios and costs of cost-efficient nationwide coverage of areas that do not yet have at least 50 Mbps, Dec. 2013; and WIK (Scientific Institute for Communications Services): Implications of a nationwide expansion of optical fibre networks and the need for subsidies, WIK Discussion papers No. 359, October 2011.

<sup>11</sup> I.e. central or very central location, regardless of the type of settlement as defined in [http://www.bbsr.bund.de/BBSR/DE/Raumbeobachtung/Raumabgrenzungen/Raumtypen2010\\_vbg/Raumtypen2010\\_alt.html?nn=443270](http://www.bbsr.bund.de/BBSR/DE/Raumbeobachtung/Raumabgrenzungen/Raumtypen2010_vbg/Raumtypen2010_alt.html?nn=443270) (a federal publication on population).

- Optimisation of the synergy offered by funding programmes, especially by properly linking the federal broadband funding guidelines with the joint task Improving Regional Economic Structures (Verbesserung der regionalen Wirtschaftsstruktur: GRW) relating to broadband connections for manufacturing and business centres.
- A gigabit roundtable with all parties concerned: telecommunications providers, the Federation, the federal states and local governments, business and associations must develop joint strategies in order to make gigabit networks possible in Germany.
- The step-by-step development of the “last mile” with cheap and quickly scalable gigabit networks: because commercial enterprises in particular require viable networks now, connecting companies to gigabit networks must be given top priority.
- Facilitating the planning and construction of gigabit networks: in order to accelerate gigabit network expansion, procedures must be simplified, lengthy planning processes must be sped up and construction costs reduced. Some ways to approach this are provided by the DigiNetz Act, a law for the implementation of the European directive on reducing costs. Specific examples include cost-effective installation methods, such as micro-trenching, above-ground cable installation, sharing of energy and transportation infrastructure.
- It is imperative that Europe take a leading role in the implementation of the next generation of mobile radio networks (5G). For this to happen, the right strategy must be determined for development and standardisation. This could be achieved for example by involving German companies in boards that set standards.
- Investment and innovation must be taken into consideration in legislation and regulatory frameworks: the approach to competition on which regulation is based must be focussed more strongly on investment, innovation and growth. Businesses must be motivated to take investment risks. In order to do this, new approaches to access and rate regulation must be developed and applied. We will develop recommendations based on discussions on digital regulatory frameworks and introduce them into the telecommunications review process in Brussels. In addition, the broadband guidelines issued by the European Commission must be updated. Current regulations hinder investments in gigabit networks.
- Bolstering current investment activity in rural areas, for example by providing better information to residents, companies and government agencies regarding the benefits of digitisation.

**“**Close cooperation with corporations and start-ups is a win-win strategy for achieving digital momentum in Germany. It is a clever industrial policy to promote this connectivity in Germany, a prime location for digitised businesses.**”**

*Oliver Samwer, CEO of Rocket Internet SE*



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## *2. Launching the New\_Start-up\_Era: Assisting start-ups and encouraging cooperation between young companies and established companies*

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Start-ups are the driver of the digital transformation. They are willing to take risks, are open for new paths and methods, have dynamic and adaptable structures, often collaborate closely with the technology and research communities and are strongly oriented toward success. Many start-ups develop digital solutions and business models that are quickly scalable and provide interesting solutions for established companies. Moreover, they are important job motors.

Given this, it is very troubling that the number of high-tech companies established between 1995 and 2015 has declined by more than 40%. We must take determined action to stop this trend by addressing the causes for the drop in founding activity, in particular in highly innovative areas, with effective promotion measures for start-ups.

In order to be successful in the long run and to establish their presence in the international market, start-ups must be relieved of unnecessary bureaucracy. About 75% of start-ups plan to become more international. To do so, they already need sufficient capital in the formation and growth phase. The financing requirements of a German start-up over two years is €2.5 million on average.<sup>12</sup> Most start-ups depend on venture capital. In Germany, however, there are presently only a few large funds that provide the capital volumes required for start-ups. This is especially true for growth financing. In addition, young companies do not often go public.

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<sup>12</sup> Federal Association for Information Technology, Telecommunications and New Media (BITKOM): Survey of 250 start-up founders, press release of 11 June 2015, <https://www.bitkom.org/Presse/Presseinformation/Start-ups-benötigen-im-Schnitt-25-Millionen-Euro-frisches-Kapital.html>

Nevertheless, there are encouraging trends, especially in Berlin. Start-ups there were able to collect €2.1 billion from investors in 2015. This makes Berlin number one in the European city ranking. Fifth and sixth place are taken by two more German cities, Hamburg (€296 million) and Munich (€206 million), which are however significantly behind London, Stockholm and Paris. A large part of the investments in Berlin, however, stem from one source: Rocket Internet, which has investments in four of the five German companies most interesting for investors.

Basically, the German venture capital market is too small compared to the magnitude of Germany's economic potential. Whereas in Germany approximately 0.02% of GDP goes to investments, in the USA almost ten times this number (0.17% of GDP) is available, and in Israel nearly 20 times (0.39% of GDP). In Germany, there were eleven IPOs in 2014, compared to 112 companies that were listed for the first time on the London Stock Exchange in that year, and in the USA 288 companies.

Germany's great potential as a strong manufacturing region lies in linking established industrial firms to aspiring start-ups. A strong capital base and proven market positions on the one hand and new ideas and unconventional methods on the other are a good combination for meeting the challenges of the fourth industrial revolution (Industry 4.0). Even in the services sector, connecting established companies with start-ups offers great potential for innovation. At the current rate, however, the economy will waste growth potential in the amount of €99 billion by the year 2020, according to a study by Accenture<sup>13</sup>, due to lack of or inefficient cooperation with start-ups. This corresponds to 3.4% of current GDP.

We want a New\_Start-up\_Era, and will encourage it with the following measures:

- *We are continuing to develop our current set of promotional tools, for example by establishing the Coparion-Fonds (a spin-off from the ERP Start-Up Fund) with the ERP Special Fund and the KfW for improving assistance for technology start-ups and young, innovative companies; by expanding the start-up funding provided by EXIST; by increasing the ERP/EIF Venture Fund of Funds; and by involving KfW as an anchor investor in the venture capital market in connection with ERP venture capital funding (with a budget of €400 million under the risk of the ERP Special Fund),*
- *and are supplementing this with a growth facility in the amount of €500 million, which will be set up in 2016 together with the European Investment Fund. This facility, as a co-investment fund together with successful venture capital managers or funds, is to invest in innovative German growth companies with about €30 million to €40 million per investment.*

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<sup>13</sup> Accenture online survey: Harnessing the power of entrepreneurs to open innovation, press release of December 9, 2015; <https://www.accenture.com/us-en/insight-b20-digital-collaboration.aspx>

- We aim to create a High-Tech Start-Up Fund (High-Tech Gründerfonds, HTGF) III with a volume of around €300 million by 2017. The HTGF will offer initial financing for young, quickly expanding technology companies. After establishing HTGF I in 2005 and the follow-up fund HTGF II, we want to once again implement this form of financial assistance. Public institutions and private commercial companies should again be able to participate, as in the other two funds.
- We will be aggressively expanding the INVEST programme in 2016. Subsidies of 20% will now be granted for venture capital investments from private individuals of up to €500,000 (previously: €250,000) and a tax refund on capital gains on INVEST shares will be granted. Furthermore, there will be a pro rata funding grant for compensation of losses. And finally, eligibility for applications will be greatly broadened.
- We want to continue to make Germany an attractive competitive location for venture capital funds and to this end are improving the legal and tax framework. We will utilise the options provided for by European court rulings regarding turnover tax on management services provided by investment funds. Another important aspect is the treatment of loss carried forward when shares are sold. When high-growth companies are refinanced or if strategic investors buy shares, tax loss carryforwards may not be lost.
- We want to relieve innovative companies of taxation of minority shares and ensure in any case that no new burdens are created for financing young, innovative companies. If the topic of such tax rules should come up again, the federal government will in any event ensure that an exception is made for financing young and innovative companies – one that is effective and conforms to EU law.
- We want the stock exchange to once again become a source of financing for young and innovative high-growth companies, thereby re-opening an important exit route for venture capital financing. The mission report issued by the roundtable created by Sigmar Gabriel, Minister for Economic Affairs, includes a number of recommendations. In summer of 2016 we will submit an update on what has been accomplished up to that point.
- We support potential start-ups in the very early planning phase with the new Digital Innovation Start-up Competition (Gründerwettbewerb Digitale Innovationen), in which business ideas are evaluated and the best ones are awarded a prize.

- We promote internationalisation of German start-ups, for example with information, advisory and support services and with international accelerators. In addition to the existing accelerators in Silicon Valley and New York, in autumn of 2015 we included the life-sciences region in Boston in the programme and started a third accelerator.
- We assist start-ups in connecting with established businesses in order to better utilise the innovative potential of start-ups for digitisation of all areas of the economy.
- We are continuing the Women as Entrepreneurs initiative (FRAUEN unternehmen), and are working more closely with the Advisory Committee Young Digital Economy (Junge Digitale Wirtschaft).
- We want to utilise the progress made in digitising government offices to make it easier to establish a company and to reduce bureaucracy so that start-ups have more time to concentrate on establishing themselves on the market.
- We will also reduce bureaucracy in the initial phase by introducing a single point of contact (Ansprechpartner 2.0) and by systematically pursuing our programme on eliminating bureaucracy (One-in – one-out).
- Furthermore, we will converge existing information and advisory services for business starters and entrepreneurs into Start-up Portal 4.0 (Gründerportal 4.0) as a tool for making the process of starting a company easier and more efficient.





**“The Digital Single Market is a promising area for digital innovations. We should grasp this opportunity – and create a suitable political framework.”**

*Prof. Dr Gesche Joost, Professor of Design Research at the Berlin University of the Arts and Internet Ambassador to the European Commission*



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### *3. Creating a regulatory framework for more investment and innovation*

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The largest share in dynamics and profit of the Data Economy can currently be found in companies and regions located outside of the European Union (EU). Whereas the information and communication technology sector in the USA contributed up to 55% to GDP growth from 2001 to 2011, this figure was only 30% in the EU.<sup>14</sup>

However, this may change in the years to come. Innovators could become world leaders within a few years and previous giants could quickly lose their influence. Who tomorrow's winner will be also depends on who creates the best regulatory framework for further digital development.

Above all, digitisation is a business project. Accordingly, we must provide room for the development of enterprising investments, product innovation and new data-based services. At the same time, we must create a reliable and objective regulatory framework. This relates to liability regulations and copyright law as well as to fair competition. All digital business models should be part of open and innovative competition. We want to eliminate isolated solutions, privileges, discrimination and "lock-in" practices. We must push the process of creating binding norms and standards. A maximum degree of market and product transparency creates the base for freedom of choice for business customers and private consumers, who should be able to make informed and independent choices. This is our vision of a digital regulatory policy.

The Internet, an international technology, requires a level playing field regarding international regulation. Here, too, we must avoid isolated solutions based on limited national interests. The European General Data Protection Regulation is not only an example of a unified European approach to consumer protection, but is also an important step on the path to competitive equality in the data economy, due to its marketplace principle (all international marketers must comply with European law). We want to build on this approach.

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<sup>14</sup> European Commission SWD(2015) 100 final: A digital single market strategy for Europe – analysis and evidence, an analysis published by the European Commission.

The European digital regulatory framework provides safeguards for the continuing digitisation of economy and society in the EU and is therefore of utmost importance for Germany's and Europe's competitiveness in years to come. The advantages of a European Digital Single Market comprise the entire economy – not only the ICT sector, but also banking, automotive manufacturing, logistics, retail trade, energy and transportation, for example. In all of these sectors companies can significantly increase their connectivity, for example by using cloud computing, the Internet of Things and company-wide uniform IT processes.

In particular, a European Digital Single Market (DSM) must serve not only consumer interests, but also those of the manufacturers, small and large. The following measures are particularly important:

- *Creating a technical DSM. The EU must take on a leading role globally in the area of norms and standardisation. In modern information and communication technology the importance of a device depends on its ability to communicate with other devices (network effect). European standardisation must keep up with global technological advances and also achieve international recognition. We must pay attention in this regard that we do not counteract promising national initiatives already in place. We want to provide political coordination and back-up measures for standardisation processes.*
- *Creating a regulatory DSM. We must have a viable European telecommunications regulatory framework. Telecommunications markets and infrastructures in all regions of Germany and the EU must be allowed to develop dynamically and efficiently in order to remain competitive in the global market. The core elements of the upcoming revision of telecommunications regulation must in particular include flexible approaches in selecting regulation instruments, creating investment incentives for broadband deployment, appropriate use of what is known as over-the-top services (OTTs), a minimum level of harmonisation of consumer rights, upholding and perhaps simplifying the current universal service concept as well as optimising the institutional framework.*
- *Online platforms and intermediaries must be involved in regulation such that competitive conditions are roughly equal for similar services. The largest online platforms are in a position to control access to online markets and exert substantial influence on the actions of other market participants and their ability to develop. For this reason we need comparable conditions for flourishing digital networks and innovative services. The first step must therefore be to ensure that the survey already underway at the European Commission on the role of online platforms is brought to a conclusion quickly, yet carefully, comprehensively and without preconceived notions.*

- *Cartel law must also take the specific characteristics of online markets into consideration. For example, large Internet companies could abuse their dominance in one particular area of service (e.g. online searches) by extending it to other markets (e.g. for chargeable services obtained online). However, because the initial service is free of charge, this type of situation has up to now been irrelevant under cartel law. Regardless, in order to take anti-trust action and prevent abuse of market dominance, it must be made clear that, even without direct payment of money, it can be assumed that there is a market.*
- *Legal barriers and other hurdles for cross-border e-commerce must be identified and removed. Cross-border e-commerce allows private individuals and companies to access a larger assortment of goods and services and to profit from lower prices.<sup>15</sup> Currently, e-commerce contributes on the whole approximately 2.5% to GDP – however, the contribution from cross-border e-commerce is one-tenth of this percentage.<sup>16</sup> Existing obstacles (both legal and resulting from anti-competitive behaviour on the part of market participants) must therefore be systematically removed.*
- *In order for Europe to achieve global technological leadership in installing the next generation of mobile radio networks (5G, see Item 1: Creating a gigabit optical fibre network), the right adjustments must be made to the frequency regulation. In particular, the member states must be able to utilise their national preferences (e.g. coverage obligations) and first-mover advantages.*
- *We must develop a European data region policy based on common principles (e.g. data security and informational autonomy). Trust in the digital environment is weakened whenever there is any concern that basic rights, such as the protection of personal data by the service provider, are not being observed. According to studies, only 22% of EU citizens have complete trust in Internet companies such as search engines, social networks and email services.<sup>17</sup> The legal and technical issues surrounding trans-border data processing and use must therefore be addressed soon at the EU level.*

Even in Germany, we must evaluate our legal framework with a view to digitisation. We recommend developing a **digital legal code** that adheres to the previously mentioned principles of open and fair competition, data security and informational autonomy, as well as European harmonisation. We need a convergent legal framework that comprises all of the media offerings and contains regulations relevant to the Internet, or relevant provisions of the Telecommunications Act (Telekommunikationsgesetz (TKG)), the Telemedia Act (Telemedien gesetz (TMG)) and the Act on Radio Equipment and Telecommunications Terminal Equipment (Gesetz über Funkanlagen und Telekommunikationsendeinrichtungen (FTEG)), and also additional aspects of technical regulations.

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<sup>15</sup> Duch-Brown, N. and Martens, B., Consumer benefits from the EU Digital Single Market: evidence from household appliances markets, JRC/IPTS Digital Economy Working Paper No 2014-03, 2014.

<sup>16</sup> Francois, J. et al., The macro-economic impact of cross-border e-commerce in the EU, JRC/IPTS Digital Economy Working Paper No 2014-10, 2014.

<sup>17</sup> European Commission, Consumer survey identifying the main cross-border obstacles to the DSM and where they matter most, September 2015.

Some of the core aspects of this digital legal code would be, in addition to co-ordinating all existing competences, continuing to develop and expand the legal framework with a view to digital issues in the following manner:

- *Creating a uniform legal framework for similar services, bringing Internet service providers into the process (over-the-top providers: OTTs)*
- *Stronger integration of digital effects (e.g. network effects, lock-in effects) with transparency requirements, data security and data portability, to the extent that the EU General Data Protection Regulation (GDPR) allows for national provisions*
- *Adaptation to new areas of business: Big Data / Location Based Services; measures: informational autonomy, data protection, transparency and information obligations (reworking national data protection laws, in particular adapting the Telecommunications Act and Telemedia Act to the GDPR)*
- *Promoting digitisation in everyday life by creating an innovation-friendly legal framework (e.g. smart meters: Act on Digitisation of the Energy Transition, the E-Health Act)*

In view of the rapid development and disruptive innovation, it is not sufficient for the government to wait for regulations to emerge from dynamic processes. Then innovation will take place where business and science can try new ideas and bring them to fruition. We should therefore think about setting up **regulatory “experimental spaces”** for new technologies and business models. For one thing, this would increase the possibility of tying value creation to a specific economic area. For another, valuable innovations can be initiated in a careful manner that takes citizens’ concerns into account. Regional experimental spaces could offer communities a chance to present themselves as an ideal location for specific technologies and innovations.

These experimental spaces should satisfy the following requirements:

- *The innovation spaces should be clearly distinct, both geographically and temporally separate and also by experiment group, and are created for high-performance innovations with an attractive technical-commercial and societal focus (e.g. telemedicine, robotics, mobility).*
- *Innovation projects must, if required, be protected by time-limited and possibly geographically restricted experimentation clauses relating to statutory or regulatory frameworks.*

- A standard requirement will always be that an evaluation and supervision are carried out independently of the innovators. These independent controllers will also be authorised to make the regulatory free-zone available while taking risk aspects into consideration, or if hazards become apparent, to restrict it. A federal Digital Agency (see Item 10) could carry out this task.
- The goal of experiments and accompanying research is to develop recommendations on what could constitute a helpful and responsible regulation that will have universal application for the future.

Furthermore, we need to bring Germany and Europe into the global market. European business locations should not compete with one another, rather join forces to compete with competitors outside Europe. For this reason we need a modern competition policy that takes the global market situation into account and is not limited to the European Single Market. Therefore,

- it will be necessary to adapt German merger control laws. Up to now, the threshold for action has only been linked to revenue of the merging companies. Particularly in the digital area however, even companies with low revenue levels may be highly influential, as reflected in the high transaction prices (example: Facebook's takeover of WhatsApp). In order to close this gap we will introduce an additional transaction value element to the 9th amendment to the Act against Restraints of Competition;
- the global competition situation must also be adequately taken into consideration when applying European merger control. A market limitation that is too narrow is not a sufficient response to global competition. The consequent risk that mergers are denied can prevent companies from being able to compete internationally. In particular, the Commission should also review and update its interpretation principles regarding the term "relevant market". Businesses would also gain more legal certainty from a better understanding of how mergers are currently analysed under aspects of competition law.

**“**The core element of tomorrow's economy is Smart Connectivity. When people communicate with machines or machines communicate with machines, new potential value added is created. Mechanical engineers are therefore becoming the gold diggers of the future. **”**

Dr. Reinhold Festge, President of VDMA, the Association of German Machinery and Systems Manufacturers



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## *4. Encouraging “smart networks” in key commercial infrastructure areas of our economy*

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The term “smart networks” stands for comprehensive and systematic use of the possibilities for digitisation in major infrastructure areas, such as energy, transportation, health, education and public administration. Familiar examples are concepts such as smart grid, smart meter, smart home, smart traffic, smart city, e-health, e-learning, e-government, e-participation or age-appropriate support systems for living a self-determined life.

Smart networks enable citizens to enjoy a higher degree of social and political participation as well as enhanced productivity, efficiency gains and growth in the basic sectors of our economy as described above. According to a study conducted by the Fraunhofer-Institute for Systems and Innovation Research<sup>18</sup>, smart networks can generate an overall benefit to society of around €56 billion annually, of which €39 billion is attributable to expected efficiency gains and €17 billion to additional impetus to growth.

In order to utilise this potential we have already launched numerous initiatives for promoting smart networks:

- *In the autumn of 2015 the federal government adopted the Smart Networks Strategy as a measure for implementing the Digital Agenda 2014 – 2017. This strategy involves four elements that were developed jointly by representatives of the business community in the scope of the IT Summit. We launched the Smart Networks Initiative<sup>19</sup> to implement this strategy.*
- *In November 2015, the federal government drafted a bill on a law to digitise the energy transition.*

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<sup>18</sup> Fraunhofer-Institute for Systems and Innovation Research: Economic effects of smart infrastructures in Germany, 2012.  
<sup>19</sup> <http://www.netze-neu-nutzen.de>

- The E-Health Act<sup>20</sup> came into force in early 2016. It will open the way to more tele-medicine to the benefit of the patient, but still needs to be optimised.

Building on these initiatives and knowledge gained from them, we must take additional measures to make Germany a global leader in smart networks. We will also actively pursue this issue in the scope of European ICT policy and convince the public of the value of digitisation and connectivity, for instance in education or in health services, by setting up model regions, for example.

In order reach this goal, obstacles must be removed and implementation processes introduced and strongly supported in the sectors applying these technologies. The following must be done:

- Facilitate investments and create legal certainty: the climate for investment in smart networks must be improved. The legal framework must be continually developed across sectors, and legal certainty must be guaranteed. In particular, transparent rules for data possession and use are essential. The General Data Protection Regulation recently passed by the European Parliament will provide for more clarity and legal certainty.
- Improve the basis for smart networks on a European level: standards must be determined in order to create a uniform pan-European market environment. The Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway (Bundesnetzagentur) will push forward the implementation and updating of the Rolling Plan for ICT Standardisation, which is also aimed at promoting smart networks. The regulations on network neutrality set forth in the General Data Protection Regulation must be applied such that Internet neutrality can be guaranteed in the future and at the same time providing latitude for innovative special services, for example in the health and transportation sectors.
- Strengthen demand and create synergies: additional information and communication with citizens and users, for the federal states and local government are the key to greater acceptance and demand for ICT solutions for smart networks. The Smart Networks initiative<sup>21</sup> is a single contact point for inquiries of all types. Since November 2015 it has used a nationwide roadshow to initiate a dialogue with participants and the interested public. An online map displays examples of best practice that could serve as models. Another key element of the Smart Networks initiative is the Open Innovation Platform<sup>22</sup>. This digital marketplace and discussion platform can be accessed by experts, users and the general public so they can actively participate in the initiative, contribute new ideas and share experiences. It is also important to create synergies for the ongoing programmes, in particular in the context of Industry 4.0, support for research and innovation in ICT, and for digitising SMEs.

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<sup>20</sup> Law on secure digital communication and applications in the health care industry and amendments of additional acts from 21 December 2015 (Gesetz für sichere digitale Kommunikation und Anwendungen im Gesundheitswesen sowie zur Änderung weiterer Gesetze); [http://www.bgblerxaver/bgblerstart.xav?startbk=Bundesanzeiger\\_BGBI&jumpTo=bgbler115s2408.pdf](http://www.bgblerxaver/bgblerstart.xav?startbk=Bundesanzeiger_BGBI&jumpTo=bgbler115s2408.pdf)

<sup>21</sup> <http://www.netze-neu-nutzen.de>  
<sup>22</sup> <http://www.oip.netze-neu-nutzen.de>

- *Initiate a Model Regions for Smart Networks funding programme: government support for model regions and lighthouse projects are a prerequisite for significant value added for society and the economy, especially in the basic sectors, e.g. education, health, energy, transportation and public administration. For supporting experimental spaces and model regions, the federal government will systematically review the legal framework with regard to provisions that help to open up opportunities and allow for experimentation (see the topic of experimental spaces in Item 3.).*
- *Establish a nationwide Alliances for Digitisation programme: the alliances will be based on the idea that digitisation affects everyone and is a practical process that evolves from the interaction between business, the government and individuals at a local level. The Alliances for Digitisation should activate the model regions and encourage cooperation on a local and regional level, between central and local government agencies, companies, associations, professional organisations and private individuals with the goal of determining and implementing specific measures for digitisation in a regional context. A services office on the federal level will initiate these alliances and assist them in planning and operation (structure, determining a strategy, course of action, coaching, communication, etc.).*
- *Create an accelerator for smart networks projects: an accelerator will support young companies right after they have been established, from the development phase up to presentation of a business plan to investors, by providing work space, strategic and technical support, access to networks and, if necessary, a small amount of financial assistance.*

**“One challenge of digitisation is developing business models and technologies that make it possible to use data without infringing on individual privacy or putting overall data security at risk.”**

*Prof. Ing. Ulrike Meyer, Professor of IT Security at RWTH Aachen University*



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## *5. Strengthening data security and developing informational autonomy*

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The digital transformation of society requires a paradigm shift in data policy. Data is the basic raw material in the digital economy. More and more aspects of business and society are being measured and evaluated, connected and marketed in an increasing degree of complexity and differentiation. Avoiding data collection and storage can no longer be our guiding principle. On the contrary, in the future the prevailing data security issues will involve individual “informational autonomy”.

Private individuals and companies must be confident that their data is protected from abuse. Users and consumers must be able to make their own decisions on how their data is used. Data security and informational autonomy are important cornerstones of our democracy and at the same time a prerequisite for the acceptability and success of a data-driven economy. If Germany does not have trustworthy and secure ICT infrastructures, we run the danger of losing competitive ability and future economic strength. Without data security it will be particularly difficult to convince our small and medium-sized enterprises that digitisation of their business is the way of the future.

According to the current report published in 2015 by the Federal Office for Information Security (BSI), the risk to IT security is estimated to be high in many areas. Information provided by the German Association for Information Technology, Telecommunications and New Media (Bitkom e.V.) indicates that more than half (51%) of all companies in Germany have been victims of cyber crime in the past two years. Small and medium-sized businesses in particular are strongly affected, at 61%, by spying or acts of sabotage (2015 survey). The annual damage to the German economy is estimated to be at about €51 billion.

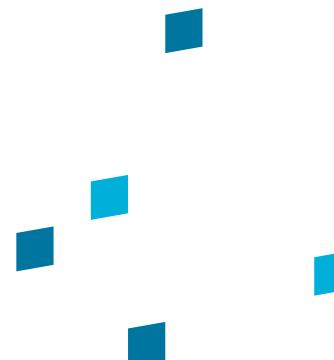
We must continue to provide stronger and more effective data security and data protection in Germany. Small and mid-size companies in particular must be in a position to recognise risks and take precautions in order to take full advantage of the opportunities provided by digitisation. They must receive assistance in taking suitable protective measures that could significantly raise their level of data security. Security and data protection should play a role starting at the initial phases of product development and process design (known as security by design). Trusted cloud offerings based on certified secure solutions can be a promising option in many cases for small and medium-sized businesses, which can then reduce their own IT and become flexible.

It is imperative to offer consumers and businesses legal certainty and a uniform competition environment. To do so, it is necessary to strike a balance between consumer, commercial and government security concerns. With the new European General Data Protection Regulation, a uniform, high level of data protection will be created for all of Europe in 2018. Fragmented national data protection rules, legal ambiguities and possibilities for circumvention will be eliminated.

It will also be important to create viable rules on handling data communication with non-European countries. Other regions in the world often have a different approach to finding the balance between consumer and business interests and security concerns. Up to now, there have been only a few agreements and conventions on these topics. With its Safe Harbour decision, the European Court of Justice invalidated the agreement between the EU and the USA. The new EU-US Privacy Shield should ensure that the Court of Justice's requirements for an appropriate level of data protection are now implemented in the USA and a reliable regulatory framework for trans-border data transmission is created.

It is the task of the many participants in this technology to work together to guarantee trust, security and data protection in an increasingly digitised world. Not only the government, but also business, the scientific community and ultimately the users themselves must contribute to this. The following measures will therefore only succeed if they are agreed upon by all parties concerned:

- *We will cooperate in exploring whether additional regulations such as product liability rules for IT security flaws and security requirements for hardware and software manufacturers are necessary and useful. Industrial espionage and cyber attacks must also be prevented with international regulations that can be enforced beyond German and European borders.*

- We must ensure that even those companies not subject to statutory requirements (because they are not critical infrastructure operators) improve their data security. We will work together with partners from business and the scientific community to expand the assistance we provide under the IT Security in Business initiative (IT-Sicherheit in der Wirtschaft).
- We will conduct a study to identify which digital capabilities and key competencies are available in Germany, also in comparison to international standards, and create a digital atlas based on this information. Using this base we will begin an ongoing competence monitoring programme in dialogue with stakeholders. The goal here is to focus on which key technologies and competencies are necessary for maintaining and creating digital independence and provide support for them.
- The European General Data Protection Regulation creates a balance between consumer and business interests, and establishes a forward-looking legal framework for data diversity and Big Data. In the course of implementation of the optionality clauses of the European General Data Protection Regulation, it will be essential to also anchor this balance in national data protection legislation. The Federal Ministry for Economic Affairs and Energy is working jointly with business and data protection authorities to lay the groundwork for a data protection certification.
- On the basis of the agreement between the European Commission and the USA on a EU-US Privacy Shield for transatlantic data communication, we will ensure that the discretionary decision of the European Commission guarantees the privacy and protection of trade secrets and, at the same time, national security.
- The data protection certification designed for cloud computing in the scope of the Trusted Cloud Technology Programme will create the basis for a European label.
- We are paving the way for the international implementation of electronic identification, a qualified electronic signature, the electronic seal for businesses and government agencies, as well as other electronic trust services. Thus we are setting the standards for EU-wide secure and reliable electronic transactions.

**“**The future is our construction site. Tens of thousands of skilled crafts companies have already arrived in the digital world, and hundreds of thousands more will follow, with the assistance of the centres of excellence for digital skilled crafts. **”**

Holger Schwannecke, Secretary General of ZDH (German Confederation of Skilled Crafts)



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## *6. Enabling new business models for SMEs, the skilled craft sector and services*

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Our goal is to get our small and mid-size companies to actively engage in the digitisation process so they can strengthen their market positions in the future and conquer new markets. There is still a lot to do in order to make this possible, in particular in the area of raising awareness for digital development possibilities. While 88% of all companies understand the connection between digitisation and commercial success, 51% of the SMEs surveyed said that digitisation is not (yet) part of their business strategy.<sup>23</sup>

In the context of our already existing Digitising SMEs initiative (Mittelstand-Digital) we provide assistance to these companies in the form of user-friendly guidelines, case examples and events.<sup>24</sup> Involved in this initiative are:

- numerous centres of excellence – one dedicated to skilled crafts in particular – that we are creating under the initiative SMEs 4.0 : Digital Production and Work Processes (Mittelstand 4.0 - Digitale Produktions- und Arbeitsprozesse);
- four Mittelstand 4.0 agencies that delve into the topics of digital communication, cloud computing, process management and commerce, and provide support services;
- the Go-Digital project with which we offer SMEs and skilled craft businesses financing for external advisory services in the three modules IT security, Internet marketing and digitised business processes (currently in the Ruhr area, Saxony and the Halle region);
- and the go-Inno programme, for which we created the Innovation Management funding facility (Förderlinie Innovationsmanagement) that provides financing for 50% of consultancy services fees for enhancing innovation management in companies with less than 100 employees.

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<sup>23</sup> Source: DZ-Bank, Umfrage Digitalisierung: Bedeutung für den Mittelstand 2014 (2014 survey on digitisation and its significance for SMEs).

<sup>24</sup> <https://www.mittelstand-digital.de>

We must considerably strengthen programmes already in place. For this reason we want to initiate a **Digitisation Campaign for SMEs** (Digitalisierungsoffensive Mittelstand) for offering SMEs specific incentives for investing in the digital transformation.

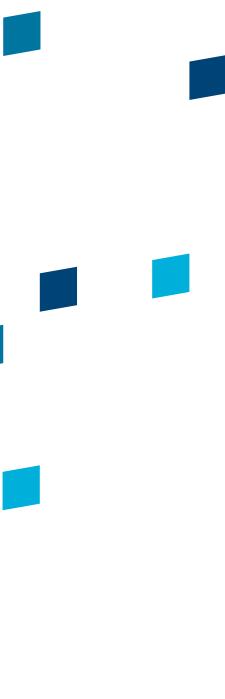
The central aspect of our digitisation campaign for SMEs is a Digital Investment programme for SMEs (Digitales Investitionsprogramm Mittelstand) with a volume of €1 billion available until 2018. This campaign addresses identified deficiencies and expands existing innovation programmes aimed at SMEs, such as the Central Innovation Programme for SMEs (ZIM: Zentrales Innovationsprogramm Mittelstand) and the Industrial Collective Research programme (IGF: Industrielle Gemeinschaftsforschung). These programmes will be expanded to €700 million and €200 million, respectively, in order to serve growing demand.

Overall, the campaign will include the following elements:

- *We will set up a user-friendly portal on digitisation to improve the visibility of available funding programmes and for reaching out to a broader range of prospective recipients.*
- *Assistance provided will include analysis and consulting, personnel and organisational development activities, development of target-group-specific technologies, and investment grants for spurring investments and IT implementation projects at SMEs, including assistance in the implementation process.*
- *These measures should at the same time contribute to developing new Internet-based platforms and business models.*
- *In addition, funding and assistance should also be provided for strengthening the digital connectivity of German SMEs in Europe by creating European and international networks as part of digital transformation.*
- *To give SMEs can have access to broad knowledge of ICT solutions, we will expand and intensify our consultation services with Digitisation Guides (Digitalisierungslotsen).*
- *We will develop new initiatives and funding programmes for non-technical innovations because they are also important drivers of new digital business models.*



- We want to set up a *Digitisation House (Haus der Digitalisierung)* in Berlin for SMEs with a national and European outreach – as a meeting point and showroom for the possibilities and feasibility of such projects, with rotating presentations and exhibits.
- Furthermore, we will strengthen the digitisation process by matching established companies with start-ups and research organisations and with best-practice examples (businesses learning from each other).
- We plan to set up an *SME Digitisation Task Force* and a one-stop agency. This task force is intended to coordinate the various activities and assist the Ministry in iterative development of the initiatives. This also comprises sponsoring the creation and operation of a central office that assists the task force as a type of one-stop agency.
- In Germany's very diverse service economy, on the other hand, there is a need for sector-specific approaches in the individual areas, for example in commerce, skilled crafts, care services and the health industry. Up until now, only one in five companies has adapted its business model to the possibilities offered by digitisation. Companies in the service provider industry would like more assistance, in particular regarding information, guidance, connectivity and introduction to best practices.<sup>25</sup>



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<sup>25</sup> Online consultation for the service industry (BMWi Service Industry Conference, with 436 participants, approx. 80% SMEs) and a TED survey of the conference participants.

**“**In the factories of the future the virtual world of 3-D design and construction will meld with the real world of manufacturing. Production will be more efficient, faster and more flexible. We are pressing ahead with this Fourth Industrial Revolution.**”**

*Prof. Dr Siegfried Russwurm, Chief Technology Officer and member of the Siemens AG Executive Board*



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## *7. Utilising Industry 4.0 to modernise Germany as a production location*

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Germany is one of the world's leading industrial locations and therefore has a pole position in the competition for the best solutions for Industry 4.0. Industrial production and services located near manufacturing areas generate more than half of total German GDP. Germany is leading in many digital innovations in connection with production technology. However, competition is keen, in particular with the USA and Southeast Asia (Japan, South Korea and China). For example, the National Network for Manufacturing Innovation in the USA is being funded with US\$1 billion between 2012 and 2022.

Digitising industry will open up potential additional cumulative value added of €425 billion in Germany alone. Projections put productivity gains at up to 30%, annual efficiency gains at 3.3% and cost reductions at 2.6% annually. The sectors that will benefit most in the next five years are the automotive industry with an increase in revenue of €52.5 billion (13.6%), mechanical engineering (€32 billion or 13.2%), process industries (€30 billion or 8.1%), the electronics industry (€23.5 billion or 13%) and ICT (€15 billion or 13.4%).

With Industry 4.0, both our notion of manufacturing and its design will change. The distinction between manufacturing and services will become less important, and global manufacturing competition will also be digitally driven or based on ICT. We have every opportunity to use and build upon our industrial edge, for example in digital control of automobiles or complex production processes. To do this we must greatly expand our own ability to construct digital technology components. Only then can we tap the enormous potential for more efficient, customer-oriented and resource-conserving production and create additional value added by means of new business models.

However, half of the companies in Germany assume that competition outside of their specific sectors, for example from the IT sector, will attack their core business. At the same time, only six out of ten companies in Germany are well prepared for Industry 4.0.<sup>26</sup>

These numbers show that there is a substantial need for support and assistance before manufacturing companies can develop sufficient evaluation abilities. In its Industry 4.0 platform, the Economic Affairs Ministry has joined forces with partners from business and the scientific community to develop practical guides and recommendations for action in the areas of standardisation, IT security, the legal framework, work and continuing education on how to implement Industry 4.0 in companies. We hold regional events where we work together with local chambers of industry and commerce to provide information on the results of these efforts and provide a look at specific examples of how Industry 4.0 has been implemented.<sup>27</sup>

It is our goal to make Germany the leading supplier and user of Industry 4.0 – and as a result, it will be the most modern industrial location in the world. We want to assist the industrial SMEs in developing their own digitisation strategies and new business models. We are convinced that Work 4.0 offers the potential for creating new jobs that have more responsibility and are less physically strenuous.

In order to develop and utilise the potential provided by Industry 4.0, the following must happen:

- *We will utilise all of the assistance programmes for SMEs (see Item 6: New business models for SMEs) in order to raise awareness, provide information and finance investments.*
- *We will introduce a funding programme for microelectronics. The sensor and actuator technology found in machines and robots that is essential for Industry 4.0 is unthinkable without microelectronics, and is also key to maintaining our digital independence. We should therefore advocate a European research and innovation project for microelectronics and contribute to it in the period from 2017 to 2019 with government subsidies of a total of €1 billion.*
- *We will implement the recommendations on the issue of Industry 4.0 that are developed at the Hanover Fair by the five working groups of the platform, particularly in the areas of standardisation, legal framework, IT security and work. Topics include secure identities and secure trans-company communication, the necessity of further development of the machine guidelines, standardisation requirements and qualification or awareness enhancement for employees, in particular in the area of security requirements. Furthermore, the platform will publish a quick check list on IT security.*

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<sup>26</sup> McKinsey & Company (2015): Industry 4.0: How to navigate digitisation of the manufacturing sector.

<sup>27</sup> See <http://www.plattform-i40.de>

- We will develop an Action Plan for Standardisation of Industry 4.0. The Economic Affairs Ministry will invite all players involved in the process and external experts to consult together and to regularly share experiences. The goal is to agree on a plan of action for the next steps, in order to quickly set up standardisation in the area of Industry 4.0 – also with an international scope. RAMI 4.0 will play a key role here, and it should be brought to the attention of and promoted by the national and international standard- and norm-setting organisations.
- We will strengthen cooperation on an international level. Bilateral cooperation with important partner countries can provide support for the Industry 4.0 transformation process. Bilateral cooperation with China in the context of Industry 4.0 can for example strengthen the position of German companies on the Chinese market. The Industry 4.0 platform will work together with US-based Industrial Internet Cooperation (IIC) in areas of joint testing, for example.

**“**Finding out what consumers want is what drives research and innovation. Digital technologies play a big role here. They help to make the world smarter.**”**

*Prof. Dr Christoph Meinel, Hasso-Plattner-Institut, Potsdam*



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## *8. Creating excellence in digital technology research, development and innovation*

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Currently, German companies invest only 14% of their annual research budget in commercial applications for digital technologies. US companies spend twice as much. We must therefore broaden digital research efforts, especially in traditional industries.

The digital maturity of the economy can be significantly enhanced with research. The two big trends, Industry 4.0 and Big Data, are already the focus of BMWi's technology funding programmes that aim to create exemplary solutions for high-tech applications. In addition, with our technology-oriented funding initiatives such as the Central Innovation Programme for SMEs (ZIM) we are providing an important impetus for strengthening SMEs in their role as providers and users of digital technologies.

These are only the first steps, however. Innovation in the area of the Data Economy in competing regions of the globe is very dynamic. In the USA, for example, Big Data solutions made up 49% of total patent applications in 2012, whereas in Germany, they constituted only less than 5%. German companies presently still use old technology for their data analyses. New technologies (NoSQL or Hadoop) are used by only one-quarter of the companies surveyed. Only one-fifth of the companies analyses social media data.

All of Europe is lagging behind other competitors in ICT research and digital innovations:

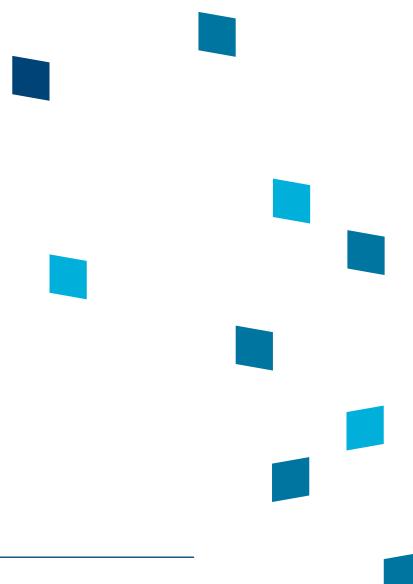
- *Europe invested only 0.21% of GDP in information and communication technology – this figure was 0.57% in Japan, 0.58% in the USA and even 1.47% in South Korea.*
- *Europe holds only 6% of all patents worldwide in technology relating to the Internet of Things – far behind the USA, South Korea and Japan.*
- *In the USA, five times as many telecommunications-related patents are submitted as in the European Union (EU).*

With regard to **manufacturing methods**, additive manufacturing (3D printing) is becoming particularly important. Global sales in products and services for additive manufacturing has climbed from US\$529 million in 2003 to US\$3.07 billion in 2013, and is projected to be at US\$21 billion by 2020 (percentage of German companies: 15–20%). In Germany, approximately 1,000 companies are active in this area, and about 90% of those are SMEs. Up until now, additive manufacturing has been used in particular for Rapid Prototyping (24.6%) and for basic technology experiments (28.9%). However, Rapid Manufacturing and Rapid Tooling have increasingly gained in importance (9.6%).

Numerous areas of application have opened up for **Service Robotics**, especially in material logistics, production and handling assistance for handwork jobs, and in small series production. The industry association IFR World Robotics expects global revenues in 2017 of US\$300 million for service robotics in logistics (mainly in manufacturing). The opportunities for service robotics in the area of consumer applications are worth keeping an eye on for prospective business ideas. This involves developing a specialised manufacturing and supplier market with a potential of billions. In addition, the health and care sectors are seen as highly relevant future users of service robotics.

**House connectivity** (Smart Home) is undergoing major change through digital platforms. The Smart Home + Building Certification Programme was the first step towards an agreement on a concept for an open integration platform to enable connectivity beyond technology and system limitations. This is essential for succeeding in coordinating the efforts of mainly SME-sized manufacturers and suppliers in Germany and to pave the way to the international mass market.

Cloud technologies make it possible to access centrally stored process data from anywhere with the Internet and to process this data using analysis software. All business processes gain in flexibility and speed.



In order to catch up with the global leaders in the area of the data economy, we must substantially increase funding for research and development of digitisation of the economy. This funding is only one-tenth the amount of that provided for energy or aerospace. By promoting R&D projects in the innovative stage we ensure that forward-looking topics in ICT are addressed early on and we help expedite the transfer of scientific results on up to market-oriented leading technologies with substantial application potential. Small and mid-size companies should also be given tax advantages for research expenditures.

The following must be done:

- *Investments in digital technology must be made more attractive with tax deductions. Investments in software and digital technology make a valuable contribution to company innovativeness. In order to accommodate the fact that investment cycles are becoming shorter and shorter all the time, depreciation schedules for hardware and software and for all digital technology devices should be reduced to a maximum of three years.*
- *We will focus our support programmes specifically on innovative technology and applications and will identify lighthouse projects. Specific examples include, in the economy platform area: the technology programme Smart Service World (Smart Service Welt); for the technologies related to Industry 4.0 and Autonomous Systems: the programme Autonomics for Industry 4.0; for product engineering, logistics, service robotics, industrial 3D applications and industrial communication: the PAiCE programme; and for smart data and Big Data: the programme Smart Data. These technology programmes will be continually improved and expanded to include new topics in the area of the Internet of Things and the challenges to IT security (security by design).*
- *We want to maintain technical independence. This will require ideas for projects that have a broad scope and involve partners from industry and the research community, both nationally and on the EU level. In particular, funding must be provided for German or European equipment suppliers in the areas of industrial communication, real-time data analysis and product engineering.*
- *We want to introduce R&D tax breaks for SMEs with up to 1,000 employees. Providing this assistance in the form of a tax allowance would also enable start-ups that have not yet made a profit to benefit from tax advantages.*

**“**In a quickly changing working world, its participants will find life-long learning more and more important for remaining attractive to the labour market. Digital learning formats offer completely new possibilities for continuing education. **”**

Anke Felbor, Managing Director of LearnNow.de and former Director of ZEIT Akademie



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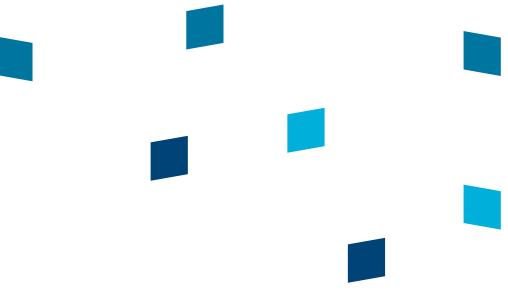
## *9. Introducing digital education to all phases of life*

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Digitisation changes the way we work. Jobs and entire professional profiles will disappear. New qualifications and combinations of qualifications and, correspondingly, new training content will be necessary. Already in 2014, no less than 509,000 data experts were being sought in Europe. Analysts estimate that, 3.5 million data experts will be needed by 2020. This demonstrates, for one thing, that we must step up our qualification programmes. For another thing, digitisation is opening up a significant amount of job opportunities.

New digital work will be more demanding and more complex. In the ICT sector alone, there are currently 40,000 open positions. In the future, more and better training and skill development will be key, in the opinion of employees. Tasks involving mostly routine activities will not be needed as much as at present. Flexibility and knowledge of methods for using digital technologies will become more important. This can already be seen in training courses where several specialised courses are combined into newer, more general training. Currently, training in flexography is part of the professional qualification for digital and print media designers.

Digital education will increasingly become a prerequisite for a successful working life and is also a requirement for our self-determination and general evaluation capabilities in the digital world – not only on the job, but also as consumers and citizens. These demands are accompanied by new possibilities: new teaching and knowledge distribution methods, along with interactive learning methods are providing expanded access to knowledge. However, even though nearly all schools in Germany have Internet access, they are slow in using new media and forms of learning, such as utilisation of tablets.



Our companies have long since recognised that we need a transformation in education and training of current and future employees. Even now, eight out of ten companies across all sectors state that further training of their qualified personnel in the digital working world is decisive for their competitive strength. The greatest need was perceived in data analysis skills (45%), social media competence (35%) and programming (35%), but data protection and data security (25%) also play an important role.

We need a **Digital Learning Strategy** that will be supported by all stakeholders. Digital technology should not be rejected across the board, rather be made a key component of an educational policy focused on self-determination in an open and well-thought-out process. Not only businesses and politicians are requesting this. A new survey shows that almost three-fourths of all teachers (73%) support this effort.

Our goals:

- *In 2025 every school pupil will have basic knowledge in information science, how algorithms function and in programming. In order to achieve this, appropriate courses must be required in lesson plans in the primary and secondary schools and in teacher education and continued training.*
- *By 2025, Germany will be one of the leaders in digital infrastructure in the education sector.*
- *By 2025, the workplace should be the number one place to acquire the newest IT knowledge.*
- *By 2025, all publicly financed educational institutions should make essential teaching material available online.*

In order to reach these goals, we must push for education in and for the digital world in 2025 at all levels – starting at school, including the dual system of vocational training, on up to university and professional continuing education. To promote digital education and to improve the digital infrastructure in the education sector, the federal government and states must work together more than ever before.

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**School education** is the key to digital general knowledge. We want the following:

- Schools in Germany should catch up with international leaders in using digital media.
- Strengthening the connectivity of companies and educational institutions by, for example, sharing innovation and knowledge management concepts developed by business with educational institutions.
- Assisting start-ups in the education sector that use digital platforms to enhance access to the creative potential and expert knowledge of teachers.

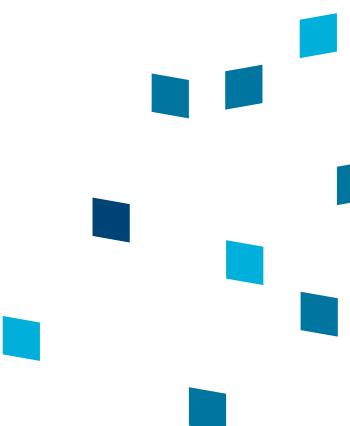
The **dual system of vocational training** is an important cornerstone of the strategy for satisfying future demand for skilled workers. It should also be a guarantee for quality and innovation ability – Made in Germany. Our goals:

- To align the dual system of vocational training with the demands of a digital economy. Existing training programmes and continuing education programmes must be updated in conjunction with management and employee representatives with a view to teaching necessary digital capabilities. This also means that methods and problem solving skills should receive stronger support and financing. In companies without their own R&D departments, employees with a non-academic background will become a more significant integral part of the innovation process.
- The industry-wide continuing education centres should be able to offer further training in digitisation at a high level. The necessary investments to set up these facilities will receive funding priority. For these purposes, an additional €8 million will be made available from 2016 to 2018.
- The dual system of vocational training for IT jobs should be oriented more strictly to practical skills required, so that companies will continue to hire graduates from these programmes as an alternative to university graduates. For application-specific software development and programming, the dual system with its practical approach can offer advantages. Curriculum, scope and distinctions between the four dual IT vocational training majors are currently being reviewed by teachers, students, employer and employee representatives, as well as representatives from the federal states (until autumn of 2016). This will be the basis for modernising the following training programmes: IT systems electronics technician, Information technology specialist, IT system support specialist and information technology officer.

- The need to adapt existing occupations and to create new trades will continually be identified and implemented with input from experience in the field. We are currently in discussions with management and employee representatives regarding creation of a new occupation: the e-commerce officer.

Highly qualified personnel is the essential basis for innovative capability and the competitiveness of our economy. **Universities** are the nucleus of digital innovation. Our goals.

- Promote the establishment of additional academic chairs and strengthen the available excellence institutions in the MINT areas, and in particular in information science, for example in the areas of Big Data analysis, industrial software and IT security. To this end we encourage stronger cooperation with business, for example by means of third-party financing and foundations.
- Information systems, data analysis and the Internet as interdisciplinary areas of study should be included in other majors – especially in the business schools and in law, political science and social science disciplines. Scientific-technical capability must be coupled with economic-political evaluation and regulation competencies. Just as digitising a company is no longer the job of the IT department and, on a macroeconomic level, no longer a topic of the IT sector, digitisation must also break down the boundaries between the disciplines at universities.
- Our programmes for funding business formations at the universities (EXIST) must be expanded in order to introduce top-level know-how to business and to make it available in Germany and in Europe.
- Online offers such as Massive Open Online Courses (MOOCs) should be better integrated into university studies in the future. E-learning should be a meaningful addition to presence in the classroom, in the sense of blended learning.

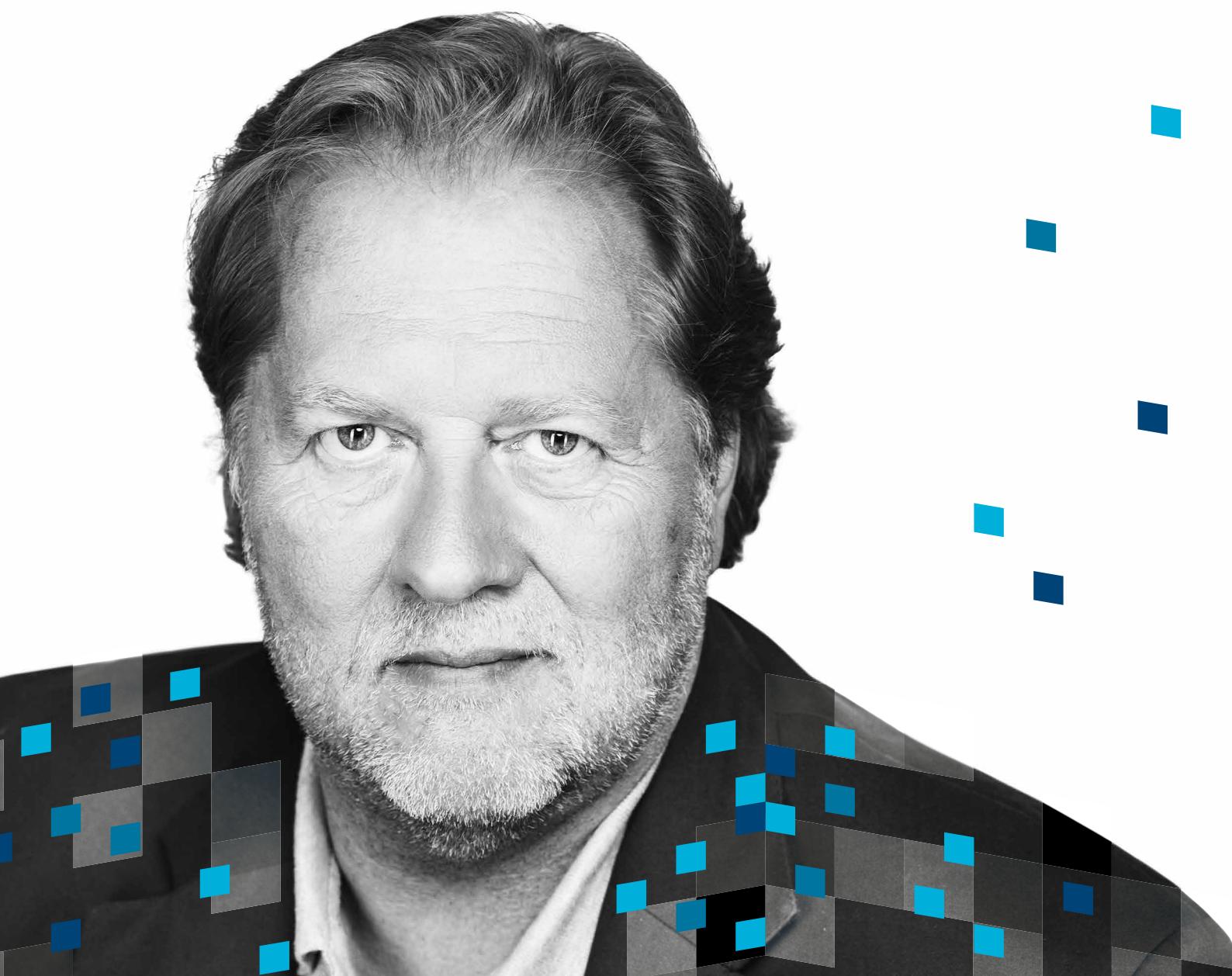


Because of the rapid pace of technical progress, **continuing education** is the key to lifelong learning and Work 4.0. We will

- *work with trade unions and employers to create means of more flexible and individualised digital continuing education, in order to provide employees with industry-wide, practical IT-related basic knowledge and supplemental knowledge on communications and project work. BMWi has already developed an approach to digital continuing education in a half-day format, particularly for SME employees. This plan will be introduced in the near future to the major actors in the area of continuing education and discussed with respect to how to conduct trials. BMWi would also fund these trial runs for a short time. One condition would be commitment from continuing education participants;*
- *place particular focus on SMEs, showing them ways to quickly and continuously train their employees. Rapid advances in technology require bigger efforts for further training, even for well-established companies and experienced employees. The Mittelstand 4.0 Centres of Excellence will provide help and instruction in digital training;*
- *continue to develop evaluation and perhaps certification systems for continuing education for employees without access to a company continuing education programme, in order to increase the attractiveness and transparency of such offers, and contribute to an effort to make continuing education generally more flexible. This includes setting up online courses for continuing education during employment;*
- *also expand media literacy and enable everyone to use the resources offered by the Internet to continue learning on their own, and to be able to judge the quality of digital information and education being offered.*

**“**To prepare for the digital transformation we must also improve our institutional infrastructure. A Digital Agency will provide the opportunity to bring together the knowledge and capabilities that are required.**”**

*Prof. Dieter Gorny, BMWi Commissioner for a Creative and Digital Economy, and Chairman of BVMI (German Music Industry Association)*



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## *10. Creating a Digital Agency as a modern centre of excellence*

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Digitisation poses big challenges to public policy and governmental supervisory authorities. The issues at the center of concern are fair competition, confidentiality of communication, security of the systems used and consumer protection. The tasks evolving from these considerations are currently carried out by a number of agencies at the federal level, including the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway (Bundesnetzagentur), the Federal Office for Information Security (Bundesamt für Sicherheit in der Informationstechnik), the Federal Financial Supervisory Authority (BaFin), the Federal Office of Consumer Protection and Food Safety (Bundesamt für Verbraucherschutz und Lebensmittelsicherheit) and the Federal Cartel Office (Bundeskartellamt).

Competencies in the area of digitisation are currently fragmented. In order to enable our institutions to deal with the dynamics and broad scope of digitisation, we need modern concepts for developing and implementing policies. In order to answer questions on digitisation in aspects relating to competition law, the market and consumers, not only do we need a digital agenda, rather also a Digital Agency that will function as a highly efficient and internationally connected centre of excellence at the federal level. This centre would provide competent, neutral and long-term assistance to the federal government both as a think tank in preparing policies, and as a service point for implementation, and would also assist in the digitisation process while representing the interest of business and consumers.

With the comprehensive and consistent approach that a digital agency could provide, Germany would take on a leading role internationally. In the G7 similar task groups have been initiated; however these have been assigned specific tasks (in particular e-government) and no generic digitisation tasks. The new federal Digital Agency, on the other hand, should be based on three pillars:

- *bringing competencies together,*
- *supporting the political digital agenda, and*
- *sustainably building up digitisation competence.*

This process should encompass the entire digital value-added chain, beginning at the content, service and application level, to connectivity, and on to devices and users. Horizontal issues such as research and development, standardisation, data protection and IT security should always be included in order to prevent silo mentality when solving conflicting objectives for the digitisation process.

Our first step is to significantly expand the Federal Network Agency's analysis capability and its ability to act. This will take the development of existing and new statutory requirements into account. It is especially necessary to strengthen our observation of the market and participants, not lastly to satisfy new European regulations on maintaining Internet neutrality. Also in the course of the current review of the European legal framework being conducted by the European Commission, we expect that the duties of national regulatory authorities for a Digital Single Market will be expanded. Setting up digital networks / Internet platforms, a start-up team is the first step toward proactively expanding and concentrating competencies.

In the mid-term however, a Digital Agency should be a service point that takes on the task of informing companies and consumers, being available to government agencies as a central competent contact and also identifying and removing obstacles to political strategies. Just like the Federal Environment Agency (Umweltbundesamt) or the Federal Office for Migration and Refugees (BAMF), a new Digital Agency can help to master one of the major challenges to society.



A likely scope of tasks for the agency would therefore include:

- *analysis, market monitoring and reporting on digitisation,*
- *consultation and advisory services for consumers and businesses, along with practical assistance,*
- *reducing macroeconomic information and coordination costs,*
- *support for important user sectors (industry, services) in utilising the potential of digitisation,*
- *dispute settlement and handling consumer complaints,*
- *contact and cooperation with municipalities, the federal states, European and international bodies as well as with companies, associations and other stakeholders.*

In addition to formalising the Digital Agenda, the Digital Agency will also be concerned with creating sustainable digitisation competence in economic, legal and technical aspects. With a view to the partly evolutionary and partly revolutionary effects of digitisation and connectivity, the dynamism of this development should be scientifically analysed and continually monitored (technology assessment). With this basis of knowledge and experience in the digital transformation, the Agency, in its function as an economically neutral think tank, would be predestined to advise the federal government on digitisation.



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