Business models of the digital economy

The digital economy is divided into the internet economy and the ‘classic’ information and communication technology industry. Innovative business models of the digital economy are based on software- and internet-based technologies such as cloud computing or the analysis of large quantities of data (big data). The business models are adopted especially by young enterprises.

Market capitalisation of companies on 1 January 2015 in billions of euros and growth since 1 January 2005

<table>
<thead>
<tr>
<th></th>
<th>Internet economy:</th>
<th>Information and communication technology:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,159 (+365%)</td>
<td>3,392 (+87%)</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td>USA</td>
</tr>
<tr>
<td></td>
<td>34 (+166%)</td>
<td>297 (+57%)</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td>Germany</td>
</tr>
</tbody>
</table>

Platform operators of the most frequently visited websites come primarily from the USA

Most frequently visited websites, international:
1. Google.com (USA)
2. Facebook.com (USA)
3. Youtube.com (USA)
4. Baidu.com (China)
5. Yahoo.com (USA)

Most frequently visited websites in Germany:
1. Google.de (USA)
2. Amazon.de (USA)
3. Facebook.de (USA)
4. Youtube.com (USA)
5. Ebay.de (USA)

Corporate value per user (figures in US dollars)

Users’ data enable companies to analyse customer preferences and in this way to offer and further develop user-optimised advertising, products and services.

Four out of five digital start-ups take place in the internet economy

Start-ups in the German internet economy between 2000 and 2014

Source: for information on start-up statistics and corporate value per user, cf. Müller et al. (2016).
The digitisation of the economy and society has been progressing for over 40 years. Contrary to some statements made in politics, the media and science, it is not a new phenomenon. But the advancing connectedness of people and objects, as well as their integration into the internet, is creating entirely new spheres of action. Policy-makers, businesses and society face major challenges as a result of this development.

Innovative business models in the digital economy, which build on software- and internet-based technologies such as cloud computing and the analytics of large quantities of data (big data), are currently being adopted particularly by young enterprises and are driving growth in the internet economy. Established companies that do not embrace this development are running the risk of losing competitiveness.

The current situation is alarming. Germany has lost ground not only in the traditional information and communication technologies (ICT) in the last few decades. Much more serious is the fact that German companies have not yet been able to build up any strengths in the new digital-economy fields in which skills in the use of IT-based processes are crucial. US companies dominate activities in the international internet economy. In addition, policy-makers in Germany have for a long time failed to create sound framework conditions for new, internet-based business models. Rather, they have tended to support established structures and incumbent business models. There is currently a lack of a convincing strategic approach to research and innovation policy (R&I policy) in the field of digital innovation.

The example of automotive engineering – one of Germany’s most important industries in terms of employment and exports – illustrates how massively the development of new digital business models can change existing value creation. Here, the companies face two key challenges:

- Internet platforms continuously collect data on the behaviour of vehicle users and their preferences. Mobile devices enable the platform operators to offer attractive services (e.g. navigation, search, music or other information services) which complement or substitute the products and services of incumbent original equipment manufacturers (OEMs). The car’s value for customers and their willingness to pay declines. In this context, automotive engineering...
could be pushed into the role of a supplier in the value chain for mobility services. In such a scenario, the strategically most important position in the value chain – that of the greatest proximity to the customer – is occupied by information providers.

In addition, automobile manufacturers will also have to reckon with competitive entries in the production of vehicles in the medium term. Internet companies like Apple and Alphabet are no longer limiting themselves to the above-described role of internet platforms and service providers. They – like the incumbent OEMs – are currently planning the launch of ‘autonomous driving’ and will probably succeed in developing their own manufacturing of electric vehicles.

However, in an analysis of digitisation from the perspective of innovation economics, it would be too narrow to concentrate only on industries that have hitherto been particularly important in the German innovation model. Digitisation affects the economy and society across the board and in all sectors. In the view of the Commission of Experts, it is therefore counterproductive to focus R&I policy on the field of manufacturing. The importance of data-driven services and business models for value creation has risen sharply in recent years and will – most probably – continue to do so. The reason for this is that the collected information and user data are no longer seen only as supporting elements in value creation, but as sources of value in their own right.

The Commission of Experts already mentioned in its last report the great opportunities – but also the considerable risks – for Germany as a location for business and innovation that stem from digitisation and connectedness. This discussion will be continued in this chapter, paying special attention to innovative internet-based business models.

### Definitions

According to the definition of the Federal Ministry for Economic Affairs and Energy (BMWi), the digital economy includes both the ICT sector – with its hard- and software manufacturers and service providers – and the internet economy. When delimiting the internet economy, the BMWi takes its orientation from national expenditure accounting, which records turnover with internet-based consumption, investment and foreign trade.

The German Digital Economy Association (BVDW) uses a narrower definition of the digital economy. It focuses strongly on the use of internet technologies. In contrast to the BMWi’s definition, it does not include ICT-based infrastructure or consumer electronics in the digital economy. Three areas of activity are highlighted as the core of the digital economy:

1. Internet service access: this covers all mobile and stationary data services for accessing the internet, internet exchange services and domain allocation.
2. Applications and services: this includes IT outsourcing, hosting, cloud computing, the creation of internet presentations, online marketing, software applications for web applications including e-learning, digital print prepress and web-to-print applications.
3. End-user interaction: this field comprises all end users, companies and consumers, i.e. all B2B (business-to-business) e-commerce, online banking, B2C (business-to-consumer) e-commerce with goods and online services (e.g. dating agencies, tickets, travel and tourism, etc.), as well as original web content (e.g. online publishing, media downloads, mobile apps, etc.).

If the focus is exclusively on the use of internet technologies, then any company, regardless of its actual industry classification, can be counted as part of the digital economy, provided that its business processes are largely digitised and web-based.

### Business models in the digital economy by international comparison

Growing market dominance of US companies in the digital economy

The rapid development and the high value-creation potential of the internet economy and the ICT sector can be illustrated by looking at the market capitalisation of companies in the two fields. Figure B 3-2 compares performance in different countries over the last ten years. The market capitalisation of the internet economy rose much faster than the ‘classic’ ICT industry in this period.

The dominance of US companies throughout the entire digital economy, and especially the strong growth in the field of the internet economy, are
remarkable. The market capitalisation of the US companies in 2015 alone (1,159 billion euros) was about 15 times the size of the entire internet economy in Germany (34 billion euros), South Korea (36 billion euros) and Sweden (3 billion euros) together. In the last ten years, the market capitalisation of the US companies has increased almost fivefold, and in South Korea it has more than tripled. Like Sweden, Germany recorded only moderate growth and is falling further behind the USA.222

In the past 15 years, many young companies in the US internet economy have grown very quickly – e.g. Facebook, Alphabet, Twitter and LinkedIn – and in some cases have exceeded the capitalisation of longer established companies in the ICT sector such as Microsoft (cf. Figure B 3-3). The three financially strongest companies in Germany with (at least some) key business activities in the ICT sector are Siemens, SAP and Deutsche Telekom (cf. Figure B 3-4). Their growth is only very weak compared to the dynamics of the new internet companies in the USA.

The market capitalisation of Alphabet alone exceeds that of all German companies in the entire digital economy. The financially strongest internet-economy companies in Germany include Zalando, United Internet and established companies like Axel Springer. Even their market capitalisation has grown only very slowly compared to the group of the new US corporations. The structure of the internet economy is thus dominated by relatively young US companies.

Growing importance of users and access to the end customer

The importance of data-driven services is further growing. Personal data from customers or users of digital services have come to be regarded as an important resource, since they secure long-term access to end customers. Companies with a large number of users are therefore especially attractive for many investors.223 At the same time, users represent an important source of innovation for companies in the digital economy. Internet-economy companies now regard them as far more important than, for example, cooperation with tertiary education or research institutions.224

Takeovers and market valuations of companies with large numbers of users show that investors recognised a long time ago that the generation and use of personal data would become very profitable (cf. Table B 3-5). Although the business model does not yet seem to have been finally clarified in some digital services, very high valuations are already being
realised in acquisitions and IPOs. Relating the corporate or acquisition value of the digital business models to the number of their users, Facebook, for example, paid 30 US dollars per user when it took over Instagram. Comparable valuations per user are also realised for other service providers with a large number of users, such as YouTube, Skype or Twitter.

Many initiatives and pilot projects launched by companies in the sectors of education, energy, health, banking, transport and administration show that further networking and the introduction of innovative digital business models are likely to proceed at a rapid pace in all sectors of the economy. Incumbent companies in many sectors must reckon with interfaces to the end customer being occupied by new intermediaries such as platform providers.

For example, banks in the USA are being confronted with new competitors in innovative mobile payment systems. There, payments are increasingly being handled via smartphones. Similar developments are also taking place in Europe. Banks are being subjected to considerable competitive pressure both by startups in the so-called FinTech (financial technology) field, and by global internet companies such as Apple, Alphabet, PayPal or Amazon (cf. Box B 3-6).
Market capitalisation of German companies in the ICT industry and the internet economy

Top 3 companies by market capitalisation; market capitalisation of the remaining companies, 2000 to 2015, in billions of euros

![Graph showing market capitalisation of German companies in the ICT industry and the internet economy from 2000 to 2015.]

Source: own diagram (stacking diagram) based on Müller et al. (2016).

Corporate value per end user

<table>
<thead>
<tr>
<th>Companies</th>
<th>Company value per end user (US dollars)</th>
<th>Year</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tencent</td>
<td>199.73</td>
<td>2014</td>
<td>China</td>
</tr>
<tr>
<td>Twitter</td>
<td>90.52</td>
<td>2014</td>
<td>USA</td>
</tr>
<tr>
<td>Xing</td>
<td>78.04</td>
<td>2014-2015</td>
<td>Germany</td>
</tr>
<tr>
<td>LinkedIn</td>
<td>62.80</td>
<td>2015</td>
<td>USA</td>
</tr>
<tr>
<td>Facebook</td>
<td>52.99</td>
<td>2013-2014</td>
<td>USA</td>
</tr>
<tr>
<td>Skype</td>
<td>50.00</td>
<td>2011</td>
<td>Luxembourg/USA</td>
</tr>
<tr>
<td>Whatsapp</td>
<td>29.95</td>
<td>2014</td>
<td>USA</td>
</tr>
</tbody>
</table>

Source: own diagram based on Müller et al. (2016).
Reference figure: a: Number of monthly active users (in millions); b: Annual average monthly active users worldwide (in millions); c: Monthly users (in millions); d: Figure generated via company acquisition.
The importance of services in general will continue to grow as things are increasingly connected, while the value-added by pure production will tend to decline. The provision of services is now already of great importance for industrial companies, too. According to a business consultancy, services are already responsible for half of the profits of European industrial companies. Business models in the digital economy have drastically reduced the entry barriers for new competitors in the services sector. This applies i.a. for cloud-based service providers, which can develop and market their products and services without investing in IT infrastructure. Incumbent firms must therefore now expect to be challenged faster and more frequently by such innovators.

In view of the fact that digital business models are emerging in all sectors, the Commission of Experts calls into question industry-targeted support strategies. Yet the Federal Government’s approaches seem to be pursuing precisely this avenue (Industry 4.0, Smart Service World, E-Health, etc.). One critical issue is cross-sectoral weaknesses – for example in the field of internet-related software and digital business models – that cannot be sensibly tackled. Rather, there is a risk that the lack of skills will not be addressed, and that the learning effects and positive externalities that can result from funding will only be partially used.

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**New digital-economy business models in healthcare, banking and energy**

The internet platform ‘ZocDoc’, founded in New York in 2007, provides a fast and efficient service arranging doctors’ appointments. It is one example of digital interaction and dialogue with patients in the healthcare sector. By collecting additional customer information, such as a patient’s medical history, the system aims to use data-driven analyses to suggest suitable screening examinations and other health services. The company is estimated to be worth around 1.5 billion US dollars. A start-up in Germany called ‘doxter.de’ offers a similar service; it is a spin-off from Berlin’s Charitè hospital.

In the banking sector, Apple Pay and Google Wallet are examples of the development and use of mobile payment systems based on new digital business models. Due to the dominance of Alphabet and Apple in mobile operating systems, it is highly likely that in future money transfers will increasingly be handled via their services. Since Alphabet and Apple also control the corresponding hardware interfaces – e.g. Near Field Communication (NFC) – via their operating systems, the two corporations could also ensure interoperability with other payment systems, e.g. in the retail trade. The number of payments using NFC technology rose sharply after Apple Pay was announced in September 2014, underlining the potential of this technology. However, money transfers between users could also form the basis for further profitable business models – Facebook, for example, is currently making inroads into this field with the payment function of its ‘Messenger’.

Start-ups in Germany in the field of internet-based payment systems include Cringle, SumUp and Barzahlen. European banks are also now getting involved in the field of internet-based payment systems.

In the energy sector, Alphabet purchased the company Nest in 2014. Like the German competitor Tado, this company makes smart thermostats which can regulate the temperature dynamically depending on how many people are present in the house. After extended periods of use, the system can use learning algorithms to raise efficiency and thus reduce energy costs. This ability could turn Nest into a competitor for established players in electricity markets. A parallel product line from Nest with intelligent smoke detectors is now being linked with building-insurance companies. When a smart detector is installed, the companies give a discount on the insurance premium. The high degree of networking between thermostats, smoke detectors and other sensors in smart homes represents a step toward the Internet of Things.
A lot of start-up activity in digital-economy business models

Digital-economy business models are frequently at the core of innovative start-ups. Start-ups that are particularly attractive for investors are currently to be found in the fields of banking and finance (Fin(ancial)Tech), education (Edu(cation)Tech), e-commerce, the Internet of Things (IoT) and social networks (social, crowd and curation models).238 In the period from 2000 to 2014, a particularly large number of new internet companies were launched in major German cities such as Berlin (approx. 6,000 start-ups), Hamburg (approx. 3,900), Munich (approx. 3,600), Cologne (approx. 2,000) and Frankfurt (approx. 1,400) (cf. Figure B 3-7). About four out of five digital start-ups belong to the internet economy – compared to a significantly smaller number of start-ups in the ‘classic’ ICT industry. It is remarkable in this context that Berlin of all places – a region that does not stand out as having a strong industrial base in manufacturing – is benefiting from start-ups in the internet economy.239

Yet the market for venture capital, which also provides the external equity capital for start-ups in the digital economy, remains marked in Germany by a severe shortage of privately provided venture capital. While the public funding of start-ups has developed well as a result of the EXIST start-up grants and the financing offered by the High-Tech Gründerfonds, the framework conditions for private investors during the growth phase240 remain poor. The Commission of Experts has already criticised this shortcoming and the evident regional disadvantage it causes in several reports.241 Yet Germany and Europe continue to fall even further behind the USA. For example, not only was significantly more private venture capital available in total in the US than in Europe in 2014, but almost 50 percent of the funds financed US start-ups in the fields of ICT hardware, programming, data processes and data hosting.242 Investment in these important areas of the digital economy make up only 20 percent of the resources invested in Europe.243

It is not only in the field of venture-capital financing that German business incubators are lagging behind other European cities. For example, a recent study, the European Digital City Index 2015, points to regional weaknesses especially in the field of digital infrastructure: e.g. the relatively high cost of broadband internet and the low average speeds of mobile internet connections and broadband downloads.244 In addition, the study refers to the high labour cost of skilled personnel, a lack of crowdfunding finance, and poorer access to mentors for start-ups in the digital industry. In the overall ranking of European business incubators, there is not one German city among the top five cities (London, Amsterdam, Stockholm, Helsinki and Copenhagen).245

A typology of business models in the digital economy

Numerous different business models are deployed in the digital economy (cf. Box B 3-8). Entrepreneurs often experiment with different forms of digital business models to identify the ones that are especially profitable.

Many business models in the digital economy aim to gain access to the end customer or user. The survival and growth of a start-up often depends on whether it succeeds in establishing as an intermediary with a large base of users – a region that does not stand out as having a strong industrial base in manufacturing – is benefiting from start-ups in the internet economy.239

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Many business models in the digital economy aim to gain access to the end customer or user. The survival and growth of a start-up often depends on whether it succeeds in establishing as an intermediary with a large base of users. In this way a start-up can, if successful, partly or completely take over the existing access to customers from incumbent companies or manufacturers by taking on a coordinator role or by arbitrage between supply and demand. For their part, incumbent companies stand to lose part of their value added, or must at least expect that start-ups or new intermediaries will gain bargaining power within value chains.

New companies often create additional customer benefit on the basis of digital business models, e.g. by greatly cutting the users’ transaction costs. Established markets – whether online or offline – can be made a lot more transparent, competitive and innovative from the users’ point of view, leading to falling prices or increasing quality of supply. At the same time this is likely to induce a more differentiated supply, and therefore broader range of services and products. Among other things, a cross-sectoral or platform-driven exchange of data can lead to attractive new bundles of services and products as the scale of connectedness grows. Greater involvement by consumers and users in the value-creation processes of the digital economy also increases the likelihood that users too will generate more innovations.
Number of business start-ups in the internet economy in Germany, 2000-2014

Source: own diagram based on Müller et al. (2016).
Remarks: Identification of start-ups based on commercial register entries (ORBIS database).
Expansion of the digital economy

More and more new fields of business activity are emerging in the digital economy as the scale of connectedness increases. These are no longer limited to the initial application fields of data processing, telecommunications and transmission technologies. Many of the transactions in the market for corporate acquisitions and disposals in the period from 2013 to 2015 suggest that new fields of application are currently being opened up which up to now have not been among the core activities of the digital economy (cf. Table B 3-9).

These new fields of application, which are leading to the further expansion of the digital economy, include among others sectors such as Smart Home, the Internet of Things (IoT), new forms of communication like WhatsApp, robotics (cf. Chapter B 2), augmented reality (using computers and data glasses246), virtual reality, mobility and security. At the same time, most of these activities are currently being driven by the financially strong corporations of the internet economy, above all US and Asian companies. They have already acquired numerous companies from other industries, including German firms. However, systematic studies suggest that companies from Europe are relatively rarely the target of such acquisitions, and that they very rarely take on the role of buyers.247

B 3-3 Digital business models in established companies

Status quo – reticence among small and medium-sized enterprises

Survey results indicate that established companies in Germany expect digital technologies to lead to changes primarily in the overall economy or in their sector. On the other hand, they only expect a minor impact on their own company.248 About a third of the firms say they see no need for digitisation activities and are therefore not planning to invest. Only two reasons are given more often to explain why companies are not investing in digital change: budget restrictions and a lack of skills.249 Yet many businesspeople are well aware that, in the course of digital change, they will have to expect new competitors and a growing dependence on other companies playing a key role in the value-creation network – for example platform services.250

Examples of digital-economy business models

**‘Free-of-charge platforms’**

are business models containing the following elements:
- ‘Free-of-charge services’ offer a free basic service (called a freemium) in order to establish a broad customer base. Income is generated by additional offerings for which a charge is made, or by other forms of returns.
- The ‘coordinator role’ combines the value-creation activities of different companies to offer customers an aggregated product.
- In ‘two-sided markets’, different customer groups are served – partly for free, partly for a fee – by a platform.
- The ‘differentiated demand’ approach is characterised by the fact that customized offers are made to heterogeneous users, and income is generated via many small payments.
- Example: Soundcloud is a platform for making contact between artists and their fans. Artists can upload up to three hours of audio material free of charge. Charges are made for larger volumes of audio material or a more comprehensive profile. Further examples of this business model include Google, LinkedIn or Xing.

**‘Experience-oriented crowd users’**

are business models containing the following elements:
- ‘User experience’ means that the customer’s (emotional) experience is at the centre of the use of the service.
- In ‘crowdsourcing’, key activities of value creation are outsourced to the crowd, i.e. to the general public or a selected group of users.
- ‘Value added from user data’ aims to generate additional income from the analysis of customer data.
- Example: Researchgate is a website and social network for scientists. The users can hold discussions with researchers in their specialist fields and upload their publications. This creates a unique atmosphere for the users, and the site benefits from the contributions of all users. Further examples of this business model include Facebook, Twitter, Flickr, YouTube or Instagram.
"Subscriptions for differentiated consumers" are business models containing the following elements:
- 'Differentiated demand' (see above).
- 'Subscriptions' requiring periodic payments by the user to the provider for a fixed term. The offer can subsequently be used in the manner stipulated in the contract. Since the reproduction of digital goods generates virtually no costs, these goods can be offered cheaply.
- Example: Babbel offers language-learning subscriptions for fixed-term, periodic payments. Alternative examples of the business model are Spotify, Apple Music or Netflix.

"E-direct sales" are business models containing the following elements:
- In classic 'trading-commerce', products or services are offered for sale via the internet.
- 'Direct sale' means that the products are sold directly to the customers by the producers, i.e. without intermediaries.
- Example: Zalando is a typical online trader specialising in shoes and fashion. Alternative examples of the business model are Amazon or Alibaba.

"Partnership platforms" are business models containing the following elements:
- 'Two-sided market', 'coordinator role' and 'differentiated demand' (see above).
- 'Partnership' refers here to commission paid for passing customers on to third parties.
- Example: Lieferheld pools the ranges of many delivery services in a region and offers the customer easy access via the platform. Alternative examples of the business model are Idealo, Billiger.de or Check24.

"Additional offer and cross-section function" are business models containing the following elements:
- 'Cross-section function' and 'subscriptions' (see above).
- In the case of an 'additional offer' a basic range is first offered relatively cheaply. The user has to pay a surcharge for an offer with more options.
- Example: ArangoDB offers its NoSQL database to many different industries. Higher fees are charged if larger quantities of data are to be supported. Alternative examples of the business model are GitHub, TeamViewer or Dropbox.

"Coordinators of individualised mass products" are business models containing the following elements:
- 'Coordinator role' and 'two-sided market' (see above).
- 'Individualised mass products' means that products are mass produced, but customized at the same time.
- Income is generated by 'cross-sectional functions' when services or products are offered for a certain part of the value chain in different industries. This digital-economy business model thus combines an individual offer with a platform on which the part-offers of individual partner providers are available.
- Example: Test Birds offers customers an individual app for testing the functional performance of websites. The business model is implemented by the crowd. Here, Test Birds functions as the intermediary between users who test and users who want to have their websites tested. Alternative examples of the business model include 3D Hubs, MakeXYZ or MakeTime.

Source: Own illustration based on Müller et al. (2016). Note: A multi-level cluster procedure was used to identify ideal-typical forms of business models in the digital economy from a sample of both successful and unsuccessful digital-economy start-ups in Germany (Crunchbase database).
### Selected holdings and take-overs

<table>
<thead>
<tr>
<th>Buyer companies</th>
<th>Target companies</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
<td><strong>Country</strong></td>
<td><strong>Name</strong></td>
</tr>
<tr>
<td>Amazon.com Inc</td>
<td>USA</td>
<td>Ziemery Inc</td>
</tr>
<tr>
<td>Apple Inc</td>
<td>USA</td>
<td>Metaio GmbH</td>
</tr>
<tr>
<td>Facebook Inc</td>
<td>USA</td>
<td>Surreal Vision Ltd</td>
</tr>
<tr>
<td>Intel Corp</td>
<td>USA</td>
<td>Vuzix Corp</td>
</tr>
<tr>
<td>SoftBank Corp</td>
<td>Japan</td>
<td>Aldebaran Robotics SAS</td>
</tr>
<tr>
<td>Samsung Electronics</td>
<td>South Korea</td>
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</tr>
<tr>
<td>Deutsche Telekom AG</td>
<td>Germany</td>
<td>brightONE GmbH-Healthcare Bus</td>
</tr>
<tr>
<td>Alphabet Inc</td>
<td>USA</td>
<td>Titan Aerospace</td>
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</tr>
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<td>Qualcomm Inc</td>
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<td>Beijing Wanghe Times Tech Co</td>
</tr>
<tr>
<td>Alphabet Inc</td>
<td>USA</td>
<td>Boston Dynamics Inc</td>
</tr>
<tr>
<td>Alphabet Inc</td>
<td>USA</td>
<td>Schaff Inc</td>
</tr>
</tbody>
</table>

Source: own diagram based on Müller et al. (2016).251
The use of digital technologies is a suitable indicator for determining the degree of digitisation of value creation and the potential advantages for German companies of launching digital business models of their own. Cloud computing and big-data analytics currently have an especially high priority for companies in Germany. Technologies and processes like mobile enterprise, social business and sensor networks in the context of Industry 4.0 are of only secondary importance.252

Interviews with company representatives confirm that many large German companies have been using IT to support or automate their business processes, e.g. with integrated information systems or workflow management systems. For example, digital platforms can be also used to organise research and development processes within the company and make them more efficient (cf. Box B 3-10).253 Such process improvements are currently only just being introduced in established small and medium-sized enterprises (SMEs).257

However, the different sectors vary – in some cases considerably – as regards the use of digital technologies. A recent study confirms that there is already a relatively high level of digital maturity in companies in the automotive engineering industry, as well as in logistics and transport.258 The authors of this study say that Germany is a long way behind in sectors such as healthcare, financial services, commerce, services and construction. There are evidently deficits specifically in those industries where digitisation is expected to have an especially big influence in the future.

SMEs seem to have particular difficulties with implementing new digital business models (cf. Box B 3-11). The smaller the company, the less important digital technologies are, according to the companies surveyed.259 The Commission of Experts is therefore concerned that a large proportion of SMEs are underestimating the importance of digital change (cf. Figure B 3-12).
The term big data covers technological developments in the field of data storage and processing, which make it possible to integrate ever greater amounts of data in many different formats and to process them more and more quickly.\textsuperscript{260} Big data thus offers an opportunity to keep control of the exponentially rising data volumes caused by the growing ubiquity of ICT and, above all, to use it to generate value.\textsuperscript{261}

According to a definition by the Federal Office for Information Security, cloud computing refers to offering, using and charging for IT services over the internet. The services provided can be rapidly adapted to changing needs.\textsuperscript{262} They are offered and used exclusively via defined interfaces and protocols. The range of services offered within the framework of cloud computing embraces the entire spectrum of information technology, including infrastructure (e.g. computing power, memory), platforms and software. Cloud computing typically has the following five characteristics:

\begin{itemize}
  \item Automated set-up: the initial provision of the resources (e.g. computing power, memory) takes place automatically without any customer-specific interaction with the service provider.
  \item Easy access via the internet: the services are available with standard mechanisms via the internet and are not tied to a specific client.
  \item Virtual pooling of resources: the provider’s resources are to be found in a pool which many users can pick from (multi-tenant model). The users do not know where the resources are located, but they can contractually stipulate the location of the memory, e.g. the region, country or data centre.
  \item High elasticity: the services can be made available quickly and with great elasticity – in many cases automatically.
  \item Costs depend on usage: resource usage is a measurable service for which the cloud users are charged.
\end{itemize}

The advantages of the cloud-computing service models\textsuperscript{263} for companies lie primarily in a lower need for investment, greater flexibility, and the easy scalability of cloud services, especially when capacity requirements fluctuate.
Germany lags behind in the use of big data and cloud computing

Big data and cloud computing are especially important digital technologies because both are said to have a disruptive effect (cf. Box B 3-13). Disruptive technologies are technological innovations that supersede existing technologies, products or services and frequently lead to the emergence of entirely new markets.

A recent study on big data shows that in 2014 only 9 percent of the German companies surveyed were using big-data solutions; another 31 percent had concrete plans for their use. While 28 percent of respondents were still at the decision-making stage, 33 percent had not yet looked into the subject.

Here, too, considerable differences can be seen between large companies and SMEs in the use of big-data approaches. While only 7 percent of SMEs actually apply big data approaches and 29 percent have concrete plans to use them, 27 percent of the major corporations are already users, and a further 42 percent have concrete plans. 36 percent of the SMEs say they have not yet considered big-data concepts, compared to only 8 percent of major companies.

In an international comparison, Germany is well below the average in the use of big-data approaches among the countries studied. Companies in India, the USA, Mexico and the United Kingdom use (or plan to use) big data twice as often as German companies.

Furthermore, only 11 percent of SMEs with 10 to 249 employees used cloud computing in Germany in 2014. By contrast, these services were used by 27 percent of German companies with more than 250 employees. The most important reason given by SMEs for not using them is the perceived risk of security problems. In many other European countries, use by both SMEs and large companies is much more widespread – e.g. in Finland (50 and 69 percent respectively), Italy (40/47 percent) and Sweden (39/62 percent).

Improving the framework conditions for the digital economy

Quickly clarify fundamental legal issues

Data-based business models raise a number of fundamental legal questions. Uncertainty regarding property rights to the data can develop into an obstacle for the digital economy. Similarly, issues involving exploitation rights and liability must be clarified promptly, but with great care. In the meantime, not only specialist bodies, but also the Bundestag are looking into these questions. It is important not to create new forms of property rights over-hastily – as in the case of the protection of databases set up by the European Commission.

Furthermore, questions of copyright, consumer protection and data protection overlap with competition issues. The Commission of Experts supports the position of the Monopolies Commission, which calls initially for an improvement in the legal opportunities of market participants to enforce market-relevant individual rights like copyright, and does not see competition law as the preferred approach for solving all problems in the field of the digital economy.

Closely monitor competition processes, ensure continuous innovation competition

It is imperative to closely monitor competition processes in the digital economy. A strong concentration of providers is taking place in many areas of the digital economy. For example, Alphabet has a market share of over 90 percent in the fields of desktop search, mobile applications and apps. The aim here must be to use the regulation of competition to prevent the emergence and consolidation of monopolies, and in this way to ensure continuous innovation competition. Competition in the markets for data and user information in particular should have a high priority here, as these markets provide key resources for new business models and business start-ups in the digital economy. The increased exchange of data leads to considerable networking, so that network effects will play an even bigger role in the digital economy in the future. Because network effects can reinforce the concentration of competition, dominant market positions must be expected to be more common in the future.
No overhasty regulatory interventions

The Commission of Experts is concerned that too detailed or premature regulation in Germany and Europe could hamper the further development and emergence of innovative business models in the digital economy. Therefore, like the Monopolies Commission and the Münchner Kreis, the Commission of Experts suggests examining flexible and dynamically adaptive regulatory measures, preferably at the international level. It recommends in particular considering the repeal of historically grown restrictions on competition in situations where incumbent firms are confronted by new services in regulated sectors. For example, in the view of the Commission of Experts the first regulatory attempts made by policy-makers in the case of Uber are to some extent going in the wrong direction. In some cases, the argument of consumer protection was put forward in order to obstruct rivalry from new competitors. This conflicts with the intention of promoting innovations via the emergence of new business models. A need for regulation is also highly likely to emerge in the developing internet-based sharing economy. But overhasty action resulting in preferential treatment being given only to incumbent structures and actors must be avoided.

Guarantee data protection and data security – at the European level

The huge potential of digital technologies and business models comes up against understandable reservations from citizens when it comes to the protection of data privacy and data security. At present, 87 percent of people surveyed in Germany find it unacceptable for online applications to access personal data automatically. At the same time, data-intensive services, such as social networks and cloud services, are being used more and more by citizens – also in Germany. Therefore, there is a need for action on statutory data-protection regulations – e.g. rules on open administration data (cf. Chapter B 4) or the cross-border transfer of personal data – in order to build trust among users and increase the acceptance of the digital economy.

The EU General Data Protection Regulation agreed in December 2015 by the European Council, the European Parliament and the European Commission makes it possible to develop an independent European position and practice in this field. The Commission of Experts explicitly welcomes this new regulation. Although it is by nature a political compromise whose individual norms are controversially discussed, it must be regarded as a great success that this new regulation will apply throughout Europe and will harmonise data-protection laws in the 28 member countries of the European Union. The regulation is to come into force at the beginning of 2018, replacing the existing EU Data Protection Directive (Directive 95/46/EC), which has been applied since 1995. It is especially important that the new regulation also establishes the validity of European data protection law for companies that offer their services within the EU, even though they are not resident in the EU and therefore process their data outside of the EU (lex loci solutionis).

The Commission of Experts also welcomes the ongoing efforts of the European Commission within the framework of the common digital single market, especially the initiatives aiming to strengthen the cross-border traffic in non-personal data. In addition to improving technical feasibility through common standards and interfaces – especially in the field of the Internet of Things – this should also include the certification and facilitated switching of cloud services and the planned establishment of a European Research Cloud. The Commission of Experts also regards the establishment of an Industrial Data Space within the framework of the Industry 4.0 platform as an expedient way to reduce reservations about cloud computing, especially among SMEs in the manufacturing sector.

In principle, (new) regulatory measures by policy-makers – especially in the big-data field – are desirable if such measures create stronger incentives for the exchange of data in the digital economy. Merging complementary data often forms the basis for new applications and business models in the digital economy. However, this benefit can only result if business risks like the loss of intellectual property in the course of data exchange are limited in a sensible way. In this area, too, what is currently needed above all is courageous experimentation among actors from business, science and policy.

Rethink start-up funding – take business-model innovation seriously

Competition in the digital economy can primarily be secured by creating better framework conditions for innovative start-ups in this field. Even though only very few start-ups survive in the digital economy,
thanks to the usually low switching costs or multi-homing for users these also ensure that dominant companies are constantly offering improved or innovative services.277

In existing public start-up funding, too, the aim should be to focus more on acute needs in the digital economy. Within the framework of the BMWi’s EXIST programme, as a rule start-ups are currently only funded if they pursue technologically demanding start-up concepts. Public funding of start-ups on the basis of innovative business models of the digital economy is generally not possible, but it should be considered. In addition, the overall decline in the number of start-ups in Germany as a result of the demographic development must at last be countered by suitable measures from policymakers. In particular, start-ups in the German internet economy which are greatly affected by the demographic development should therefore step up their recruitment efforts among the international pool of talent. This should be flanked by corresponding measures to attract start-up entrepreneurs or entrepreneur teams from abroad (cf. Chapter B 1).

B 3-5 Assessments and recommendations

Looking at the overall picture of digitisation activities, Germany is currently at the level of international average at best.279 Up to now, it has not been able to build up noteworthy strengths either in the classic ICT industry or in internet-based industries. Business models in the digital economy represent disruptive innovations. The Commission of Experts takes it as given that

– they lead to the development of considerable value-creation potential, but
– at the same time they also trigger considerable upheavals in established industries.

Value creation, employment and prosperity are redistributed as a consequence of these developments.

R&I policy in Germany must therefore pursue a double strategy: on the one hand, German firms must be supported in their efforts to open up new value-creation potential in the internet-based economy; on the other hand, support must be provided for the transformation of sectors that are threatened by disruptive innovation.

Review of existing policy measures

The Federal and Länder governments have become aware of the challenges due to digitisation. However, the Commission of Experts observes a fragmentation of funding activities and strong policy competition between government departments. The new opportunities are only being recognised hesitatingly; the focus lies on defending incumbent and hitherto successful sectors and actors. The Federal Government’s policy seems defensive.

The Commission of Experts believes that the Federal Government’s strong focus on a relatively small area of digitisation is unlikely to yield the intended results. For example, Industry 4.0 one-sidedly targets efficiency gains in the field of manufacturing technology.279 Similarly, other industry- or application-specific initiatives – such as Smart Service Welt or eHealth – are limited in their ability to generate positive funding effects across the broad range of digital applications.260

The Commission of Experts welcomes the fact that the Federal Government has already initiated some important steps since the beginning of the legislative period. These include:

– the conversion of Industry 4.0 from a platform of industrial associations into a more clearly structured and fast-working ‘Platform Industry 4.0’ involving important government departments;281
– the conception and funding of internet-related security research by the BMBF;282
– increased funding for medical informatics, also by the BMBF;283
– the systematic processing of steps that have been decided by the government parties in the Digital Agenda – in this field, more than half of the measures have now been implemented under the auspices of the BMWi;284
– work on an Industrial Data Space, primarily geared to the needs of SMEs;285
– the establishment of an Institute for Internet Research to engage in interdisciplinary research into “the ethical, legal, economic and participatory aspects of the internet and digitisation”;286
– the funding of digitisation in SMEs under the BMBF’s recently announced ten-point programme.287
However, a convincing overall strategy is still lacking at present. At the beginning of the legislative period the Digital Agenda was a useful collection of analyses and areas requiring action. Up to now, however, it has not been developed into a consistent strategic overall concept that clearly identifies Germany’s weaknesses in digitisation and develops across-the-board measures aimed at improving Germany’s position. Instead, separate fields of action have formed – separately run by government departments, often competing with each other for a dominant position – e.g. Industry 4.0, Smart Services, Smart Home. Connections and complementarities between these fields of action remain unclear. There is still a considerable need for action here.

**Recommendations for further measures of R&I and industrial policy**

- German companies are lagging behind their competitors in other countries in the application of cloud computing and big-data approaches. Software, digital technologies and new business models are too often seen as cost drivers and too rarely as opportunities to attain a promising edge over the competition. The onus here is on the corporate sector; to rest on the laurels of past export and innovation successes in the face of an emerging wave of disruptive innovations is not the appropriate strategy.

- At the same time, Federal Government policy in particular must lead by good example. The quality of e-government in Germany is in urgent need of improvement (cf. Chapter B 4). This would stimulate government-induced demand specifically for German suppliers.

- The Commission of Experts is concerned that a ‘digital divide’ could emerge in the corporate sector. SMEs in particular seem not yet fully aware of the importance of the upcoming changes. Funding restrictions make it difficult for these companies to tackle the necessary changes. The process of developing new digital business models could be considerably delayed in many German SMEs. There is a risk of losing market shares even in niches where German companies have hitherto been operating very successfully. The Federal and Länder governments should try to give interested SMEs access to ‘business-model academies’ which teach implementation strategies for digital business models.

- Germany has a large number of start-ups that are building up new sources of value creation with ambitious business-model innovations. But these companies currently do not have sufficient access to venture capital. They must seek their medium-term growth abroad in view of the lack of a suitable stock-market segment. The Commission of Experts reiterates its recommendation to work towards setting up such a stock market segment.\(^{288}\)

- German citizens and households – like German companies – are lagging behind international standards in handling digital technologies and models. For example, the Eurostat indicators point to a lack of skills in the population in the field of digital technologies – particularly when it comes to internet skills.\(^{289}\) Skills development in handling digital technologies and models of their application should be supported across the board – in all education and further-training segments. People should be encouraged to practise sensible ways of handling their own data as early as possible. School curricula should pay more attention to fundamental digital skills than they have hitherto.

- Students of all subjects at tertiary-education institutions should be proficient in software coding for the applications in their respective disciplines. Computer sciences should be understood as a new key discipline and be incorporated more closely into the curricula of other training courses.

The Commission of Experts is confident that Germany can succeed in the catching-up and adjusting process that it must undergo. The challenges are not to be underestimated, but Germany in particular has every reason to approach these tasks with optimism. After all, it already mastered one wave of digitisation in the 1980s.