Smart Service Welt

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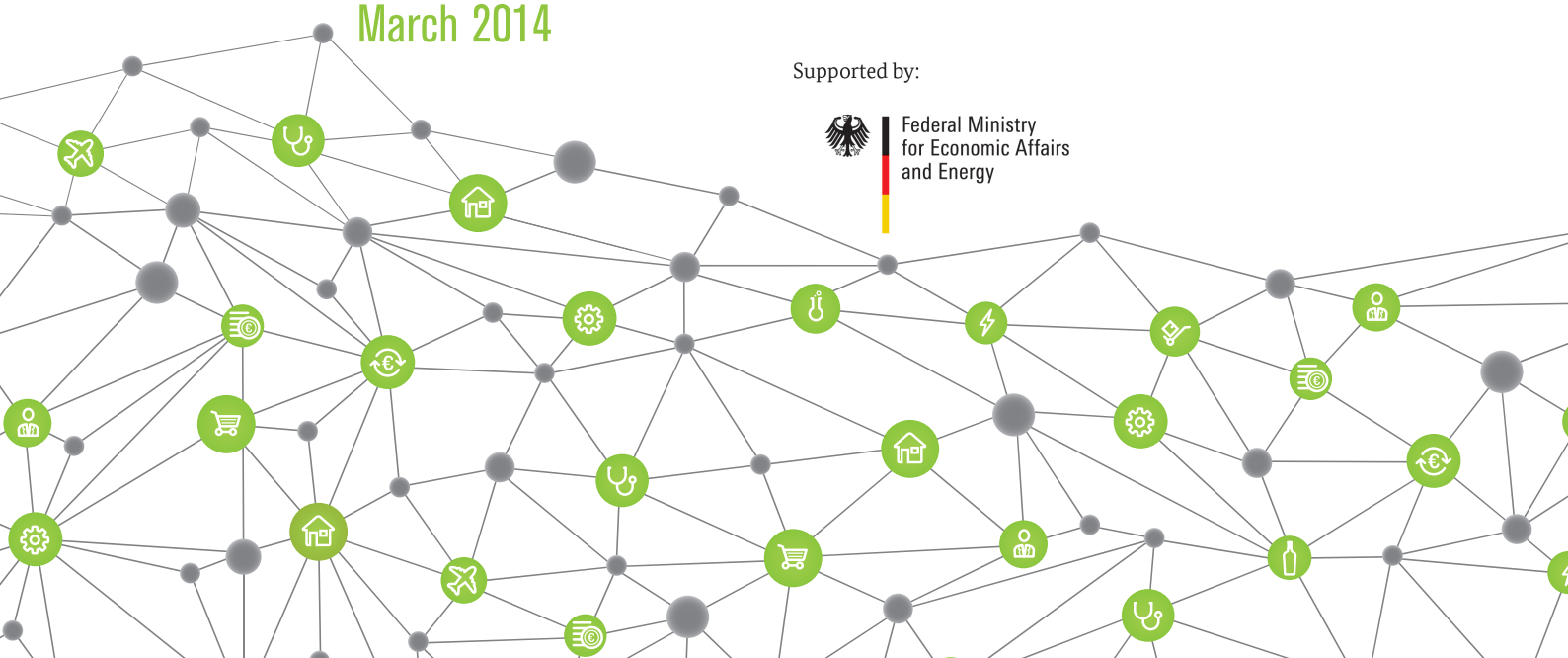
SMART SERVICE WELT

Recommendations for the Strategic Initiative Web-based Services for Businesses

March 2014

Supported by:

Federal Ministry for Economic Affairs and Energy



Imprint

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Publication date: März 2014

Supported by:

Federal Ministry
for Economic Affairs
and Energy

on the basis of a decision
by the German Bundestag

The Working Group would also like to thank the following organisations for their support:
Accenture GmbH
Boehringer Ingelheim Pharma GmbH & Co. KG
Deutsche Bahn AG
Deutsche Post AG
Deutsche Telekom AG
Google Germany GmbH
IG Metall
Nokia GmbH
Robert Bosch GmbH
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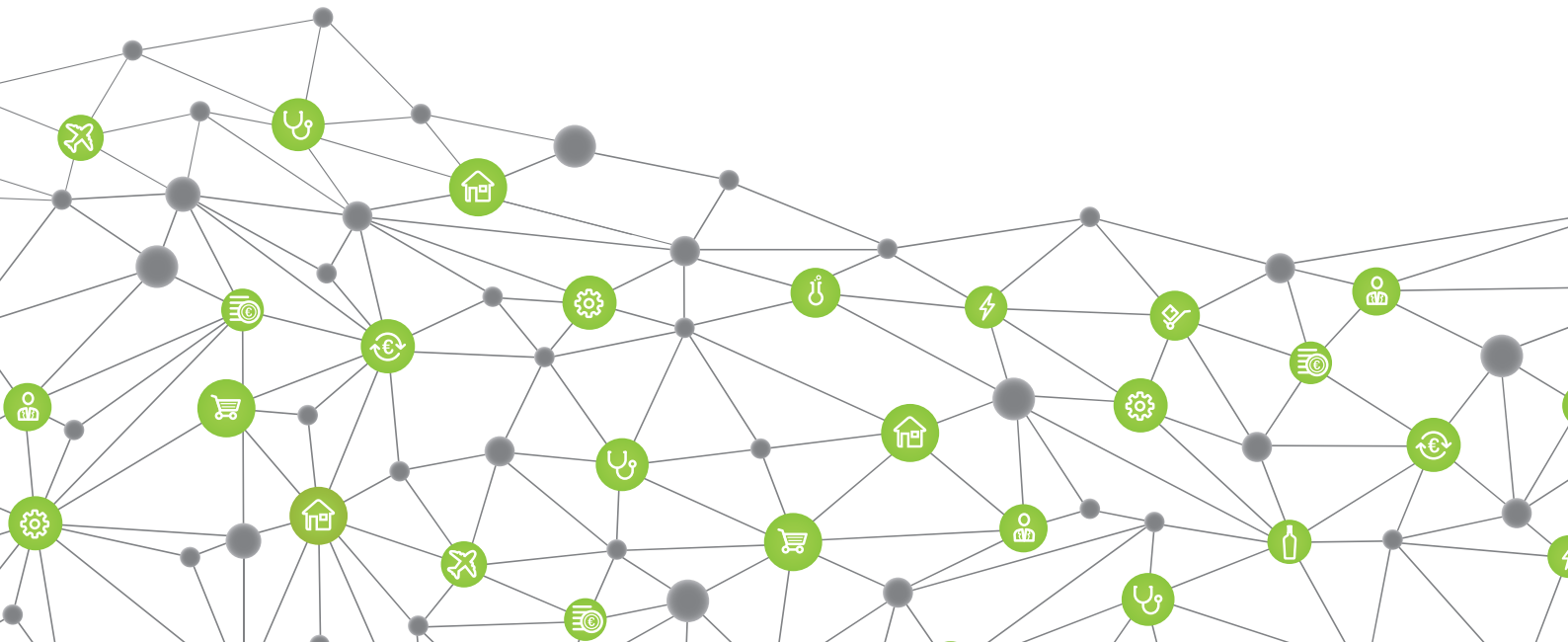

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Executive Summary

Information and communication technology has become an integral part of our industry and society as a whole. Digitally enabled products, processes and services are increasingly being combined in innovative ways to create on-demand, personalised Smart Services that meet the needs of individual consumers. These new services and business models make use of the growing volume of data that is being captured every day in all areas of our private and working lives.

The **disruptive impact of Smart Services** is already being keenly felt in the retail trade, for example in online marketplaces. However, the changes are also affecting the traditional business models of Germany's flagship industries, such as the automotive, mechanical engineering, chemicals, electrical engineering, medical technology, logistics and energy technology industries, not to mention the rest of the economy. These industries are already benefiting from the support of Web-based services. In the not too distant future, however, the business models of suppliers, manufacturers and operators alike will be faced with a genuine revolution as a result of being systematically digitised, analysed, augmented with Smart Products and Services and networked with each other.

Germany has set itself the goal of becoming the number one country in Europe in terms of digital growth. With its first strategic initiative "Industrie 4.0", Germany has already taken an important step towards being the first country to tap into the potential of this new form of industrialisation. Now, the second strategic initiative, entitled "Smart Service World", is focusing on the value chains that incorporate the Smart Products made by Industrie 4.0 once they have left the factory. Smart Products are combined with physical and digital services to create Smart Services that then can be marketed as a flexible, on-demand service.

An **extraordinary paradigm shift** is taking place in our economy. Individual suppliers of traditional products and services will no longer be at the centre of the new model but consumers in their respective roles as users, patients, employees, technicians, passengers, entrepreneurs, etc. Consumers will expect the right combination of products and services to meet their individual needs anytime, anywhere. Businesses must therefore get ready to cooperate with partners from other industries and systematically and continuously adapt or expand their product and service portfolios.

Digital infrastructures and enablers

New digital infrastructures will be required to enable physical and digital services to be combined to create innovative Smart Services. These infrastructures will play a system-critical role in the imminent transformation of our economy and society. The key requirement in terms of technology infrastructure is the upgrading of the broadband network in order to enable networking of products, services and people in different areas such as public transport infrastructure, healthcare and the urban environment.

However, it is the platforms built on this infrastructure that will hold the key to success. These platforms can be divided into three levels. Smart Products themselves simultaneously serve as **networked physical platforms**, for example an individual car acting as a node on the Internet or a machine in a factory equipped with Web-based control. The Smart Products are constantly capturing data which is then collated and processed at the next level, known as **software-defined platforms**. Since these platforms are deployed in many different areas of application, they need to meet all type of requirements. It is therefore necessary to deliver research and technological developments across a wide range of different fields. Software-defined platforms enable modular configuration of value chains which can then be combined to form network-like business models. In this context, the key concept is virtualisation, thanks to which the different products, processes and actors need no longer to depend on specialised hardware. Finally, the data are refined at the **service platform** level in order to create Smart Services. The service platform connects all kinds of different product suppliers and service providers, allowing completely new services to be put together. For this to be possible, all the companies involved must speak the same lan-

guage. Service platforms therefore facilitate digital cooperation between businesses by stipulating basic rules governing the interactions between the various actors and objects. They will provide standards, tools, processes, interfaces and in particular simple mechanisms for clarifying the legal basis of cooperation in distributed business processes.

The seven **use cases** described in this report show how the business models and services based on these platforms may differ significantly depending on their specific application and consumer profile. This is illustrated by the example of a company that operates a networked charging station infrastructure for electric vehicles. Only customers who have signed a contract stipulating how the service will be paid for can currently use this company's charging stations. In the future, the same company will use a service platform that holds data about all of its own charging stations as well as charging stations belonging to other operators. This platform will provide a billing and payment system for electric mobility that is accepted throughout Europe, allowing all electric vehicle users to charge their batteries at any station belonging to any operator. Furthermore, the marketplace also connects other service providers both to each other and to the charging infrastructure operators. As well as simply charging their vehicles, this means that customers can also benefit from additional services. For example, they can use their mobile phones to find and reserve a charging slot at the nearest available charging station.

The digital infrastructures are, however, no more than technological enablers. In order to unlock the full economic and social development potential of these digital infrastructures, new innovation, information, organisational and human resources management methods specifically targeting Web-based services will be required. Different businesses will need to pool their expertise and form **alliances**. It will also be necessary to employ **education and training programmes** and new learning technologies to ensure that people are well prepared for the digital society, both in their capacity as employees of new digital enterprises and as sovereign consumers. Moreover, a successful digital transformation will not be possible unless people are confident about the security of both Smart Services and their personal data and convinced that the physical infrastructure can be reliably controlled by digital means.

Challenges and opportunities

The new digital business models in the Smart Service Welt will cause existing control points to shift towards software-defined platforms and service platforms or lead to the emergence of completely new ones. As a result, leading providers of digital business models in different industries will attempt to gain control of the platforms to become the leading suppliers of the **digital control points** for Smart Services. However, any intermediary that is able to supply the customer and data interfaces of smart, networked products and services can occupy a key service control point that could potentially relegate the manufacturers and providers of these Smart Products and Services from the position of leading suppliers to being just one among many interchangeable suppliers.

Germany must treat digitisation as an opportunity and seek to creatively harness its disruptive power. Any business that is quick to recognise the opportunities provided by Smart Services and implement the corresponding innovations will be able to tap into this **potential for growth**. The digital infrastructures are a key to the success of German industry, since they are ushering in a fundamental transformation of our economy and society. Germany is a global market leader in the engineering and manufacture of complex Smart Products. It now needs to develop critical system knowledge about digital value networks and hybrid Smart Services. Having already commenced work on introducing the Internet of Things, Data and Services into the manufacturing environment, Germany has consolidated its strengths in networked physical platforms and is therefore in a well-positioned starting point.

Recommendations of the Smart Service World Working Group

Technological sovereignty is of system-critical importance in maintaining and expanding Germany's ability to innovate and compete. A number of programmes addressing some of the key technologies required to up-

grade Germany's digital infrastructures have already been established. As well as research and development, the establishment of the Smart Service World will also call for industrial and industrial policy initiatives. In addition to the continued development of the Industrie 4.0 Platform, the Working Group therefore recommends four further initiatives:

1) **The establishment of cross-industry national competence centres for Smart Service platforms.**

2) **The establishment of knowledge platforms to enable the joint development of products and services by several different companies.**

3) **The formulation of an Integrated Research Agenda on "Software-defined Platforms".**

4) **The creation of a single digital market in Europe.**

In order to be at the forefront **of the digital Smart Services market**, Germany will need to develop leading software-defined platforms and service platforms. This will play an essential role in securing Germany's competitive position in the global market and will also be indispensable for helping to find flexible solutions to some of the challenges facing our society, such as healthcare provision. There is an opportunity for Smart Services bearing the "made in Germany" brand to become known for providing systemic solutions, not only in Germany but around the globe.

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1 Introduction

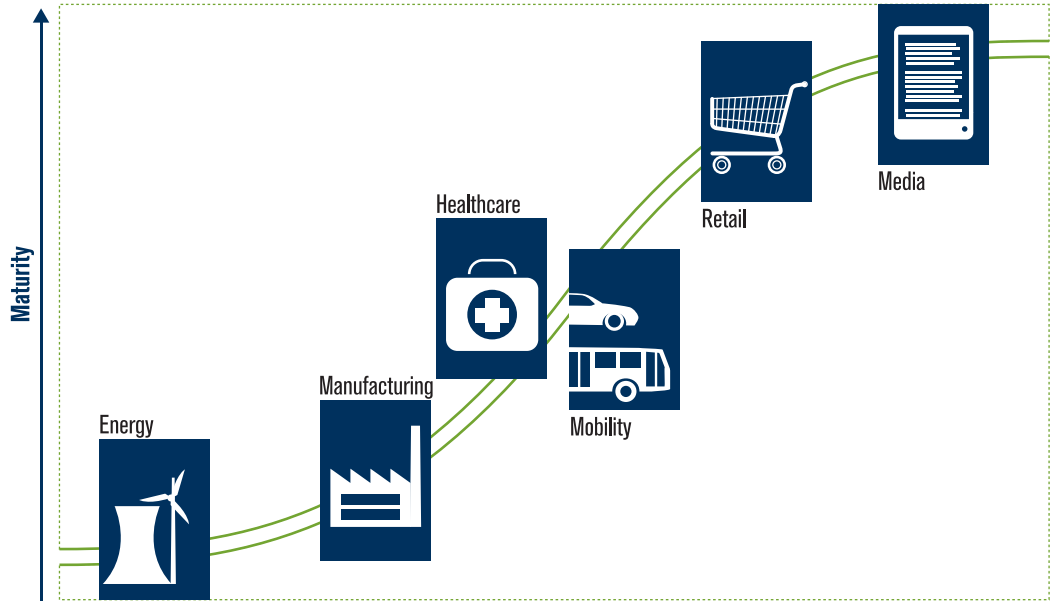
1 Introduction

In recent years, Information and Communication Technology (ICT) has spread at an extremely rapid rate. The growing digitisation of products and processes in our economy is triggering far-reaching changes in business models and the associated organisational systems, networks, consumption patterns and ways of working. Germany has set itself the goal of becoming the number one country in Europe in terms of digital growth. With the first strategic initiative "Industrie 4.0", Germany has already taken an important step. "Industrie 4.0" focused on the value chains used by manufacturing industry to make Smart Products and the associated interactions between human beings and machines. This report will address the second strategic initiative, entitled "Smart Service Welt". It is focused on the value chains based on these Smart Products once they have left the factory.[1] The components of the value chains considered in this report thus include the entire spectrum of tangible and intangible digitally compatible services (Smart Services). The number of Smart Products and Services connected to the Internet will continue to grow exponentially. This will result in the emergence of numerous innovative, Web-based business models as well as new forms of social organisation both within and between the world of work and people's private lives.

Both the power and the disruptive force of these innovations first became apparent in industries that were relatively easy to digitise such as the media, music and advertising (see also Fig. 1). In the space of a decade, new digital market leaders with a global presence such as Apple and Facebook have created completely new business models that have undermined the business models of established companies that often only operate at a regional level. This trend is now gaining further disruptive momentum as a result of the rapid growth in the number of products and services connected to the Internet. In the retail trade, Amazon, eBay and PayPal provide a telling example of the dramatic impact that hybrid services combining digital and physical services – based on a mix of digital marketplaces, secure online payment and first-class physical logistics – can have on traditional business models.

This transformation is set to affect a whole range of other industries. The basis for new services is provided by the growing volume of new data being acquired every day across all areas of our private and working

Figure 1:
Maturity of digital business models



Source: accenture

lives. **In future, Web-based and physical services will be combined in order to meet the needs of individual consumers.** In this report, the term **Smart Services** is used to describe these combinations of different service types. The key to the competitive success of Smart Services is entailed in the way they are customised to provide benefits to individual consumers, both in specific situations and in their lives in general. By adopting a context-specific understanding of their 'service users', service providers can provide consumers with context-specific combinations of services that meet the specific requirements of their current situation in terms e.g. of work, leisure, health, mobility, travel or education.

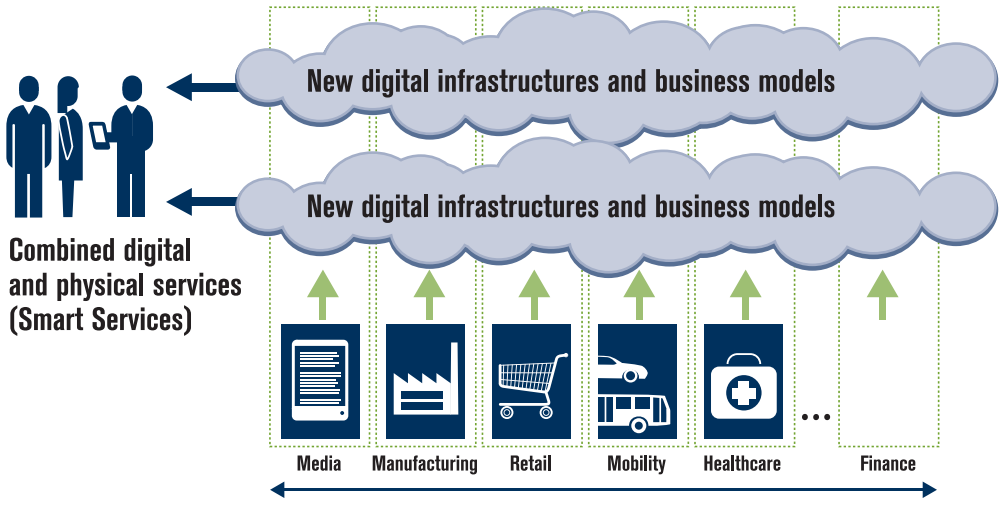
The huge paradigm shift occurring in our economy will undoubtedly have social repercussions, particularly in terms of the continuing convergence of people's working and private lives. Individual suppliers of traditional products and services will be replaced at the centre of the new model by consumers in their respective roles as users, patients, employees, technicians, passengers, entrepreneurs, etc. Consumers will expect the right combination of products and services to meet their individual needs anytime, anywhere (see Fig. 2). These expectations will influence future business models in the Business-to-Business (B2B) market as well as the Business-to-Consumer (B2C) market. Consequently, businesses of all types will need to address the impact of these universal changes on their own business model.

This applies in equal measure to Germany's flagship industries – such as the automotive, mechanical engineering, chemicals, electrical engineering, medical technology, logistics and energy technology industries – and to the rest of the economy, particularly innovative small and medium-sized enterprises. While today, manufacturers' and suppliers' underlying business models are already supported by Web-based services, so far they have not threatened them fundamentally. However, as digitisation reaches a higher degree of maturity, it is unlikely to be long before businesses in Germany and Europe will experience a genuine revolution. This revolution will be characterised by the systematic digitisation of all business models in order to incorporate Smart Services and Products developed and organised in smart networks.

Greater flexibility and an increased willingness to experiment and take risks will become more important as a result of the rapid pace of innovation. Startups will have an excellent opportunity to trial and implement new business models in this uncertain environment.

Developments in the field of autonomous driving are an example of the enormous impact that these changes can have on an established flagship industry such as the automotive industry. If and when it becomes possible to build and use autonomously driven cars that can reliably and safely convey passengers to their destination, and if suitable vehicles of the required size and feature set can be made immediately available on demand for the cus-

Figure 2:
New digital infrastructures and Smart Services



Source: Deutsche Post DHL

tomer's next journey, then huge numbers of people can be expected to take advantage of this mobility service in order to meet their specific needs. The key selling points of autonomous cars will be increased comfort and the fact that passengers will be able to engage in a wide range of activities during their journey. As things currently stand, no clear favourite has yet emerged in the race for market leadership in a business model based on customer access, vehicle fleets, logistics and digital add-on services. The only certainty is that in the not too distant future the automotive industry will look very different to what it looks like today.

However, it is important to avoid simply perceiving these far-reaching structural changes as a threat to established organisations and businesses. Instead, we should seek to **actively and creatively harness the disruptive power of digital innovations in order to take full advantage of the potential that they offer for innovation and growth in both Germany and the rest of Europe**. The number of smart, networked products and services will continue to multiply exponentially across all industries. Smartphones and tablets have rapidly become established around the world as the mobile access portals for a whole host of consumer-centric digital products and services, transforming the way people consume and live their lives: "Digitisation is increasingly becoming a driving force in all areas of innovation and of society."[2] The Internet of Things, Data and Services will result in extensive convergence of the physical and digital worlds and the emergence of smart digital infrastructures. These have the potential to become a key driver of innovation and growth. Any business – be it a manufacturer, service provider or intermediary – that is quick to recognise the opportunities provided by digitisation and implement the corresponding innovations will be able to tap into this huge potential for growth. It will be of critical importance for the German industry to establish and become a supplier of these digital infrastructures, since they are ushering in a fundamental transformation of our economy and society.

1 See also the new German government's coalition agreement of November 2013: "We will drive the digitisation of traditional industry through the strategic initiative Industrie 4.0. Thereafter, the next step will be to promote smart services." (Coalition agreement between the CDU, CSU and SPD, Shaping Germany's future, 18th Legislative Period (November 2013, p. 139)

2 See Industry-Science Research Alliance (Ed.): Industry-Science Research Alliance Prospect Study. Prosperity through research – What tasks lie ahead for Germany? (in English), 2013, Berlin.

2 Vision

2 Vision

2.1 The Smart Service Welt

Smart Services and Products that connect to the Internet during operation will form the basis of a whole range of new data- and service-based business models. The key enablers that need to be developed to make this possible are digital infrastructures and services that are built on these infrastructures and can be reconfigured in various different combinations in order to create new value chains and networks (for further details, see Chapter 5). The trends outlined below will go a long way towards determining business models in the Smart Service Welt:

- **Digital industrial convergence and alliances:** Individual companies often lack the capabilities needed to unlock the development and growth potential of the digital revolution. In order to create integrated physical and digital products and services from components that sometimes come from very different industries, it will in many cases be necessary to combine know-how from different companies. The prime examples of this imminent digital industrial convergence are the alliances that have been formed in the fields of electric mobility and networked smart cars. The ability to rapidly translate new alliances and efficient forms of cooperation into innovative business models is set to become a key competitive advantage. This provides opportunities for new intermediaries to bundle data and services from different companies. While startups can play a particularly innovative role in this regard, manufacturers also have a chance to act as orchestrators, shaping value networks in keeping with the interests of their own company and promoting the establishment of ecosystems.

- **Everything as a Service:** Combinations of products and services will no longer necessarily be acquired as property – instead, they will simply be used flexibly "as a service", as and when required. While sharing and service business models such as those used by car hire companies are nothing new, they are gaining in popularity. Smart Products will allow both their manufacturers and intermediaries to develop new business models. In addition to the sale and servicing of products, they will also be able to offer combined digital and physical operation as a service. This will require the manufacturer or intermediary to acquire a profound understanding of their customers' needs and lives. One way in which they will be able to gain a competitive advantage will be by gathering, analysing and accurately interpreting large volumes of data. For example, the operators of diagnostic equipment might collect and analyse data from all the diagnostic devices that they are responsible for operating and use this data to create new services, e.g. to provide suggested diagnoses. The volumes of data involved in this type of model will be several times higher than in current business models.

- **Open innovation platforms and crowdsourcing:** While a large amount of dedicated, specialised knowledge already exists today, it is very difficult for an individual to obtain information about the overall picture. In the future, ecosystems will be created for knowledge sharing, training and continuing professional development (CPD). An increasingly important role will be played by teams that use virtual collaboration platforms to discuss complex questions, find solutions and create innovations anytime, anywhere. The startup ResearchGate is an excellent example of this trend. This professional social networking site networks some three million scientists around the world, allowing them to upload and share papers and scientific data, discuss research questions and find people to collaborate with. Both knowledge and learning and CPD services can be traded like goods in these expert communities. The global digital knowledge sharing that this enables can, for example, help to accelerate the development of digitally enabled products and services and reduce the time to market of the next product release. The short life cycles of consumer IT products are a sign of things to come in this regard.

- **Security and trustworthiness:** The Smart Service Welt will only flourish if users have complete confidence in the security and dependability of Smart Services. If your autonomous car crashes into a tree either because the steering system failed or because someone hacked into the service, or if you learn of opaque agreements between the operators of a piece of diagnostic equipment that you are using and your life insurance company, then you will lose faith in these services. The collection, storage and analysis of large volumes of data pose new data protection, data security and regulatory challenges. If physical infrastructure is to be operated digitally, then it is of paramount importance for this process to be secure. Protecting individuals' privacy, ensuring end users' autonomy by granting them comprehensive user and modification rights, and providing protection for digitally networked products are thus all key requirements for the successful functioning of the Smart Service Welt. Furthermore, attitudes will need to change in the B2B market. Even today, the sensors on board manufacturing machinery can be managed over the Internet. This has led to concerns among the owners of the machinery about the danger of their company's know-how falling into the hands of third parties (see Use Case 2). A new approach to cooperation between companies is therefore called for, together with clearly defined rules governing this type of interaction. One option might be to use independent intermediaries.

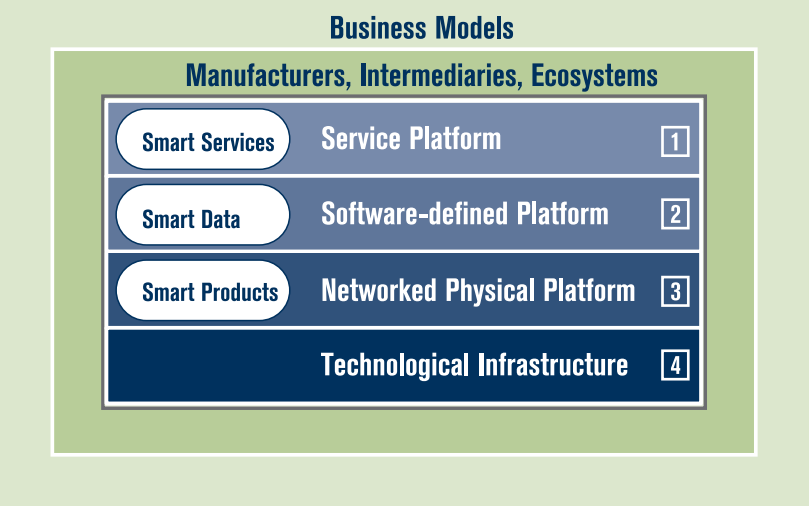
Germany is a global market leader in the engineering and manufacture of complex smart components and products. In view of the increasing proportion of software embedded in these Smart Products, the fact that they can connect to the Internet anywhere in the world and the emergence of new, data-centric business models fuelled by the use of Smart Products, it is necessary to reflect on how German and European industry can develop critical system knowledge about digital value networks that combine digital and physical services.
As already mentioned above, the ability to combine very different digital and physical services to meet a specific need can constitute both an opportunity and a potential threat for businesses. By supplying the customer and data interfaces of smart, networked products and services, intermediaries can create a key control point that could potentially relegate the manufacturers and providers of these Smart Products and services from the position of leading suppliers to being just one among many interchangeable suppliers. In this context, the meaning of 'technological sovereignty' is no longer confined to the association of the "Made in Germany" brand with world-class product technology. Instead, the term also now encompasses a certain symmetry between product technology, digital business models and services, not just within Germany but throughout the globe.

2.2 New digital infrastructures

IT technologies have now become so affordable that virtually any product or service can support digital connectivity and expandability. A tipping point has been reached, whereby these technologies have gone from being an optional extra to comprising an integral part of new solutions. Indeed, the reality is that they are already in widespread use all over the world.
New digital infrastructures are required in order to enable the synergistic combination of physical and digital services that characterises the Smart Service Welt. While there is no doubt that the much-discussed upgrading of the broadband network as part of the "Technological Infrastructure" (Layer 4) is urgently necessary, this on its own will not be sufficient to allow the new digital business models to function properly. It is only the platforms built on top of digital infrastructures that allow these infrastructures' disruptive impact to be felt (see Fig. 3). The system-critical role of these platforms in the imminent transformation of our economy and society will be comparable to that of the railways during the 2nd Industrial Revolution.
The following types of digital platform will have a key part to play:

- **Networked physical platforms (Smart Products, Layer 3):** Billions of Smart Products made by all kinds of manufacturers now exist for a wide variety of different applications. These products all connect

Figure 3:
Layer model:
digital infrastructures



Source: DFKI / acatech

to the Internet during operation. Many of them are also equipped with high-resolution sensor networks that allow them to provide context-sensitive real world data both cheaply and in almost any granularity. Moreover, Smart Products use actuators in order to make their capabilities available as the building blocks of digital services. Smart Products thus simultaneously act as networked physical platforms. Examples include individual cars acting as nodes on the Internet or Web-based control of a machine in a factory.

- **Software-defined platforms (Smart Data, Layer 2):** The next requirement for creating innovative business models is to enable planned or ad hoc cooperation between Smart Products and their users. Software-defined platforms can employ virtualisation to integrate heterogeneous physical systems and provide connectivity for Smart Products. Highly automated cloud centres process huge volumes of data (Big Data) and use learning algorithms to extract information almost in real time. This information is then combined to generate new knowledge (Smart Data). The key technologies include virtual data networks, semantics, big data, real-time analytics and cloud services, particularly mashups as a service. It seems likely that a whole host of software-defined platforms will be established, e.g. for mobility (see Use Case 5), electricity distribution, operating production equipment (see Use Case 4), managing buildings or entire cities and in the field of healthcare (see Use Case 3).

- **Service platforms (Smart Services, Layer 1):** Web-based business models that dynamically combine digital and physical services require service platforms to enable modular configuration of value chains which can then be combined to form network-like business models. Within these networks, all manner of suppliers of goods and services provide the service user with services that are either planned or put together on an ad hoc basis (see Use Case 4). There are a number of industries in Germany whose strength on the global market would appear to make networked solutions as service platforms for Web-based services an attractive proposition. These include mobility and logistics, healthcare, energy and resources, the retail trade, manufacturing, home, building and urban management and education. A service platform in a city could, for example, act as a marketplace for a range of Smart Services delivered through smart cars, homes, streets and indeed smartphones. These services might include digitally advertised special offers for people passing by a retail store based on their personal preferences or

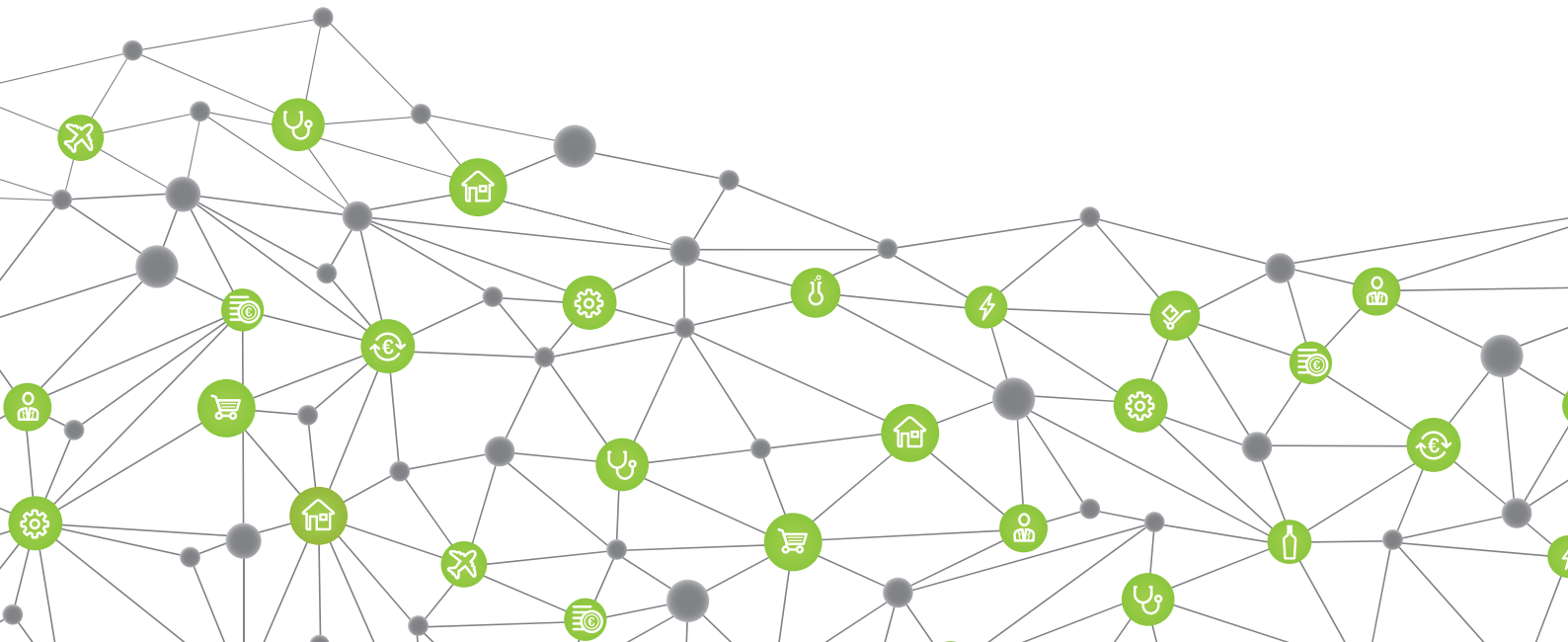
a function that directs electric vehicles to the nearest charging station in response to an automated message sent by a sensor in the car's battery indicating that it needs recharging. A variety of intermediary business models will also become established on these service platforms. These will be operated by providers who use data and information obtained through the operation of third-party products to provide new, value-added services offering e.g. cheaper prices or additional benefits (see Use Cases 2 and 6). Taxi apps, for example, enable digital, personalised and automated location-based communication between the customer and the next available taxi, bypassing the need to go through the taxi company's office. Services become 'Smart' Services through the use of smart data to configure and adapt the service to meet the needs of the individual consumer and specific context.

Service platforms will make it possible for individual services in specific areas of people's lives to be combined to create aggregated value-added services for consumers. In order to enable flexible networking in a **digital ecosystem**, the participating companies must be willing to cooperate, must establish operational and information communication structures with each other and must be prepared to share previously proprietary knowledge and the associated data and information.

In order to facilitate digital cooperation between businesses, service platforms or intermediaries and specialised service, providers will have to supply standards, tools, processes, interfaces and in particular the frameworks and principles needed to clarify the legal basis of the cooperation (legal frameworks and onboarding processes). This will be done in form of distributed business processes and will allow participation and cooperation between the different market players to be enabled rapidly and without the need for significant additional preparatory work on behalf of the individual actors.

Intermediaries can help to build trust and enable new forms of cooperation. They provide the links that bridge the gap between the value creation components of different actors, enabling these components to be integrated into a closed value chain. By balancing out the interests of the different actors, intermediaries ensure a win-win situation for everyone involved. Knowledge that they have obtained and made available about one particular customer relationship can be applied as appropriate to a different customer relationship, thus facilitating overarching global optimisation. Other functions that can be performed by intermediaries include quality assurance, the development of new business contacts and the clarification of the legal situation. It is clear from all of the above that cooperation between different businesses and industries will constitute a key competitive advantage in the Smart Service Welt.

3 Challenges and opportunities for Germany and Europe



3 Challenges and opportunities for Germany and Europe

The approach taken by German innovation policy is to consolidate the country's strengths while at the same time minimising its weaknesses. Thanks to its highly-skilled workforce and productive research infrastructure, German industry is highly competitive compared to other countries around the world. Furthermore, Germany is a leading supplier of manufacturing equipment. Work has now commenced on the implementation of the strategic initiative "Industrie 4.0" which focuses on the application of the Internet of Things, Data and Services in industrial processes. Germany has thus already taken an important initial step towards being the first country to tap into the potential of this new form of industrialisation and towards using the resulting quantum leap in knowledge and experience to secure the future of its manufacturing industry. Over the coming years, smart factories will produce an even wider range of Smart Products that will act as platforms for Web-based services, providing new opportunities to create both value and jobs. By taking the measures described above, Germany has consolidated its strengths in the third layer ("networked physical platforms") of the digital infrastructure (see Fig. 3) and is therefore is therefore in a well-positioned starting point.

Nevertheless, further continuous effort and investment will be required if Germany wishes to play a leading role in actively shaping the impending changes that are set to result in the disappearance of the traditional split between the industrial and service sectors. In the new Smart Service Welt, digital business models will be accompanied by **a shift in existing control points and the emergence of new ones**, i.e. a shift in the responsibility of decision-taking pertaining to a business model's critical aspects. In a Web-based home care scenario, for example, it is quite conceivable that the care service provider could be involved in decisions relating to the technical equipment used, the dosage of the patient's medication and the selection of doctors to be included in the network.

As a result, the providers of digital business models in different industries and areas of application will attempt to build and control software-defined platforms and service platforms so that they can become the leading suppliers of the digital control points for Smart Services. Moreover, they will seek to increase the scalability further by creating digital ecosystems. In other words, they will make their platforms available so that third parties can use them to develop their own Web-based business models, thus ensuring that they become even more widely adopted and unlocking new sources of revenue.

These platforms are still in the early stages of their development and it remains to be seen whether the winners in this new market will be companies that already feel at home in the virtual environment and have understood that digital business models must be wholly demand-led and finely tuned to customers' needs, or companies that are rooted in the real, physical world, i.e. the companies that currently manufacture and operate Smart Products and Services. For example, will traditional manufacturers be able to cope with the changes required to make autonomous cars, or might actors from outside of the automotive industry steal a march on them by providing customer-centric solutions? Even today, it is becoming apparent that **a key role will be played by businesses** that succeed in developing and operating the platforms described above (see Use Case 4), controlling access to them, gaining the end user's acceptance and/or acting as intermediaries for Smart Services (see Use Cases 2 and 5). In most cases, the keys to commercial success will be large numbers of users and the ability to create economies of scale.

Having taken the first step with Industrie 4.0, the crucial second step now needs to be addressed. This will involve identifying the specific consumer and user processes that are important to German industry, defining them in terms of **software-defined platforms** and **service platforms** and ensuring that the relevant best practice solutions and standards are supplied by Germany. Funding programmes have already been established for some of the key technologies required to build the relevant digital infrastructure:

1. Sensor networks and Cyber-Physical Systems (CPS): Powerful microcomputers known as embedded systems are now being built into all kinds of different objects in their billions, endowing these objects with 'intelligence' (Smart Products). Smart objects equipped with sensors and actuators record data from their surroundings and then use the data to influence these same surroundings. The physical and virtual worlds thus converge to create CPS.[1] Advances in sensor technology are making it possible to capture ever more detailed information about the environment, thus enabling models to produce increasingly accurate approximations of reality. Thanks to programmes such as AUTONOMICS (Federal Ministry for Economic Affairs and Industry – BMWi), Germany is well placed in this particular area.

2. Big Data: The wealth of data generated by digital processes – commonly referred to as big data – can be mined using information extraction processes and smart learning algorithms based on classification, regression and factor analysis. The data are analysed in real time and patterns are identified. These are in turn used to derive information which can be correlated in order to produce new knowledge, turning 'big data' into 'smart data'. In other words, huge volumes of unstructured data with a low information density are distilled into high-quality data. Efforts to find smart ways of using large volumes of data are being supported by the German government through the funding of programmes such as BIG DATA (Federal Ministry of Education and Research – BMBF) and SMART DATA (BMWi).

3. Semantic technologies allow data to be enhanced with background information and linked to other relevant units of information. As a result, machines become capable not only of reading content but also of understanding it, thus transforming data into information. This information can then be browsed and interpreted more rapidly and efficiently. Instead of being swamped with huge quantities of information from search engines, it becomes easier for people to "find" the right services and providers. The THESEUS research programme (BMWi)[2], which concluded in 2011, has delivered a number of key advances in this area. However, further research is required in order to realise the vision of 'Web-based services'.

4. Cloud computing: By separating applications and the information required by them from the underlying physical infrastructure and the method used to deliver them (virtualisation), it becomes possible to use IT resources on demand, anytime, anywhere. As a result, resources can be used more efficiently, new applications become available more rapidly and billing will generally be based on actual usage. Cloud computing is thus a key enabler of innovative Web-based services. The TRUSTED CLOUD (BMWi) programme has begun to address the requirements in this area.

Overall, Germany already meets many of the key requirements for using software-defined platforms and service platforms to become a leader in the Internet of Things, Data and Services. Germany is well placed with regard to sensor networks and CPS, big data and semantic technologies, although more work still needs to be done in some areas to ensure that the relevant technologies are successfully and profitably marketed. However, as far as cloud computing is concerned, the global market is currently dominated mainly by the US but also by China and Singapore. Almost half of the leading cloud computing services on the German market come from the US.[3] In order to create system-critical, software-defined platforms, it will be necessary to drive the development of new cloud solutions from Germany and elsewhere in Europe. Clarification of the legal framework and the ability to guarantee security are among the most important challenges that will need to be addressed in order to encourage greater take-up of cloud computing by businesses, particularly SMEs.

The establishment of software-defined platforms and service platforms is of fundamental importance if Germany and Europe wish to become global market leaders in the Smart Service Welt. The key to this will be the creation of a single digital market in Europe that allows consumers to use online content and services in different countries and provides businesses, particularly SMEs and startups, with straightforward ac-

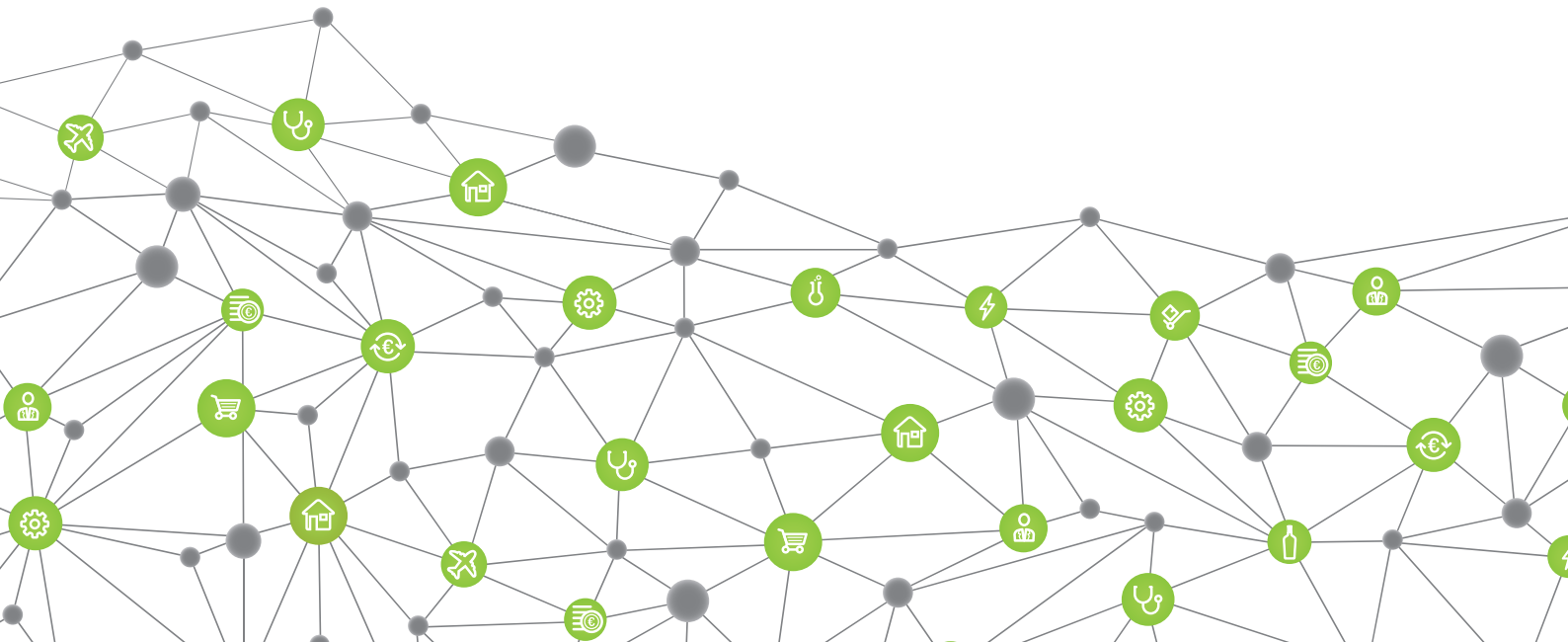
cess to a European digital economic area. We need to make the most of the opportunities that the Smart Service Welt has to offer Germany and the rest of Europe. To this end, action programmes should be set up to encourage consortia of large-scale undertakings, SMEs and startups to work together to develop the relevant platforms and establish them on the global market, thus ensuring that we become global leaders in Smart Services.

1 For more details, see: Eva Geisberger/Manfred Broy (Eds.): agendaCPS – Integrierte Forschungsagenda Cyber-Physical Systems, acatech STUDY (in German), March 2012, Sankt Augustin.

2 Federal Ministry of Economics and Technology (Ed.): The THESEUS Research Programme: New Technologies for the Internet of Services, 2010. Home page: theseus-programm.de/.

3 See Hans-Jürgen Appelrath/Henning Kagermann/Helmut Krcmar (Eds.): Future Business Clouds. Ein Beitrag zum Zukunftsprojekt Internetbasierte Dienste für die Wirtschaft, acatech STUDY (in German), January 2014, Munich, p. 106.

4 Use Cases in the Smart Service Welt



4 Use Cases in the Smart Service Welt

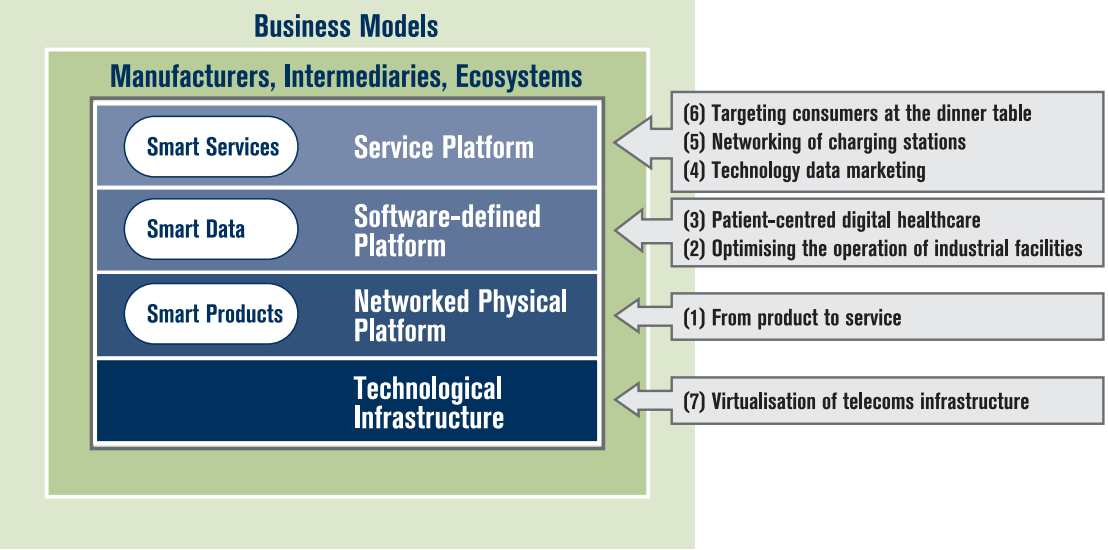
In the Smart Service Welt, Smart Services and Products that connect to the Internet during operation will form the basis of a whole range of new data- and service-based business models. In this chapter, several concrete use cases are presented that describe the typical features of the Smart Service Welt. It is these features that make it possible to develop new business models in order to address and take advantage of trends such as "Digital Industrial Convergence and Alliances", "Everything as a Service" and "Open Innovation Platforms and Crowdsourcing" (see Chapter 2.1). The seven use cases serve to illustrate how a product can be developed into a service, how several Smart Products can be combined on software-defined platforms to provide a basis for new services and how new service business models and ecosystems can be established on service platforms (see Fig. 4).

- **Use Case 1 – From product to service:** The first use case illustrates how new business models can already be developed today using the facilities provided by Industrie 4.0. In the future, the use of a gas generating set (acting as a networked physical platform) will be marketed as a service in accordance with the principle of "Everything as a Service". Rather than marketing generating sets per se, the generating set manufacturer now markets the use of the gases produced by the generating set and various other associated services such as an efficient energy management service.

- **Use Case 2 – Optimising the operation of industrial facilities:** This use case illustrates how several smart devices can be networked during operation via a software-defined platform in an industrial facility (e.g. a mine). This makes it possible to collect large quantities of operational data from individual devices and use them as a basis for optimising the overall operation of the facility. The use case also shows how new, non-confrontational intermediaries and data-based services can become established, shifting the control point at the customer interface from the facility operator to the service provider.

- **Use Case 3 – Patient-centred digital healthcare:** This use case focuses on the implementation of a software-defined platform for providing patients with medical care in their homes. The most notable features of this platform are its interoperability, its

Figure 4:
How do the use cases fit into the layer model?



Source: DFKI / acatech / accenture

high security and trustworthiness standards and its real-time capabilities. These are important, since one of the uses of the platform is for sharing patients' medical data in order to enable optimal home care. Different services for specific diseases can also be developed and operated using this software-defined platform. Since this is an industry-specific platform, a single provider or a consortium from the healthcare industry can provide it.

- **Use Case 4 – Technology data marketing:** In the fourth use case, a production equipment manufacturer expands its control point at the customer interface. As part of its service platform, the manufacturer operates a marketplace where, in addition to the smart product itself, information on optimising the machine's operation is also marketed.

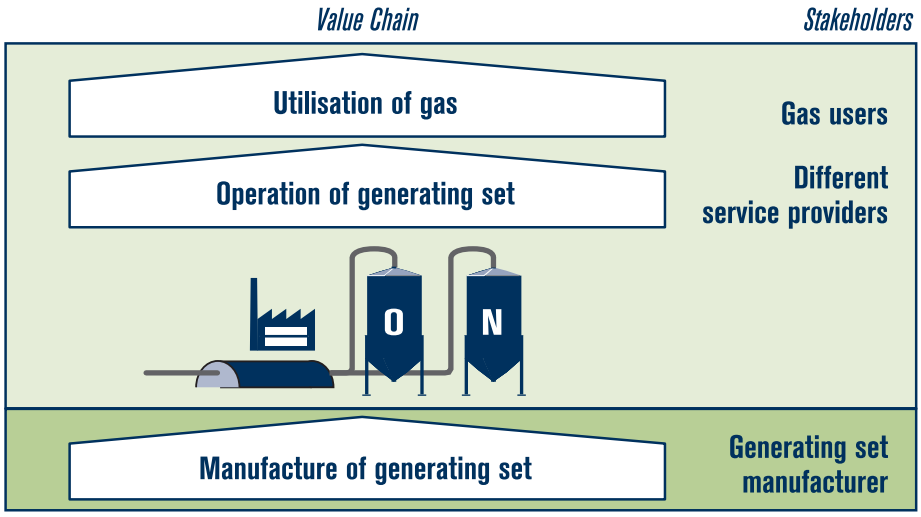
- **Use Case 5 – Europe-wide networking of charging stations:** In the "Europe-wide networking of charging stations" use case, the network is established via a service platform that is used to collate all the data relating to the charging station infrastructure. A standard billing and payment system allows electric car drivers to charge their vehicles' batteries at any station, irrespective of its operator. The platform can also be used by other service providers to market their own services, for example a mobile app to help people find the nearest charging station.

- **Use Case 6 – Targeting consumers at the dinner table:** In this use case, a service platform developed by a kitchen equipment manufacturer uses the everyday activity of making dinner to demonstrate how the networking of Smart Products and the ad hoc bundling of hybrid services originating from different industries can enable the creation of new service value chains or the dynamic reconfiguration of existing ones. Several different service providers, creating a digital ecosystem, can access the service platform. This simple scenario demonstrates how industrial convergence can be instigated, irrevocably disrupting the industry's traditional structures.

- **Use Case 7 – Virtualisation of telecoms infrastructure:** The final use case addresses the development of the underlying technological infrastructure (Layer 4) that enables the virtualisation of network infrastructure in much the same way as the virtualisation of processing power. This use case illustrates how homogeneous network infrastructures can be provided to Internet service and content providers who are increasingly operating on a global scale.

USE CASE 1:
From product to service: expanding a product portfolio

Today



Source: Siemens AG

The manufacturer in this use case makes gas generating sets for the chemical industry. The manufacturer's customers use the generating sets to produce the gases they need for their own manufacturing processes. Based on their forecast requirements, the customers produce the relevant quantities of gas using the generating set and store them in tanks. They also need to store a back-up supply to ensure that sufficient gas is available to keep production running during scheduled and unscheduled stoppages of the generating set. The user of the generating set generally uses several different service providers to keep it running smoothly.
One of the generating sets' key components are their high-performance electrical drives. These are naturally subject to wear and tear and therefore require regular servicing.

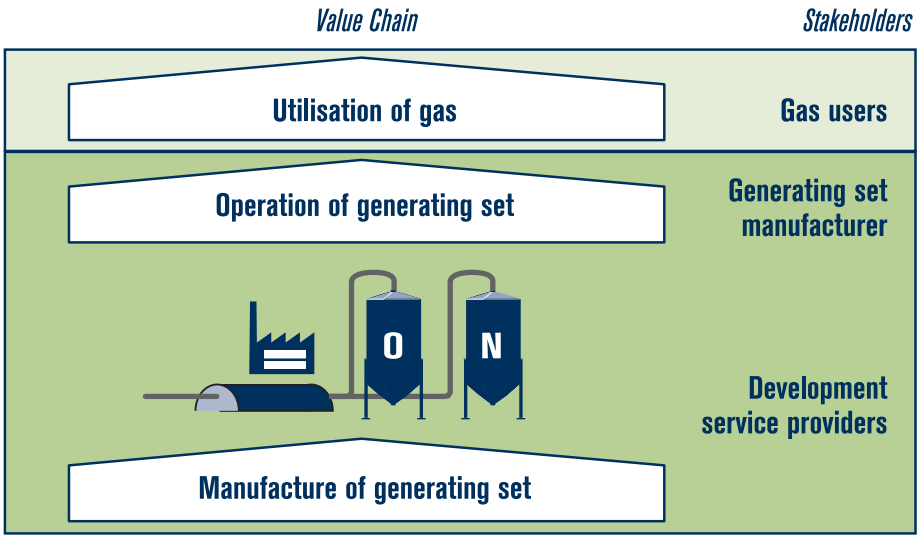
Benefits and value-added:

- The customer can focus on his core business (the use of the gas in his manufacturing processes) and only buys in as much gas as he needs.
- The generating set manufacturer optimises operation of the generating set by minimising energy costs and undertaking preventive maintenance, thus preventing unscheduled stoppages. Most users do not possess the in-depth understanding of the generating set technology required to do this.
- The operating data obtained from the generating set allows the manufacturer to become more competitive by implementing further improvements to the machine.
- By adopting new business models – for example acting as the operator of the generating set – the manufacturer can tap into new markets.

Participants: Generating set manufacturers and operators, service providers as enablers of the generating set operators, customers

How the use case fits into the layer model: A manufacturer of Smart Products (Layer 3) decides to equip them with increased digital connectivity so that the products can be enhanced with services. This allows the manufacturer to become the operator of the Smart Products. In accordance with the principle of "Everything as a Service", they now market the use of the product and not alone the product itself.

Tomorrow



Source: Siemens AG

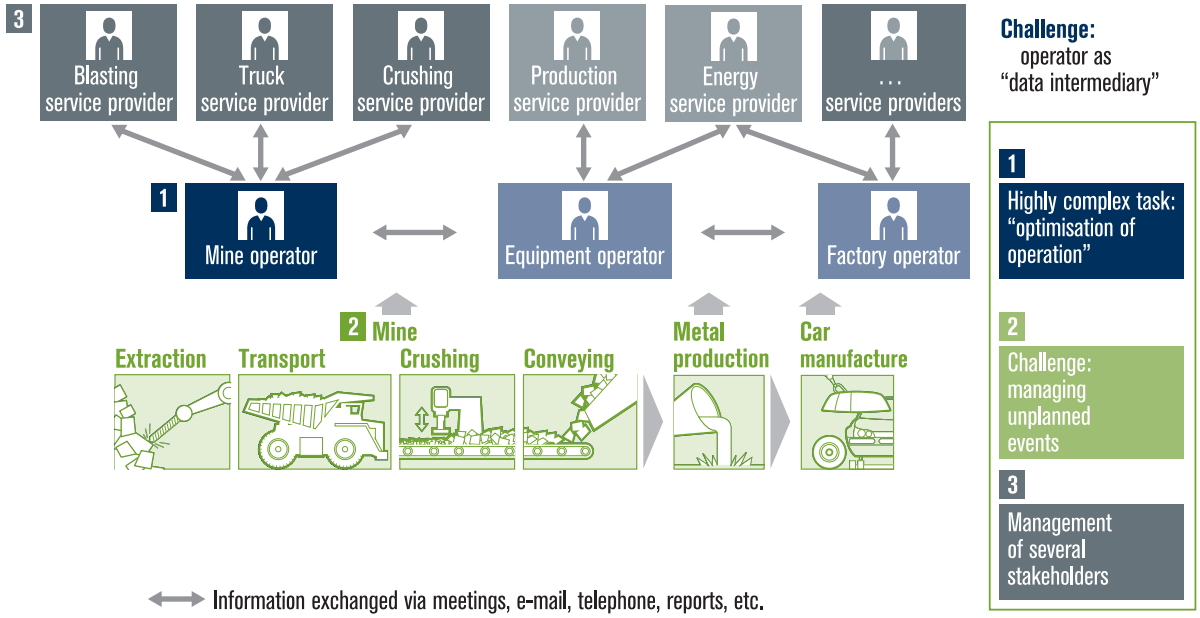
The manufacturer offers to supply the customer with gas as a service. As the operator of the gas generating sets, he brings in competent development service providers to deliver new functionality.
For example, status information about the generating set is captured and analysed on a continuous basis, particularly vibration analyses. Furthermore, the generating set is equipped with a remote access facility, allowing a service centre to provide early warnings of any potential malfunctions so that preventive maintenance work can be performed.
An energy management system is used to produce operating schedules to ensure that the generating set produces gas when electricity prices are low. The levels of gas stored in the available tanks are optimised in order to minimise energy costs whilst ensuring that demand is met and also taking scheduled stoppages of the generating set into account.

Closing the gaps and required actions:

- There is a need for cost-effective remote access technologies capable of operating in an industrial environment (i.e. with a long service life despite operating in challenging conditions), as well as integration into a cloud solution covering multiple generating sets.
- There is a need for dependable and widely accepted IT security concepts and solutions for remotely accessing the generating sets via cloud infrastructures.
- It will be necessary to employ learning techniques in order to analyse the status information gathered from the generating sets over the course of time and draw valid conclusions regarding potential malfunctions.
- It will also be necessary to employ effective and robust optimisation techniques so that reliable operating schedules can be produced for the generating sets.

USE CASE 2:
Optimising the operation of industrial facilities

Today



Source: Siemens AG

The operators of industrial facilities within a value chain constantly have to optimise the way that they run the facility based on economic considerations. This optimisation is dependent on the current market situation and has to take a wide range of different factors into account (resource consumption, the facility's capacity utilisation and throughput, the quality of the manufactured product, etc.). Optimisation is a highly complex task that is usually performed by the facility operator. One of the challenges involved is how to cope with unplanned events (e.g. a flat tyre that has a direct impact on the delivery of raw materials and also requires a replacement tyre to be delivered). In order to run a facility, the facility operators have to coordinate many different suppliers and service providers (maintenance, logistics, spare parts, etc.).

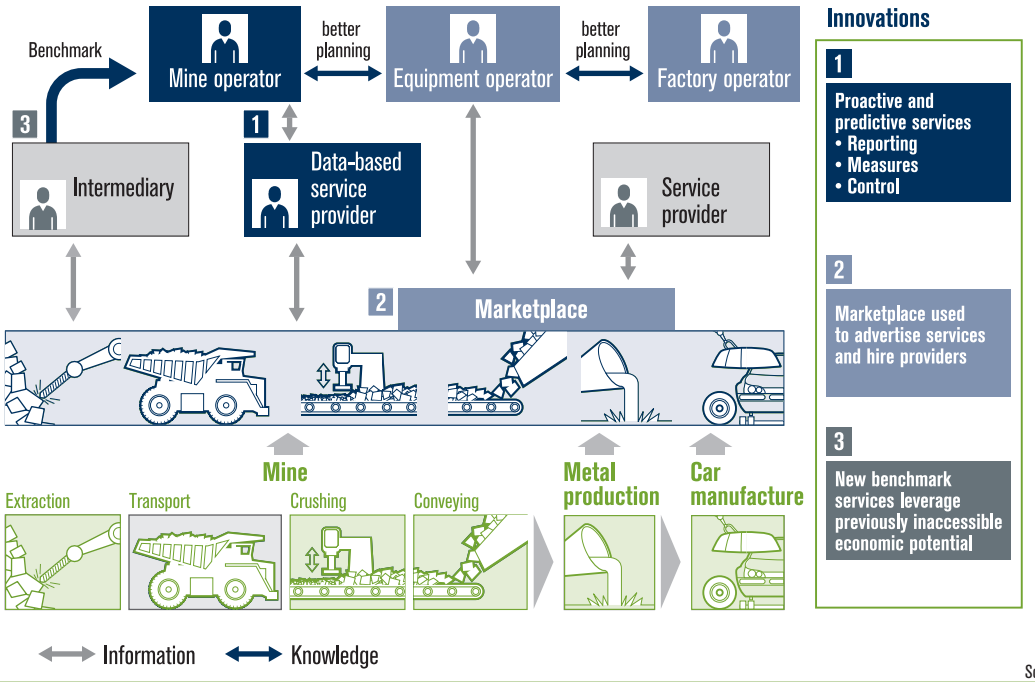
Benefits and value-added:

- The facility operator is provided with support for optimising the running of the facility. The prevention of certain unplanned events means that accidents and unscheduled stoppages can be kept to a minimum. This allows the operator to focus on his core business. In addition, non-value-added processes in the running of the facility can be outsourced to service providers.
- Intermediaries can use data-based services to establish a new control point and can build business partnerships based on manufacturing and operational expertise. Their position as intermediaries enables them to build trust, meaning that the different market players will be prepared to divulge information to them. Global benchmarking enables hitherto untapped economic potential to be leveraged.
- The service provider can use the available information to optimise their costs and improve their service performance planning.

Participants: Industrial facility and machine operators, service providers and intermediaries

How the use case fits into the layer model: This use case illustrates how a software-defined platform and service platform (Layers 1 and 2) can allow new intermediaries and new data-based services to become established and how the control point at the customer interface can shift from the facility operator to the service provider.

Tomorrow



Source: Siemens AG

A service platform stores and updates data about the facility together with digital models. Process and sensor data are transmitted to the platform where they are collated. Service providers use smart, proactive and preventive data-based services and make their expertise available through reports (to provide transparency), recommendations (early detection of potential malfunctions) and even direct interventions in the facility (in this instance, the facility operator relinquishes some of its control over the facility). Instead of having to hire service providers directly, the facility operator can use the information in the service platform to post a request for a particular service and find a provider via a marketplace. Finally, intermediaries can provide new benchmark services by analysing the entire value chain and all the different facilities that form part of it.

Closing the gaps and required actions:

- It will be necessary to establish acceptance and trust on behalf of the facility operators so that they can develop their relationships with the service providers into long-term partnerships. This will require them to divulge certain information that was previously kept in-house. They will also need to have confidence in the quality, security and durability of the relevant technologies.
- From a technological perspective, the requirements include data analyses of logged historical data, forecast algorithms for establishing factors that could have an influence on future events, and techniques for assessing the intrinsic value of the new knowledge that is generated.
- The new role of the intermediary will need to be established. It will therefore be necessary to systematically investigate the potential different types of intermediary, the factors that are key to an intermediary's success and the capabilities that they will need to possess.

USE CASE 3:
Patient-centred digital healthcare: enhancing prevention and treatment

Today

A wide range of patient data is already available today (e.g. through GP's practices, hospitals, health insurance companies, etc.). Moreover, patients are increasingly making use of smartphone apps and similar applications (Layer 3) to measure and document their everyday lives or their medical history. However, there are strict regulations governing how this smart data can be combined and analysed, meaning that the associated opportunities have hitherto barely been tapped into at all.
According to the experts, the use of personal and/or anonymised patient data is expected to offer huge potential for improving treatment outcomes and preventing complications and medical errors.
Whilst personalisation, active consumer participation and faster and more efficient information sharing are already the norm in other industries, the healthcare sector has failed to keep pace with these very necessary developments.

Tomorrow

By collating personal data, innovative smart health services provide a new level of transparency for patients and the doctors who are authorised to view the data. Other smart data, some of which may be anonymised, can be used to develop empirical and evidence-based clinical pathways, leading to significant improvements in both diagnosis and treatment.
Patients benefit from the greater transparency of evidence-based medicine, both in emergencies and over the course of chronic diseases. They receive patient-oriented and patient-centred medical care.
New cooperative business models are developed that may include actors who are completely new to the healthcare sector. These models draw on additional personalised data obtained e.g. through sensors or other monitoring systems in patients' homes.

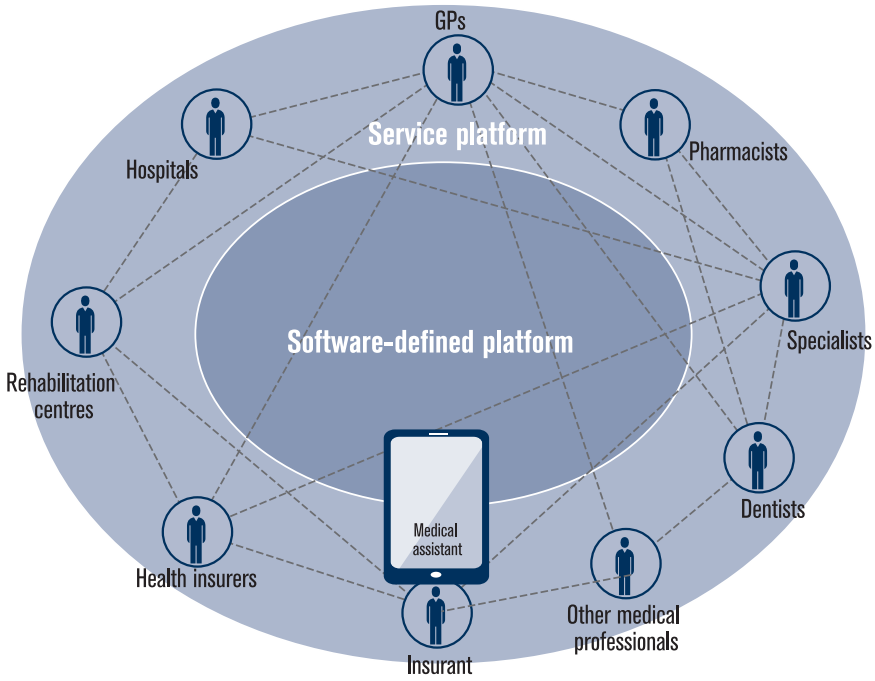
Benefits and value-added:

- This approach enables patients to receive medical care in their own homes whilst also ensuring greater autonomy and increased transparency with regard to their diagnosis and treatment.
- It also enables the establishment of services and tools that allow patients to choose which type of preventive support they receive for acute and chronic conditions.
- Significant cost savings are delivered through the reduction/prevention of hospitalisations.
- There is a positive impact on the course of treatment.
- The better quality of data used as the basis for patient care leads to efficiency and effectiveness gains. Evidence-based diagnosis and treatment and standard processes for collecting, processing and sharing patients' medical data make it possible to detect and correct errors in the treatment regime at an earlier stage or even prevent them completely.
- The result is a lasting improvement in the standard of care, a higher number of successful outcomes, shorter treatment durations and lower costs for the healthcare system.

Participants: Patients, physicians, hospitals, nurses, the pharmaceuticals industry, medical technology suppliers, health insurance companies, care providers, IT service providers and family members who care for patients

How the use case fits into the layer model: In the future, it will be possible to use smart data (in some cases originating from Smart Products) to provide improved transparency and analysis of patients' medical data, thus enabling better preventive care, diagnosis and treatment. A software-defined platform can act as an integrating layer to enable the creation of patient-friendly services (Smart Services).

Tomorrow



Healthcare sector

134
Statutory health insurance companies

90 % (–70 Mio.)
statutory insurance scheme members

2.100
hospitals

21.000
pharmacies

208.000
GPs, specialists and dentists, incl. registered psychotherapists

2,3
other healthcare professionals (specialist medical professions and medical technicians)

80,2
million inhabitants

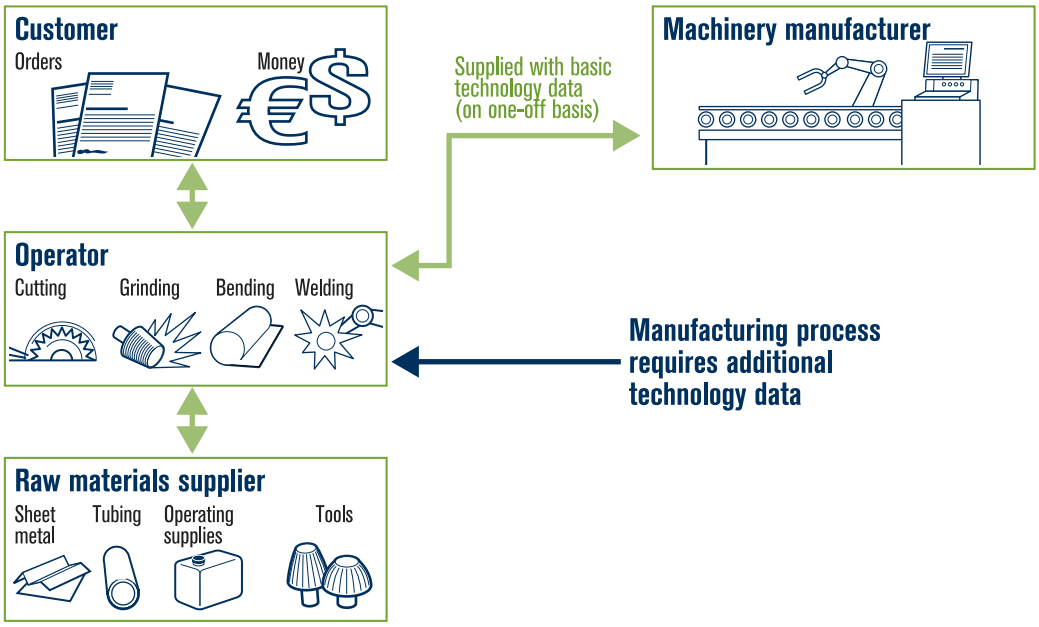
Source: gematik

Closing the gaps and required actions:

- It is necessary to ensure interoperability by systematically implementing existing data standards and developing new ones where necessary.
- It is necessary to develop semantic analyses and other analysis algorithms for evidence-based diagnosis and treatment.
- It is necessary to expand the telematics infrastructure so that it can provide the smart network needed to form the basis of a communication-based healthcare system.
- The stakeholders' ability and willingness to embrace change needs to be increased through new cooperation platforms (cross-industry networking).
- Knowledge platforms should be developed in order to increase patient empowerment.
- It is necessary to establish flexible reimbursement rules and needs- and market-oriented approval processes for safe, innovative and patient-friendly medical equipment, treatments and drugs.
- It is necessary to introduce statutory regulations regarding the funding of large-scale networks in the healthcare system.

USE CASE 4:
Technology data marketing: a manufacturer expands the control point at the customer interface

Today



Source: TRUMPF

Changing parameters (e.g. material properties, desired product quality, throughput, etc.) mean that production equipment operators constantly have to optimise their machinery's processing parameters using the appropriate technology data to adjust the relevant settings. The machine manufacturer will generally supply standard parameters for a range of different applications. The operator will then usually add to and optimise the technology data to meet the requirements of their specific applications or will pay the manufacturer to do this for them.

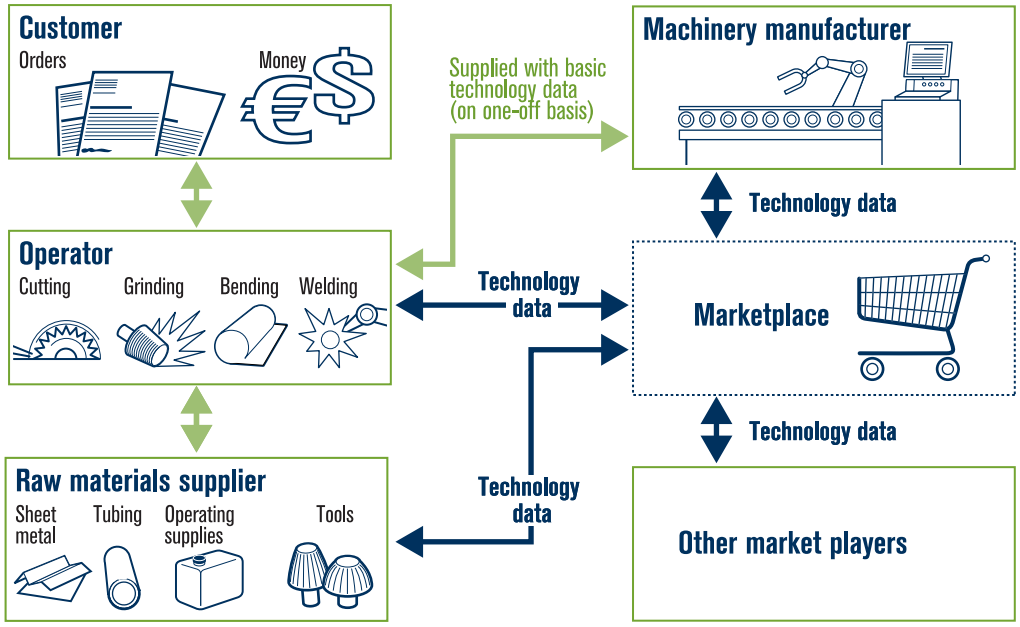
Benefits and value-added:

- The machinery operator is able to obtain reliable technology data that are not supplied as standard with the machines. The use of a transaction platform to access in-house and external technology know-how enables them to deliver their orders on time and to the required quality standard. They can also share experiences with other operators.
- The manufacturers are able to increase customer loyalty and enhance their production equipment with digital services. They can build on this by providing operators with enhanced services for overall process optimisation. They can "learn" how the operators use the product and employ this information to make improvements to it.
- Raw material suppliers also have an opportunity to increase the value of the materials that they supply by enhancing them with technology data, thus augmenting their value-added.

Participants: Manufacturers and operators of production equipment, raw material suppliers

How the use case fits into the layer model: A production equipment manufacturer (Layer 3) uses a service platform (Layer 1) to expand its control point at the customer interface. In addition to marketing the smart product itself, the manufacturer also sells information on optimising the production equipment's operation.

Tomorrow



Source: TRUMPF

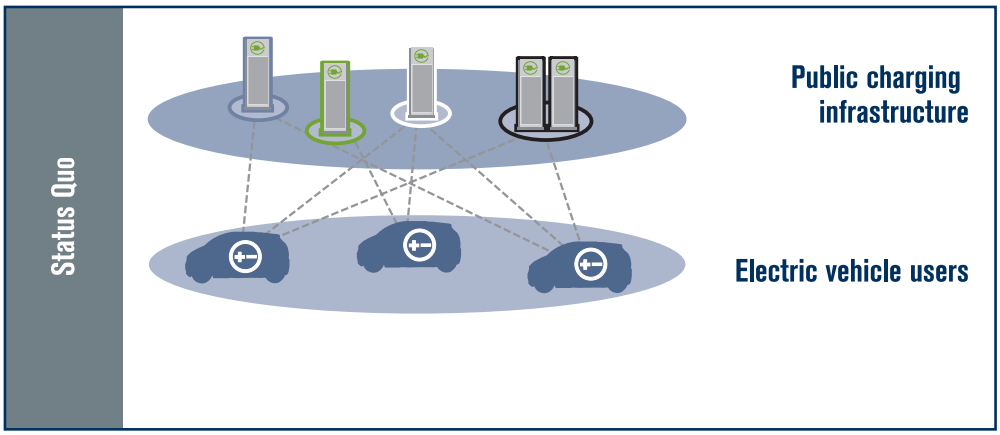
The manufacturer enhances its manufacturing equipment products with digital services by supplying new or optimised technology data for a wide range of different raw materials via a suitable transaction platform. The production equipment operators can also upload their own technology data to this platform. This leads to the emergence of a data marketplace that also serves as a basis for new business models. In the future, it will therefore be possible e.g. for raw material suppliers to enhance the value of their products by linking them to technology data, whilst machinery suppliers will be able to act as intermediaries for materials with technology data. Some of the benefits can be delivered even without the machinery needing to be connected to the Internet. However, only once data can be exchanged directly between the machinery, the materials and the trading platforms does it become possible for the business models to function optimally and new potential to be leveraged.

Closing the gaps and required actions:

- One of the challenges involves the technical and organisational development and operation of the transaction platform and the achievement of a critical mass of marketplace users. The inherent complexity in this process should be managed from a cross-manufacturer perspective.
- It is also necessary to achieve widespread acceptance of this approach. This is because some customers may regard technology data as a USP and might not be prepared to make optimised or new technology data available via a marketplace. It will be particularly important to provide dependable and widely accepted data security concepts and solutions.

USE CASE 5:
Europe-wide networking of charging station operators

Today



Source: Hubject

The first electric mobility market phase that began in 2009 witnessed the emergence of isolated proprietary solutions for the operation of the charging infrastructure, since the establishment of inter-regional networks was not initially a priority. As a result, comprehensive customer-oriented business models can now only be supported to a limited extent. The suppliers in the electric mobility market are confronted with the challenge of enabling interoperability between the different charging stations currently in use by networking the various charging station management systems.

The ability to use charging stations from different suppliers is regarded as an important feature of a customer-friendly charging infrastructure. However, a universal, customer-friendly charging station network has yet to be established. At present, customers wishing to use public charging stations are therefore forced to enter into several different contracts with their respective operators.

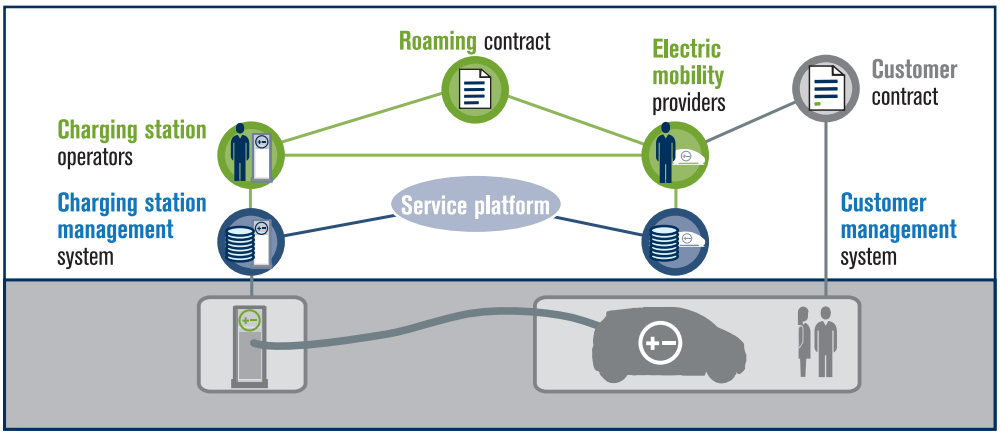
Benefits and value-added:

- A compatibility symbol serves to build customer confidence.
- Efficient market access is provided through access to a Europe-wide charging infrastructure network using a single contract and a single IT interface.
- The service platform facilitates efficient deals between partners regarding individual prices and services.
- This open approach enables greater transaction cost efficiency.
- The open technology, innovation-friendly platform provides a basis for new services.
- All of the proven technologies for using charging stations (RFID, smartphone apps, Plug & Charge) are supported.
- Operators benefit from an increase in their charging stations' capacity utilisation.
- By linking the different elements in the "electric mobility service" value chain to each other, it becomes possible for energy suppliers, vehicle manufacturers and mobility service providers to develop new business models.

Participants: Charging station operators, electric mobility service providers (automotive industry, insurance companies, automobile associations), value-added service providers (e.g. GPS data and telematics service providers), local authorities and the public sector.

How the use case fits into the layer model: Electric vehicle charging infrastructure operators (Layer 3) use an eRoaming service platform (Layer 1) to increase the number of people using their infrastructure by establishing a network with charging stations run by other European operators. Value-added service providers can also use the platform to market their services.

Tomorrow



Source: Hubject

Charging infrastructure providers can agree to add their charging stations to a network via a marketplace. A compatibility symbol used throughout Europe provides consumers with a recognisable guarantee of reliability, in much the same way as the Maestro symbol does in the banking industry. From a technical point of view, all the providers need to do in this model is adapt their stations to use a standard IT interface. This allows transaction and implementation costs to be reduced for both charging station operators and mobility service providers. In addition to the contractual framework, various technical software-related issues concerning the networking of charging station management systems also need to be addressed. Doing so will allow the different value creation stages to be connected to each other – from the delivery of electricity via the charging infrastructure to the provision of information about charging station availability and the charging station reservation facility.

Closing the gaps and required actions:

- It will be necessary to incorporate more (currently isolated) European solutions into the network in order to increase customer confidence in electric mobility. It will furthermore be necessary to support an efficient market model.
- It will be necessary to drive the technical harmonisation of interfaces, connectors and data standards across Europe.
- The activities of national and international research funding and demonstration projects will need to be coordinated.
- It will be necessary to create a European institution for issuing harmonised, standard operator and provider IDs in order to enable transparent identification of charging station operators and mobility service providers.
- It will be necessary to create a clear legal framework in order to facilitate long-term product development on behalf of electric mobility service providers (e.g. in relation to the minimum technical standards for the charging infrastructure, parking space use, signage and billing).

USE CASE 6:
Targeting consumers at the dinner table: a personal process assistant for buying and preparing food and providing nutritional advice

Today

Source: Deutsche Post DHL

Buying and cooking food is a regular part of our everyday lives. However, since doing so eats into our leisure time once we have finished work, it can come to be regarded as an inconvenience. This can have the effect of reducing the variety and quality of our diet. Individual consumers first have to decide what they would like to have for dinner. They then need to visit one or more food stores in order to buy the necessary ingredients. It is often only once they get to the shop that they realise they have no idea which ingredients they already have at home. They are then faced with either having to go home and check or ending up buying too little or too much. It is also easy for consumers to get into habits that cause them to lose sight of their personal nutritional and consumption patterns.

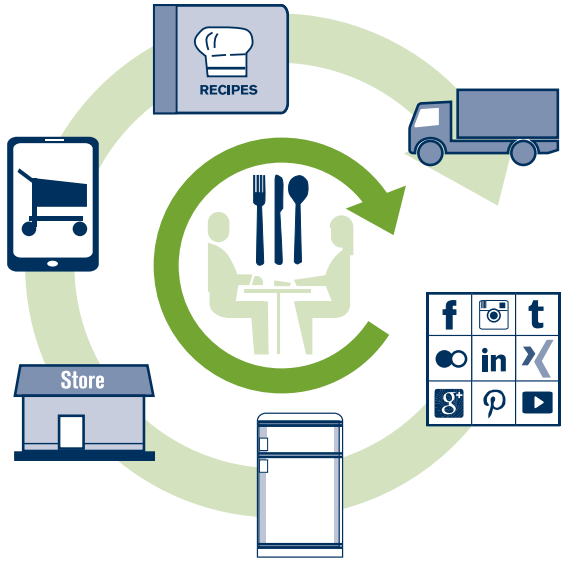
Benefits and value-added:

- Consumers are provided with support in their specific, frequently time-consuming everyday consumer processes. A data-based assistant supplies them with detailed product information and gives them a transparent overview of their nutrition. This enables them to live more environmentally-friendly and healthier lives.
- By analysing sales data, retailers can plan their product ranges to more accurately reflect what consumers actually buy, thus preventing overproduction and waste. Service providers' internal processes can also be optimised.
- Customers can be offered additional benefits such as coupons or other types of loyalty programme. These special offers target customers' needs so accurately that they perceive them as value-added services.
- New targeted ecosystems and Smart Services are created, providing e.g. nutritional advice, customer product customisation, crowd-based transport, etc.

Participants: Intermediaries, producers, over-the-counter, local and online retailers, logistics companies, payment service providers, consumers and their social networks, communities

How the use case fits into the layer model: A Smart Service is used to represent the simple everyday activity of making dinner on a service platform (Layer 1). An intermediary reconfigures several service providers from different industries and their services. The resulting ecosystem has the potential to revolutionise traditional industry structures.

Tomorrow



Source: Deutsche Post DHL

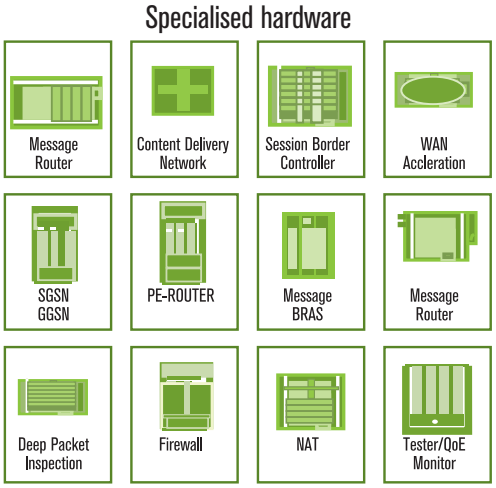
An intermediary reconfigures digitally enabled services provided by retailers, logistics companies, nutritional advice providers and social media in order to create a Smart Service. Refrigerators fitted with cameras and connected to the Internet provide a remotely accessible overview of their contents and the available selection of different foodstuffs. Together with the customer's data-based user preferences and nutritional goals, this information is used as a basis for providing them with recipe suggestions accompanied by detailed product information. If the user chooses one of these recipes, the intermediary sends out the relevant orders to the businesses that belong to the consumer goods ecosystem. A logistics firm is employed to collect the goods from the different retailers and deliver them to the customer in a refrigerated container at a time of their convenience. The customer is also provided with cooking instructions and tips from the community. Payment of the entire order is arranged with the different service providers via the intermediary.

Closing the gaps and required actions:

- It will be necessary for an independent intermediary to develop a service platform for combining the services and ensuring their interoperability. It will also be necessary to define standard, extensible protocols and interfaces such as product catalogues and semantic term networks.
- Service modules will be needed to enable the parties involved in the Smart Services to connect rapidly to the service platform. These modules should be simple enough to be used even by small, over-the-counter retailers (SMEs), so that they too can form part of the new hybrid value chain.
- Authorisation modules will also be required so that more than one company can access personal customer data.
- It will be necessary to develop smart, data-based analysis techniques for the assistant.

USE CASE 7:
Virtualisation of telecoms infrastructure

Today



Source: EIT

The major ICT providers and network operators are facing the challenge to deliver an extensive portfolio of end-to-end network solutions to increasingly internationally operating service providers. Thanks to the virtualisation of communications network infrastructures these service providers are now able to advance into the telecoms network operators' core business, attracting their customers away from them and in some instances even taking over the entire network infrastructures. The established standardisation mechanisms are thus gradually being invalidated and supplanted by new, 'de facto standards'.

Benefits and value-added:

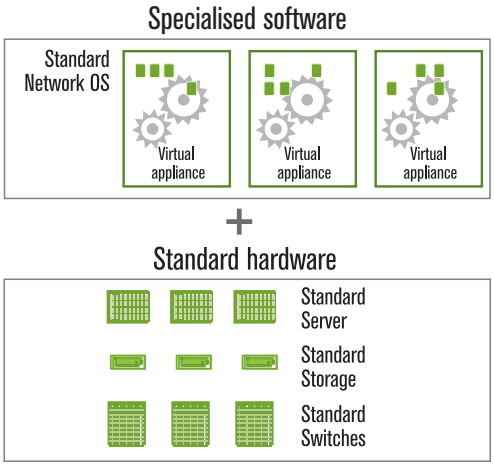
An implementation-oriented programme to create the relevant industry standards for interfaces and processes could be driven e.g. by national or international initiatives. The goals would be to promote competition and to create collaboration platforms for similar services and infrastructures in order to leverage synergies. The expected impacts are as follows:

- Collaborative initiatives would be strengthened as an alternative to takeovers.
- Telecommunications services are available supraregionally.
- European solutions and infrastructures based on a "federal approach" and benefiting from the security and trustworthiness advantages would be developed and expanded.
- The aim is the positioning of "federal broadband standards" and corresponding products recognisable as German export successes.

Participants: Telecoms network operators, communication service providers, network equipment providers, Internet service providers

How the use case fits into the layer model: Until now, standards in the telecommunications industry have been set at the level of technological infrastructure(Layer 4), however, they are increasingly being determined by the platforms that lie above this level (Layers 1-3).

Tomorrow



Source: EIT

Supranational and scalable models for combining and delivering ICT infrastructure services on a service platform make it possible to integrate networks, network-based services and value-added services. This enables flexible data exchanges between different network providers that go beyond simple IP peering. Moreover, standard operating and billing system interfaces make it possible for different network functions to be combined. These interfaces allow service providers to be integrated into the service platform in order to provide network-based value-added services and access products. This enables ICT providers and network operators to grow their services portfolio and use the technological advances to their own advantage.

Closing the gaps and required actions:

German industry must lead the way in the development of open, interoperable interfaces between communication providers. The demise of specialised hardware (see illustration) could lend momentum to the continued development of networks at the software level that needs to be accompanied by the following practical measures:

- It will be necessary to develop and adapt efficient and secure interfaces for network and communication services, based on Software-Defined Networks (SDNs) and Network Function Virtualisation (NFV).
- It will be necessary to establish intermediary services and business models for processes involving several different countries and services.
- Alliances need to be formed, both vertically (between manufacturers, operators and services) and horizontally (e.g. between several different operators in different countries).

5 Enablers

5 Enablers

The enablers for the digital infrastructures of the Smart Service Welt are represented schematically in the layer model in Figure 5, which depicts how each layer is built on the one below it. This chapter will begin by providing a general overview of the enablers before moving on to a detailed discussion of the individual platforms and other factors in sections 5.1 to 5.4.

The bottom layer, which forms the basis of all digital services, is the **technological infrastructure** (Layer 4). This must guarantee affordable, **secure broadband Internet access** anytime, anywhere and for anyone. At the same time it must connect digitally enabled products with each other and with their human users in order to enable **extremely low-latency real-time applications**. In addition to the Internet, another important pillar of the technological infrastructure will be provided by **sensor networks**, not just in factories and buildings but also in the public transport infrastructure, the energy supply system and the urban environment. It will be possible to (pre-) process the data obtained through these networks in the software-defined platforms so that they can subsequently be refined at the service platform level in order to provide innovative services. The same is true of the **next generation of position location systems**. These will use e.g. Galileo and hybrid position location techniques to enable completely new services offering a high degree of precision for both indoor and outdoor environments – for example highly automated driving with a collision avoidance function made possible by the ability to pinpoint a vehicle's location to within an accuracy of under 10 centimetres.

Industrie 4.0 is focused on the development of networked physical platforms (Layer 3) as Smart Products. The strategic initiative addressed in this report, meanwhile, aims to drive progress on **software-defined platforms** (Layer 2) and service platforms (Layer 1), which are the key enablers of the digital service economy. The central concept underpinning software-defined platforms is **virtualisation**. This frees the platforms from dependency on specific hardware at all the different levels, making IT solutions extremely flexible, adaptable and robust. The concept includes everything from virtual networks, virtual storage farms and virtual computer clusters to full virtualisation of application solutions that can run completely independently of any specific hardware as a guest system in a

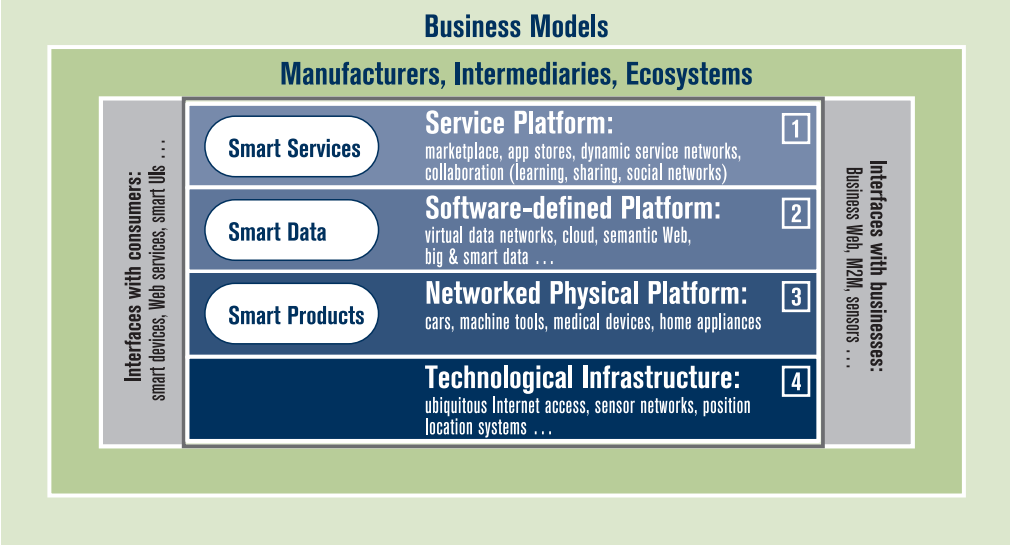


Figure 5:
Detailed layer model: digital infrastructures

Source: DFKI / acatech

standard virtual environment without suffering any noticeable drop-off in performance. Software-defined radio systems, virtual data networks and of course **cloud systems** are all based on these virtualisation layers. In addition to cloud structures, however, another important component of software-defined platforms involves **virtualised information infrastructures** for the storage and real-time processing of extremely large and unstructured quantities of data (big data) or the critical data sets (smart data) derived from them, as well as for semantic annotation and ontology-based searching and inferencing. The basic systems needed to make this possible can be tested rapidly and dynamically using generic enablers such as those provided in the cloud by the FI-WARE catalogue of the EU's Future Internet Public-Private-Partnership (FI-PPP). They can also be configured and reconfigured using the Lego principle (for further details, see 5.1).

Concrete Smart Services are built directly onto the **service platforms** which constitute the highest generic layer of the digital infrastructure. **Marketplaces** for information relevant to the services, as well as for mobile **apps** and software-based add-on functionality for physical devices can be configured using generic enablers and operated and serviced on these platforms. Furthermore, innovative **social networks** that can be used for new services and innovative **learning** and **collaboration networks** can be implemented cheaply and rapidly on service platforms using the standards, tools, processes and interfaces that they provide in order to facilitate legally robust cooperation in distributed business processes. The dynamic composition and orchestrated implementation of semantically described services allows new situation-specific, consumer-centric services to be put together from existing services on demand. These **mashups**[1] also enable distributed billing.

The digital infrastructures and their implementation in the four different layers are, however, no more than technological enablers for the establishment of successful businesses and the delivery of sustainable value-added in the Smart Service Welt. Whilst undoubtedly necessary, the implementation and utilisation of the four platform levels will not in itself be sufficient to create successful and innovative business models. Success will ultimately be determined by **management innovations** in the new **digital enterprises**. Section 5.3 describes how new **innovation, information, organisational and human resources management** methods targeted at Web-based services will be required in order to unlock the full economic and social development potential of the digital infrastructures.

Human beings will continue to occupy a position at the centre of the Smart Service Welt, both as producers and as consumers. Accordingly, good **socio-technical workplace design**, secure, transparent and user-friendly **human-technology interaction** (usability), customer support and systematic business model marketing are all key to the successful roll-out of the vision outlined in this report. It will also be necessary to implement **innovative education and training programmes** and innovative organisational structures for enabling cooperation within and between businesses, networks and communities. This will ensure that people are well prepared for the digital society, both in their capacity as employees of new digital enterprises and as sovereign consumers. Section 5.4 illustrates how **innovative learning technologies** in this area can themselves make use of the software-defined platforms and can be combined in new service platforms to create extensive learning networks. As a result, new business models such as Massive Open Online Courses (MOOCs) can also be established in the field of education and training.

5.1 Software-defined platforms

Software-defined platforms provide the technological basis for novel Web-based services. One key requirement for the establishment of competitive software-defined platforms is the availability and deployment of innovative high-performance components that offer the different platforms a clear advantage over previous approaches. Another important factor is the availability of technical experts capable of designing, operating and continuing to develop these platforms. The

basis for these requirements is provided by continuous advances in science and technology and the generation and dissemination of implementation and application know-how. It is clear from the use cases presented in Chapter 4 that the platforms' technological requirements and specific features will vary significantly from one case to another. For example, a company might provide a marketplace based on a software-defined platform as a service platform for trading technology data (Use Case 4), an intermediary might use an innovative business model to optimise processes at several different companies (Use Case 2), and a service provider might create a secure platform for personal data (Use Cases 3 and 6). In order to adequately address this diversity and ensure that software-defined platforms are deployed in as many applications as possible, a broad spectrum of actors will need to deliver research and technological developments across a wide range of different fields.
Although some of the requirements for software-defined platforms already exist, these individual solutions will need to be combined with new, as yet unexplored technologies so that industry-specific software-defined platform solutions can be developed to meet the specific needs of different situations. For example, a smart data platform used in the retail trade will need different services than one used in manufacturing, where the primary concern is direct real-time optimisation of machine control. The strategic initiative "Web-based Services for Businesses" must therefore be accompanied by a research programme to address the fundamental methods and software components required to enable a wide range of different platforms that allow innovative solutions to be developed for implementing the use cases described in this report.

The next section will examine the key fields and topics where substantial research is still required. These priority themes were identified by leading German researchers from industry, universities and research institutes. They cover the fundamental technological principles required to enable the emergence of a wide range of platforms and ecosystems for data-based services. Germany is already among the world leaders in some of these research fields. For example, the core project SINNODIUM of the Leading-Edge Software Cluster (BMBF) is developing an architecture framework for **emergent software components**, services and tools. The framework is based on the widely used software industry layer model comprising infrastructure services (IaaS), development services (PaaS), a wide range of specialised components (SaaS) and business process use cases (BPaaS). This service-oriented architecture framework can be seen as a refinement of the key aspects of the top two platform layers in the more general digital infrastructure layer model used in this report (see Fig. 5). Notwithstanding the above, further targeted efforts are called for in order to stay in touch with our global competitors and develop the technological basis for platforms that enable the implementation of digital-, data- and service-based services.

5.1.1 Data security

Enterprises and intermediaries will only be prepared to collaborate and share data on **trustworthy platforms** (see Use Cases 2, 3, 4 and 6). Effective security solutions should therefore form an integral part not only of all software-defined platforms but also of **collaboration platforms and information marketplaces** (Layer 1). The specific themes requiring further research in this field are:

- User-friendly methods for robust user authentication, identity management and trusted computing.
- Efficient searching and processing of encrypted data.
- Security and privacy protection for Smart Services.

5.1.2 Cloud-based virtualisation and interoperability

In addition to cloud structures, another important component of software-defined platforms involves **virtualised information infrastructures** for the storage and real-time processing of extremely large and unstructured quantities of data (big data) or the critical data sets (smart data) derived from them. **Virtualisation** is essential in order to provide the software-defined platforms with hardware-independent, standardised infrastructures. It will also be necessary to enable **integration and migration** of legacy systems to these

new platforms (see Use Cases 2, 3, 4 and 7). It will be especially important to ensure that they can connect to cloud infrastructures, something that is currently only possible to a very limited degree. This will call for applied research geared towards the needs of industry in the field of **innovative middleware solutions**. More specifically, it will be necessary to carry out research on the following topics:

- Infrastructure virtualisation and federation.
- Middleware for orchestrated service environments.
- Migration tools, middleware and connectors for the integration of Smart Services into existing service landscapes and for enabling the switch to in-memory computing and multicore or cluster architectures.
- Elastic cloud platforms for comfortable, service-oriented integration of SOA, Internet of Things and legacy systems.

5.1.3 Semantic service integration

The conversion of existing services into **semantically composable service clusters** will call for new search and composition methods that allow users to benefit from the value-added of the networked semantic services, whatever their current location. Moreover, service users should also be able to compare and use services that have been specifically recommended to them (see Use Cases 2 and 6). **Learning methods** for describing the available services will allow services to be implemented more rapidly. More research will be required on the following specific topics:

- Adaptive meta-search engines for apps and snippets.
- Easy to use, lightweight tools for semantic service description across a wide range of industries.
- Automated and scalable composition of Web-based services based on their semantic descriptions (semantic mashups).
- Learning methods for generating service descriptions using extraction techniques for unstructured or semi-structured sources.
- Context-sensitive comparison and recommendation systems for hybrid services.

5.1.4 Data analysis

Many data-based services are only possible thanks to the analysis of extremely large and heterogeneous quantities of streamed data. These include hybrid, personalised product-specific services that rely on the ability to recognise what an individual is doing at a given point in time. Many innovative data-intensive knowledge-based services require **massive parallel data processing systems** and **scalable analysis techniques** for structured and unstructured data and data streams. Advanced **machine learning**, statistical and signal processing analysis techniques are particularly significant in this context. They include training methods for data-based forecasting models that make it possible to predict e.g. production stoppages (see Use Case 2) or demand for a particular product (see Use Case 6). Research into parallel data processing systems capable of applying these techniques to big data is still in its infancy. Furthermore, very few people currently have the expertise required to operate these complex data analysis systems effectively in all their different applications. It is therefore also necessary to prioritise research into technologies geared towards **simplifying the analysis specification**. In conjunction with **automatic optimisation, parallelisation** and **hardware adaptation** this will be essential in order to enable a wide range of users to analyse large static and streamed data sets, thereby making this technology available for more widespread use.

The key research themes in the field of data analysis are as follows:

- The development of massive parallel execution systems capable of meeting the demands of complex data analysis algorithms.
- Techniques for real-time processing of data streams associated with complex events (CEP) and linking them to static big data sets.
- Automatic optimisation and parallelisation of declarative data analysis programs.
- The development of innovative multilingual information extraction, trend, attitude and opinion analysis techniques for informal language.
- RAM-based analysis mechanisms.

- A continuum of analysis methods covering everything from data streams to RAM-based operational data and static big data sets.

5.1.5 User and data interfaces

Innovative hybrid services require interfaces between the IT systems and the real world. **Multimodal, mobile, collaborative interface technology** provides a promising approach for enabling intuitive service interactions and the exploration of big data sets. A number of important research questions arise in connection e.g. with **augmented reality-enabled mobile interaction interfaces** as described in Use Case 6. Future dual reality interfaces will enable innovative hybrid process services. It will also be necessary to develop solutions for sensor coordination and efficient processing of the data gathered by sensor networks in order to enable fully automatic capture of big data sets, e.g. for the optimisation and maintenance of manufacturing facilities (see Use Cases 2 and 4). The key concrete research themes in the field of user and data interfaces are as follows

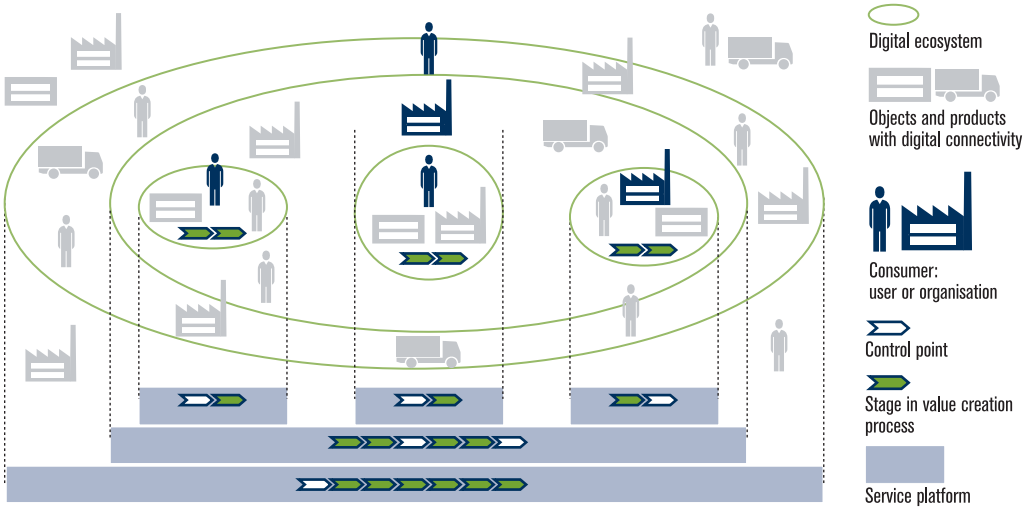
- Innovative searching, browsing and visualisation techniques for smart data and Smart Services.
- Innovative multi-sensor systems and sensor fusion techniques for Smart Services.
- Probabilistic activity and plan recognition based on multi-sensor environments.
- Mobile assistants for augmenting the cognitive abilities of human service providers (smart glasses, body sensors).
- Innovative multimodal, multi-adaptive and multilingual dialogue systems for using hybrid services.
- User-centred methods for the design and evaluation of multimodal services.

5.2 Service platforms

Service platforms are a fundamental requirement for the formation and organisation of digital ecosystems. They are built on software-defined platforms that allow CPS and digitally enabled products to connect to each other and exchange data. Real-world objects and products with digital connectivity can be represented digitally on the software-defined platforms and service platforms. By connecting them in this way, it is possible to bridge the gap between the real and digital worlds. The service platforms thus perform an integration function for digital value networks. In the future, **control points** that used to be primarily physical will now also be represented on the platforms. The control points describe the critical intervention points of the value creation process. In other words, they are key to enabling the success of specific business models and define how these business models are accessed (see e.g. Use Cases 2, 4 and 6). Figure 6 illustrates the interactions between digital ecosystems and service platforms.

The key function of service platforms is to enable collaboration by providing the **collaboration environment** required for cooperation between different organisations. The service platforms contain and predefine all the processes, interfaces, tools, standards and rules needed to enable interaction and collaboration between the actors and objects that form part of the ecosystem.
Cooperation is enabled by linking individual application services to aggregated value-added services within the service platforms. The service platforms use **service modules** to configure value chains and combine them to create network-like business models (see Fig. 7). Standard interfaces allow different services to be combined and integrated. The cooperation between the different actors is governed by rules. This means that cooperation in both the digital and real worlds can take place almost on an ad hoc basis, without needing to agree the detailed terms of the cooperation beforehand. Fungibility will be a key requirement of future system architectures.
Data and know-how sharing facilitate the generation of know-how and know-how transfer between companies. Virtual collaboration platforms can be used to discuss complex questions and develop solutions anytime, anywhere. Knowledge is generated through expert communities and made available through services. Service platforms thus help to **increase** the ecosystems' **efficiency** whilst also providing a **learning environment** for developing new solutions. Data collection, analysis and inter-

Figure 6:
Building digital ecosystems



Source: FIR / WZL / Fraunhofer IPT

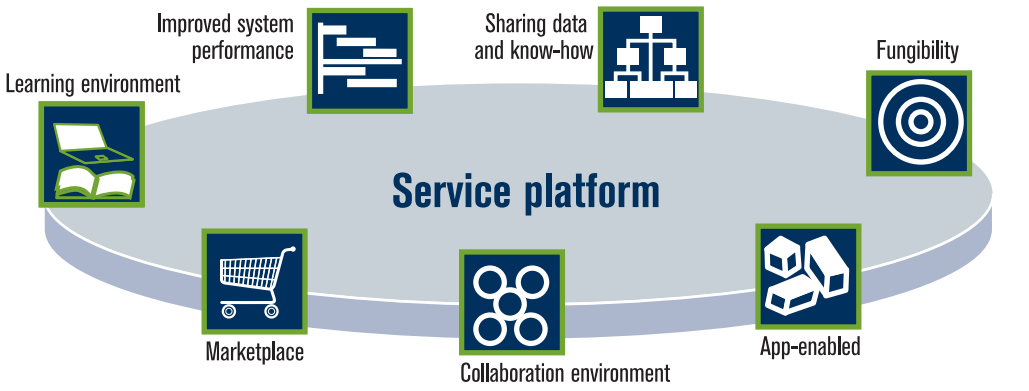
pretation are combined with information extraction, pattern recognition and inferenceing techniques to identify implicit problems, optimisations and new approaches. Data scientists and technical experts can be brought in to find new solutions and deliver them as services. This helps to drive a continuous improvement process that employs user and operator data to generate new knowledge throughout the entire product life cycle and enables context-based usage, behaviour and decision-making support based on the latest knowledge. The knowledge generated in this way can also be used to identify new success enablers and control points that in turn provide a basis for new business models.

If service platforms are to become established, they must be easy to access. Potential users can obtain access to the services that interest them via app stores. Users can employ mobile apps to directly configure the content and specification of the service anytime, anywhere. The fact that the service platforms are **app-enabled** thus allows them to integrate the digital and real (service) worlds.

5.3 Information and knowledge as the fourth factor of production

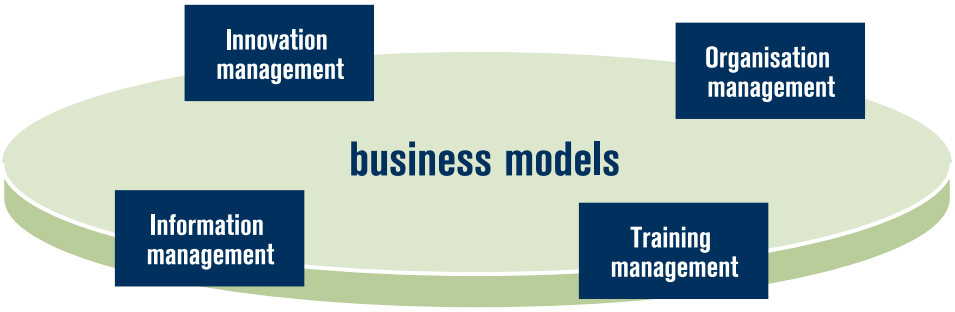
Service platforms characterise the shift from current corporate structures that are based on process and

Figure 7:
Key service platform components



Source: FIR / WZL / Fraunhofer IPT

Figure 8:
Management processes for innovation, information, organisation and training



Source: Scheer Group

resource efficiency to ecosystems based on innovation, information and personalisation which develop and provide Smart Services through a network. Companies incorporating their products and services into digital ecosystems move from being users to providers of Web-based services. Businesses will not automatically benefit from the opportunities associated with service platforms. In order to do so, they will need to use information and knowledge as the fourth factor of production[2], which will enable them to successfully implement new business models. The principal challenges are in the fields of education and training as well as innovation, information and organisation management (see Fig. 8). The following sections take a closer look at the issues of innovation, information and organisation management.

5.3.1 Innovation management: networked innovation

Corporate management principles are still based on fundamental tenets that were developed in the 20th century. Essentially, these involve managing businesses to meet efficiency and productivity targets. These principles have also found their way into the methods used to manage research, development and innovation processes. Approaches such as the Stage-Gate Process seek to use quantifiable indicators as a basis for the systematic selection of ideas and innovation projects in the product development process. Over the past 15 years or so, growing importance has been attached to the contribution made to corporate value creation by creative and innovative knowledge owners (e.g. enterprises, employees, customers and external idea providers).

Nowadays, in addition to the conventional strategy of making improvements to the product, there is growing interest in developing new approaches to delivering market success through the provision of innovative services. Innovations in Germany are no longer confined to traditional high-tech product innovations.[3] Indeed, process, service and business model innovations together with significant new, value-added combinations of products and services (Smart Services) are now unlocking potential benefits for consumers.

Several empirical studies[4] have addressed the factors that determine whether companies are able to innovate successfully. The most innovative (service) companies are distinguished by the adoption of a systematic approach to their innovation activities. This includes a clear innovation strategy, the promotion of an open climate of innovation, the establishment of the appropriate structures and processes (i.e. procedures and their 'owners') and the relevant metrics or indicators. Innovative companies go about implementing these factors through cross-functional in-house cooperation and external vertical and horizontal cooperation models with partners throughout the value chain (networked innovation). At present, the most advanced strategy is the crowdsourcing approach that draws on 'collective intelligence' or the 'wisdom of the crowd'. The innovation outputs pursued by innovative enterprises increasingly involve new business models and game-changing innovations. These companies create new functions such as the "intrapreneur" – a person, who understands both in-house and external processes, envisions a culture of dynamism and knows how to combine closed and open innovation. Intrapreneurs thus help businesses to be-

come more agile in the way that they respond to a rapidly changing environment.
Digitisation and increasingly open innovation processes have led to the realisation – and challenge – that especially disruptive innovations are often no longer generated through closed and controlled standard processes. Instead, they are the result of complex organisational and/or social processes centred around human creativity. In order to enable collective innovation, people should be given creative freedom in every part of the organisational system, and all the actors in the organisational system should have the opportunity to work together, i.e. young and old employees, different departments and people with different perspectives and expertise.
These current trends pose a number of challenges for businesses as far as the development of service platforms is concerned:

- Digital vision and culture: Corporate strategy reviews in response to the requirements of the digital age result in the adoption of new, customer-centred values. Once these values have been given concrete expression in the shape of a vision, they need to be communicated. This will enable the creation of a culture of innovation for the Smart Service Welt, based on creative and collaborative freedom, outside-in approaches, intra- and entrepreneurial mind sets, the elimination of silo thinking and structures, new digital lifelong learning methods, the establishment of mobile, flexible workplaces and working time models and the creation of a new standard of employee protection without detriment to the company's efficiency.
- Smart innovation strategy: The development of the innovation strategy begins with customer processes, not with corporate internal processes. New approaches enable closer cooperation between companies from different industries (industrial convergence) and synchronised service engineering.
- Innovation metrics: It will be necessary to develop incentive systems and metrics that allow the effectiveness of any initiative to be evaluated in order to monitor the progress.

It will be especially important to devise new methods and incentives for simplifying innovation activities and the associated cooperation between different companies via service platforms, in order to deliver improvements for both, employees and companies.

5.3.2 Information management for businesses and end users

Smart data pose a series of new challenges for corporate information management which are often referred to as the "three Vs". This is an allusion to the expected exponential growth in the quantity of data (volume), data traffic speeds (velocity) and the diversity of the data content (variety). The issues posed by smart data thus involve much more than just big data processing and will call for fundamentally new information management principles.
The development of Smart Services via service platforms involves the management and exchange of information as a commodity in the information economy. The information management aspect relates to the comprehensive (re-) definition of business models for service platforms. It is here that the benefits for the customer are specified – i.e. the value-added that customers can expect – as well as which ecosystem of suppliers and partners will be responsible for providing and marketing the service. It is also necessary to plan the resources and management structures for the service platforms. Consequently, Smart Service information management also addresses the digital infrastructure. However, there have hitherto been very few instances of Digital Business Model Management Systems (DBMMS) actually being implemented by corporate management.
Many smaller companies lack the information technology know-how needed to implement new Smart Service business models. Web-based services and their potential benefits are not currently being studied in sufficient detail or used as a basis for realigning business models. Many industries are thus simply continuing to use their established business models. Pre-defined service platforms can help to implement new business models more quickly and adapt them to the requirements of the relevant ecosystem. The challenges in the field of information management are as follows:

- Service platform management in the B2C and B2B markets.
- The connection of infrastructure, machinery, equipment and consumer goods to hybrid services that interact with each other and with users in ecosystems.
- The development of scientific and technical Smart Service processes that enable new discoveries to be made, for example in the fields of genetic engineering and medicine.

5.3.3 Organisation: enhancing human-technology interaction

From a technological perspective, digital working is now the most widespread form of work in the modern world. In 2012, 63 percent of the workforce regularly used a computer at work, rising to 98 per cent in the financial services sector. 55 percent of the workforce used the Internet and 15 percent used a mobile device (laptop, smartphone, etc.) with mobile Internet access.[5]

Even in the digital society, many Smart Services – for example in the healthcare and social services sectors – still require human beings to play a central role. There is a limit to how much IT systems can help people work on and with other human beings, particularly in situations that require social and emotional intelligence as well as sensory-motor and cognitive intelligence. Nonetheless, even in these fields, people spend an average of approximately 30 percent of their working time using IT systems to document the services they provide. One important goal is therefore to free up highly skilled professionals by employing mobile assistants to perform these time-consuming tasks wherever possible. This would allow them to concentrate on the core aspects of their work, meaning that medical professionals, for example, would have more time available to talk to their patients.

In addition to reducing the amount of administrative work, Smart Services can also support knowledge- and communication-intensive work processes. For instance, Smart Services and smart data can allow changes in a patient's health to be detected more rapidly, meaning that they can receive the appropriate treatment more quickly (see Use Case 3).

The changes outlined above will place additional requirements on the planning and implementation of future-ready infrastructures for use by people both inside and outside of the workplace. If the boundaries continue to blur between work and home and between manufacturing, service provision and people's private lives, it is likely that completely new types of private and public infrastructures will emerge to support people both at work and in their everyday lives. These will include factories that are located near to the towns and cities that they serve – and logistics concepts that take this into account – as well as service concepts focused on local communities and enhanced intermodal mobility services based on the improved networks and human-technology interaction enabled by digital infrastructures.

5.4 Education and training

Value creation through Web-based services and the transformation of companies into digital businesses through the establishment of a Smart Service Welt will require highly skilled workers who possess the necessary knowledge and skills at every level of a business. By ensuring that the right people are doing the right jobs and providing them with opportunities to work together and cooperate – for example digital platforms or in-house cooperation facilities – it will be possible to ensure that the skills people have acquired are used in a smart and context-sensitive manner that meets the requirements of the current task.

Education ecosystems are becoming established around the world, providing personalised continuing professional development (CPD) combined with individual local mentoring. The Internet is already the primary means of accessing information and knowledge and it is also set to become the platform of choice for lifelong learning, CPD and the development of smart forms of joint knowledge production and personal development for all employees. At present, Germany still has huge potential for growth in this area as well as many problems that remain to be solved, especially with regard to the smart use of Web technologies for communicating the latest practical, applied knowledge to businesses and industry. This continues to be the

case, in spite of the fact that early initiatives such as the "Software Campus" and "Academy Cube" have met with considerable success and have even been well received in other parts of the world.

Continuing professional development and companies as knowledge providers

There are several respects in which education and training are of strategic importance to the design and implementation of Smart Services and business models. The wide-ranging training needs of employees can be more effectively met through the use of digital learning systems in human resources development and continuing professional development services (professional education). However, in the future, companies will also become knowledge providers by enhancing their products and services with smart customer services involving e.g. the interaction of virtual or augmented reality-based digital smart adaptive knowledge services with production machinery or home networks (professional learning solutions). In both instances, new approaches such as mobile and social learning, MOOCs, smart knowledge services and adaptive learning systems will have an important role to play. In order to ensure that these methods are both sustainable and widely accepted, it will be important to take each company's culture and history into account when designing the relevant education and work processes, as well as to include the social partners and guarantee both data protection and information security. To this end, it is recommended that companies should cooperate with the relevant research institutes in order to obtain academic support.

Self-organised acquisition of new knowledge using the Internet

The establishment of a Smart Service Welt in the corporate environment will require employees to have levels of knowledge far beyond those that they currently possess and will far exceed the capabilities of traditional information processing methods. The importance to product and service development of consolidating research findings in ever shorter cycles, and the availability and analysis of information and its aggregation over the Internet make it necessary for people to continuously update their knowledge and methods. Highly skilled knowledge workers are therefore required who are capable of using the Internet and education ecosystem services on their own initiative in order to acquire new knowledge, develop their skills and engage in lifelong learning. This will require the development of smart knowledge services focused on imparting practical and self-organisation skills as well as factual knowledge via the Internet. It will also be necessary to produce knowledge content and provide employees with training on new topics such as digital intrapreneurship, agency, liaison/hybrid managers, change management, open innovation, distance management and resource efficiency.

Social Learning – Mobile Learning – Workplace Learning – Networked Learning

In order to train people for the Smart Service Welt and to develop hybrid services it will be necessary to employ modern learning techniques and novel training methods. This will be particularly important with a view to the establishment of learning and work processes suited to people of all ages, especially as they get older. It will be necessary to integrate on-demand learning into the everyday working environment and design work processes that promote learning. New methodological benefits can be delivered by social learning focused on informal knowledge, fine-grained mobile learning services in changing contexts and workplace learning that employs VR and AR technology to provide procedural knowledge in the workplace. MOOCs offer a modern method of training large groups of people, while adaptive learning systems allow AI-based personalisation of the learning process. The use of competency models and the employment of self-assessment methods or learning analytics to analyse learning requirements and pathways can help to ensure that the services provided match the individual learner's needs. In view of the potential cost savings, developers of new resources and services should strive to promote networking of learners from similar corporate environments via diverse communities of practice, as well as the sharing and reuse within companies and ecosystems of education resources with high-quality content, didactic approaches or technological features.

Example: The potential for a successful export market in smart knowledge services for the dual training and CPD system

Today

The dual vocational training system is one of the strengths of German industry. Indeed, the combination of practical training in industry and academic education at a (higher) educational institution is becoming more and more popular, since it allows people to receive a high standard of education whilst also acquiring practical skills and boosting their individual productivity. This is amply demonstrated by the rapid growth in the number of dual study courses on offer, while the number of dual training qualifications remains as high as ever. This success has meant that Germany's dual education model and its school, higher education and CPD systems have aroused considerable interest around the world. Furthermore, many German businesses are keen to see this training and CPD model adopted by other countries where they have manufacturing facilities.

The dual vocational training system is currently faced with a number of problems. While some traineeships remain unfilled, in other areas the number of applicants is greater than the number of available places. In many places there is a lack of both expertise in the relevant subjects and access to higher educational institutions in order to enable knowledge and technology transfer. Drop-out rates are too high and there is only limited networking between dual training and CPD providers. Last but not least, there are various shortcomings regarding the provision of up-to-date, hands-on knowledge with practical relevance to specific applications. The dual vocational training system is therefore in need of fresh ideas if it is to improve the quality of courses that combine practical training in industry with academic education at a (higher) educational institution and ensure the highest educational standards both in Germany and abroad whilst doing so in a cost-efficient manner.

Tomorrow

Germany has become a successful exporter of smart knowledge services for a wide variety of products and manufacturing processes, as well as smart adaptive digital knowledge modules for the dual vocational training system. Schools, higher education institutions, enterprises and Germany's national and foreign chambers of commerce and industry employ innovative education and training platforms to provide unique, high-quality knowledge services to businesses both at home and abroad, using cutting-edge Web technologies. The educational resources of Germany's schools and higher education institutions can be used and marketed around the world, with training and CPD being enabled by digital education brokers. The standard means of cooperation between vocational training centres, training companies, universities and research institutes is via digital training and CPD networks. By exporting a smart dual education network with smart knowledge services and smart adaptive knowledge modules positioned at the interface between (higher) education institutions and businesses, Germany has succeeded in setting new global quality standards for vocational training and CPD.

Online education resources, especially MOOCs, have become the established means of imparting declarative knowledge, whilst leading experts in the fields of theory and practice are involved in training and CPD provision around the world. They form one of the key pillars of the smart dual education network, alongside personalised e-learning resources based on smart adaptive learning technologies, smart knowledge services e.g. for enabling AI-based autonomous configuration and reconfiguration of knowledge modules, and education and training platforms from German pro-

viders that offer everything from short courses to full degrees using the dual training and CPD model. New didactic models help to improve teaching standards and provide small businesses with new ways of recruiting and training trainees. The Internet and the smart dual education network provide the basis for CPD throughout people's lives. Modern education technologies are employed to provide procedural, hands-on knowledge in the workplace. These combine autonomous, situational and personalised AI learning systems for didactically based, expertise-related knowledge representation with virtual and augmented reality technology that enables multidimensional, multimodal visualisation. During the training process, these education technologies also interact autonomously with manufacturers' equipment, machinery and facilities and employ smart techniques to analyse large volumes of learning progress data in order to provide personalised support. MOOCs and smart knowledge services have become core components of Germany's dual vocational training system and also form a key part of the German Web-based education services that are marketed around the world.

Value-added

The incorporation of innovative technologies and smart knowledge services into the dual educational system offers German education providers and IT companies the opportunity to more effectively market their education and training resources to a global audience using online platforms with shared content, shared apps and shared services e.g. with regard to Industrie 4.0. The roll-out of these facilities will enable the establishment of an online dual education network that encompasses smart consultancy, content, methods and services, setting a new global standard for high-quality vocational education at the interface between the academic and business worlds. Modern multimodal applications and analysis techniques should be used to promote the emergence of IT and e-learning infrastructures that can be smartly combined and recombined. In order for Germany to supply the control points for the international market and ensure widespread acceptance, it will be necessary to promote extensive know-how transfer so that the relevant standards are communicated and enforced. This will be key to the success of the technologies and platforms that are developed.

A smart dual education network made in Germany will be a valuable export, offering local human resources development support to German companies that have a global presence (professional education) and providing educational resources that use cutting-edge technology (professional learning solutions). Both of these elements have been shown to be key to the successful establishment of the platforms. In its capacity as an innovative ecosystem, the smart dual education network has transformed schools and higher education institutions from places that people need to visit in order to obtain knowledge into nodes in the dual training and CPD system's global knowledge network. Germany is unique in providing complete smart online education service marketplaces to enable the use of the content, applications and services within this ecosystem. German industry has become a knowledge provider and IT companies now also operate as training organisations, developing in-house solutions or buying in the expertise required for a given ecosystem from third parties. Research institutes and universities of technology play a key strategic role as knowledge service providers.

1 "Mashup" is a technical term used in information science to describe the integration of several different Web services within a newly composed Web application. In the Smart Service Welt, mashups combine different services to create value-added for consumers.

2 The four factors of production or input factors refer to the tangible and intangible resources and services required to produce other goods and services. They are as follows: 1) land, 2) labour, 3) capital, 4) knowledge/know-how.

3 Expertenkommission Forschung und Innovation (Ed.): Innovationen ohne Forschung und Entwicklung. Eine Untersuchung zu Unternehmen, die ohne eigene FuE-Tätigkeit neue Produkte und Prozesse einführen, Studien zum deutschen Innovationssystem No. 15-2011, (in German), December 2010, Mannheim/Karlsruhe.

4 See e.g. Jeffrey S. Hornsby/Donald F. Kuratko/Daniel T. Holt/William J. Wales: Assessing a Measurement of Organizational Preparedness for Corporate Entrepreneurship, in: Journal of Product Innovation Management, 2013, 30 (5), pp. 937–955; Thorsten Büschgens/Andreas Bausch/David B. Balkin: Organizational Culture and Innovation: A Meta Analytic Review, In: Journal of Product Innovation Management, 2013, 30 (4), pp. 763–781; German Aerospace Center (DLR), EBS Business School & innoexperts (Eds.): Innovationstreiber Kooperation – Chancen für den Mittelstand (in German), 2013, Mülheim an der Ruhr.

5 Karl-Heinz-Brandl: Megatrend Digitalisierung (in German), in: Gegenblende – Das gewerkschaftliche Debattenmagazin, 23 October 2013.

6 Innovation-oriented Framework

6 Innovation-oriented Framework

It is clear from the content of this report that digitisation is set to transform many aspects of our economy and society. Innovation cycles are getting shorter, creating more opportunities to compete but also resulting in more challenges. It is therefore important to consider how the development of Smart Services can be strengthened through the establishment of an innovation-friendly technical, economic and legal framework. In designing this framework, it will be important to strike the right balance between robust legal safeguards on the one hand and the greatest possible degree of freedom to innovate and implement new business models on the other. The framework should also make it possible for businesses to rapidly scale up their activities within Europe, i.e. to minimise the costs and time involved in tapping into a single European digital market. At present, conditions vary significantly from one country to another. If the Smart Service Welt is to be rolled out successfully, it will therefore be necessary to establish a standard framework that is compulsory throughout the whole of Europe.

6.1 The importance of data to modern industry

In the future, the use of data to create value both in the business world and in society as a whole will be one of the keys to ensuring the success of German industry. Data regulations are therefore required that can restore trust and confidentiality with regard to the use of data whilst also promoting innovation by recognising the key role of data as an economic commodity. Well-designed data regulations will protect end consumers' basic rights while also enabling economic growth and trade. In order to develop innovative digital business models, it will be necessary to provide a high standard of data protection without at the same time encumbering businesses in Germany and the rest of Europe with bureaucratic hurdles and inefficient barriers (see Use Cases 2, 5 and 6). The specific regulations in sensitive areas such as healthcare and the insurance industry should also be reviewed in order to facilitate the continued digitisation of these sectors.

Example: Removing barriers to the networking and digitisation of the healthcare sector

The telematics infrastructure provides a smart network that could enable cross-sector sharing of medical data and information between all the various individuals and institutions involved in a patient's treatment. Although digital networking of the healthcare sector is believed to have huge potential in terms of enabling high-quality, universal and cost-effective healthcare (see Use Case 3), only faltering progress has been made with regard to the expansion of the telematics infrastructure. One of the reasons for this is the regulatory framework. In addition to special data protection rules governing the handling of sensitive patient and treatment data, the complex nature of telemedicine processes means that there is also a lack of clarity regarding the respective liability of medical consultants and attending physicians. Furthermore, remuneration systems need to find ways of ensuring that telemedicine services are appropriately remunerated. Other key requirements include statutory funding to ensure that the network covers the entire country and the promotion of new telemedicine-based treatment methods.

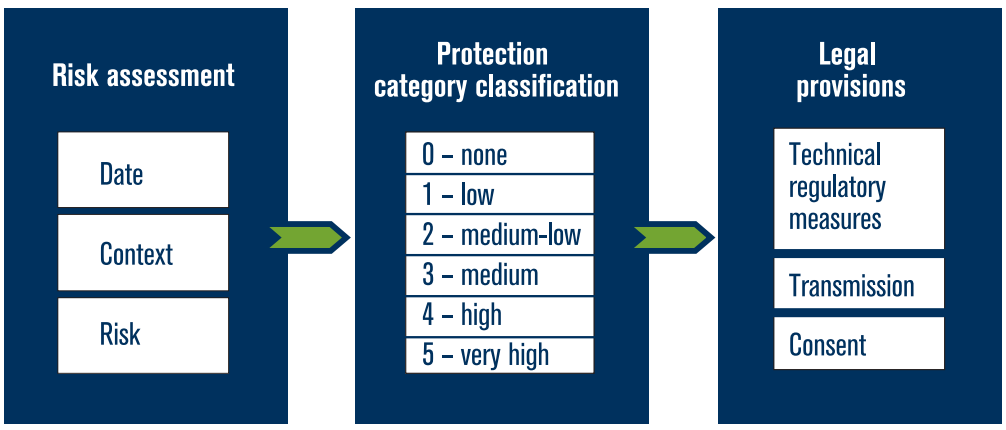
It is necessary to review current protection mechanisms without reducing the level of protection provided:

- In many cases, existing statutory regulations have proven impractical. Regulations that have failed to keep pace with technological advances and the fact that different healthcare authorities sometimes have different versions of the same regulation contribute to an uncertain legal situation that puts off potential customers from awarding what they perceive as risky third party data processing contracts. In the case of cloud computing, for example, customers often find it next to impossible to comply with their monitoring responsibilities for purely practical reasons. It is therefore necessary to pursue the development of a clear legal framework that provides appropriate and practical regulation of the relevant new technologies and also addresses the handling of personal data.
- The process should begin with a risk assessment of data in Europe. Data should be classified into different protection categories (see Fig. 9) in recognition of the fact that different types of data entail different types of risks (and opportunities) for their owners, as well as having different degrees of usefulness for society as a whole. It is therefore only appropriate that they should be subject to different levels of protection. More research is needed regarding the technological feasibility of different data protection concepts and technical protection categories, as well as into ways of implementing them on a nationwide basis and ensuring that they have a user-friendly design. This calls for appropriate levels of research funding.
- The different data protection categories should form the basis of a tiered regulatory approach. More specifically, various different types of requirements could be established e.g. with regard to the type and level of consent required, the technical security measures, the restrictions on transmitting data either within Germany or internationally, and the relevant pseudonymisation or anonymisation measures. In order to make sure that the risk assessment does not simply result in the creation of additional practical obstacles, it will be necessary to provide clear definitions of which data should be assigned to the higher-level protection categories with the strictest protection measures.

The new business models will be characterised by the transfer of data between different companies and countries:

- A regulatory framework should be developed for multinational corporations, establishing simplified rules for sharing data across organisations located in different countries but belonging to the same group (i.e. a special regime for multinational corporations). Clear and practical rules are needed to regulate the sharing of data between companies

Figure 9:
Risk-based data protection



Source: HP / BDI / Universität Würzburg

within the same group. These should take into account how the roles of individual businesses interact with the group's corporate structures and the extent to which the different businesses in a group form a single economic entity.
- The regulatory framework should also contain clear and practical standards for enabling simple cross-border data sharing between different corporations.
- Efforts should also be made internationally to promote harmonisation or regulatory convergence of the different national regulatory frameworks.

6.2 Security issues for government, industry and the public

In the Smart Service Welt, security and reliability should be treated as economic factors that can be used to differentiate between the various Web-based services on the market. Suppliers should be encouraged to differentiate their products on this basis in order to create distinct products and markets. Conversely, the market needs to be able to take these features into account on the demand side. It is therefore necessary to raise awareness in the market of the fact that IT and data security have the potential to become a genuine competitive advantage (see Use Cases 3 and 6). Certification schemes should also be developed in order to provide a further means of differentiation.

- Further elaboration on the legal protection of corporate data (e.g. the regulations governing the protection of trade and business secrets) is necessary.
- If the decision is taken to adopt new cyber security regulations, it would be desirable from the corporate perspective for them to be harmonised with other European and global initiatives and with existing regulations. Furthermore, the regulations should be clear and unambiguous and should help to clarify any legal uncertainties.

Addressing security concerns: The vision presented in the previous chapters relies heavily on the new services being accepted by both consumers and SMEs. Acceptance will have a direct impact on the planning, development and roll-out of Web-based services. Many of the issues connected with the acceptance of Web-based services are attributable to uncertainty regarding the integrity and availability of the necessary infrastructure, as well as the services' legal compliance and reliability. Enhanced usability, better information and campaigns to raise awareness of cyber security risks can all make an effective contribution to addressing the relevant threats. In addition to trialling different regulatory measures, government guidelines can be developed for self-regulated certification schemes in areas such as data protection and data security.

Intangible asset rights and intellectual property: In the Smart Service Welt, the intangible assets (including know-how) and intellectual property of companies competing on the global market will continue to require extensive protection. Moreover, it will be necessary to ensure that the rights associated with this protection can actually be enforced in practice. In the past, protected intangible assets would only be used within the company that owned them. Now, however, the manufacturing process is being opened up to the outside world and can involve any number of different service providers, turning the traditional scenario on its head. It is thus necessary to formulate a road map that provides an overview of the different reform initiatives around the world to determine relevant actions and goals for the German government. The opening up of manufacturing processes referred to above will also necessitate amendments to laws such as patent law and the associated legal procedures. The enforcement of intellectual property rights grounded on traditional national production processes in different countries has already proven the difficulty to address global interconnectedness even today.

Review of international tax legislation: Cross-border value creation models call for clarification of how companies report revenue-generating activities in virtual value creation processes. The primary aim should be for tax law to enable straightforward planning and reporting of digital value creation processes drawing on national (German) and European principles but also

ensuring compatibility with international law. Current EU initiatives – especially those being implemented under the auspices of the Tax Fraud and Evasion Action Plans – should be investigated in terms of the extent to which they promote innovation. It will be important to avoid any protectionist tendencies that might prevent services from other parts of the world from gaining access to the market.

Improving the demand-side conditions for digital ecosystems: Two key challenges will need to be addressed in order to strengthen the demand-side conditions for digital ecosystems: the establishment of the digital infrastructure needed to enable the services of the future and clarification of the uncertainties in terms of international law and liability.

Clarifying the legal uncertainty regarding cross-border real-time services: Since Web-based services for businesses operate across national borders, often in real time, they can fall under more than one jurisdiction. It is important that the relevant regulations and treaties should reflect the fundamental need for a flexible legal framework. One of the priorities should be how to address liability issues. Efforts should also be made to improve cooperation with regard to data protection and data security in order to provide a legal basis for profiling secure data services on the global market. This cooperation should commence as soon as possible in order to enable convergence of international regulations. Indeed, this is exactly what German industry has been calling for in the context of the Transatlantic Free Trade Agreement[1]. There should be no restrictions on the scope of this regulatory cooperation, although it should pay particular attention to technical issues.
National and international trade restrictions should be removed wherever possible (e.g. excise duty on services) and any remaining restrictions should be made more transparent (e.g. with regard to the use of cryptography products). A clear regulatory framework is extremely important as far as businesses are concerned.

Standardisation and interoperability: The countries aiming to be leading global suppliers of Web-based services should align themselves with the processes and structures of the companies that are expected to develop and provide the new Smart Services. It will be important to address standardisation and interoperability issues in order to ensure that the services are compatible with different markets around the world. It does not really matter whether the implementation of any international standardisation and interoperability standards is enforced via innovation and competition policy interventions (i.e. regulation) or whether it comes about as a natural consequence of voluntary measures to promote innovation. Either way, however, one of the key enablers will be the access to and more widespread use of open data.

Promoting open access to information (open data): Open data refers to the provision of machine-readable data by government and public institutions. The type of data can include anything from geographic information, statistics, weather information and the results of publicly funded research projects to e-books and e-libraries. Open data facilitates the development of new business models and markets. Businesses can enhance the value of the information provided and develop innovative new applications and services. Whilst these entail minimal costs for government and public institutions, their targeted use by the public administration can create significant value-added. The open data approach should enable easier access to the data from publicly funded research projects, benefiting the competitiveness of the economy as a whole without harming the commercial interests of the relevant businesses and universities.

6.3 Removing the entry barriers for SMEs and startups

In order to ensure a successful roll-out of the Smart Service Welt, the platforms and components described in this report will need to deliver easy access and usability at low cost. This will be the key to enabling SMEs and startups to take their place in the emerging digital ecosystems (see Use Cases 3 and 6).
Meeting the market's needs through a new culture of dialogue and quality: In order for Web-based ser-

vices to establish their business successfully on the market, it will be necessary for the service providers and users to engage in a dialogue from the outset. Furthermore, tailoring Web-based services to individual customer requirements will call for detailed exchanges at every stage of the development process. Open innovation platforms that network the relevant stakeholders from industry, civil society and government can help them to join and participate in the new digital ecosystems. In order to establish a new way of doing business, it will be necessary to create a new innovation and startup culture in Germany and Europe, based on the principles of close customer involvement, user-friendliness and transparency. Government initiatives could help to accelerate this process, which should also embrace diversity and show greater sensitivity towards the specificities of different regions and cultures.

Scaling up for increased competitiveness: Increased competitiveness also derives from growth effects. Funding is required to help German startups to scale up their operations and to promote the establishment of regional networks and clusters that include higher education and research institutions. Platforms are a particularly important means of helping SMEs and startups to join new ecosystems so that they can access new business models. It is therefore necessary to address the following challenges:

- The hybrid organisational structures of digital enterprises are particularly suited to encourage larger companies into adopting a more open approach and either do business with or help to finance SMEs and high-tech startups. A funding programme should be established to support this type of development and promote hybrid organisational innovations on the user side, especially among SMEs. As far as the supplier side is concerned, the establishment of an open technology research funding programme focused on "corporate software for hybrid digital networks" (perhaps as part of the "KMU-innovativ" SME innovation funding programme) would help to create innovative solutions, particularly for small businesses. As far as funding is concerned, recent years have witnessed the launch of numerous corporate venture capital funds, as well as incubators funded by major corporations. This process should be encouraged as and where necessary.
- It is important to raise awareness of the importance of establishing clusters among the business, scientific and research communities. Successful corporate network initiatives in Germany's regions should be identified to gain a better understanding of their key success factors.

1 The Transatlantic Trade and Investment Partnership (TTIP) is a free trade agreement between Europe and the US that was conceived as a response to the rapid economic growth occurring in Asia as well as a means of boosting the low domestic growth rates currently being experienced by its members.

7 Provisional recommendations

7 Provisional recommendations

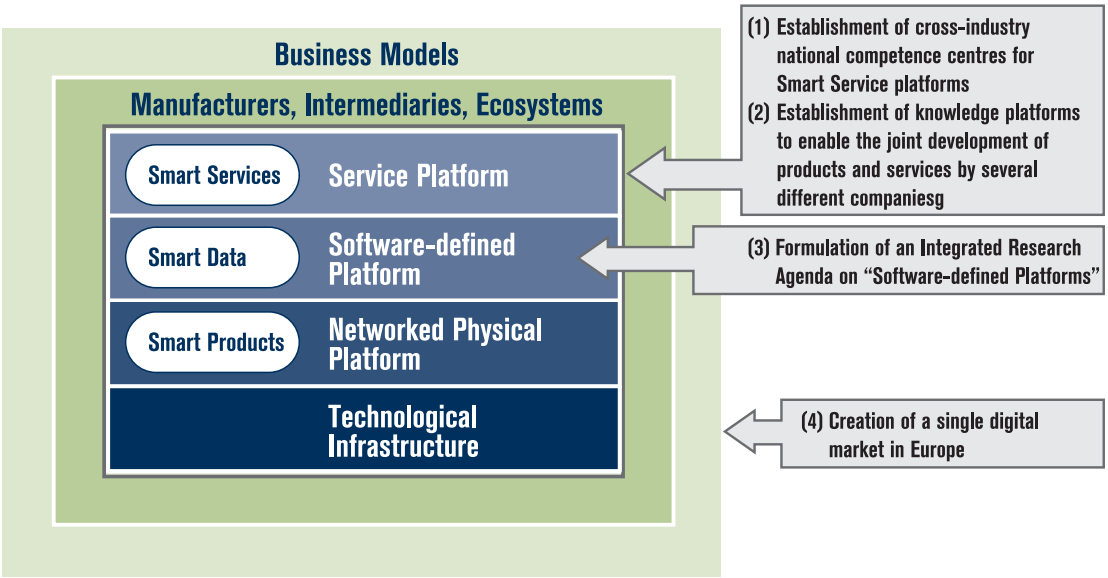
Germany can become a leader in smart, networked products and services.

The number of smart, networked products and services will continue to multiply exponentially across all industries, so that businesses in Germany and the rest of Europe will soon be facing a genuine revolution. The Internet of Things, Data and Services will result in extensive convergence of the physical and digital worlds. In the future, **consumer-centric business models based on Smart Products and Services** that are developed and organised in smart networks will be key to global market success.

Germany has set itself the goal of becoming the number one country in Europe in terms of digital growth. In order to maintain and enhance Germany's ability to compete in the tightly contested race for digital supremacy, the "Made in Germany" brand needs to be associated with more than just world-class product technology. Domestic German suppliers must now also become leaders at **combining product technology with Web-based and physical services and digital business models in order to create Smart Services**. These systems will also be indispensable for solving some of the challenges facing our society in fields such as climate/energy, health/food and mobility/transport. **Smart Services bearing the "made in Germany" brand** now have the opportunity to become known for providing systemic solutions, not only in Germany but around the globe.

Technological sovereignty is of system-critical importance to anyone seeking to become a leader in the global digital Smart Services market. What this means is that suppliers in our region will need to establish new digital infrastructures known as **software-defined platforms and service platforms** and serve these platforms through German and European ecosystems. The key enablers of this process will include on-going development of **employees' digital skills** and the establishment of **knowledge platforms to enable the joint development of products and services by several different companies**. For many companies, the implications of these changes are clear: they need to start transforming themselves into l**eading suppliers of smart digital services** as soon as possible. Should they fail to do so, today's Smart Product market leaders could soon find themselves relegated to the position of just one among many interchangeable smart service providers.
The current digital market leaders such as the US and

Figure 10:
How do the provisional recommendations fit into the layer model?



Source: DFKI / acatech / accenture

China enjoy a key competitive advantage thanks to the economies of scale provided by their large and uniform domestic markets. In order to become a player in the global digital market, **Europe must establish both an innovation-friendly framework and a single digital market throughout the continent**. This would allow Europe's leading suppliers to benefit from the **economies of scale associated with a uniform domestic market**. A specific instance involves the harmonisation of digital network infrastructures by European federations, made possible by modern network technologies.

In addition to the continued development of the Industrie 4.0 Platform, the Working Group therefore recommends four further initiatives directed at supporting Germany to establish its position as a **digital market leader in the Smart Service World:**

1) The establishment of cross-industry national competence centres for Smart Service platforms

The key components of the Smart Service Welt are digital and physical services and products that can connect to the Internet. Various different combinations of these components are configured to form new value chains and networks and provide consumers with on-demand, personalised services. German and European industry must therefore develop extensive system knowledge about digital value chains in which combinations of products and services can be provided as a flexible, on-demand service.

The technological infrastructure required for the widespread introduction of Smart Services can be established through partnerships between industry and the scientific community. These should also include small and medium-sized enterprises and startups. This approach will ensure interoperability and promote indispensable cooperation between different industries and sectors, thus providing the basis for the creation of digital ecosystems.

The Working Group's recommendations are as follows:

- Cross-sector expert forums should be established in order to develop and test Smart Service platforms. These forums should develop and promote a coordinated strategy encompassing everything from basic research to market launches. The strategy should aim to make Germany a leading supplier of solutions that are focused on Germany's flagship industries, i.e. automotive and mobility, manufacturing facilities and machinery, retail and logistics and healthcare and medicine.

- A further expert forum should address the strategic theme of "Energy and Consumers", bringing together members of industry, science, civil society and government to devise a joint strategy for profitable applications of digitisation and networking in the energy sector.

- National competence centres focusing on the basic principles of Smart Services should be established to complement the platforms for cyber security (e.g. Deutschland sicher im Netz – A Safe Online Germany) and BIG DATA. It is of paramount importance that these competence centres should help not only to disseminate the latest research findings but also to ensure their transfer into scientific and business practice.

2) The establishment of knowledge platforms to enable the joint development of products and services by several different companies

In the Smart Service Welt, it will not only be at the technological level where more systematic networking occurs. Businesses, too, will need to enter into innovation partnerships with research institutions, consumers and other social actors. In order to do so, they will also need to develop and test efficient forms of cooperation and collaboration. In the future, knowledge and information will become the fourth factor of production and will constitute a key competitive advantage for those businesses that apply them to become more innovative.

The Working Group's recommendations are as follows:

- A systemic roadmap should be produced to address the use of information and knowledge to add value as the fourth factor of production for businesses. The transformation currently being undergone by our economy should be investigated and recommendations should be formulated based on the findings of this research. Furthermore, pilot projects should be launched to trial new models. The focus should be on the following priority themes:
  - Structural change from predominantly closed and inflexible innovation processes to dynamic innovation networks using Web-based services;
  - Approaches to knowledge sharing and development, communicating with customers and other market players and bundling knowledge on platforms;
  - Future ways of working, technologies for enabling both more flexible working and virtual team integration, the impact on workforce productivity and innovation, and appropriate pay and remuneration models;
  - Upgrading of educational resources into digital knowledge services suitable for large numbers of users that can be used for managing and optimising education and training processes in businesses.

- The creation and expansion of thematic, networked knowledge communities should also be promoted, e.g. by establishing links between (research) databases, library catalogues and open access educational resources and journals.

3) The formulation of an Integrated Research Agenda on "Software-defined Platforms"

Software-defined platforms enable the planned or ad hoc cooperation between Smart Products and their users that is essential in order to establish innovative business models. They thus provide the technological basis for the Smart Service Welt.

The Working Group's recommendations are as follows:

- An Integrated Research Agenda should be drawn up in order to assess the current state of science and technology for software-defined platforms around the world, identify the key risks and barriers to acceptance and formulate prioritised recommendations and research goals.

- The provision of the basic systems required for the Smart Service Welt platforms can be supported through the development of a high-tech generic enabler toolkit at European level (including Future Internet PPP, FI-WARE, etc.).

- Basic information and communication technology has now become so affordable that virtually any product can support digital connectivity and expandability. The deployment of these technologies has thus gone from being an optional extra to comprising an integral part of new solutions. Indeed, the reality is that they are already in widespread use all over the world. It is therefore particularly important to ensure **regulation and standardisation of the digital connectivity of Smart Products on software-defined platforms**. Germany should play a leading role in establishing these standards and regulations.

4) The creation of a single digital market in Europe

The establishment of the Smart Service Welt will require an innovation-friendly framework. In order to promote the creation and scaling up of open digital ecosystems and new businesses in Germany and the rest of Europe, it will be necessary not only to upgrade the technological infrastructure but also to actively address a number of other areas where action is required. In addition to regulatory action, this will also call for initiatives on behalf of the business community.

The Working Group's recommendations are as follows:

- The establishment of a single digital market in Europe is key to enabling digital value creation. Germany should therefore play a leading role in promoting existing strategies and initiatives at European level and incorporate them into its own digital agenda.

- In order to promote a free market for digital ecosystems, it will be necessary to remove national and international trade restrictions and fiscal barriers and establish a clear regulatory framework. Germany should take the lead in driving this process at European level.

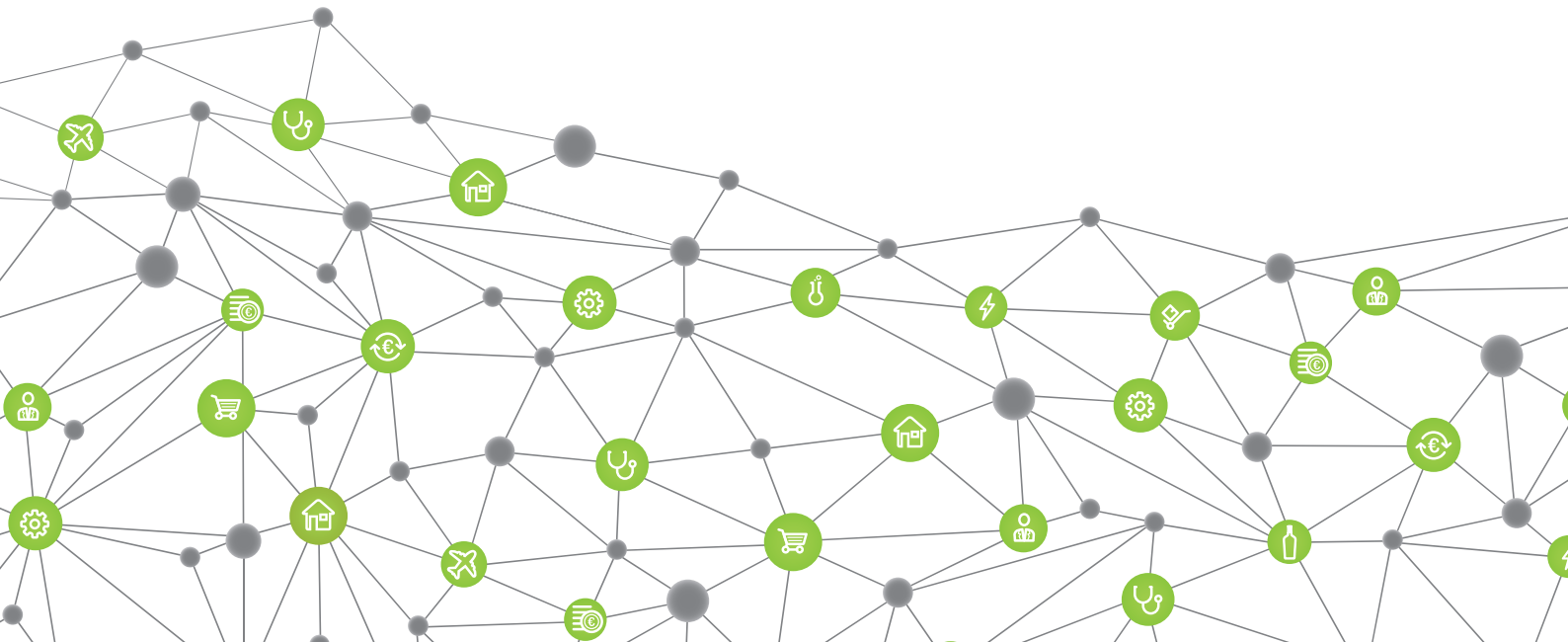
- The Smart Service Welt will only flourish if consumers have complete confidence in the security and reliability of Smart Services. If physical infrastructure is to be operated digitally, then it is of paramount importance for this process to be secure. It is therefore necessary to introduce a single European data protection regulation that reconciles individual privacy protection with the cross-border data collection that forms the basis of Smart Services. Another key requirement for the successful functioning of the Smart Service Welt is the protection of digitally networked products.

- International tax law should be harmonised to enable straightforward planning and reporting of cross-border digital value creation processes.

- In order to increase the competitiveness of German and European businesses and startups, the framework should facilitate access to open data without detriment to existing data protection principles. Both government and businesses should support this open access strategy as a basis for new business models by establishing new public services, methods and tools for using open data. This will allow value creation in Germany to be sustained and developed.

- In the medium-term, the objective should be to establish seamless electronic process chains between different government institutions and between government and businesses. In its capacity as an innovative "operating system" that provides active support to society and in particular industry, the state should promote greater efficiency and effectiveness, faster processes and lower expenditure and costs for all the actors.

The Smart Service Welt Working Group



The Smart Service Welt Working Group

Background

"Smart Service Welt – Web-based Services for Businesses" is a strategic initiative of the German government that was initiated by the "Digital economy and Society" (formerly "Communications") Promoters Group of the Industry-Science Research Alliance (FU) and was subsequently adopted by the German government in early 2012 as part of its High-Tech Strategy 2020 action plan.

In 2006, the German government adopted a High-Tech Strategy geared towards interdepartmental coordination and pooling of its research and innovation initiatives. The strategy aims to make Germany a leading provider of solutions to global challenges, secure the competitiveness of German industry through technological innovation and improve people's quality of life. It focuses on five priority areas: climate/energy, health/food, mobility, security and communication. The Industry-Science Research Alliance comprises 28 high-level representatives of industry and the scientific community organised within six Promoters Groups. Up until the end of 2013, the group provided the German government with support for the implementation of the High-Tech Strategy by initiating a number of strategic initiatives that address concrete medium-term goals in specific fields over a timescale spanning ten to 15 years.

The Smart Service Welt Working Group

The two strategic initiatives designated by the "Digital economy and Society" Promoters Group of the Industry-Science Research Alliance in the field of communication are "Industrie 4.0" and "Web-based Services for Businesses". Following a successful start to the roll-out of the strategic initiative Industrie 4.0, the Promoters Group established the Smart Service Welt Working Group in March 2013.

The Working Group comprises more than 150 representatives drawn from industry, the scientific community, the trade unions, industry associations and government institutions. This composition reflects the understanding that the Smart Service Welt is an area of innovation that relies on high-quality networks, not just from a technological point of view but also in terms of cooperation between the relevant actors. The Working Group was co-chaired by acatech President Henning Kagermann and Frank Riemensperger, Managing Director of Accenture GmbH. Its five interdisciplinary and cross-sectoral sub-committees investigated the opportunities and challenges for German-branded Smart Services. The Working Group's five sub-committees addressed the following priority themes:

Sub-committee 1: Integrated Production and Service Innovation
Chair: Dirk Hoke, Siemens AG

Sub-committee 2: Internet and Service Economy
Chairs: Dr. Johannes Helbig, Deutsche Post DHL and Dirk Stocksmeier,]init[AG
Sub-groups: Health, Mobility, Finance, Public, Data-based Services, Retail & Commerce

Sub-committee 3: Technological Enablers
Chair: Prof. Dr. Wolfgang Wahlster, DFKI

Sub-committee 4: Business Organisation Requirements
Chair: Prof. Dr. August-Wilhelm Scheer, Scheer Group GmbH

Sub-committee 5: Innovation-oriented Framework
Chair: Dieter Schweer, BDI

The recommendations presented in this report were formulated by the entire Working Group based on the outcomes of the sub-committees' work and were submitted to the German government at CeBIT 2014. The Working Group will progress its work in a number of different formats over the coming months and will continue to drive the changes needed to establish the Smart Service Welt.

Smart
Service
Welt