Smart Service Welt

acatech
NATIONAL ACADEMY OF SCIENCE AND ENGINEERING

SMART SERVICE WELT

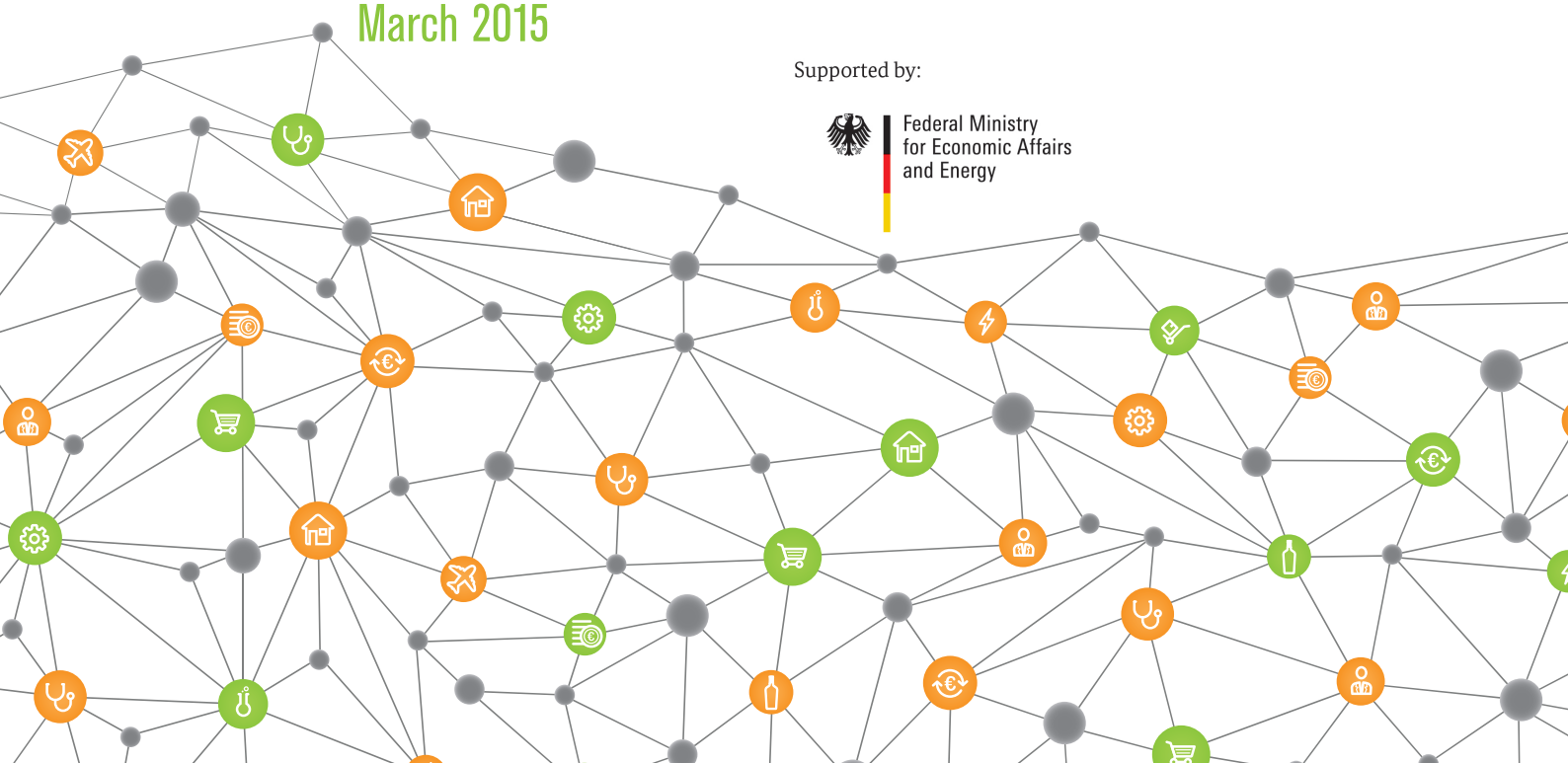
Recommendations for the Strategic Initiative Web-based Services for Businesses

FINAL REPORT
LONG VERSION

March 2015

Supported by:

Federal Ministry for Economic Affairs and Energy



Imprint

Editors

SMART SERVICE WELT WORKING GROUP

Prof. Dr. Henning Kagermann (co-chair)
acatech – National Academy of Science and Engineering e. V.
Frank Riemensperger (co-chair)
Accenture GmbH

Dirk Hoke (spokesperson Sub-committee 1)
Siemens AG
Prof. Dr. Günther Schuh (spokesperson Sub-committee 1)
RWTH Aachen University – WZL

Prof. Dr. August-Wilhelm Scheer (spokesperson Sub-committee 2)
Scheer Group GmbH
Prof. Dr. Dieter Spath (spokesperson Sub-committee 2)
Wittenstein AG

Bernd Leukert (spokesperson Sub-committee 3)
SAP SE
Prof. Dr. Wolfgang Wahlster (spokesperson Sub-committee 3)
German Research Center for Artificial Intelligence (DFKI)

Dr. Bernhard Rohleder (spokesperson Sub-committee 4)
Federal Association for Information Technology, Telecommunications and New Media e. V. (BITKOM)
Dieter Schweer (spokesperson Sub-committee 4)
Federation of German Industries e. V. (BDI)

in partnership with

acatech – NATIONAL ACADEMY OF SCIENCE AND ENGINEERING

Coordination and editing

Veronika Stumpf
Stefanie Baumann
Christoph Uhlhaas
acatech
Sigrid Stinnes
Accenture GmbH

Copy editing

Dunja Reulein

English translation

Joaquin Blasco
Dr. Helen Galloway

Layout and typesetting

HEILMEYERUNDSERNAU ■ GESTALTUNG
heilmeyerundsernau.com

Logo design

Blomqvist Design

Graphics

Erfurth Kluger Infografik GbR

Printing

g[b]k – MARKETINGSERVICES

Contact

acatech – National Academy of Science and Engineering
Unter den Linden 14
10117 Berlin
acatech.de

Publication date: March 2015

Supported by:

Federal Ministry for Economic Affairs and Energy

on the basis of a decision by the German Bundestag

EIT ICT Labs

The Working Group would also like to thank the following organisations for their support:

ABB Ltd.
Accenture GmbH
BDI
BITKOM
BTC AG
Boehringer Ingelheim Pharma GmbH & Co. KG
Deutsche Bahn AG
Deutsche Post AG
Deutsche Telekom AG
Google Germany GmbH
IBM AG
IG Metall
Merck KGaA
Nokia GmbH
Robert Bosch GmbH
SAP SE
secunet Security Networks AG
SICK AG
Siemens AG
Sirrix AG
Trumpf GmbH & Co. KG

and Dr. Lars Schatilow

Recommended citation:
Smart Service Welt Working Group/acatech (Eds.): Smart Service Welt – Recommendations for the Strategic Initiative Web-based Services for Businesses. Final Report, Berlin, March 2015.

Smart
Service
Welt

Contents

Legend of symbols

highlight the key messages throughout the whole report.

designates a cross-reference to other chapters in the Final Report that contain related or more detailed information.

indicates that further information is available online.

Note

All personal attributes in the following report equally apply to women and men regardless of their grammatical form.

Foreword: Germany's journey towards the Smart Service Welt

Are you holding a hard copy of our report in your hands or are you reading it on your smartphone? Do you still feel you really need your own car, or does a digital mobility service provider help you with your travel arrangements? Do you work out your own fitness regime or do you wear a fitness band and receive personalised daily recommendations? There are some smart services that we are already using every single day of our lives – we have already embarked on the journey towards the Smart Service Welt[1]. A world where instead of buying off-the-shelf products and services we now go online to buy **individually configured bundles of products and services known as "smart services"**. This report aims to provide a glimpse into the digital future of Germany's economy.

The underlying trend towards increasing digital interconnectedness and convergence of the real and virtual worlds is already at the core of the economic and social agenda. The German government has highlighted the importance of the digital revolution both through the Digital Agenda and in its new High-Tech Strategy. It has set itself the goal of making Germany Europe's leading nation in terms of digital growth. And there is a good reason. Whilst at the first national IT summit in 2006 many people still believed that the convergence of industry and IT was by no means inevitable, today it has become perfectly clear to all the stakeholders that **digital technology is a key innovation that is transforming every single area of our economy.** We can no longer insulate ourselves from these changes or simply opt out of them. Smart services are just too attractive to consumers, their impacts too widespread and the gains in terms of quality and resource efficiency too great. Consequently, we must embrace smart services, but shape them in a way that provides a better proposition for users, contributes to social welfare and permits workers to enjoy decent working conditions.

The Smart Service Welt is disruptive. It is centred around users with their respective preferences and needs as consumers, employees, citizens, patients, tourists, etc. The new data-driven business models are built on flexible networking and largely automated collaboration in digital ecosystems. **Digital platforms are a key requirement** for the formation and organisation of these digital ecosystems. We originally drew attention to this issue in our interim report that was launched at CeBIT 2014. The Federal Ministry for Economic Affairs and Energy (BMWi) responded by organising the technology competition "Smart Service Welt – Web-based Services for Businesses". Our final report provides the first detailed, application-based description of the enablers and modules required for these digital platforms. We have consciously chosen to describe use case scenarios that might not be the first thing that comes to mind when you think of digital technology. We did this to illustrate how smart services will transform every area of our economy, from port logistics to heavy industry. Another key issue addressed in this report is the impact that this transformation will have on the way businesses are organised and on the world of work. Finally, security and data protection are topics that have the potential to be the Smart Service Welt's Achilles' heel and are therefore accorded particular attention.

We are competing in a race against other countries around the world. By introducing the Internet of Things, Data and Services into industrial processes, Germany has carved out a good starting position for itself. Furthermore, Germany is a world leader in many of the relevant research fields, such as semantic technologies, machine learning and digital modelling of products and users. The foundations were laid by the THESEUS research project that was launched as part of the 2007 IT summit process. Key contributions have also been made by the BMWi and the Federal Ministry of Education and Research through programmes such as AUTONOMICS, TRUSTED CLOUD and BIG DATA as well as the SMART DATA competition. **As the world's leading equipment supplier, Germany's strengths provide an excellent basis for innovation**. The next step is to enhance its products and services

with smart services. At the same time, however, the big Internet companies that provide the world with its networks are now expanding into traditional industries. The next few years will decide who gets to set the new ground rules.

We are well positioned to shape the Smart Service Welt. If we successfully embark on this journey, we will be able to deliver sustainable gains in growth, value-added and employment. However, if we remain narrowly focused on niche market leadership, we will be putting our technological pre-eminence as leading suppliers on the line. This is a race that will be decided by speed. One key to ensuring that we get off to a quick start will be to enable rapid growth of new business models within a homogeneous local market. We therefore urgently need a European digital single market together with coordinated upgrading of Europe's digital infrastructure. Even more importantly, however, we need people with innovative ideas who are committed to embarking on the journey towards the Smart Service Welt. With this in mind, we hope you enjoy reading our report.

Henning Kagermann
President acatech – National
Academy of Science and Engineering

Frank Riemensperger
Managing Director
Accenture GmbH

1 The German term "Smart Service Welt" is rendered as "Smart Service World" in English. However, for the purposes of this report the authors have chosen to retain the German expression.

Working Group Members | Authors | Experts

Working Group Members | Authors | Experts

Chairs

Prof. Dr. Henning Kagermann, acatech
Frank Riemensperger, Accenture GmbH

Sub-committee spokespersons

Sub-committee 1 – Establishment of cross-industry national competence centres for Smart Service platforms and development of further use cases
Dirk Hoke, Siemens AG
Prof. Dr. Günther Schuh, RWTH Aachen – WZL

Sub-committee 2 – Establishment of knowledge platforms and reference models for cross-company product and service development
Prof. Dr. August-Wilhelm Scheer, Scheer Group GmbH
Prof. Dr. Dieter Spath, Wittenstein AG

Sub-committee 3 – Formulation of an Integrated Research Agenda on "Software-defined Platforms"
Bernd Leukert, SAP SE
Prof. Dr. Wolfgang Wahlster, DFKI

Sub-committee 4 – Creation of a single digital market in Europe
Dr. Bernhard Rohleder, BITKOM
Dieter Schweer, BDI

Members from industry

Jan-Henning Fabian, ABB AG
Guido Sand, ABB AG
Dr. Bernhard Rieder, Accenture GmbH
Frederik Kerssenfischer, Allianz SE
Dr. Heinrich Arnold, Deutsche Telekom AG
Volker Presse, Deutsche Telekom AG
Klaus-Dieter Wolfenstetter, Deutsche Telekom AG
Christian Schulmeyer, Empolis Information Management GmbH
Dr. Stephan Wess, Empolis Information Management GmbH
Andreas Brandt, Eurex Frankfurt AG
Thomas Weber, Fresenius Medical Care AG
Ansgar Baums, Hewlett-Packard Deutschland GmbH
Eckhard Malcherek, IBM AG
Ralf Bucksch, IBM AG
Matthias Dietel, IBM AG
Friedrich Vollmar, IBM AG
Dr. Tobias Blickle, IMC AG
Dirk Stocksmeier,]init[AG
Dr. Christiane Gebhardt, Malik Management Zentrum St. Gallen AG
Dr. Bernhard Schaffrik, Merck KGaA
Dr. Michael Bültmann, Nokia GmbH
Eva Schulz-Kamm, NXP Semiconductors Germany GmbH
Dr. Edelbert Häfele, PATEV Associates GmbH
Dr. Janin Hofmann, PATEV Associates GmbH
Dr. Dieter Hötzer, Robert Bosch GmbH
Sven Schenkelberger, Robert Bosch GmbH
Dr. Reiner Bildmayer, SAP SE
Dr. Albrecht Ricken, SAP SE
Dr. Hans Jörg Stotz, SAP SE
Thomas Feld, Scheer Group GmbH
Volker Schneider, secunet Security Networks AG
Dr. Kay Fürstenberg, SICK AG
Gerhard Mutter, SICK AG
Michael Butschek, Siemens AG
Prof. Dr. Volker Tresp Siemens AG
Dr. Ammar Alkassar, sirrix AG security technologies
Carsten Kestermann, Software AG
Detlev Hoch, thehighground
Dr. Reinhold Achatz, ThyssenKrupp AG
Karsten Hoff, ThyssenKrupp AG
Karsten Tonn, TRUMPF Werkzeugmaschinen GmbH + Co. KG
Stefan Kistler, TÜV Informationstechnik GmbH
Michael Milbradt, Volkswagen AG
Thomas Zembok, Volkswagen AG

Academic members

Prof. Dr. Christoph Igel, DFKI – CELTECH
Prof. Dr. Volker Markl, DFKI
Prof. Dr. Diane Robers, European Business School EBS
Walter Ganz, Fraunhofer IAO
Dr. Josephine Hofmann, Fraunhofer IAO
Rainer Nägele, Fraunhofer IAO
Prof. Dr. Christoph Meinel, Universität Potsdam – HPI
Dr. Martin Junghans, KIT
Prof. Dr. Rudi Studer, KIT
Prof. Dr. Christoph Weinhardt, KIT
Prof. Dr. Andreas Butz, LMU München
Prof. Dr. Susanne Boll-Westermann, OFFIS
Dr. Christoph Mayer, OFFIS
Prof. Dr. Michael Abramovici, Ruhr Universität-Bochum
Prof. Dr. Wolfgang Maaß, Universität des Saarlandes
Prof. Dr. Stefan Jähnichen, TU Berlin – FZI
Luise Kranich, TU Berlin – FZI
Dr. Alexander Lenk, TU Berlin – FZI
Prof. Dr. Stefan Tai, TU Berlin
Prof. Dr. Helmut Krcmar, TU München
Prof. Dr. Thomas Hoeren, Universität Münster
Dr. Barbara Kolany-Raiser, Universität Münster
Prof. Dr. Oliver Thomas, Universität Osnabrück
Dr. Markus Rohde, Universität Siegen
Prof. Dr. Volker Wulf, Universität Siegen
Berthold Haustein, Universität Würzburg
Prof. Dr. Eric Hilgendorf, Universität Würzburg

Members from other organisations

Sophie Baumann, BITKOM
Christoph Gürtler, BITKOM
Mirco Dragowski, Bundesverband Deutsche Startups
Dr. Michael Littger, Deutschland sicher im Netz
Dr. Michael Liecke, DIHK
Iris Wolf, IG BCE
Konrad Klingenburg, IG Metall
Lothar Schröder, ver.di

Guests

Ingo Ruhmann, BMBF
Jens Brinckmann, BMWi
Imme Müller, BMWi
Dr. Kirstin Pukall, BMWi
Dr. Alexander Tettenborn, BMWi
Dr. Jasmin Franz, DLR
Dr. Regine Gernert, DLR
Dr. Walter Mattauch, DLR

Core team of authors

Dr. Svenja Falk, Accenture GmbH
Sigrid Stinnes, Accenture GmbH
Stefanie Baumann, acatech
Veronika Stumpf, acatech
Xenia Konstanzer, BDI
Jan Christian Sahl, BDI
Constanze Osei-Becker, BITKOM
Dr. Lars Schatilow, Deekeling Arndt Advisors in Communications GmbH
Christine Rösner, Deutsche Telekom AG
Dr. Anselm Blocher, DFKI
Dr. Dietmar Dengler, DFKI
Dr. Norbert Reithinger, DFKI
Dr. Ingmar Kumpmann, DGB
Dr. Nils Faltin, IMC AG
Dr. Christian Fabry, RWTH Aachen – FIR
Dr. Arnold Niedermaier, SAP SE
Holger Kirchner, Scheer Group GmbH
Dr. Ulrich Löwen, Siemens AG
Michael Steinbauer, Siemens AG
Dr. Harald Schöning, Software AG

Additional authors from the Working Group sub-committees

Dr. Marco Ulrich, ABB AG
Dr. Daniel Huedig, Accenture GmbH
Matthias Wahrendorff, Accenture GmbH
Dr. Till Luhmann, BTC AG

Dr. Michael Stadler, BTC AG
Dr. Christian Rusch, Claas KGaA mbH
Holger Ewald, Deutsche Bahn AG
Ingo Schwarzer, Deutsche Bahn AG
Ernst Joachim Steffens, Deutsche Telekom AG
Bernd Altpeter, DITG GmbH
Dr. Achim Luhn, EIT ICT Labs IVZW
Alexej Roytburg, Eurex Frankfurt AG
Prof. Dr. Tim Conrad, Forschungscampus MODAL
Sebastian Crusius, Hubject GmbH
Isabel Eder, IG BCE
Dr. Constanze Kurz, IG Metall
Julian Wenz, IG Metall
Marco Brunzel,]init[AG
Andreas Steffen, Nationales E-Government Kompetenzzentrum
Dominik Bertram, SAP SE
Florian Hilbert, Siemens AG
Klaus Bauer, TRUMPF Werkzeugmaschinen GmbH + Co. KG
Gerd Brenner, TRUMPF Werkzeugmaschinen GmbH + Co. KG
Dirk Metzger, Universität Osnabrück
Deniz Özcan, Universität Osnabrück
Prof. Dr. Lutz Heuser, Urban Software Institute GmbH & Co. KG
Peter Liebhardt, Urban Software Institute GmbH & Co. KG
Dr. Martin Beckmann, ver.di
Holger-Helmut Schmidt, Volkswagen AG

The Working Group would like to thank all the external participants in the workshop "Security, Safety and Privacy in the Smart Service Welt" held on 27 November 2014 in Berlin for their thoughtful input:

Dr. Michael Schneider, Bundesdruckerei
Prof. Dr. Michael Backes, Universität des Saarlandes – CISPA
Drazen Morog, Deutsche Bahn AG
Dr. Jens Haupert, DFKI
Jörg Heuer, Deutsche Telekom AG
Dr. Christoph Peylo, Deutsche Telekom AG
Mario Hoffmann, Fraunhofer AISEC
Gerhard Sutschet, Fraunhofer IOSB
Michael Herfert, Fraunhofer SIT
Dr. Mario Strefler, KIT – KASTEL
Rainer Göttmann, metafinanz Informationssysteme GmbH
Jacques Olaf Kruse Brandao, NXP Semiconductors Germany GmbH
Gordon Mühl, SAP SE
Steffen Heyde, secunet Security Networks AG
Stefan Heumann, PhD, Stiftung Neue Verantwortung
Prof. Dr. Heiko Mantel, TU Darmstadt
Prof. Dr. Max Mühlhäuser, TU Darmstadt
Dr. Katrin Gassner, VDI/VDE Innovation + Technik
Alfons Botthof, VDI/VDE Innovation + Technik
Dr. Inessa Seifert, VDI/VDE Innovation + Technik

Smart Service Welt 2025: A vision for optimising industrial processes

Smart Service Welt 2025: A vision for optimising industrial processes

The **Smart Service Welt 2025 vision** focuses on manufacturing, both to provide continuity with the vision of Industrie 4.0 and because Germany is starting from a particularly strong position in this area.
Nevertheless, it can also be directly **carried over to other fields of application**. Automated marketplaces for logistics service providers are already a reality in the private transport sector today and can be expected to become established in heavy goods transport in the future. Data-based optimisation of the value chain – covering everything from seed quantities and fertiliser type to the entire harvest processing and logistics chain – will become increasingly widespread in the agricultural sector. Healthcare will benefit from significant gains in effectiveness and efficiency as a result of both decentralised monitoring of patients' condition through continuous data collection and personalised treatment thanks to the improved diagnoses enabled by intelligent algorithms. In the smart grids sector, new business models are already springing up in areas connected with the energy trade. It is thus apparent that in certain fields of application it will be possible to implement individual aspects of the Smart Service Welt vision even sooner than in the manufacturing sector. Further details are provided in the use cases.
⮚ Chapter 2

The Smart Service Welt 2025 vision follows on from the vision of smart factories in Industrie 4.0. In the **smart factory, individual customer orders determine** manufacturing processes and the associated supply chains. The smart factory produces smart products: intelligent, networked objects, devices and machines that underpin the services provided in the Smart Service Welt. These smart services are put together based on users' needs.

In the Smart Service Welt, all of these **machines**, systems and factories can be easily **connected to the Internet via digital platforms**, using the "plug & use" approach. They are then represented virtually on these platforms. Their integration via the platforms enables the field data level – i.e. the products' operating data – to be accessed from any location.

The **platforms are operated by German and European companies**. They are available to machinery manufacturers and users as well as to service providers and form the infrastructure of the new digital ecosystems. The platforms consist of a number of different software components. Critical (software) **modules** and **enablers** are developed and supplied by German and European firms. As a result, the smart manufacturing services provided via these platforms have become a **successful export for Germany and Europe**. A European digital single market ensures efficient market access and rapid scalability for new smart services. This has created numerous opportunities for **startups** and **small and medium-sized enterprises**, which have become pioneers of the Smart Service Welt by providing complete smart services or developing individual modules and enablers. On the shop floor, employees have gone from being no more than machine operators to being creative leaders and decision-makers in the smart factory. Meanwhile, top floor **employees** systematically leverage the opportunities offered by digital technology. Smart services help these smart talents to manage the complexity of the new environment.

In the Smart Service Welt, all kinds of different smart services are realised for users (see Figure 1):

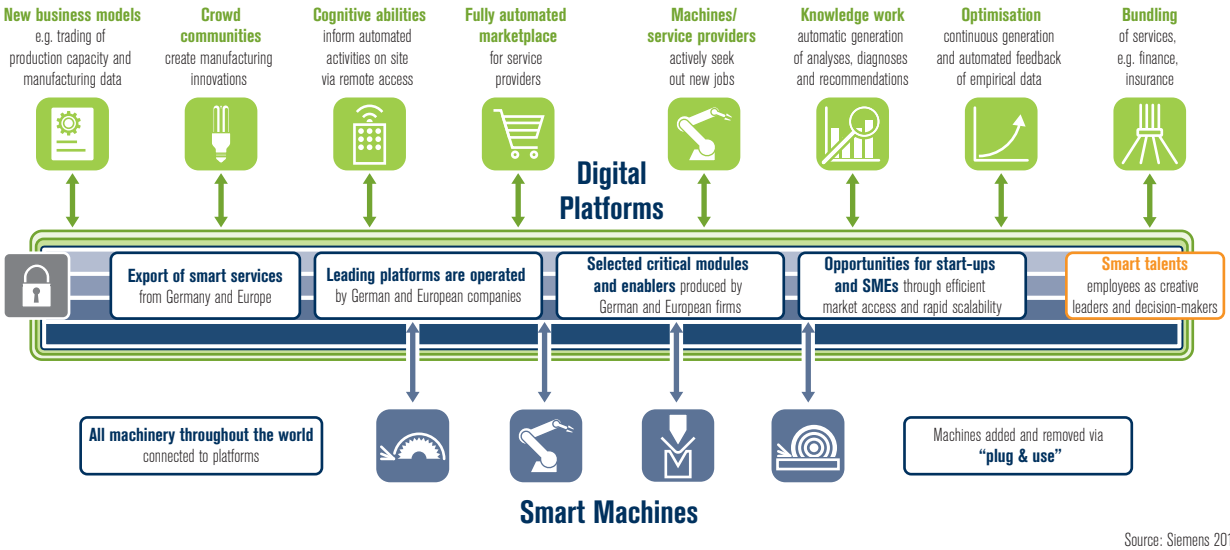
- Potential disruption or goal conflicts in cross-company value networks can be anticipated and prevented thanks to the wide availability of the relevant data. Factories automatically post requests for any services needed to resolve these issues **on fully automated marketplaces**. Conversely, machines and service providers actively seek out work on these marketplaces. Orders for complex smart services continue to be placed by the customer, however.
- Service providers offer fully automated delivery of smart services either remotely or on site. Crucially, this is done predictively, before problems actually occur. This is also made possible by **better-quality knowledge work**. This gain in quality can be achieved thanks to the fact that analyses, diagnoses and recommendations in the Smart Service

Welt are generated automatically and are thus available at all times. Machines, systems and factories continuously feed back operating – i.e. empirical – data into the platforms. This enables **self-optimisation** of the value-added processes. Moreover, **remote access** ensures that human experience and cognitive abilities also inform processes on site.

- **New business models** have become established, for example the trading of production capacity or manufacturing data as an alternative service, or performance contracting. Manufacturing **innovations** and data-based product and business model innovations are developed by crowd communities.
- The greater transparency of industrial processes has led to the establishment of **new smart finance and insurance concepts** such as "everything as a service", "pay-per-use" and customer-/system-specific insurance policies.
- Systematic training and continuous professional development ensure that **employees** have the skills needed to cope with the digitisation of value creation in the Smart Service Welt. Employees' role in the Smart Service Welt is characterised by responsibility and autonomy.
- At a technical level, it has been possible to establish **comprehensive security management** with proactive protection mechanisms for the Smart Service Welt. These have been systematically built in by design and implemented at an operational level through supporting organisational measures. The security offered by German smart service solutions has increased their appeal and popularity around the world.
- The tension between privacy and IT security has dissipated thanks to the forging of a widespread consensus on this issue throughout society.

As a result, by 2025, the productivity of German manufacturing industry has risen by more than 30 percent. Despite being a high-wage economy, Germany has been able to maintain value creation and employment levels whilst securing its long-term competitiveness.

Figure 1:
Smart manufacturing services 2025



Source: Siemens 2014

Executive Summary of the final report and general recommendations

Executive summary of the final report

Smart products are already ubiquitous. The term "smart product" refers to objects, devices and machines that are equipped with sensors, controlled by software and connected to the Internet. They collect all types of data, analyse them and share them with other devices. One in two Germans now owns a smartphone. Moreover, a high proportion of the machines made in Germany already connect to the Internet during operation. These include passenger cars and trucks, construction and agricultural machinery, turbines and engines, solar installations, heating systems and smart meters, fire alarms and other alarm systems, lifts, internal doors, traffic lights, cameras, TVs and music players, kitchen appliances, toothbrushes and increasingly also wearables. No industry and no area of our daily lives have been left untouched. Even public squares, crossroads, exhibition halls, factory buildings, conference rooms and rooms in people's homes are increasingly being digitally connected to create smart spaces.

The global race for data is truly underway

Today, in 2015, around 15 billion products around the world are connected to the Internet. By 2020, this figure is expected to rise to 30 billion.

At present, the consumer and domestic technology sectors account for approximately 50 percent of smart products, while the mobility sector accounts for 25 percent and industry for 20 percent.

The data volume in the Internet of Things, Data and Services will continue to grow rapidly. If German industry wishes to rank among the key players, then it has two to three years to ensure that as many as possible of its smart products installed all over the world are connected to the Internet so that the data generated by them during use can be employed to produce smart services. In other words, Germany must become a global leader in the supply of smart products and smart services and use its position as Europe's leading market to put these products and services to the test.

Smart services enhance smart products

Smart products are the products manufactured by Industrie 4.0, a vision of the fourth industrial age that has been jointly formulated by government, industry, the research community and the social partners. Industrie 4.0 is characterised by the mass manufacture of customised products in batch sizes of as low as one in a highly flexible manufacturing environment, together with the development of processes to enable self-optimisation, self-configuration and self-diagnosis. The factories of the future are run by well-trained employees who are supported in the performance of their complex tasks. The communication and interaction with the machines is facilitated by personalised information tailored to individual machine workstations. The potential of Industrie 4.0 in practice is amply demonstrated by examples such as Siemens' Amberg plant, the manufacturing facility at Wittenstein and the new production system introduced at Festo.

It is estimated that Industrie 4.0 can deliver annual manufacturing efficiency gains of between six and eight percent.

Once they have left the factory, smart products are connected via the Internet. They exchange ever-larger volumes of data during use. It could be argued that these mountains of data (big data) actually constitute the most important raw material of the 21st century. The big data is analysed, interpreted, correlated and supplemented in order to refine it into smart data. This smart data can then be used to control, maintain and enhance smart products and services. Smart data can generate knowledge that forms the basis of new business models. In other words, big data is refined into smart data, which is then monetised through new, individually combinable smart services. In the industrial context, a smart service might, for example, involve providing compressed gas "as a service" to meet the needs of specific situations, as opposed to simply selling compressors. For private consumers, meanwhile, a smart service might allow them to freely mix and match mobility services online instead of having

to buy their own cars. German businesses continue to be too slow to make the switch from suppliers of high-quality products to providers of attractive and flexible smart services.

Smart service providers are able to anticipate customers' wishes more and more accurately. New high-power algorithms that include 1,000 or more parameters for interpreting data from heterogeneous sources are improving the quality of business process forecasts by a factor of 1,000, 10,000 or even 100,000.

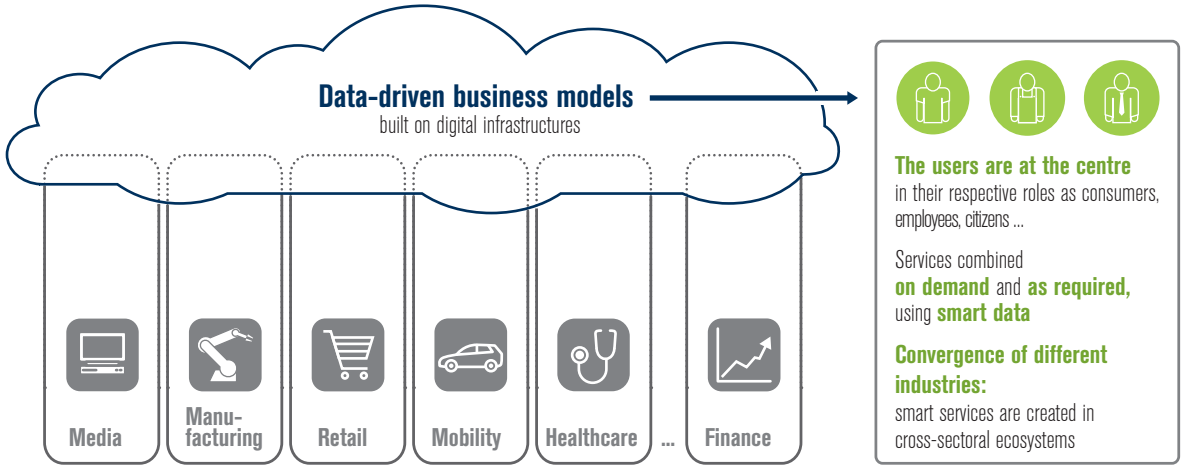
The mail order company Otto is a case in point. It uses an intelligent algorithm provided by startup company Blue Yonder to calculate daily updates to its sales forecasts for the coming weeks and months for each and every one of the two million plus items in its range. The algorithm incorporates around 200 variables such as the previous year's sales, current product promotions and even the weather forecast. This provides Otto with a strategic advantage, allowing the company to improve the accuracy of its sales forecasts by between 20 and 40 percent, depending on the product category. As a result, they are able to ensure that products do not sell out too quickly whilst still reducing stock levels in their warehouses.

The Smart Service Welt is disruptive – it is centred around the user

The Smart Service Welt is centred around the users who employ services in their respective roles as consumers, employees, citizens, patients and tourists. As far as the customer is concerned, smart services mean that they can expect to obtain the right combination of products and services to meet the needs of their current situation, anytime, anywhere (see Figure 2).

Smart service providers therefore require an in-depth understanding of their users' preferences and needs. This calls for them to intelligently correlate huge volumes of data (smart data) and monetise the results (smart services). To do this, they require data-driven business models. In order to develop these business models, providers need to understand the user's ecosystem and situational context. This understanding is based on data and its analysis. All the actors in a network collect data. The ability to correlate huge quanti-

Figure 2:
Smart services: the user is at the centre



Source: Deutsche Post DHL

ties of data obtained through smart products in real time and use this information to provide customers with highly customised smart services is having an enormously disruptive impact on traditional business models throughout the economy. In addition, the marginal costs involved in scaling up smart service business models are much lower. This is because the "as a service" model is often significantly cheaper than the equivalent "ownership" model.

Smart service providers can also use smart data for producing forecasts (real-time predictive analytics) that provide direct input into how the products are controlled, enabling previously unattainable levels of quality and service. For example, a lift manufacturer whose lifts are controlled using software that knows the movements of people on different levels of the building and at its entrances, as well as people arriving from the local public transport network, can increase the lifts' carrying capacity over the course of a day by 50 percent or more. Any competitors who do not have access to this smart service may quickly lose their ability to compete.

These disruptive business models are built on three key components: 1) digital ecosystems and marketplaces, 2) integrated payment functionality and 3) secure user IDs (see Figure 3).

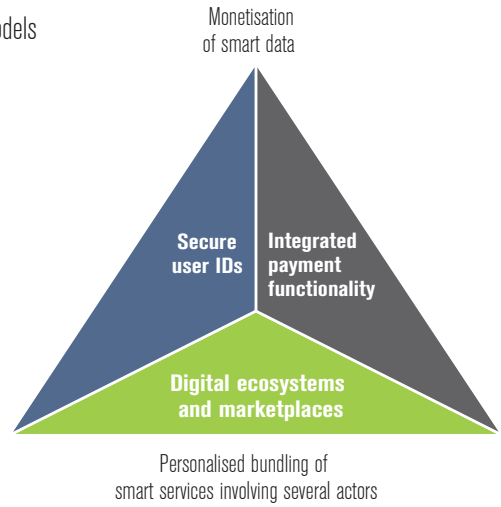
The user has now replaced individual suppliers with their traditional products and services at the centre of these business models. These digitally savvy users expect the right combination of products and services to meet their individual needs to be available "as a service" at all times. Users possess a secure digital ID that is linked to an integrated payment function for smart services.

This shift from product-centric to user-centric business models entails a particularly painful paradigm shift for suppliers of successful products. Since most manufacturers will lack the in-house expertise to execute this switch, smart products will often be combined in real time with third-party services on new digital platforms in order to create smart services.

Digital market leadership will require new digital infrastructures and platforms

At a technical level, these new forms of cooperation and collaboration will be enabled by new digital infrastructures. **Smart spaces** are the smart environments where smart, Internet-enabled objects, devices and machines (smart products) connect to each other (see Figure 4). They are reliant on an underlying high-

Figure 3:
Key components of smart service business models



Source: Accenture 2015

performance **technological infrastructure**. In addition to the much-discussed nationwide upgrading of the broadband network, the ability to guarantee domain-specific latencies (5G) is also key to ensuring real-time data analysis and delivery of the associated smart services. The technological infrastructure will therefore play a system-critical role in the forthcoming transformation of industry and society.

While the term **"smart products"** can refer e.g. to actual production machines, it also encompasses their virtual representations. These products are described as "smart" because they know their own manufacturing and usage history and are able to act autonomously. They are connected to each other via the technological infrastructure layer in order to form **networked physical platforms**.

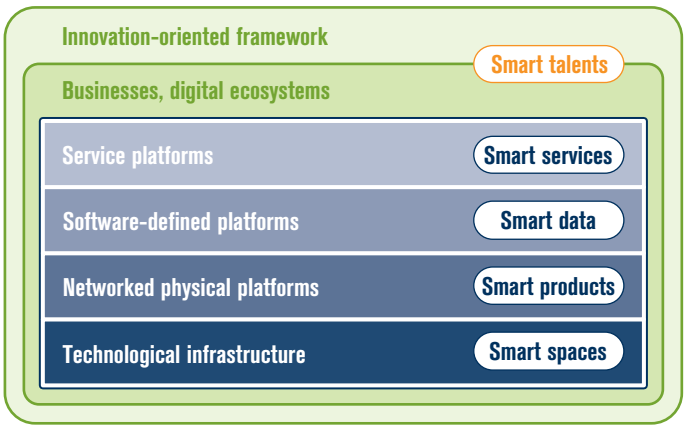
In the next layer, the data generated on the networked physical platforms is consolidated and processed on **software-defined platforms**. Complex algorithms are used to collect, combine and analyse the data. Software-defined platforms then make this refined data available to smart service providers. Virtualisation also means that service platforms are no longer tied to physical objects or to a specific manufacturer's smart products. Software-defined platforms thus constitute the technology integration layer for heterogeneous physical systems and services.

In conjunction with comprehensive service engineering – i.e. the systematic development of new services – the data are finally refined at the **service platform** level to create smart services. Providers connect to each other via these **service platforms** to form **digital ecosystems**. The service platforms act as the business integration layer, providing the basis for seamless, largely automated and legally compliant collaboration between the different actors so that they can share knowledge and trade information, goods and services.

The establishment of software-defined platforms and service platforms – and the online marketplaces and app stores built upon them –, together with their associated ecosystems, will be key to competing successfully on the global market.

However, successful new business models will only emerge where complex smart products and smart services are combined and orchestrated by well-trained employees, or **smart talents**.

Figure 4:
Layer model of digital infrastructures



Source: DFKI/acatech/Accenture

Smart services are transforming Germany's leading industries

Germany's strength lies in the incremental development of complex, premium-quality intelligent products such as vehicles, machine tools, medical equipment and domestic technology. Increasingly, these products are software-controlled, augmented with supplementary digital functions and able to connect to the Internet. These enhancements are turning them into smart products.

According to two recent Accenture studies[1], Germany's leading suppliers in the mechanical engineering, automotive, logistics, energy and chemical industries compare very favourably with their international competitors in terms of the excellence of their smart products (see Figure 5). Exceptionally well-trained skilled workers, a modern approach to management and first-rate products mean that Germany's industrial enterprises are extremely well placed to succeed in the Smart Service Welt.

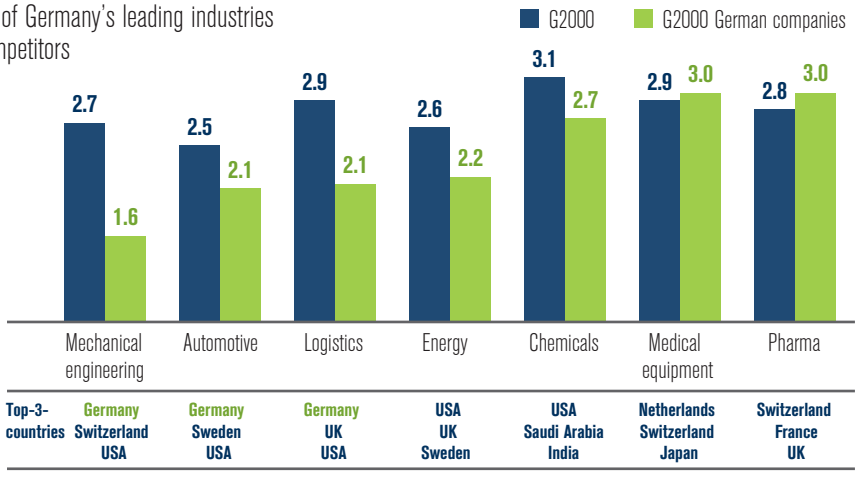
Product support-based digital business models are not very profitable at present

In terms of the maturity of smart services, however, German industry is still largely at the stage where it is using them to optimise and increase the efficiency of existing processes (see Figure 6). This strategy is already widely employed in practice. Heidelberger Druckmaschinen was one of the early trailblazers, while Trumpf's machine tool business, GEA's milking machine business, Siemens' gas turbine business and Thyssen-Krupp's lift business all use smart services to optimise their equipment's operation. However, it is often difficult for manufacturers to bill customers for the smart services that support their products, meaning that they struggle to recoup their investment in digitisation. As far as the customer is concerned, they expect the equipment to function correctly one hundred percent of the time. If that means that the manufacturer has to invest heavily in digitisation, then it is certainly something the customer wants, but rarely something for which they are prepared to pay a premium.

Many German manufacturers of premium products appear to be prisoners of their product support-based business models.

However, continuing to focus narrowly on product-centric niche market leadership is no longer a viable option. Smart services are unleashing a wave of disruptive business model innovations that has already swept through many industries and will be coming to the rest before long. Critical system knowledge about

Figure 5:
Digital competitiveness of Germany's leading industries compared to global competitors



Digital competitiveness of G2000 companies by industry (n=227); Ratings: 1 = highly digitised, 2 = digitised to some extent, 3 = digitised to a very limited extent, 4 = not digitised at all); based on Accenture G2000 company rankings and Accenture's Digital Index.

Source: Accenture 2015

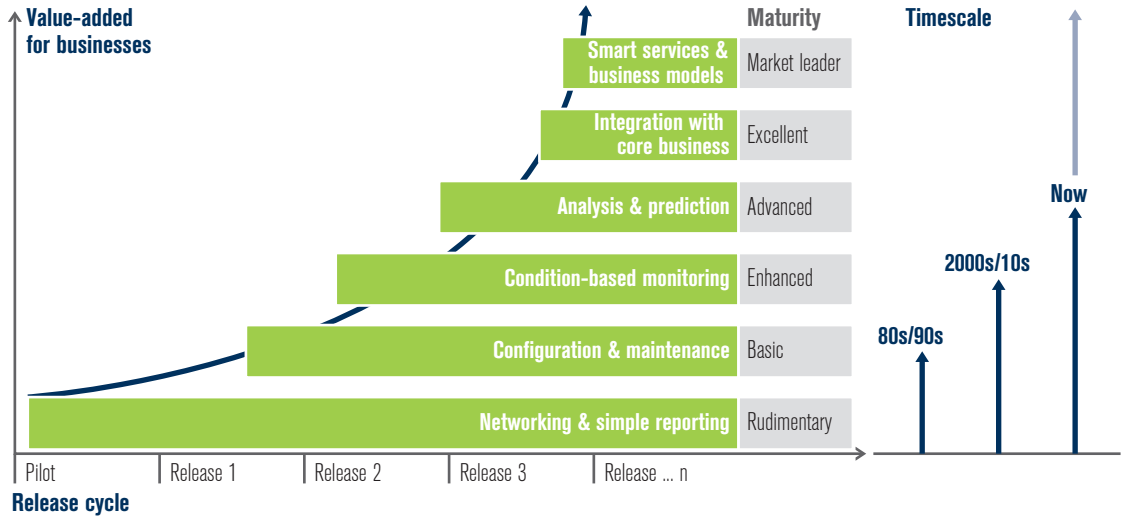
digital value networks and combined smart services is therefore key to the survival of German and European industry. In the final analysis, whoever controls the service platforms will also gain control of the entire value chain. Trustworthy, neutral intermediaries are in a position to balance the interests of providers and customers. However, intermediaries can also attempt to supplant manufacturers and service providers by gaining sovereignty over the data and seizing control of value-added control points so that it is they who ultimately write the new ground rules. The global race for control of the data and platforms is already truly underway.

Chapter 1

This is illustrated by the example of Uber, a company that provides a taxi hiring service without actually having physical assets of its own. Uber uses platforms to scale its business model. This allows it to add new online customers or drivers – i.e. people who use their own cars to provide the service – at virtually no cost to the company.

There is nothing new about platform markets. Indeed, the success of platform markets is a big part of the history of e-commerce. Auction portals and online marketplaces have revolutionised the retail trade, while hotel and travel portals have had a similar impact on the tourist industry. As the Internet of Things,

Figure 6:
Maturity of digital business models



Features of smart services

- User-centric, cross-company and cross-sector
- Very often data-driven
- Extremely agile – short release cycles
- Data and algorithms increase value-added – economies of scale are key
- Lateral business benefits often come about as a side-effect
- Market leaders employ the following elements:
  - Algorithms
  - Platforms
  - Marketplaces and digital ecosystems

Source: Accenture 2015

Data and Services continues to grow, these platform models are now also finding their way into traditional industries.

Nevertheless, the vast majority of smart product manufacturers have yet to join the race. Even though they do have expertise in connecting smart products, collecting and analysing big data and providing specific smart services, this is still not enough for them to become players in cross-company smart service ecosystems. These ecosystems are characterised by the erosion of boundaries between companies and a readiness to work with different partners, all supported by underlying digital platforms. This requires suppliers of smart products and services to develop new cross-sectoral cooperation models.

There is already fierce global competition to control both the platforms and smart products' operating data. However, only a handful of smart product manufacturers have entered the fray – companies with specific smart data and smart service expertise currently dominate the market.

Despite this, there is no reason why a machine tool manufacturer like Trumpf, for example, should not become a smart service provider, e.g. by establishing a marketplace for their products and the associated data. This would enable tens of thousands of users to share information, allowing them to optimise set-up times, material usage, machine parameters and power consumption, as well as minimise fault sources and downtime, etc. The practical experience built up by thousands of users adds value to the machines, since this store of operational expertise is now available to everyone. The machine manufacturers can either ask people to pay a service charge for using the marketplace or charge users for downloading apps.

Some of the other use cases outlined in this report also highlight a fundamental trend towards vertical industrial solutions. This strategy involves suppliers trying to cover several of the layers within the digital ecosystem by starting with their own product portfolio and supplementing it with smart services and smart talents. There is no real difference in this respect between companies from Europe and the US such as Bosch, General Electric, Philips and Siemens.

Nonetheless, many German product manufacturers remain wedded to their traditional product-centric business models. The rate at which they move is determined by their products' relatively slow innovation cycles. Furthermore, many of them lack both in-depth expertise in the field of digital business and the ability to develop new, data-driven services and business models. They are thus a long way off being able to engage in flexible and open cooperation in digital value networks.

This means that it is (far too) easy for new market players originating from digital niche markets to gain a foothold. These players' innovation cycles are significantly shorter than the development cycles of product manufacturers. Moreover, visionary smart service entrepreneurs tend to be willing to live with lower quality if this means that they can get the service out onto the market more quickly so people can start benefitting from it. First generation satnavs are a case in point.

Technological sovereignty is key to future profitability and job protection

The success of the German automotive industry demonstrates that not all the basic technologies and components for digital business models necessarily need to come from Germany or Europe. It will, however, be crucial to be the leading supplier of the elements that are strategically important for adding value, especially the engineering and systems integration services for the platforms. Germany was one of the early pioneers and market leaders in the fields of business software and big data platforms. Software companies such as SAP and Software AG as well as research organisations such as the German Research Center for Artificial Intelligence (DFKI) and the Hasso Plattner Institute (HPI) have given Germany a competitive advantage in this market. Europe must maintain or attain technological leadership in the system-critical components that are key to success. These include the principal building blocks of the platforms such as security technologies, semantic technologies, real-time algorithms, predictive analytics and cloud computing.

Chapter 3

Software-defined platforms and service platforms provide an open run-time environment for smart services. In other words, they provide the general basic functions for systems integration, data analysis and collaboration in digital ecosystems. These platforms run in highly automated cloud centres.

In the Smart Service Welt, cloud centres play the same role as factories in the product-centric world – they are the manufacturing facilities of smart services.

The control points for the digital value chains reside in the software-defined and service platforms. Failure to steal a march on the competition in terms of access to these platforms and the associated data will mean that the race for digital leadership is lost. If this happens, it will be others who skim off the profits from smart services.

Now that platforms are the new control points in terms of profitability, the development of system knowledge has become a critical success factor. German businesses and research institutions therefore need to develop and implement platform architectures, integrating the individual components to create commercially viable platforms. Furthermore, the suitability for everyday use of the individual platform solutions must be tested in use in order to assess their cost-effectiveness, user acceptance and reliability. This will be key to enabling rapid scaling up of German platform solutions.

The Industrial Internet[2] Consortium (IIC) launched in the US is indicative of the widespread interest that exists with regard to cross-company cooperation to test smart services in use. The IIC was established in March 2014 by GE, Cisco, Intel, AT&T and IBM. As an open consortium, it now counts more than 130 organisations from around the world among its membership. The participating companies provide the technology environments for developing Innovative Industrial Internet[2] prototypes that can be rapidly realised in testbeds for certain priority areas. The initiative has thus created an ecosystem of companies from different industries that work together and share ideas, best practices and thought leadership in connection with the Industrial Internet.

German industry needs to establish an agile strategy similar to the Industrial Internet Consortium to enable pre-competitive, cross-company test bed piloting of use cases and its own leading platforms. This strategy should be organised and paid for primarily by the industrial sector.

Security and trust are the Achilles' heel

The Smart Service Welt requires complex networking of a wide range of decentralised components via the Internet. This often involves the exchange of large volumes of sensitive data where each component is accompanied by its own security risks. In conjunction with the rapidly rising proportion of software in all areas, the fact that several components are connected to each other across different companies means that there is a much bigger target for potential attacks. As a result, the number of targets for cybercrime and cyberterrorism is rising. IT security and data protection are therefore key to the success of the Smart Service Welt.

⇨ Chapter 3.3

100 percent safety and security can only be achieved in closed systems. However, open systems are a fundamental requirement in the Smart Service Welt paradigm. Safety and security can therefore only be relative. Industries such as the automotive industry and the manufacturing sector have already been living with the "relative" safety paradigm for many years. Today, if an automotive manufacturer tried to convince its customers that its vehicles could offer them 100 percent safety, their promise would not be considered credible. However, manufacturers have learned to provide "relative safety", offering very high safety standards as a product feature that can be certified by third parties such as the TÜV. Smart service providers need to adopt a similar approach by defining verifiable quality indicators so that they can establish quantifiable relative security standards. It will be essential for these security solutions to be both transparent and user-friendly. It should be easy for users to tell whether the service they are using is sufficiently secure to meet their needs. This will instantly enable them to take better precautions themselves.

"Resilience by design": the new security paradigm of the Smart Service Welt

It is not that there is a shortage of security solutions. The problem is that they are not being used systematically and cost-effectively.

IT security comes at a cost. Truly effective security solutions for the Smart Service Welt need to be implemented right from the planning and development phase (security by design). This involves substantial planning and investment which is nonetheless indispensable. In order for our society to continue its journey towards the Smart Service Welt, the underlying technological infrastructure will need to be largely failsafe, reliable in use and protected against all forms of tampering. Since 100 percent security is not a realistic proposition, the infrastructure will need to be capable of responding flexibly to unexpected attacks and preserving or rapidly recovering its functionality – in other words, it will need to be resilient.

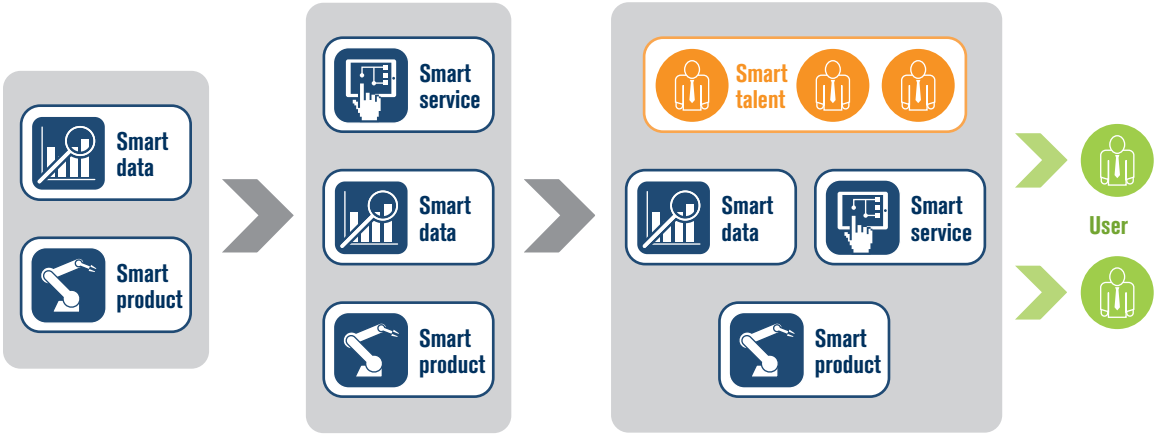
Many industries – for example the aviation and rail industries and electronic stock exchange and payment systems – already have established IT security solutions that guarantee a high level of security and resilience for their services. These solutions can be carried over to the other fields of application in the Smart Service Welt. Resilience by design thus constitutes the security paradigm of the Smart Service Welt.[3]

The formula for becoming a leading digital supplier

Successful new business models will emerge where complex smart products and smart services are combined and orchestrated by well-trained employees, or smart talents. These digitally trained smart talents will deliver combined physical and digital services that are increasingly provided "as a service" (see Figure 7).

These value chains extend far beyond the boundaries of any individual company. They require highly-scaled platforms where all the players are organised into an ecosystem and knowledge that increases the smart services' value-added is traded on marketplaces. "Smart talents" are the architects of these digital business models. Well-trained human resources who are capable of working with integrated physical and digital services will be absolutely indispensable in order to achieve leadership in the digital economy. Smart services should therefore be shaped in a way that pro-

Figure 7:
Smart talents as a key success factor



Source: acatech

vides a better proposition for users, contributes to social welfare and permits workers to enjoy decent working conditions.

It is by combining smart products, smart services and smart talents that it will be possible to become a leading supplier in the Smart Service Welt. Germany is well placed to do just this.

The following example from the field of healthcare illustrates the point. An X-ray machine (smart product) manufacturer creates a service platform that provides access to an image database containing millions of X-rays of specific cases. In addition to supplying the actual X-ray machine, this allows the manufacturer to provide diagnosis support "as a service" (smart service), giving them a valuable competitive advantage. As the ecosystem grows, so does the reservoir of expertise for providing the service, i.e. the knowledge of the radiologists (smart talents) who use the platform.

Global competition requires a paradigm shift in companies and the workplace

Another important requirement for the journey towards the Smart Service Welt is to ensure that business leaders fully understand the new challenges. In the Smart Service Welt, management will have to collaborate with other companies in value networks as and when the need arises. Competitors will cooperate with each other and employees will engage in automated interactions with platform operators, meaning that they will no longer be managed by the traditional in-house management structures of the company that employs them. The changes in management, culture, collaboration and business models could be so profound as to require corporate rethinking rather than mere optimisation of the existing organisation. In view of the high competitive pressures, teams of "accelerators" should drive the rethinking process both in-house and across several different companies. Connected digital pilot groups provide an effective means of rapidly and successfully managing the transformation of businesses in the Smart Service Welt.

Chapter 4

Working in dynamic digital networks requires a high degree of integrative knowledge.

Communication skills and competencies such as being a team player, having the ability to organise one's own work, having an understanding of the overall system and lifelong learning will all be essential. The new skill sets will also include a basic knowledge of data processing, working in virtual environments and using digital assistants. The teaching and learning process itself will also be transformed. In the Smart Service Welt, training and continued professional development together with the need for a far more agile training system will all be of fundamental importance.

New jobs such as data scientist and user interaction designer are becoming increasingly important.

The Smart Service Welt entails both threats and opportunities for workers. On the one hand, it is causing some employee groups to become replaceable. This applies equally to certain functions in manufacturing industry and to knowledge work and frontline roles in the service sector. At the same time, however, new job profiles and areas of employment are emerging, for example in fields such as development, administration, design, consultancy and support. Since these new employment opportunities will not automatically compensate for all of the jobs lost as a result of smart services, the challenge will be to ensure that the transformation process creates good-quality jobs with decent working conditions. There is an opportunity to afford employees greater autonomy and make many aspects of their work more interesting. Nevertheless, there is also a danger that jobs could become increasingly precarious, as well as of higher workloads and the polarisation of employees into highly skilled knowledge workers on the one hand and people who perform purely administrative or functional work on the other. The rise in mobile ways of working thanks to the virtualisation of work processes will provide an opportunity to achieve a better work-life balance. However, it could also have harmful consequences for employees' health by eroding the boundaries between their

work and their private lives. The use of crowdsourcing to farm work out via the Internet could also have a negative impact if it results in permanent employees with guaranteed social rights being increasingly replaced by freelancers with precarious employment conditions.

In order to make the most of the Smart Service Welt's opportunities and minimise the threats, it will be necessary to ensure that all the relevant actors participate in shaping the changes right from the outset – including government, businesses, the social partners and company-level worker participation bodies. Employees should also be directly involved. Widespread training will be required to prevent polarisation of the workforce. Measures to mitigate the dissolution of mobile and digital work protect employment and social standards will also need to be taken. It will furthermore be necessary to protect the co-determination and participation rights of individual employees in cross-company value networks.

Europe must complete its digital single market as quickly as possible

Innovative companies in the US have a significant head start over their European counterparts in that they are able to scale up their smart services in a large, homogeneous domestic market before expanding internationally. The digital market in Europe, on the other hand, is highly fragmented. The complex array of different regulations in Europe is particularly challenging for SMEs and acts as an obstacle to them scaling up their business models.

In order to provide a level playing field for growth, the European Union must create a single regulatory framework for a European digital single market, so that smart service providers can reach all of the EU's 500 million citizens. It will also be necessary to introduce a single data protection regulation for the whole of Europe in order to harmonise the rules on privacy, data storage and copyright.

Chapter 5

There is a particular need for an EU-wide approach in the field of copyright and patent protection. This is because the growing trend for completely different companies to come together to form user-oriented partnerships could in some cases infringe third-party (intellectual) property rights. Reliable solutions will need to be found to address this issue.

In order to ensure future competitiveness, it will be necessary to create a European digital single market accompanied by a single data protection regulation for the whole of Europe and harmonised copyright and patent protection rules.

Building a consensus on informational self-determination in Europe

The Smart Service Welt is built on data-driven business models that configure customised services for individual users using a wide array of data sources. To make this possible, big data applications often collect, store and correlate data in countless different combinations over lengthy periods of time. As such, the collected data is not only important for the current application but also provides the basis of analysis techniques that have yet to be developed.

Personal data protection standards in Germany are among the highest in the world and the relevant legislation is correspondingly strict. A growing data protection movement is highly critical of the trend to collect and store increasing quantities of data, expressing concern about flagrant abuses of individual privacy and data sovereignty. According to the critics, we need to heed the warning signs and ensure that the principles of data minimisation, anonymisation and informational self-determination are upheld. Data that has not been collected cannot be analysed, while anonymised data cannot be used to harm the interests of the individual.

These views are perfectly understandable and justified. However, the Smart Service Welt is fundamentally driven by data and most of this data is inevitably going to be personal in nature. The concept of autonomous driving, for example, will never be feasible if

some road users refuse to share details of their vehicles' movements with everyone else. It is already clear that many solutions in the Smart Service Welt will be fiercly debated. It is therefore necessary to establish a broad consensus throughout Europe regarding which data can and should be publicly available and which should remain private. Users should have the right to decide how their own personal data is used.
In Germany, and across Europe as a whole, people's occasionally rather cavalier attitude to how they handle their own personal data is directly at odds with their concerns about the powers that be snooping on employees, patients and members of the general public. We have yet to develop either a culture of privacy and trust with regard to how data are used or the technical, regulatory and societal framework needed to make this possible.[4]

One problem is that the rate at which society and government are able to arrive at a consensus is much slower than the pace of the digital revolution – not least because of the strongly opposing views regarding the content of the new Data Protection Regulation.

While data protection requirements in Germany are high, so are the needs of data-driven smart services. Moreover, in some cases people have a rather cavalier attitude towards how they handle their own personal data. It is therefore necessary to establish a broad consensus throughout Europe regarding which data can and should be publicly available and which should remain private.

Germany's key role in shaping the European Data Protection Regulation

Europe needs to find a balance between trust and data protection on the one hand and the economic and social benefits of digital technology on the other.

A European digital single market is needed that provides a Europe-wide regulatory framework with as few national access barriers as possible. This will be particularly crucial to small and medium-sized enterprises. Germany must therefore play a key role in shaping the European Data Protection Regulation and must work towards a solution that enjoys widespread support throughout Europe. The European Data Protection Regulation will need to be adopted by 2016 at the latest if Europe is to avoid jeopardising its technological leadership. If adopted, this Europe-wide data protection solution will have a huge impact and influence throughout the rest of the world. It will be necessary to reach a sensible compromise so that we do not pass up this opportunity and lose our position as market leaders.

Stepping up the pace and solving the digital dilemma

The digital dilemma facing European industry arises from a lack of speed and agility. The life cycle rate of smart services is constrained by slow product development times.

In one recent survey[5], only one in five German businesses said that they were strongly focused on both smart products and smart services. Moreover, four out of every ten companies are not doing anything at all in this area. Almost 80 percent of the firms that took part in the survey said they had little if any cooperation with other companies in the field of digitisation.

The journey towards the Smart Service Welt is effectively a race to use smart data in order to gain access to customers. The race will be won by whoever has the best understanding of customers and their needs and preferences. It is this understanding that is the key to the new business models. Consequently, the leading providers of digital business models will endeavour to gain control of the software-defined and service platforms in every part of the economy so that they can monopolise the control points for smart services. If an intermediary is able to control the customer and data interfaces, they will be in possession of a key service control point. From

this position, they will be able to relegate the manufacturers and providers of smart products and services from the role of leading providers to nothing more than interchangeable suppliers. On the other hand, if Germany's particularly strong leading suppliers succeed in upgrading their products and services into smart services, they will be in a position to unlock new potential for growth, profitability and employment.

The outcome of the race remains uncertain. Germany and Europe must therefore act swiftly to drive the establishment of smart service business models and promote and develop the platforms, infrastructure and talents needed to make them possible.

1 Accenture: International Benchmarking of Digital Performance in 2014, 2014 (unpublished); Accenture: Digitization Index 2014/15, continued (unpublished).

2 Terms such as "Industrial Internet", "Internet of Things" and the German "Industrie 4.0" concept all describe the same evolutionary trend – the arrival of the Internet of Things, Data and Services in the manufacturing environment and the comprehensive value chain integration enabling it.

3 acatech (Ed.): Resilien-Tech, „Resilience-by-Design": Strategie für die technologischen Zukunftsthemen (in German) (acatech POSITION PAPER), April 2014; Thoma, K. (Ed.): Resilien-Tech, "Resilience by Design": a strategy for the technology issues of the future (acatech STUDY), Heidelberg, April 2014.

4 acatech (Ed.): Internet Privacy. Taking opportunities, assessing risks, building trust (acatech POSITION PAPER), Heidelberg, 2013; Buchmann, J. (Ed.): Internet Privacy. Eine multidisziplinäre Bestandsaufnahme / A multidisciplinary analysis (acatech STUDY), Heidelberg, 2012.

5 Accenture/Die Welt (Eds.): Mut, anders zu denken: Digitalisierungsstrategien der deutschen Top500, 2015, available online at: accenture.com/de-de/Pages/service-deutschlands-top-500.aspx (accessed 4.2.2015).

General recommendations

The user is at the centre of the **Smart Service Welt's data-driven business models**.
Digital platforms refine data originating from smart products and a variety of other sources in order to build up a precise picture of individual users' preferences and needs. They also provide the technological infrastructure for marketplaces and ecosystems. Based on the user's needs, products and services from different providers are bundled together on the digital platforms to create individual smart services.
The Smart Service Welt's **user-centric business models** are replacing the product-centric business models found in manufacturing industry. This disruptive change will have a direct impact on Germany's industrial core and will also shape the future of work. It is therefore important to ensure that businesses, government, research institutions, the social partners and civil society in Germany all pull in the same direction when it comes to building cross-company digital platforms and their components and **establishing smart services made in Germany**.

The Smart Service Welt Working group recommends:

1) A Smart Service Welt Implementation Platform

A **Smart Service Welt Implementation Platform** would allow businesses and research institutions to carry out pre-competitive cross-company piloting of digital platforms and their components.

- The implementation platform should be **business-driven**. It should be led by Germany's leading companies, but should be open to businesses of all sizes and from any industry, as well as incorporating selected international companies.
- The primary goal should be to **establish and operate** digital pilot platforms to be run as **living labs** for key fields of application.
- This will require the development of innovative, rapidly realisable prototypes in testbeds provided by the participating companies. Doing so will lead to the creation of an ecosystem where players from different industries and sectors work together and share best practices and thought leadership in connection with the Smart Service Welt.
- The platform should address **as many smart service fields of application as possible**, with a particular focus on mobility, machinery and plant (Industrie 4.0), trade and logistics, health and medical care, energy and consumers.
  ⇨ Chapter 2 and Appendix
- The **priority areas** identified through the digital pilot platforms should be studied in depth in **four working groups**:
  - Regulations and Standards
  - Security and Privacy
  - Work Organisation and Training
  - Global Framework
- An **interdisciplinary research advisory board** should be established, comprising representatives of the business and research communities. In addition to providing advice for the implementation platform, the

board should be tasked with formulating integrated research roadmaps on the following themes:
  - Digital platform technologies
  - Transforming organisations and the workplace
- The implementation platform's work should draw on **experts from a wide variety of fields** such as business development, product management, service development, law, psychology, industrial sociology, etc.
- In addition to the findings of the Smart Service Welt Working Group presented in this report, the implementation platform should also **build on other existing initiatives**:
  - the national IT security competence centres,
  - the software clusters, which can provide a starting point for creating a smart service competence centre,
  - Siemens' Automation and Digitalization Campus.
- The people involved should ensure **coordination with related initiatives** such as the Industrie 4.0 dialogue platform.

2) A Smart Service Welt Innovation Platform

A **Smart Service Welt Innovation Platform** initiated by the German government and anchored in the IT Summit process should act as a multiplier of conditions that support innovation, promoting a dialogue with the public on the economic implications of the Smart Service Welt transformation, as well as knowledge transfer and the establishment of consortiums, especially for SMEs.

- The innovation platform should be **policy-driven** and include as many as possible of the Smart Service Welt's stakeholders.
- The innovation platform should pursue the following goals:
  - It should facilitate a **dialogue between government, business, the research community, the social partners and civil society**. A broad dialogue with the public should address the opportunities and threats of data-driven smart service business models and create the basis for their widespread acceptance.
  - **Priority areas** should be identified through this ongoing dialogue, in consultation with the implementation platform. The innovation platform should use these to drive the creation of the conditions needed to establish the Smart Service Welt.
  - The innovation platform should **establish transfer centres** that act as multipliers for SMEs.
- The innovation platform should be **anchored in the IT Summit process** and should coordinate closely with the implementation platform through shared experts and joint actions.
- The innovation platform should address the following **key work organisation issues**:
  - Strengthening company-level worker participation so that it also includes cross-company networks, workers' right to be unavailable when contacted outside of agreed on-call hours, guaranteeing employees' right to informational self-determination, updating occupational health and safety regulations for mobile and digital work and changes to the social security system in order to counter the threat of precarious digital employment.

- In addition, the social partners and company-level actors should shape the way work is organised to provide employees with greater autonomy and create good jobs that involve a wide range of different tasks. The employees themselves should also be involved in this process. The way work is organised should furthermore comply with the relevant occupational health and safety requirements. The greater flexibility that now exists should be used to improve employees' work-life balance. Comprehensive training initiatives should be implemented in order to prevent polarisation of the workforce and help employees to retain their employability.

3) Key research areas

In order for Germany to create internationally groundbreaking platform solutions, it will be necessary for researchers and businesses to work together to address a variety of urgent research issues connected with the Smart Service Welt and to develop the **appropriate measures**. The key areas are as follows:

- end-to-end semantic modelling, personalised interaction and high-scale real-time data analytics for smart services;
- the development of reusable, open and interoperable software modules for digital platforms;
  Chapter 3.1
- the development and testing of business models for the operation of digital platforms and providing the services traded on them;
  Chapter 3.2
- the urgent development and demonstration of proactive security systems and data security and protection strategies, together with targeted measures for disseminating knowledge about IT security and raising awareness of security threats;
  Chapter 3.3, Chapter 5
- investigation of training requirements in the Smart Service Welt and the development of targeted training models;
  Chapter 4.1
- analysis of the opportunities, threats and requirements of the Smart Service Welt in terms of how work and businesses are organised. The German government's "Future of Work" labour research programme provides a basis for this, but will need to be expanded and developed in a targeted manner;
- analysis of employment trends, changes in employment structures and work organisation challenges, together with formulation of the relevant labour policy strategies.
  Chapter 4.2

4) Conditions for supporting innovation

Alongside the technological infrastructure, the key condition for growing digital value creation in the Smart Service Welt is the **establishment of a European digital single market**. Germany must act decisively to drive existing strategies and initiatives at European level and integrate them into its own initiatives.
Chapter 5

1 The goal: global digital leadership

1 The goal: global digital leadership

The global trend towards product-service-integration

The digital convergence of traditional industries is increasingly causing the boundaries between the industrial and service sectors to disappear, leading to the emergence of new opportunities to create value and employment. Around the world, this phenomenon is referred to as the servitisation of manufacturing. It involves switching from the sale of individual products to the sale of product-service bundles. The provision of these smart services is also referred to as "everything as a service". In Germany, the term "smart services" is drawn from the Industry-Science Research Alliance's strategic initiative "Web-based Services for Businesses".

In response to this challenge, the technology competition "Smart Service Welt – Web-based Services for Businesses" was launched in October 2014. The Federal Ministry for Economic Affairs and Energy (BMWi) is running this fifty million euro "Smart Service Welt" technology competition as a targeted means of promoting the establishment of the smart service platforms described in this report's recommendations. In addition to the research and development of prototype platform solutions it also aims to foster the creation and growth of digital ecosystems covering a wide spectrum of economically significant fields of application. The one billion euro research programme "Innovations for Future Manufacturing, Services and Employment" (Innovationen für die Produktion, Dienstleistung und Arbeit von morgen) that was launched by the Federal Ministry of Education and Research (BMBF) in 2014 will make a valuable contribution to services research and will study issues such as knowledge work and work organisation.
In addition, the past few years have seen the establishment of various programmes that address some of the key technologies required to build the relevant digital infrastructure. These include the BMWi's AUTONOMICS programme on sensor networks and cyber-physical systems[1], the BMBF's BIG DATA and BMWi's SMART DATA programmes on turning big data into smart data and the BMWi's THESEUS programme on enhancing these data with background information using semantic technologies. In addition, the industry association-led "Industrie 4.0 Platform" and the leading-edge cluster "it's OWL" have helped to generate significant momentum for the implementation of Industrie 4.0 at the interface with the Smart Service Welt.

The extensive funding initiatives in Germany are a clear indication that – alongside the manufacture of high-quality complex products – the integration of products and services has been recognised as being key to the success of German industry. car2go and DriveNow are two examples of successful smart service business models that have already been established in the automotive industry. Since German industry accounts for 26.1 percent of the country's total value-added, Germany is starting from a strong position in terms of leveraging this potential. According to a study carried out by the OECD[2], this figure places Germany well above the EU average of 19.1 percent. At 17.2 percent, industry's share of GDP is also significantly lower in the US. Nevertheless, many countries – including the US – have begun to buck the trend of recent years by showing signs of a move towards reindustrialisation. Moreover, in the industrialised nations, the service sector has already been growing strongly for quite some time. For example, its value-added share in the US and France currently stands at 79 percent, while Germany's figure of 69 percent is also towards the upper end of the scale.

European Union initiatives

It is the stated aim of the new EU Commission that has been in office since November 2014 to continue to drive digitisation in Europe. The completion of Europe's digital single market alone is expected to generate additional value-added of up to 500 billion euros by 2020. Smart services, consumer rights, copyright, and security and trust are all regarded as key themes in this respect and are set to be identified as priorities in 2015's new Digital Agenda for Europe. It is expected that

smart services – which have already received considerable attention at national level in some countries – will be discussed in this EU document and accorded greater weight than has hitherto been the case. In October 2014, the European Economic and Social Committee published a document that provides a basis for future policy development. The study[3] presents a well-founded opinion on the relevance of smart services and includes a number of practical proposals for measures to promote them. The "Horizon 2020" framework programme already promotes research and innovation geared towards developing the leadership of European industry. The Public-Private Partnerships Future Internet PPP, 5G PPP and Big Data Value PPP, which have received a total of 1.5 billion euros in EU funding, are currently the leading initiatives geared towards laying the foundations for the Smart Service Welt. The Future Internet PPP's FIWARE initiative is developing key enablers for open software-defined platforms and service platforms. Meanwhile, 5G PPP's priorities include network virtualisation and software-defined networks, whereas the Big Data Value PPP is driving research into big data. The outcomes, particularly of this last initiative, will be extremely important for the data-driven Smart Service Welt.

Initiatives in other parts of the world

In the **US**, the Industrial Internet Consortium (IIC) is particularly indicative of the widespread interest that exists with regard to cross-company cooperation. This private sector initiative is primarily geared towards the commercialisation of hybrid business models. The initiative's focus lies in the area of standardisation and interoperability. Other important initiatives in this area include the Open Interconnect Consortium and the AllSeen Alliance. Established in 2013, this alliance of eighty members manages the AllJoyn open source project that provides free software code for connecting smart devices. The Open Internet Consortium initiative also involves a number of multinational IT companies such as Intel, Dell, Cisco and Samsung that have come together to drive standardisation of device-to-device communication. In addition to the largely industry-driven initiatives described above, the US government has also recognised the importance of the digital revolution. The National Institute of Standards and Technology has earmarked a budget of 785 million euros for 2015 for accelerating the development of market-ready technologies. The Advanced Manufacturing Tech Consortium has, for example, been awarded 13 million euros, while 4.3 million euros will go to the Manufacturing Innovation Institutes Coordination programme, which is due to start in 2015. The Smart Manufacturing Leadership Coalition is a project bringing together businesses, research organisations and government bodies to jointly develop a smart manufacturing platform using testbeds. Meanwhile, in a recently published report on big data privacy, the White House calls for the protection of educational data, the availability of government data as a public good, the protection of consumer data (Consumer Privacy Bill of Rights) and the use of big data to stop cyberdiscrimination on the Internet. Overall, the initiatives in the US are characterised by a practical and open stakeholder approach. However, unlike the German initiatives, they often fail to include the social partners.

In **China**, industrial policy funding programmes are primarily focused on the Internet of Things, for which the Chinese market is expected to be worth up to 140 billion euros by 2020. In the 2010-2015 five-year plan, the Chinese government sets out its intention to create 10 clusters and 1,000 Internet of Things (IoT) firms in order to build a "100 billion dollar industry". Smart cities are a particular priority in this regard. The Chinese IoT Alliance that was launched by the China Electronics Technology Group Corporation supports the development of public services in connection with the Internet of Things. Its forty members include e.g. China Telecom and Tsinghua University.

South Korea is another country that has huge potential in terms of IoT solutions. In May 2014, the Ministry of Science, IT and Future Planning published a comprehensive action plan entitled the Master Plan for Building the Internet of Things that calls for companies to cooperate more closely with each other in ecosystems. It attaches particular importance to smart

services based on IoT, cloud, big data and mobile technology, as well as user-oriented creative services. In addition, two South Korean hardware manufacturers (LG and Samsung) recently announced that they intend to develop a common IoT standard by 2015 in order to support IoT sales in their regional market. **Japan** is another regional player. Although the i-Japan 2015 Strategy (2009) and the Active Japan ICT Strategy (2012) make no specific mention of smart services, the Japanese government's strategic objectives do address smart services indirectly.

Initiatives in Europe

A comparison of individual European countries and their funding priorities reveals clear differences. In **the UK**, for example, the focus is on implementing digital technology in traditional industries as an opportunity to win back market share in certain areas of manufacturing industry. In addition to modern materials engineering and manufacturing processes, there is an emphasis on the promotion of new business models explicitly connected with services. At Rolls Royce, for example, services already account for fifty percent of turnover. Related funding initiatives worth 96 million euros are channelled through e.g. the UK Research Councils (Digital Economy Research Council), InnovateUK (formerly the UK Technology Strategy Board) and the recently established Catapult Innovation Centres (Connected Digital Economy Catapult and High Value Manufacturing Catapult). Examples of some of the key thematic areas that are benefiting from funding are provided by the Internet of Things Clusters that are investigating technologies and services in eight application domains and have developed the HyperCAT catalogue standard for the Internet of Things.

The national funding programmes in **France** and **Italy** closely follow the themes of the Horizon 2020 programme. Despite the importance of industry, especially in Northern Italy, there are no specific national flagship projects for industrial smart services. In contrast, the initiative "34 plans de la nouvelle France industrielle", which is funded by the French Ministry for the Economy and Finance, does focus on the opportunities that digital technology offers for industry.The most recent report from the Conseil National du Numérique, who advises the government on this and other programmes for promoting digital technology, extends the concept of net neutrality from the telecommunications infrastructure to all types of Internet platforms. Although there is no specific focus on smart services, these initiatives are nonetheless extremely relevant to them. The programme La French Tech, for instance, aims to promote a digital startup ecosystem in order to establish France as the "Startup Republic".

In **Sweden** and **Finland**, the service economy has already benefited for many years from public research and business funding, in keeping with its economic importance. Sweden's national innovation agency vinnova, is funding projects that are relevant to smart services under four of its eleven strategic priorities: Smart Electronics, Internet of Things, Process and IT Automation and Production 2030. Each of these areas benefits from an annual investment of approx. forty million euros through public and private funding. In Finland's Future Industrial Services programme, which received 36 million euros of funding up to 2015, the companies and higher education institutions in the Finnish Metals and Engineering Competence Cluster fimecc are investigating the key success enablers for future industrial services. Meanwhile, the recently launched Industrial Internet Program will study the potential and impacts of smart services on a broad scale. One hundred million euros of funding has been made available to this programme. Finnish examples of the growing importance of services within traditional industrial enterprises include the lift and escalator manufacturers KONE, Ponsse, who have developed a high degree of expertise in digital diagnostics and remote maintenance for their forest machines, and enevo, who install sensors in waste containers and use them to provide a range of smart services.

In the **Netherlands** and **Spain**, other than general funding initiatives (ICT Doorbraakprojecten in the Netherlands and Strategic Action in Digital Economy and Society in Spain) designed to accelerate the

transformation into a digital economy, there are no specific funding programmes for smart services in industry. Despite this, the importance of smart services is acknowledged, for example in the Smart Industry Agenda drawn up by the Dutch Ministry of Economic Affairs in partnership with other stakeholders. In the Netherlands, Philips has pioneered the embedding of traditional products in a digital infrastructure. Meanwhile, Spain's Telefónica has established itself as a prominent development partner in projects focused on the development of smart cities (e.g. RECI, Red Española de Ciudades Inteligentes).

This overview of selected initiatives reveals significant differences in the national funding programmes connected with the Smart Service Welt. While the US, China and the UK are primarily seeking to drive the implementation of digital technology in industry, the EU and in particular the Scandinavian countries and Germany are more focused on concrete research programmes relating to smart services.

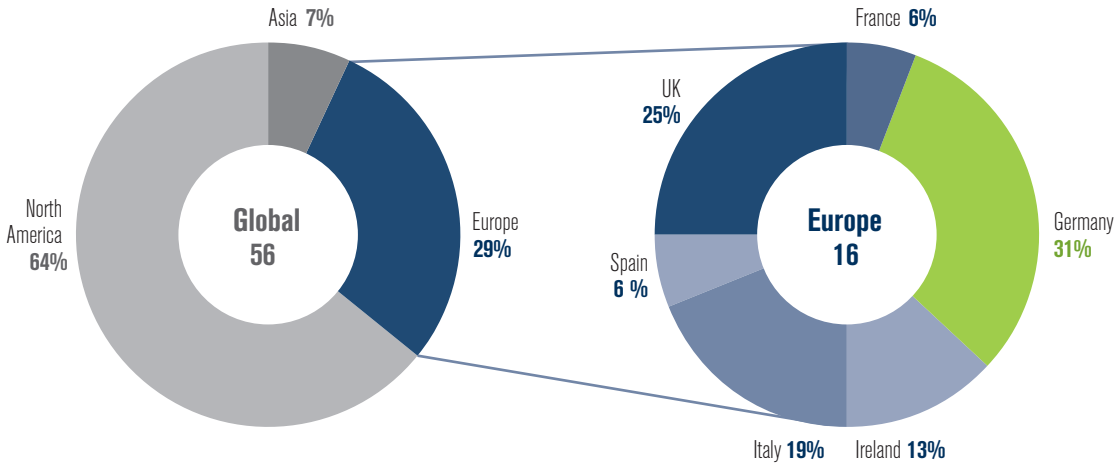
International platform providers

With businesses already positioning themselves right across the layer model for digital infrastructures (see Figure 4), different approaches to the monetisation of new business models have emerged. Some suppliers are seeking to drive vertical integration – i.e. to cover several different layers within the digital ecosystem – by adding smart services to their existing product portfolios. Meanwhile, others are operating open systems and interfaces and positioning themselves as intermediaries between the customer and data interface.
An international benchmarking study[4] looked at 56 platform providers operating in different industries, from hardware suppliers of industrial products or devices to software and cloud providers and technology integrators. The results clearly demonstrated that many providers are positioning themselves across the whole of their core business, but only a few have so far managed to cover the entire digital value chain. Industrial enterprises such as General Electric are currently driving the development of vertical industrial solutions, while network equipment suppliers like Cisco are also building solutions and services around their own hardware.
According to Forbes, this trend towards the integration of products and services promises a huge surge in growth worth billions of euros. German industrial suppliers are also developing mainly vertical solutions based on their own product portfolios. Examples from Germany include Siemens in the energy sector and Bosch in the mobility sector. Proprietary solutions tie users to both the new digital services and the company's own product portfolio. This can have the drawback of failing to offer customers sufficient flexibility (due to the high transfer costs) and insufficient scalability of vertical applications as far as the platform providers are concerned. While we already know the winners of the global battle for interface supremacy in established platform markets (e.g. app stores, social networks, search engines, etc.), the key challenge is now to try and connect predominantly vertically structured industries to each other in digital ecosystems.
The race to create digital platforms is on. However, it is not yet clear whether the outcome will involve either a single or small number of ubiquitous platforms or different dominant platforms in each market – both alternatives can currently be observed. US companies such as Jasper, Arrayent, Etherios and Echelon are making particular use of their strengths in software development and integrate devices and sensors in order to enable the development of smart services. In this segment, the small, ambitious companies (with a turnover of less than one hundred million euros) include EVRYTHNG and Arkessa in the UK and Device Insight, being Germany's only noteworthy representative. Middleware providers (e.g. Novatel Wireless and Prosyst) and Application Service Providers (e.g. PTC, WindRiver and Plat.One) are also establishing hardware-independent platforms based on open interfaces that enable integration of devices and sensors in order to provide smart services. Major IT companies such as Microsoft Azure, Amazon Web Services and Salesforce.com are seeking to become established in the platform market as cloud providers. This market segment also contains smaller providers such as the US firms SeeControl and Xively, which are positioning themselves closer to devices, and OpenShift, Splunk and Pivotal, which enable the devel-

opment of smart services and apps. Large software firms such as Oracle and SAP already have a strong presence among the target group, as they significantly expand their smart service portfolios. At the same time, business service providers like Accenture and IBM are also increasingly using their strengths in integrating these solutions to position themselves as open platform operators.

As can be seen from the above comparison, established providers, startups and SMEs are all increasingly developing business models as platform operators. Although proprietary solutions currently dominate in the field of hardware manufacturing, there is enormous growth potential for platforms with open interfaces that offer flexible ways of developing apps, enabling new ways of implementing smart services. The big winners will be the two or three providers of the service platforms that these smart services run on. As can be seen from the breakdown of leading platform operators in Figure 8, the US clearly leads the way in this segment, with 36 of the 56 providers included in the study. The US has the great advantage of having widely used software and a dynamic startup sector. Germany is the leading European nation, despite only having five notable providers. Although Germany could use its strong industrial expertise to further expand its portfolio in this area, the structure of the German SME sector makes it difficult to deliver scalable solutions. Efforts to promote the establishment of leading platform operators from Germany and Europe should therefore be significantly strengthened.

Figure 8:
International comparison of platform providers



Source: Accenture 2015; Data valid as of October 2014

1 acatech (Ed): Cyber-Physical Systems – Driving force for innovation in mobility, health, energy and production (acatech POSITION PAPER), Heidelberg, 2011; Geisberger, E./Broy, M. (Eds.): agendaCPS – Integrated Research Agenda Cyber-Physical Systems (acatech STUDY), Heidelberg, 2012.

2 OECD: OECD Factbook 2014. Economic, Environmental and Social Statistics, Published: 6 May 2014, available online at: oecd-ilibrary.org/economics/oecd-factbook-2014_factbook-2014-en (accessed: 5.12.2014).

3 Opinion of the European Economic and Social Committee on the impact of business services in industry, 16 October 2014, available online at: edz.bib.uni-mannheim.de/edz/doku/wsa/2014/ces-2014-0493-de.pdf (accessed: 5.12.2014).

4 Accenture (Ed.): Driving Unconventional Growth through the Industrial Internet of Things, Published: 16 September 2014, available online at: accenture.com/SiteCollectionDocuments/PDF/Accenture-Driving-Unconventional-Growth-through-IIoT.pdf (accessed: 8.12.2014).

2 The Smart Service Welt: use cases

2 The Smart Service Welt: use cases

A number of different use cases have been developed, evaluated and described by experts from the working group in order to illustrate the potential of the Smart Service Welt (see Figure 9). The use cases evolved from the co-working of one or more companies that are already commercially active in the relevant field and consider the use case to represent a concrete future business opportunity. While all the use cases are characterised by innovation, their implementation timescale varies from one to ten years. A key feature of the use cases is that they are based on the principle of overarching cooperation between different companies in the shape of a digital ecosystem. Although the use cases outlined below cover all the different layers in the layer model, their main focus is on software-defined platforms and service platforms.

Figure 9
Overview of use cases

Ecosystems refer to cross-company strategic partnerships between several different stakeholders, users, organisations that make use of objects (smart products) and are organised to form a business network. An ecosystem delivers a value proposition that is greater than the sum of the value propositions of the individual companies that form part of the ecosystem.

Overall trends

The trends described here can be discerned in the use cases outlined below and correspond to some of the general trends that can be observed in the digital revolution.

Trends in the relationship between users and service providers:

- The relationship between customer and service provider is changing from a simple "transaction relationship" to a partnership based on a high degree of trust. More and more focus is being placed on users, as well as their value-added and needs. This requires increased user/customer loyalty and the acquisition of additional knowledge about user requirements so that customised services can be provided.
- In order to achieve a sustainable improvement in the relationship between user and service provider, the user must be convinced that the service offers them value-added. This is key to ensuring that new services and technologies can be deployed without users feeling that their security requirements are being compromised. At the same time, service providers have a growing need for information about potential personalised service and marketing opportunities arising from users' increasing needs and heightened awareness.
- Users expect the experiences and technologies from the consumer market to also be implemented and available in the industrial environment. It is particularly those customers, service providers, workers, etc. who belong to Generation Y and have new expectations of industry.

Trends in the overall environment:

- It is becoming harder and harder to obtain significant profit margins from standard mass-produced goods.
- In the manufacturing environment, technologies are subject to higher demands in terms of quality, reliability, safety and security, longevity, etc. However, users will continue to employ a variety of heterogeneous machines from different manufacturers.
- Businesses are always striving to use resources more efficiently in order to gain a competitive advantage. They expect smart services to drive efficiency gains. This is linked to paradigms such as "hiring rather than buying" or "OPEX rather than CAPEX". (It is, however, necessary to take the regional, cultural and legal context into account.) It is also conceivable that there will be more business models with value-oriented sales philosophies. There is currently a trend towards specialisation and focussing on core competencies, meaning that a single company can no longer cover all the different elements in a value chain. New product ideas and even products themselves are being developed together with customers in ideas competitions, while development is increasingly being farmed out to external developer communities via crowdsourcing.
- The increasing interconnectedness of manufacturing processes and systems, coupled with affordable worldwide access – often initially through different systems – and the rise in cooperation between different companies requires products and services that make this growing complexity manageable.
- In addition to the established major IT firms, completely new market players are emerging from niche markets (particularly ones with an "IT" background). More and more marketplaces for digital commodities are being created.

Trends in technology:

- A shared infrastructure and interoperable systems will make it possible to leverage the potential of connecting different interest groups. A growing number of Machine-to-Machine (M2M) solutions enable ID detection and provide access via smartphones and tablets. Enabling technologies for service platforms, application development and delivery and data management are available as standard products or through open source distribution.
- Smart products are being created as a result of the increasingly widespread use of information technology. This is enabling the delivery of new services in industry and is transforming competitor and partner landscapes. The introduction of new information technologies is leading to increased customer security needs. This explosion of data poses new challenges for customers and service providers alike.
- Short product life cycles and in particular personalised products require highly flexible but nonetheless cost-effective manufacturing processes. New manufacturing processes such as 3D printing are transforming value chains into flexible value networks.

Common model framework for the use cases

All of the use cases share a common framework characterised by the following features:

Intermediaries:

- These perform a **new role** within the emerging ecosystems. An intermediary provides portfolio components that lie between two value-added processes that are currently linked to each other in a value chain. They may position themselves as independent **mediators** between different parties.
- One of the key roles of intermediaries is to **create trust** (e.g. with regard to data sharing, by regulating the ecosystem and controlling access to information) among the participants in an ecosystem and the users of the relevant platforms. However, they may also position themselves between the provider and the customer in an established interface, thereby relegating the provider to the role of an interchangeable supplier.

Transaction platform:

- Transaction platforms are used to trade goods. They do away with the link between the suppliers and buyers of these goods. Examples of the goods traded on transaction platforms in the Smart Service Welt include services (e.g. predictive maintenance), **data** (e.g. technology data), **knowledge** (e.g. about energy storage capacity), **manufacturing processes** (e.g. test facilities), **spare parts** (e.g. controllers), **recruitment** (e.g. of technical experts), and **software** (e.g. diagnostic tools, apps).

Knowledge and benchmarking:

- One key feature of the use cases is the **provision of knowledge** relating e.g. to energy price forecasts, consumption-based electricity tariffs, fertiliser usage figures, fuel consumption, manufacturing process parameters, personalised medical analyses and recommendations, predictive services, support for investment decisions, instructions, training materials or order status information. An important role is also played by **best-in-class benchmarking services throughout entire value chains**, e.g. with regard to machine use, required quantities of particular items, keeping consumable costs down or machine health information.

Collaboration:

- At its core, this model focuses on **breaking down information silos and facilitating operational processes**, e.g. between doctors, between farmers and farm labourers, between suppliers, manufacturers and customers, between port operators and haulage companies or between consumers and energy suppliers. Among consumers, but also increasingly among businesses, a key role is played by **social networks**, e.g. in order to obtain customer feedback on a service or on what a product is like in use.

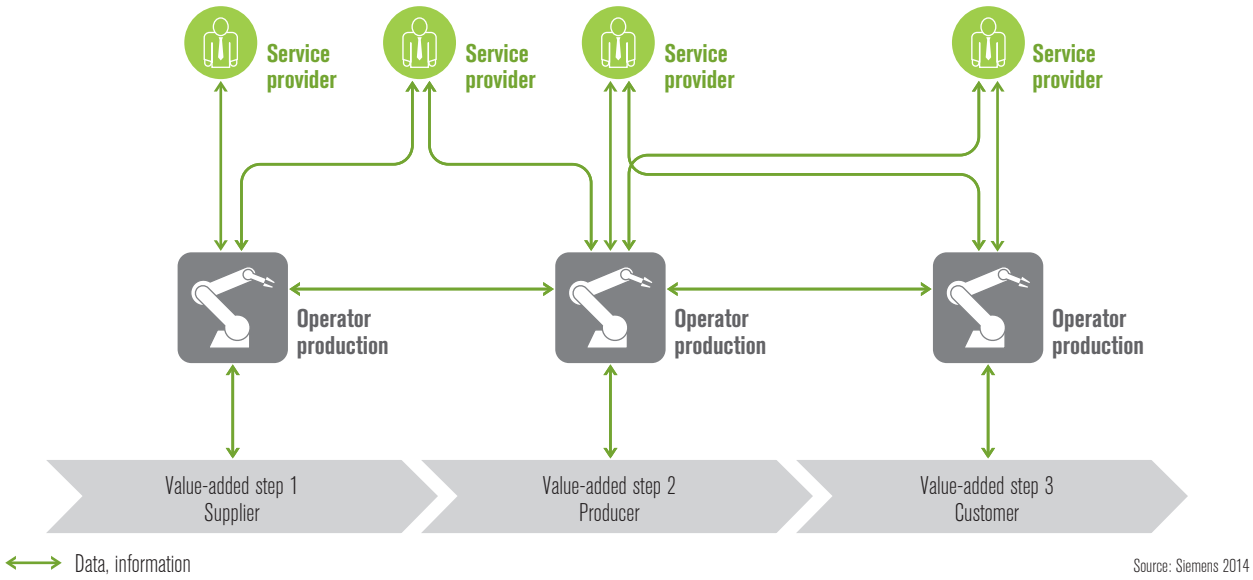
1 This phrase is particularly common in the field of cloud computing and describes the shift towards operating expenditure (OpEx) instead of capital expenditure (CapEx) owing to the migration of IT functions to the cloud.

Use cases

Smart Production Services I

The ecosystem: The relevant ecosystems involve cooperation between industrial services providers, plant operators (in their respective roles as suppliers, producers and customers), machinery manufacturers and the operators of the underlying platforms. There are also actors who perform new roles including that of the intermediary and potentially also other business partners. Both closed ecosystems (e.g. within a company or group) and open ecosystems (e.g. for SMEs) are created.

Today



Source: Siemens 2014

- Today, a number of **silos** exist right across the horizontal physical and digital value chain.
- Within their silos, the plant operators act as **data intermediaries** and manage the different business partners manually.
- **Services** are provided **reactively**, usually after a failure has occurred.
- **Not enough use is made of** operating **data** in the manufacturing environment.
- There is a lack of **transparency** with regard to the **service providers and services** that are available on the market and the required and available **production capacities**.

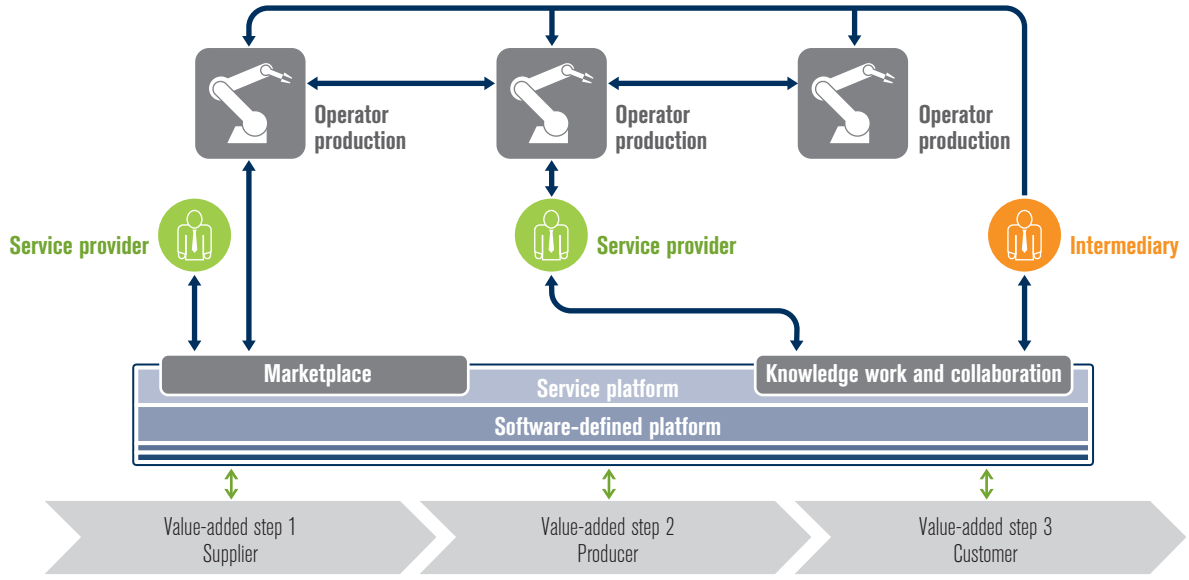
Value proposition

- Plant operators benefit from manufacturing process optimisations that result in **productivity gains for plant components and manufacturing processes**, as well as competitive advantages and improved customer satisfaction.
- **Cost savings** for the plant operator are delivered through **consumables optimisation**. These cost savings are achieved through everything from suggestions to active intervention in the relevant process.
- **Condition monitoring and health information and forecasting for manufacturing equipment** allows plant operators to increase customer satisfaction and deploy their assets more efficiently. It also leads to the emergence of predictive, value-based and data-driven business models for machine manufacturers.
- **Support for investment decisions throughout the production system's entire life cycle** allows the plant owner to optimise investment costs and subsequently enables the increase in plant productivity and availability on behaf of the plant operator.
- **Industrial services such as repairs, maintenance and upgrades** can be performed predictively for the plant operators and owners.

Productivity gains in digital ecosystems

Placement in the Smart Service World: The key enablers of smart production services are **software-defined and service platforms** that enable productivity gains based on the use and analysis of **data, knowledge** and associated processes **from several different companies**. The knowledge generated as a result enables **predictive action**, is **traded on transaction platforms** and is made available to the ecosystem in collaboration environments. The intermediary facilitates trust among the participants and regulates cooperation within the ecosystem.

Tomorrow



Source: Siemens 2014

- The silos that exist throughout the value chain are broken down and the different steps in the production chain are connected to each other.
- The relationships between operators and service providers are decoupled via marketplaces. This allows **new partners to participate**, enabling **resources to be used more efficiently**.
- A service platform enables more efficient and effective c**ollaboration and knowledge sharing** between operators and service providers.
- Access to information from across the entire value chain enables innovative services and operator models.
- **Horizontal integration** in the operators' shared information environment leads to **optimisations** throughout the **value chain**.
- Smart, data-based **predictive and proactive services** help operators to increase their productivity.
- Intermediaries develop new **benchmarking services**, in particular for SMEs.

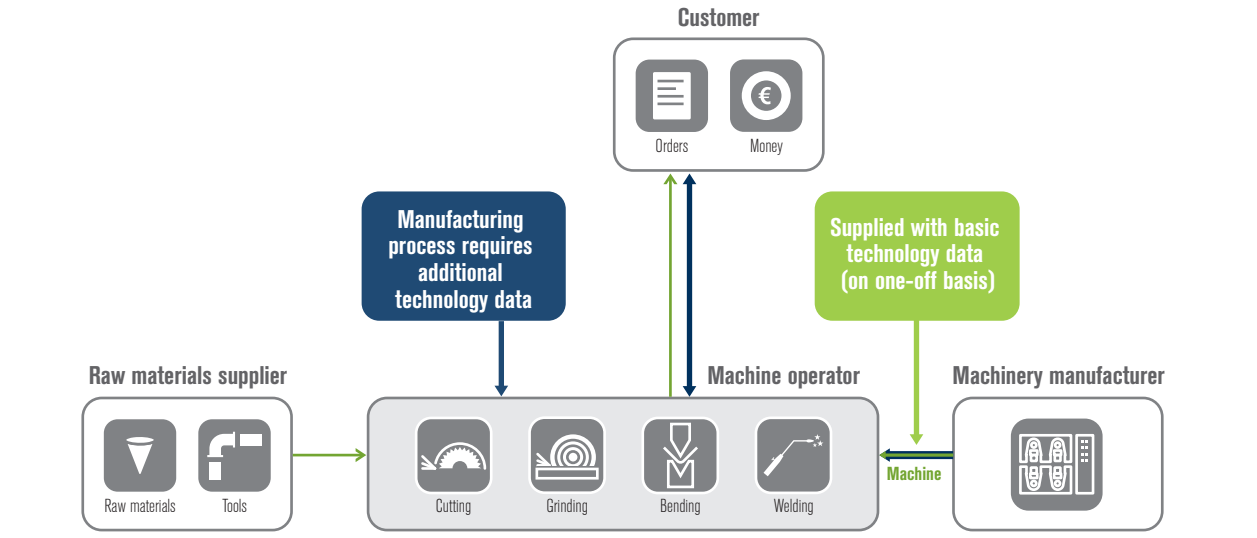
- **The offering and provision of production capacity** is facilitated between the plant operators and owners.
- The **provision of instructions and documentation for verification purposes** allows plant operators and service providers to acquire additional expertise and competencies and enables them to document process conformity.
- The **provision of order status information** throughout the value chain enables more accurate planning between suppliers and customers.
- The **provision of new "best-in-class" benchmarking services** leads to **productivity gains**.
- **Software and platforms are provided** in the shape of flexible, scalable and cost-optimised services.

For a detailed description please see the German long version, p. 129 ff.

Smart Production Services II

The ecosystem: In the future, a trading platform will be used to trade and exchange process parameters for complex manufacturing systems, e.g. laser cutting data for specific types of sheet stock. In addition to the plant operators and manufacturers, other potential participants include raw material suppliers and new stakeholders who may act both as users and as data providers.

Today



Source: Trumpf

Today, the manufacturers of a production system will supply a set of standard parameters with the machine when they deliver it. The plant operators will optimise these data themselves in accordance with their own requirements and in some cases may even have to calculate completely new data, e.g. for new materials. In addition to the necessary training, this also requires sufficient time and testing material. If the operators are unable to calculate the required data themselves, it can be bought in as a service.

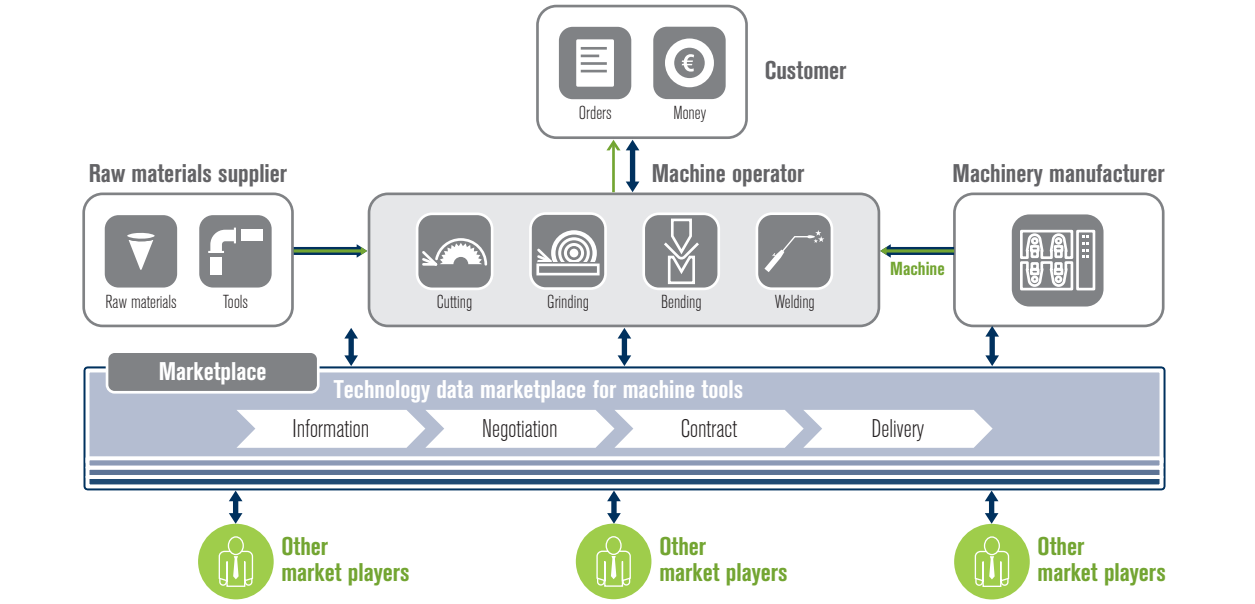
Value proposition

For manufacturing system operators, the acquisition and optimisation of technology data involves costs arising from the staff, materials and machinery needed to perform the necessary tests.
A marketplace where technology data are provided as a service can significantly contribute to improved flexibility and cost-effectiveness for the plant operators. This allows them to respond rapidly to customer order enquiries. The fact that the data costs are known enables improvements to both the costing and production of an order and allows the entire process chain to be optimised, from order enquiry to order execution.
In addition, the plant operator is able to respond more flexibly to the growing trend towards batch sizes of one, since they can acquire the necessary process data from the marketplace as required.
Furthermore, the overall quality of the finished product can potentially be improved without companies needing to hire their own process experts.

A technology data marketplace

Placement in the Smart Service World: The technology data marketplace can be classified as a service platform that provides a transaction platform for describing content and quality data, and enabling this data to be traded amongst the participants. The data marketplace acts as an intermediary between the suppliers and buyers of the digital commodity (i.e. the process parameters), providing comprehensive security as well as the necessary transparency.

Tomorrow



Source: Trumpf

In the vision of Industrie 4.0, the plant operators will be able to automatically acquire any missing data via a transaction platform, as and when required. In other words, the necessary data will be available through a suitable cloud service, with automated ordering and delivery. The success of this type of service will depend on the data required to meet the customer's needs being readily available and easily located. Owing to the rapidly rising number of variants and special materials, it is unlikely that the production system manufacturers will be able to profitably provide all of this on their own. It will therefore be necessary to enable other partners to contribute data. For example, plant operators could contribute data that they have captured themselves, providing them with an additional source of income or allowing them to swap data with other users. Meanwhile, mere service providers can specialise in the job-oriented investigation of missing data. This would lead to the emergence of a marketplace for trading process data. Data would become a commodity and potentially also a type of currency.

Instead of obtaining the data directly through the marketplace, it is possible to conceive of alternative business models where other players such as raw material suppliers enhance their products with data from the marketplace. This could potentially offer the plant operators the possibility to more simple and efficient processes, since the machine could immediately start processing the material on-demand, without the need for any intermediate steps.

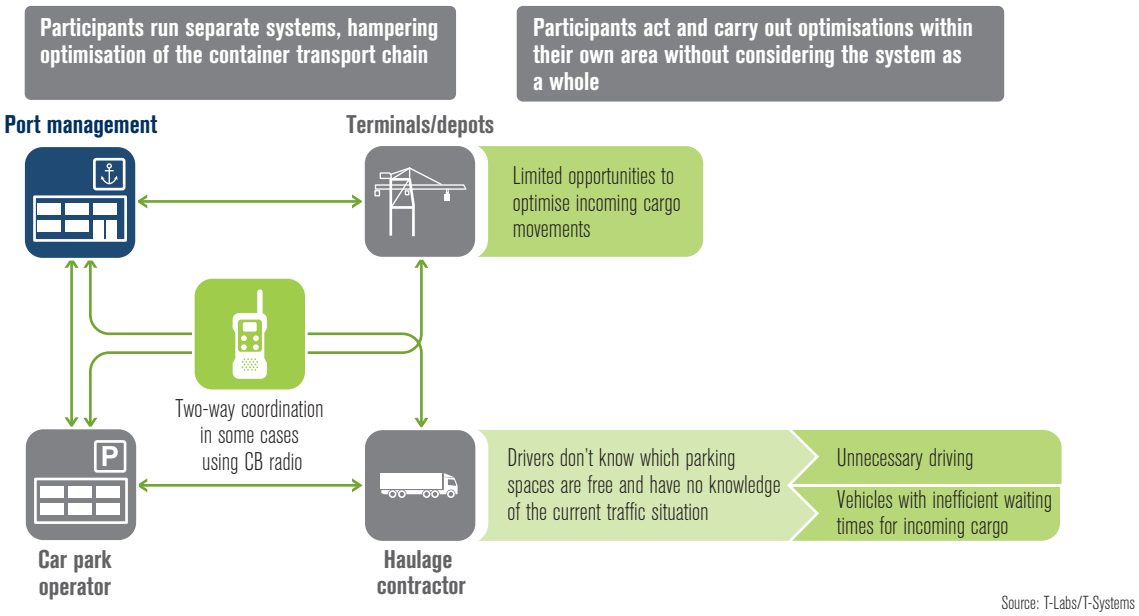
Appropriate licensing models would potentially enable the suppliers of the data to obtain a higher ROI for their service.

For a detailed description please see the German long version, p. 134 ff.

Smart Logistic Services

The ecosystem: In order to implement the vision of growing trade volumes, shorter delivery times and more reliable planning whilst using less space and fewer resources, Germany needs a smart transport system. The ecosystem comprises different actors: sea port operators, container terminal operators, logistics network operators, port management, shipping companies, car park operators, haulage companies, heavy goods transporters and a variety of other firms and service providers. By coordinating the various stakeholders, it is possible to achieve efficiency gains in container handling and inter-regional traffic flows.

Today



Source: T-Labs/T-Systems

The extremely dynamic business environment that Europe's sea ports operate in is characterised by global competition and high cost pressures. Port infrastructure is coming under growing pressure from rising freight volumes and passenger numbers, especially since only limited physical expansion is possible. While the processes and certain parts of the infrastructure used by individual actors are already smart, there is a need for a global system that employs a shared infrastructure in order to optimise overall goods flows within ports as well as their integration into the regional transport infrastructure. This is especially true for bulk and heavy goods transport which is subject to special regulatory and logistical requirements owing to the extremely large size and high value of the goods in question (e.g. the products made by Germany's machinery and plant engineering industry).

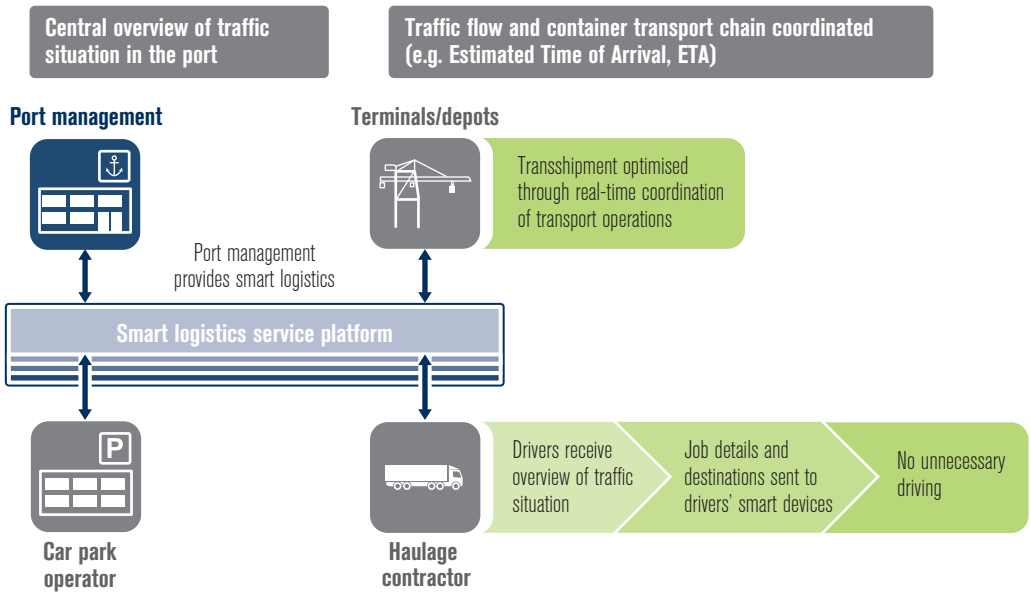
Value proposition

The value proposition of smart services lies in the overall optimisation of logistics processes, achieved by integrating all the different actors, from the port logistics level to the cargo's final destination. At the same time, the consolidation and global-level utilisation of digital data facilitates new business models. For example, data analysts from the field of big data can charge for providing the ecosystem with special algorithms for enhanced goods and transport flow forecasting. Furthermore, real-time oriented data and service infrastructures allow the different car-

(Sea) ports and heavy goods transport

Placement in the Smart Service World: A wide range of efficiency gains and opportunities are becoming available to a variety of different users as a result of increased availability, coordination between different actors and new, real-time oriented technologies for analysing and pre-processing digital data. In order to unlock this potential, it is essential to have a trustworthy operator (intermediary) to run the relevant service platform.

Tomorrow



T-Labs/T-Systems

The value-added offered by a smart logistics infrastructure lies in the real-time oriented consolidation, storage and analysis of data on infrastructure, traffic and logistical objects, and processes. Powerful analysis and forecasting tools enable the development of innovative assistants that can potentially be used by any participant in the digital ecosystem. The fact that user-specific data (e.g. sensor data) is input into the system means that all the system's users also contribute to the optimisation of the system as a whole. Data protection standards can be enforced through appropriate access rules and/or technical solutions (e.g. anonymisation). Standardised IT networking allows smart sea ports to be integrated into regional logistics and transport systems (e.g. bulk and heavy goods transport). This is realised by offering e.g. manufacturing companies the opportunity to integrate the entire logistics chain into their planning and production processes.

riers and/or sea ports to use their existing capacity more efficiently. Networked systems, cloud infrastructures, data-centric architectures and typical Internet access and integration mechanisms mean that it is now relatively simple to use smart services without the need for any major IT investment.

For a detailed description please see the German long version, p. 137 ff.

Smart Energy Services

The ecosystem: Genutzt werden die Smart Energy-Serviceplattformen (bzw. der Energiewende-App-Store) durch Anbieter energiebezogener Dienste inkl. der klassischen Energielieferung. Auch Mehrwertdienste außerhalb der Energieversorgung können hier angesiedelt werden. Als Betreiber kommen Akteure wie Energievertriebsgesellschaften, Netzbetreiber oder Messstellenbetreiber, aber auch IT-Unternehmen mit solidem Wissen über die Energiedomäne infrage.

Today

Source: BTC

In the current energy system, information is exchanged on a purely application-by-application basis. As a result, expanding the data and information provided in order to include new applications is both technically and economically inefficient. The provision and marketing of innovative energy-related services is severely hindered by the lack of suitable platforms. This has the following serious consequences:

- There is very little scope to enable dynamic cooperation with new players on energy-related matters by taking advantage of flexibility in production and consumption.
- It is not possible to use energy data for smart services such as energy coordination or in the fields of healthcare and security.
- There are high technical entry barriers to the electricity market for small-scale power generation operators.
- The interaction between suppliers and their customers is confined to contracts and bills. There is a lack of awareness of customers' individual needs.
- Access to information and control functions is largely restricted to established market players in regulated market processes.

Value proposition

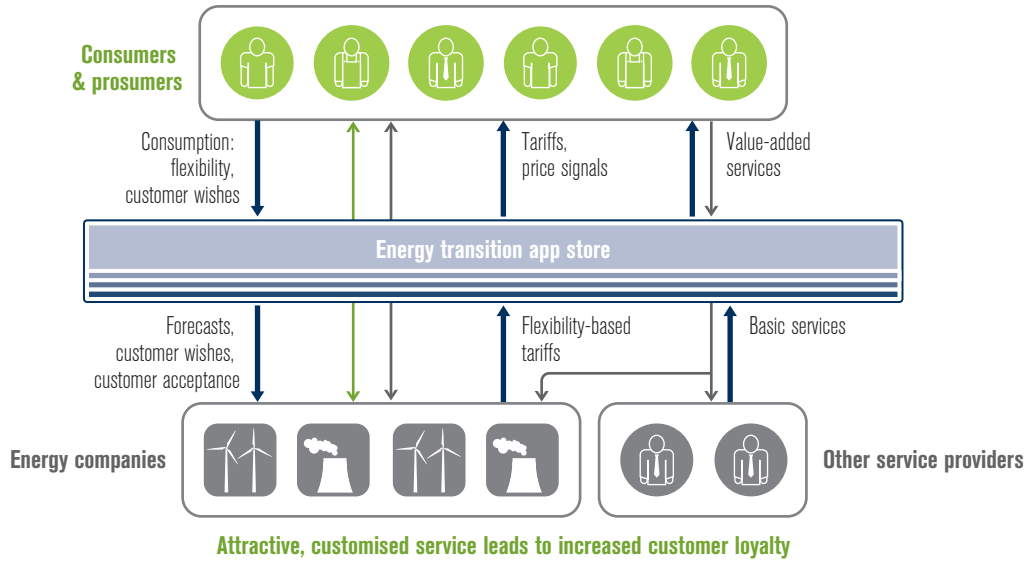
The development and operation of smart energy service platforms e.g. by sales companies/energy service providers adds value in various applications, including the following examples:

1) Procuring energy services for customers.
2) Information on customer requirements for energy suppliers and energy service providers.
3) Access to virtual power plants for power generation operators.
4) Brokering of electricity storage capacity.

Providing a glimpse into the energy transition app store

Placement in the Smart Service Welt: Die Smart Energy-Serviceplattformenstellen Transaktions-, Wissens- und Kollaborationsplattformen zur Unterstützung der Bedürfnisse einer Vielzahl von Akteuren des Energiesystems und benachbarter Bereiche dar.

Tomorrow



Source: BTC

Smart energy service platforms provide information about flexibility in electricity consumption and generation (opportunities to power down/up, changing the time when certain operations are performed, etc.), as well as the available grid capacity at any given time and when there is a danger of grid congestion. These service platforms form the basis of new provider business models by delivering the services required for technical and commercial collaboration between energy system participants in a standard format. It will be important to ensure a choice of service platforms and to minimise the barriers to the establishment of new services, along the lines of Internet app stores.

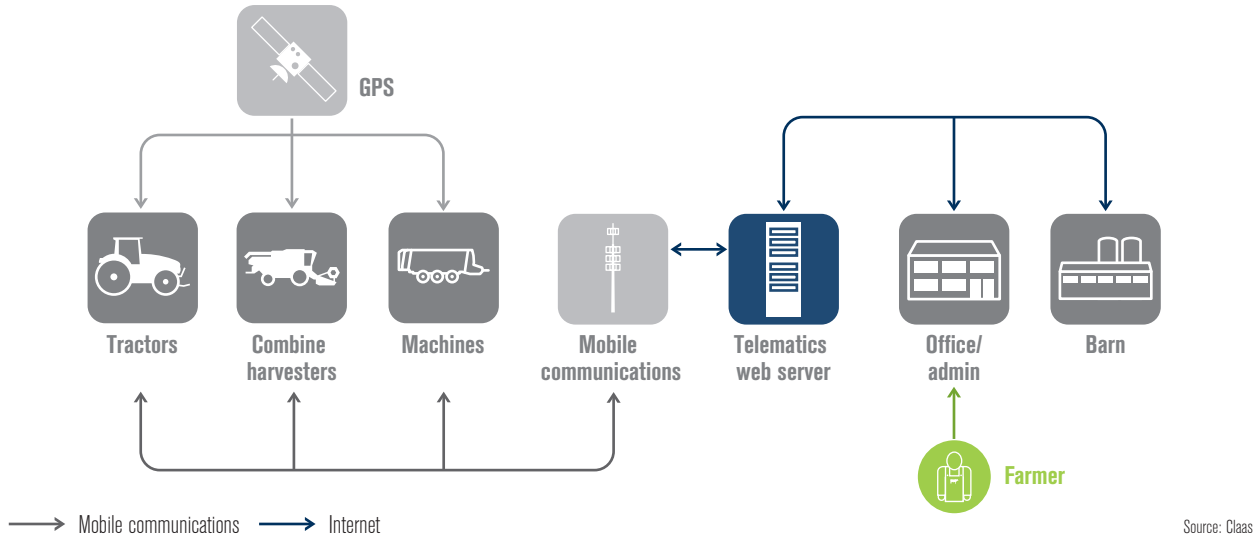
5) Coordination of energy communities.
6) Support for/alerting of home care services by deploying sensor technology using selected energy data and supplementary sensors.
7) Use of energy data by the emergency services, e.g. for central fire incident reporting systems or fire detection systems.
8) Use of smart energy data by the civil protection services so that they can plan and respond appropriately in crisis situations.

For a detailed description please see the German long version, p. 143 ff.

Smart Farming Services

The ecosystem: In the agricultural sector, agricultural technology manufacturers and agricultural service companies have to serve many different types of customers, from part-time farmers to agricultural holding companies. Furthermore, the highly heterogeneous nature of farmers' machinery makes it difficult to network machines (and their parts) and to ensure interoperability of the machinery used by the customer.

Today



Source: Claas

The modern agricultural technology products that are available today are already highly automated. Hence, they are ideally suited for undertaking further advancements with regards to networked farming. In order to optimise resource utilisation (e.g. of seed and fertiliser) and yield it will be necessary to fully integrate agricultural vehicles as data providers (e.g. of data on soil and crop quality) and data recipients (e.g. work schedules, setting work process parameters, control and documentation). Networking of mobile machines made by different manufacturers and their integration into the Internet of Things, Data and Services poses a number of major challenges for the industry, being:

- the heterogeneity of the machinery pool used by agricultural businesses,
- the high percentage of work performed by general contractors whose machines connect to the systems of different businesses, with enormous repercussions for IT security, and
- the lack of standardisation regarding security for the connection of machinery to the Internet.

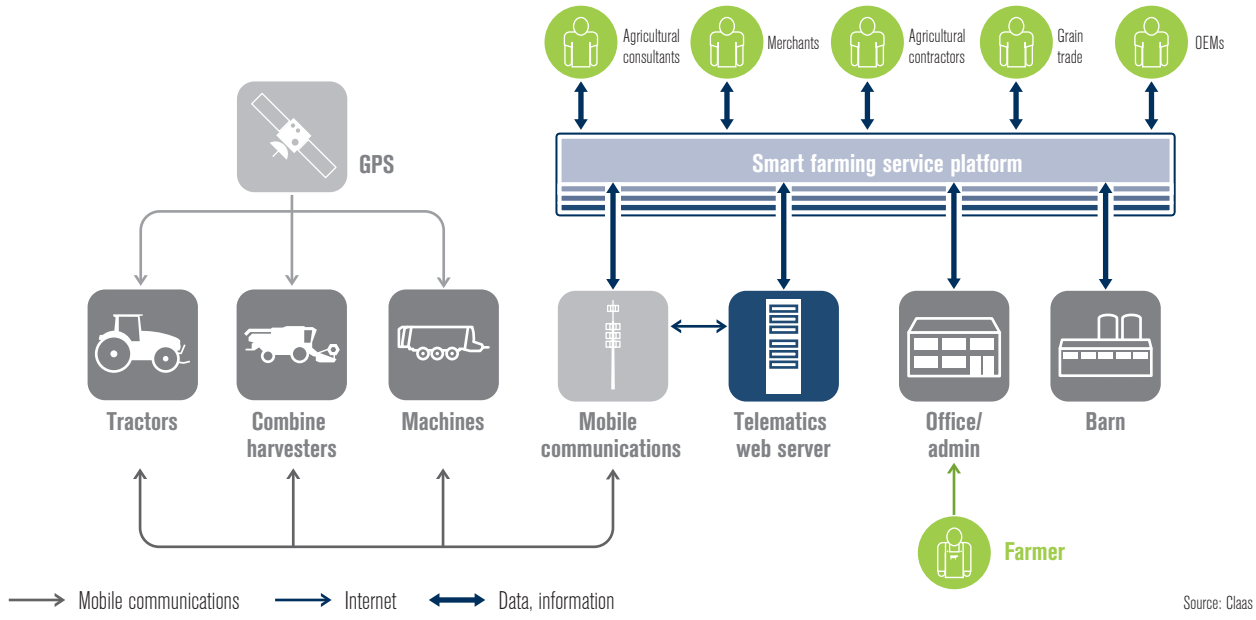
Value proposition

The value proposition to the customer comprises a hybrid solution consisting of applications, services, hardware and software. This includes the initial set-up of the basic infrastructure and the corresponding support (defined Service Level Agreements). A cloud-based and easily upgradable service platform provides the customer with secure access from any location to all the relevant operating data and enables integration of other partners and machines offering their own services (e.g. applications for smart glasses or virtual learning environments) without the need for any major investment.

Boosting productivity through networking

Placement in the Smart Service World: The establishment of a service platform that brings together all the different processes, data and information is a key requirement in order to enable discussion e.g. of machine data, fuel consumption and harvesting efficiency. It also serves as a knowledge database and a benchmarking tool for other players.

Tomorrow



Source: Claas

Connecting the machines to each other will facilitate a dynamic exchange of data together with further automation that will ultimately enable autonomous operating processes. This will allow agricultural businesses to further increase their productivity.

The relevant innovations are as follows:

- **Technological:** the establishment of a standard communication infrastructure that connects the machines and everyone involved in the different processes to each other. This will require the development of hardware and software interfaces and their integration into the relevant systems.
- **Organisational:** the establishment of a standard information base (using software-defined platforms) and the integration of all the relevant actors into the value network (via a service platform). This will make it possible to develop data-based value-added services that facilitate the optimisation of value creation within the ecosystem.

These innovations will enable networked process management and control. “Knowledge” of the status and goals of the other actors is a key requirement for reducing waste, particularly in highly heterogeneous processes.

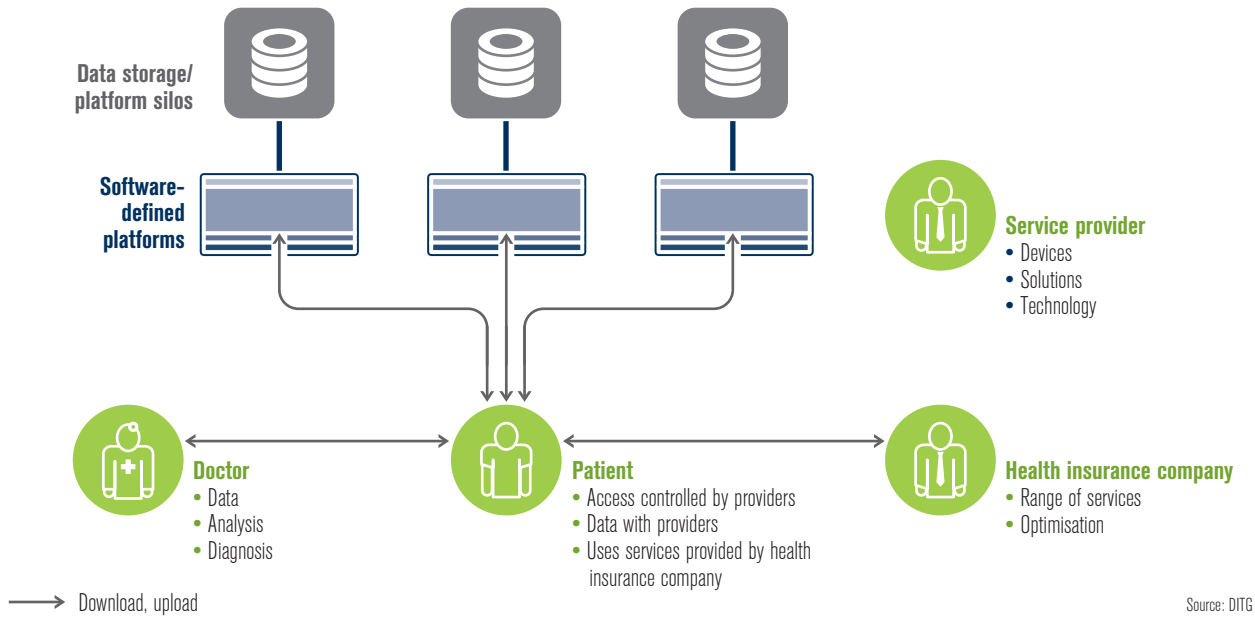
The farmer has access to a wide range of services that help provide him with value-added in terms of **transparency** (more reliable planning, more easily measured process steps), **effectiveness and efficiency** (shorter journey times, lower fuel consumption), **security** (with regard to data, investment protection and theft prevention), **networking** (integration of partners, suppliers, merchants, etc.) and **flexibility** (scalability of the solution, ability to adapt it to changes in operating parameters).

For a detailed description please see the German long version, p. 148 ff.

Smart Healthcare Services

The ecosystem: The stakeholders in the emerging ecosystem include healthcare service providers, insurance companies, doctors, medical equipment manufacturers and providers of Web technologies such as health portals. The service platform serves to organise all of these different services by facilitating access to the market, providing interfaces and making them easier to use overall by synchronising the entire user interfaces.

Today



Source: DITG

Since the providers in the healthcare system prevaingly aim at operating within closed systems, today, a number of **silos** exist in the delivery of horizontal physical and digital services. This lack of networking makes the introduction of innovative solutions extremely complex and can hamper the access to the market for other market players or prevent it entirely. Consequently, it is particularly difficult and expensive to bring in innovations.

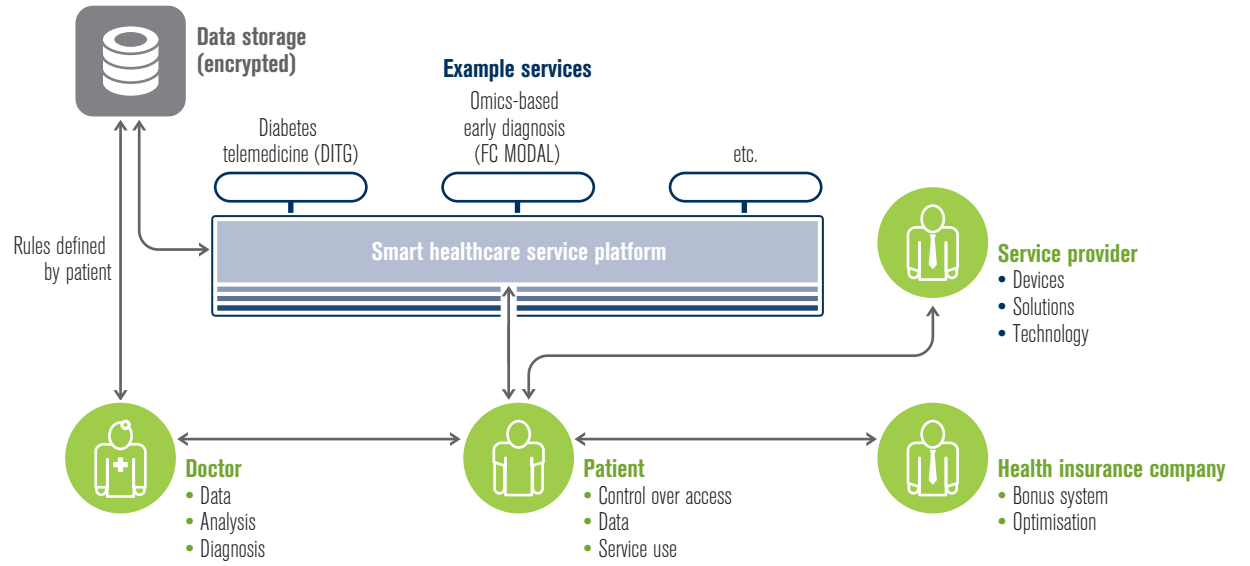
Value proposition

- The current healthcare system's effectiveness and efficiency is improved through enhanced data availability and access to the latest diagnosis methods and treatments. Patients have complete sovereignty over their data at all times and can personally decide whom they grant access and use rights to.
- Medical expertise is available through digital services and is not dependent on location, time or financial outlay.
- Medical equipment suppliers benefit from improved transparency regarding the services on the market that their equipment can connect to. This helps to generate valuable data for optimising diagnosis and treatment. In addition, a simplified plug & play approach means that they can participate in the market and provide access to innovative products without having to develop their own portal solutions.

Patient-centred care

Placement in the Smart Service Welt: The **service platform** enables enhanced patient diagnosis and care by providing patients with more effective access to innovative services. The platform also provides access to medical expertise. In addition, it enables collaboration models for the participating service providers and mechanisms for optimising treatments.

Tomorrow



Source: DITG

- All the relevant stakeholder groups, including the service providers, are connected to each other via an open and neutral service platform. This enables **innovators and smaller providers to join the market and provide valuable expert know-how to patients**.
- Big data and data provided directly by members of the public is used to develop new mathematical diagnosis methods and optimise outcomes (e.g. successful treatments) (**horizontal integration**).
- **Collaboration and knowledge sharing** between service providers and so-called payers can be implemented more efficiently and effectively.

- Cost savings thanks to better diagnosis and support for therapeutic decision-making and optimised treatment strategies allow conditions to be diagnosed early and treatments to be optimised. This not only generates direct savings in terms of medication and other therapeutic aids and similarly enables costly complications and hospitalisations to be prevented or delayed.
- Decentralised monitoring of patients' condition via continuous data collection and personalised treatment enhances both the effectiveness and efficiency of medical care.
- Centralised data storage ensures that patients have access to all of their data 24/7 and can also consult doctors in other locations.
- Comprehensive indication- and treatment-related digital documentation of all health data enables enhanced quality management and transparency, affording patients better protection.

For a detailed description please see the German long version, p. 151 ff.

3 Digital platforms: open, connected and secure

3 Digital platforms: open, connected and secure

3.1 Software-defined platforms: the technology integration layer

The enablers of the digital infrastructures for the Smart Service Welt are represented schematically in the layer model in Figure 4 that depicts how each layer is built on the one below it. Software-defined platforms constitute the lowest purely software-based layer for innovative services, whereas the technological infrastructure and networked physical platform layers that lie below them are heavily hardware-based.

Virtualisation as a key principle

The concept of virtualisation frees services from reliance on specific hardware in different physical environments whilst at the same time ensuring their connectivity and guaranteeing an extremely high degree of flexibility, adaptability and robustness for overarching IT solutions. Software-defined platforms thus enable planned or ad-hoc cooperation between smart products and services. This is achieved, for example, through full virtualisation of the application solution meaning that it can run independently of any specific hardware as a guest system in a standard virtual cloud environment without suffering any noticeable drop-off in performance. Software-defined platforms provide their infrastructure virtualisation services "as a service" in standardised form through highly automated cloud infrastructures. In addition to representing the interfaces with the physical world, this also involves providing standard basic functions for managing, interpreting and structuring the associated data sources that are independent of value creation. The conceptual design of software-defined platforms is such that they can be modified without affecting the physical level in any meaningful way. There is no compelling need for the cloud infrastructure to operate in accordance with the proprietary standards of the major commercial providers – it can also just as easily use open source software like OpenStack. OpenStack is based on the **"Infrastructure as a Service"** (IaaS) service model and provides a free and scalable cloud computing architecture for virtualising memory and processing resources.

An open runtime environment for smart services

In the overall context of the digitally compatible smart services and products in the Smart Service Welt, software-defined platforms provide the virtual runtime environment that is connected to the real world. Software-defined platforms are always technically oriented and ignore the service users' view, meaning that the target groups they address are largely confined to service platform and hardware providers and application developers. Software-defined platforms are dependent on the underlying networked physical platforms and technological infrastructure, which they access via programming interfaces. However, they provide their services domain-neutrally (i.e. they can be used in any domain) via semantic service descriptions either to the service platforms built on top of them or directly to the end user via multimodal interfaces.

The service platform layer, on the other hand, is commercially oriented. It provides a collaboration environment that enables end users to search for, buy and use innovative smart services whilst also allowing service providers to build new smart services from existing services. Service platforms therefore serve as an integration point for new digital domain-specific value chains. Within the layer model's overall structure, software-defined platforms and service platforms are connected to each other in an n:m relationship. On the one hand, a software-defined platform can provide the basis for several service platforms, whilst on the other, service platforms can use services provided by a range of different software-defined platforms (potentially belonging to different manufacturers). However, this does not affect the software-defined platforms' domain-neutrality (see Table 2).

Technology components for smart services

In service domains such as manufacturing, mobility, logistics, energy management, building and neighbourhood management and patient care, to name but a few examples, software-defined platforms act as the technology integration layer for smart services. This is achieved through software implementation of service

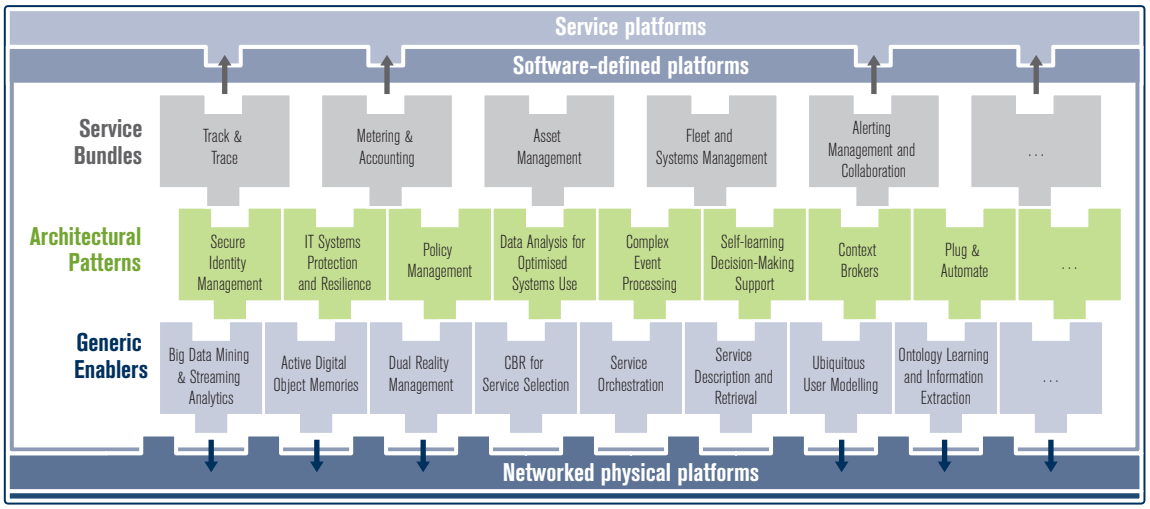
engineering, e.g. by making use of semantic annotations or ontology-based searching and orchestration of service components and the technical components of a service automation as enabled by specific workflow and event systems. Virtualised information structures are used for the storage and real-time processing of extremely large quantities of unstructured data with a low information density (big data processing) or to produce critical data sets condensed into highly valuable smart data packages. Components such as HANA, Terracotta and Apache Flink can be deployed in order to achieve rapid, reliable, powerful and scalable big data processing. Collaboration between businesses and intermediaries based on the exchange of smart data can only succeed on trustworthy and robust platforms. Software-defined platforms must therefore provide effective security solutions in the shape of integrated data protection and security measures, as well as guaranteeing trouble-free operation through measures to increase and ensure the resilience of the platform services. In order to make sure that these cross-component features of software-defined platforms are provided systematically and consistently, they are implemented "by design", in other words they are incorporated both conceptually and operationally right from the earliest stages of the development of the software-defined platforms and their enabler components.

Technical structure and variants

The modular principle underpinning software-defined platforms provides for a variety of components as the level of structural complexity increases, ranging from generic enablers and enabler structures in the form of architectural patterns right up to specific, complex enablers in the shape of service bundles (see Figure 10). This principle of encapsulated, hybrid software enablers is also used e.g. in FIWARE, a project of the EU's Future Internet Public-Private Partnership (FI-PPP) that provides a catalogue of enablers in the cloud in order to rapidly and dynamically test components and configure or reconfigure them using the Lego principle.

While the groupings within software-defined platforms that are illustrated above reflect the typical structural features of the enabler components in question, they do not constitute strict categories like those found in a layer architecture, for example. Accordingly, depending on the intended application, different networked combinations of components from different groupings can

Figure 10:
Generic enablers, architectural patterns and service bundles in software-defined platforms



Source DFKI

provide services to the service platform built on top of them. Particular emphasis has been placed on selecting enablers that have high development and ROI potential for German industry.

Generic enablers

Generic enablers are the structurally simplest components of software-defined platforms. One of the central paradigms of the Smart Service Welt is the concept of "Everything as a Service" (XaaS). This requires semantic service descriptions and technical service orchestration to be provided as generic enabler modules. A smart service can comprise almost any conceivable combination of smart products, objects or environments and both physical and digital services. When a potential customer makes an enquiry, the relevant smart services must be efficiently selected from an extensive service catalogue using a comprehensive **Semantic Service Description**. This must be done in accordance with the customer's needs and situation and taking into account the relevant contextual factors. **Service Orchestration** and simple service configuration then allow new, innovative services to be put together in a largely automated and even ad-hoc manner. This requires specific technical composition methods. New processes use **Self-learning Methods** to further increase the degree of automation and are capable of replacing service bundle components with alternative equivalents at runtime (fungibility, resilience), for example in order to comply with prior service level agreements or increase productivity. Over and above the traditional service sector, the benefits of service abstraction and orchestration are increasingly also being recognised by industry. **Case-based Reasoning** (CBR) is another generic enabling technology that solves new (unfamiliar) problems by looking for similarities with familiar cases and their solutions in a case memory. Once an appropriate semantically-based case memory has been built up, this reasoning principle can also be used e.g. in automated service selection to locate the relevant service choreographies and adaptations. In the future, the creation of smart data will often only be possible by analysing extremely large volumes of heterogeneous streaming data. **Big Data Streaming Analytics** as a generic enabler is not confined to analysing huge streams of data – it also specifically addresses the "velocity" aspect of big data, i.e. the need to rapidly process high volumes of particularly heterogeneous incoming data on the fly in order to obtain extremely up-to-the-minute information that loses its value as it gets older. The analysis is typically subject to strong time constraints, for instance the aggregation must be performed within a particular time window, patterns need to be recognised within the same time window and trend analyses or predictions need to be updated as things change over time. Big Data Streaming Analytics derives much of its power from combining data streams from different sources, e.g. energy consumption data with the weather data for the time in question. The widespread use of mobile devices means that combinations based on geographical information are also becoming increasingly important.

Architectural patterns

Within software-defined platforms, architectural patterns represent a more complex service that is defined by a structured combination of interacting components that can include generic enablers. As a result of the huge rise in the number of technological components in smart spaces that can be used with the help of services, the convergence of IT and operational technology (OT) is posing new challenges with regard to systems integration. The **Plug & Automate** architectural pattern constitutes a technological enabler for addressing this issue. This metaphor is already being successfully employed in practice at the technology infrastructure level with the Bluetooth and USB standards, e.g. in order to integrate smartphones from different manufacturers and of different generations with the hands-free systems on board cars without the need for any engineering modifications. Once the relevant security settings have been made, the Plug & Automate approach allows physical components to connect automatically to OT systems and employ two-way negotiation to determine which information and functions can and should be made available by a given physical component to a given OT system.

In order to ensure that the data generated following successful system integration also meets the relevant

data security and privacy requirements, the **Policy Management** architectural pattern is intended to provide a simple means of ensuring that information processing complies with data protection standards. This architectural pattern also provides both application developers and users with data provision support. While data policies have traditionally been geared mainly towards specifying and verifying access rights, the policies in software-defined platforms address a different level – they establish the balance between the data user and the data provider as a specific formulation in a policy language. Whilst it is necessary to guarantee the data provider's right to privacy, the data user's interests should also be accommodated. With the aid of the policy description it is possible to produce a formal description of access and type of processing e.g. for Big Data Analytics and incorporate it into the data processing system. The highly dynamic and complex systems made up of distributed, virtualised hardware and software components that are used to produce smart data must also be capable of withstanding the rapidly growing threat of cyber-attacks. Consequently, there is a need for architectural patterns that increase the **Protection and Resilience of IT systems**, including in particular the secure and continuous monitoring and control of individual software components and systems. These Online Security Monitors (that are comparable to watchdogs) run in separate, virtualised execution environments and enable monitoring of individual platform functions, together with a system-compliant response should any anomalies be detected. The fact that the Online Security Monitor is virtualised means that its operation can be guaranteed even if the function being monitored fails or is attacked.

Service bundles

Service bundles represent structurally complex enabler components in software-defined platforms where the primary focus is not solely laid on the immateriality of the service, but where the integration of the material and service elements is supported instead. Particularly, when more complex operator models are involved, the use of service bundles can cause the responsibility for processes to shift, for instance, if product suppliers become service providers. The company Kaeser Kompressoren that has changed its strategy from selling compressors to selling compressed air provides a good example. Service bundles in software-defined platforms are also characterised by the fact that they are not confined to a particular domain or industry. The **Asset Management** service bundle, for example, is developing into one of the core components within the Smart Service Welt. It is used to manage all the key information about a system throughout its life cycle. Event-triggered processes enable automatic updating of the system description in the event of changes such as maintenance work and repairs or the replacement of components with newer versions. Particularly in highly automated manufacturing environments, production systems management and the associated optimisations are becoming increasingly important. Component use profiles can, for example, provide valuable information for future adjustments. Meanwhile, the **Fleet and Systems Management** service bundle addresses the integration of data from different sources such as the condition monitoring of individual pieces of equipment, Manufacturing Execution Systems, engineering databases and both in-house and external information services. It also incorporates a module for evaluating and enhancing data quality. The more in-depth analysis of this heterogeneous data using big data tools provides fertile ground for the development of new services. Dependencies between the data arise from well-known correlations (e.g. physical or engineering correlations) but are difficult to extract. This problem can only be solved using a combination of model-driven and data-driven methodologies.

For illustrative purposes, the table below takes the example of the "Smart Logistics Services" use case in order to estimate the importance of the different enablers for building the relevant software-defined platform.

Chapter 2

Table 1: Use of enablers in the "Smart Logistics Services" use case (Source: "Smart Logistics Services Use Case" expert team)

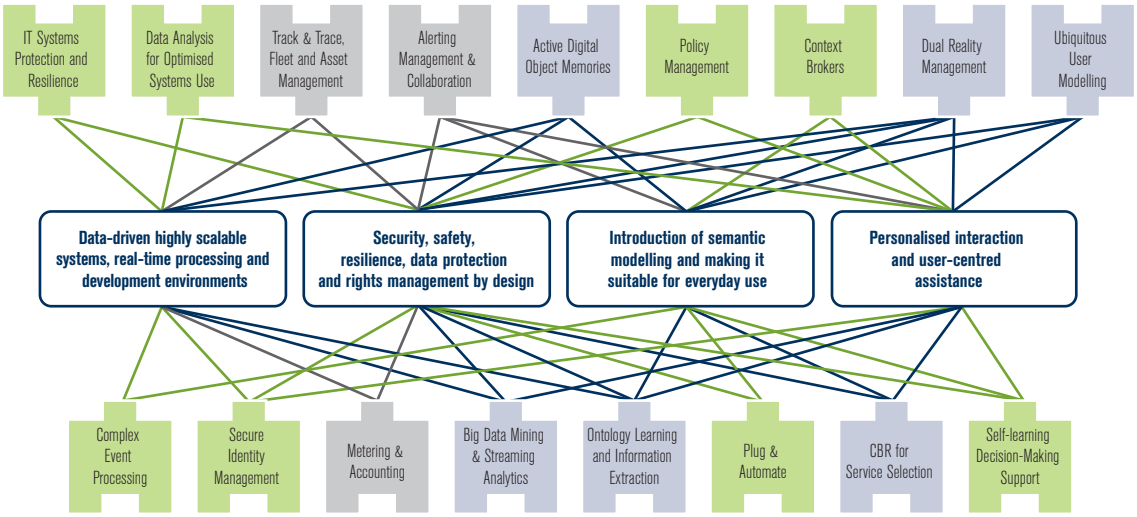
Enablers	Importance
Service bundles	
Track & Trace	high
Metering & Accounting	medium
Asset Management	medium
Fleet and Systems Management	high
Alerting Management and Collaboration	high
Architectural patterns	
Secure Identity Management	high
IT Systems Protection and Resilience	high
Policy Management	medium
Data Analysis for Optimised Systems Use	medium
Complex Event Processing	medium
Self-learning Decision-Making Support	medium
Context Brokers	high
Plug & Automate	medium
Generic Enablers	
Big Data Streaming Analytics	high
Data Mining & Big Data Analytics	high
Active Digital Object Memories	low
Dual Reality Management	high
Case-Based Reasoning for Automated Service Selection	medium
Service Orchestration	high
Service Description and Retrieval	medium
Ubiquitous User Modelling	medium
Automated Ontology Learning and Information Extraction	low
Automatisches Ontologielernen und Informationsextraktion	wenig

Research requirements for software-defined platforms

The modular structure of the Smart Service Welt's digital ecosystems will enable both full service providers and specialists (start-ups and SMEs) to implement their respective business models. Software companies, for example, will be able to provide customised services via software-defined platforms, e.g. in the context of Industrie 4.0, whilst at the same time tapping into other promising new software market segments. The key to the Smart Service Welt lies in smart generic and specific services that interact with each other on a software-defined platform to provide the services requested by customers. In the following section, significant research requirements for the development of technological enablers are discussed. The four fields of development presented are key for the success of the Smart Service Welt.

For a detailed description please see the German appendix, p.156 ff.

Figure 11:
Research requirements for software-defined platforms



Source: DFKI

Data-driven highly scalable systems, real-time processing and development environments
By harnessing the data generated in the service sector it will be possible to create new value, services and business models. This trend can be expected to develop its full potential over the coming years. The relevant data streams can originate from a variety of different sources, for example the Internet of Things – i.e. sensors, smart products and wearables –, social networks, current market data, clickstreams, etc. The integration of data from different sources such as the condition monitoring of individual pieces of equipment, engineering and servicing databases, in-house information systems and external information services such as weather services is a key requirement for efficient **Fleet and Systems Management**. Highly scalable systems, real-time processing and development environments are needed in order to manage these data streams in real time. It will also be necessary to develop systems that enable cross-company and interdepartmental real-time data integration and exchange, virtualised representation of products, systems and fleets, and scalability of data analysis processes (e.g. from small data technologies to big data technologies). **Big Data Mining & Streaming Analytics** provides a variety of tools for analysing large volumes of static data, e.g. for extracting semantic content. **Big Data Streaming Analytics** refers to software that is capable of filtering, aggregating, enriching, combining and analysing dynamic streaming data in real time in order to derive up-to-the-minute information about the status quo, critical situations, issues requiring immediate action, etc. Big data streaming analytics requires development environments that provide and simulate time-consistent correlation of data streams from different time contexts at the time of development, as well as ensuring that they are seamlessly displayed. In addition, it is necessary to investigate how smarter analysis methods can be achieved by integrating machine learning into big data streaming analytics in a way that enables model learning based on historical data streams to be combined with the application and testing of these models on real-time data streams. This would make it possible, for example, to address a key service domain issue like **Data Analysis for Optimised Systems Use**, e.g. in the context of remote preventive maintenance. Large medical equipment, buildings, gas and wind turbines, traffic management systems, vehicles and manufacturing systems can be monitored by radio or data

link so that preventive maintenance can be carried out as and when necessary. The number of sensors in these future applications will require systems that are tolerant of errors and contradictions, meaning that it will be necessary to develop new methods of processing real-time data that are able to cope with uncertainty and unreliable data. The processing of this data will require highly scalable systems at the runtime level in order to enable adaptive load balancing.

Security, safety, resilience, data protection and rights management by design

The emerging Smart Service Welt with its highly dynamic and complex systems made up of distributed hardware and software components must be structured in such a way that the systems are able to respond securely and flexibly to changes in their environment and can thus be upgraded at any time. Guaranteeing the systems' performance at all times is the number one priority. Any malfunction or failure of the software-defined platforms – for instance as a result of a cyber-attack – could cause widespread damage to businesses and the economy as a whole. The principal challenges pertaining to the systems integration of physical components with the software-defined platform involve the (semi-) automated integration of physical components and the automatic establishment of communication between the physical components using **Plug & Automate** architectural patterns. It is also necessary to take into account the security and safety requirements of the current application domain. In addition to the evolution of standard reference architectures and interfaces through Service and Interface Lifecycle Management, the Plug & Automate approach also requires further development of agent systems for peer-to-peer communication between physical components. These will need to incorporate strategies such as sensor data fusion in order to prevent data flooding. Separation and virtualisation technologies for ensuring the **Protection and Resilience of IT Systems** require further development in order to keep up with the growing demands upon them and the changing system environments in which they operate. The need for extensive further research is particularly pronounced in connection with real-time capabilities, highly dynamic distributed systems and the new risks posed by advanced persistent threats. While new hardware technologies such as trust zones offer a promising approach, they will need to be integrated into software architectures. Security must be treated as a matter of priority.

In the German-speaking nations and throughout Europe as a whole, the need to comply with data protection regulations in order to guarantee people's privacy poses a number of major challenges for information processing in general and the Smart Service Welt in particular. Services frequently use and exchange information that has to be handled separately in order to comply with data protection regulations. **Metering & Accounting** processes underpin business processes such as service billing, tax payments and process management, whilst in the future it is also expected that they will provide measurements for active efficiency management. Future application-specific engineering solutions will need to be made compatible with the introduction of the generic methods and services that will be required in a globalised Smart Service Welt. Furthermore, it will also be necessary to develop flexible, context-based metering & accounting models that meet the requirements of both conventional models (smart metering) and of generic sensor data acquisition (CO2 footprints) whilst also taking account of the relevant security and data protection aspects. In order to keep up with the growing security requirements and changing system environments, it will be necessary to drive further development of separation and virtualisation technology and associative computers. It will furthermore be necessary to investigate innovative transport and storage methods for metering & accounting data with reference to "Content-Oriented Networking". Mechanisms for data protection and for protecting data sovereignty and ownership of any incoming or processed data will need to be built into objects and their Active Digital Memories, with embedded partial implementations of a smart service implemented within memory. Software-defined platforms will require trustworthy technologies for the efficient and effective implementation of policy-based information processing that make it possible to formalise,

manage and verify data protection regulations, as well as enabling and, where practicable, enforcing dynamic compliance with these regulations at runtime. Future **Policy Management** will require tools for modelling domain-specific language extensions, taking account of the technical, economic and legal perspectives. Tools will also be needed for combining statistical and heuristic methods to enable automated annotation of sensitive data, automated policy compliance evaluation and the identification and clarification of infringements.

⇨ Chapter 3.3 and Chapter 5

Introduction of semantic modelling and making it suitable for everyday use

In order to make semantic methods and tools suitable for everyday use by service providers, developers and operators in the Smart Service Welt, it will be especially important to investigate and establish the right balance between a comprehensive **Semantic Service Description** and the lightweight requirements of individual domains. It will also be necessary to assess whether and how it might be possible to automate or semi-automate the formulation and updating of certain facets of service descriptions. The complexity of the semantic processing should remain hidden from the user, with suitably simple, robust and intuitive access being provided via a smart user interface. As far as **Service Orchestration** is concerned, there is a need for further development of infrastructure and tools in order to support the provider at all levels of digital and physical services, from the abstract process level right up to human providers of physical services. Specific infrastructure measures include e.g. self-learning processes that enable orchestration to be more highly automated or auto-regression tests of (orchestrated) service interfaces in order to guarantee smooth operation (service automation). **Complex Event Processing** techniques can also be employed, but will need to be augmented with semantic technologies, using Case-Based Reasoning, for example.

Model Management and Visualisation for Dual Realities makes it possible to display the virtualisation of the current environment. Dual reality links with the physical environment allow contextual changes to be detected by networks of sensors and actuators and communicated to the virtual model so that it can be synchronised with the real-world environment. The key research priorities in this area include further development of simulation behaviour in combinations of real and virtual worlds through targeted control and specification of the input and output parameters of smart services, as well as the situation- and task-dependent pre-processing and displaying of information captured from the environment via smart services. Further research is also needed into how to guarantee consistency and data quality when synchronising the models with reality.

Personalised interaction and user-centred assistance

The design of **Adaptive User Interfaces** is key to the acceptance of smart services. Achieving user-friendliness and intuitive use e.g. of the smart work clothes, smart watches and smart glasses that form part of the wearables megatrend poses specific design challenges in terms of displaying and interacting with information. If a tradesman's smart glasses were able to provide an on-demand digital display of all the relevant steps for performing a particular task, then any tradesman could in principle fix any household appliance. New and additional sensors such as pedometers allow wearables to provide extra activity feedback as well as enabling hands free operations such as automatic logging of individual work steps. Home carers, for instance, will be able to automatically log billable services using sensors that are built into their work clothes, avoiding the need for time-consuming activity documentation. Over the next few years, traditional mobile platforms such as smartphones and tablets will be significantly augmented and in some cases completely replaced by wearables in the Smart Service Welt. Further research is required in connection with the orchestration of the sensor sources to produce a context-adaptive, personalised value-added service, in order to ensure that privacy aspects in different application domains are taken into account, for example. This will require the development of appropriate models and tools. It will also be necessary to continue researching and improving activity recognition using a

larger number of highly diverse input channels, as well as the embedding of these channels into smart environments. Moreover, interaction designs and metaphors for adaptive user interfaces for wearables and their use will also need to be developed. Customised software-defined services are reliant on information about the user, which they combine with new data (e.g. sensor data) in order to generate models about the user's goals, preferences and attitudes that go far beyond traditional CRM techniques. **Ubiquitous User Modelling** provides the central source of knowledge for both institutions and end customers. In the context of the Smart Service Welt's disruptive new user models, the challenge of guaranteeing secure storage and transmission of personal and institutional data are particularly acute. Services can receive data from different user models and input new data into them. Ontologies are used to represent this data semantically, so that the user modelling service itself can also make inferences that can then be shared with other services. Ubiquitous user modelling provides end users and institutions with control over their own user model. A glass box or black box approach is employed depending on the type of data. The glass box approach offers full control over the data and inferences, whereas the black box approach comes in when it is necessary to

Table 2: Differences between software-defined platforms and service platforms

Criteria	Software-defined platform SWD-P	Service platform SRV-P
Abstraction level	• technically oriented • processing-oriented	• business-oriented • service delivery-oriented
Dependencies	• dependent on the underlying networked physical platform	• not dependent on the physical platform • dependent on the software-defined platform
Target group	• service platform and hardware providers, application developers	• service providers, intermediaries and end users
Interfaces	• with underlying physical platform via programming interfaces • with overarching smart services via semantic service descriptions • with the service provider via multimodal interfaces • domain-neutral	• with the end user via inheritance of the SWD-P • with the service provider via SDK • with the end user via multiadaptive HCI • domain-specific
Requirements	• end-to-end virtualisation • concrete service orchestration • service semantics • mobility support • security, robustness, reliability • scalability & performance (incl. for big data with real-time processing)	• contextualised, adaptive service engineering • abstract service orchestration and choreography (mash-up) • service automation • efficient service monitoring • Web and cloud capability
Required level of expertise (design time)	• technological expertise • integration expertise	• process knowledge, operational processes • business models, organisational structure

guarantee compliance with legal regulations pertaining to the data. When managing user profiles, it is necessary to make sure that inferences are disaggregated (to prevent their traceability). This will require the development of appropriate monitoring techniques with adaptive user interfaces that make them easy to access, control and adapt. Typical assistance tasks in the Smart Service Welt include forecasting and decision-making support. In today's service sector, typical machine learning applications include e.g. condition monitoring, failure prediction, **Self-learning Decision Support** and self-learning control (reinforcement learning). Whilst increasing quantities of sensor data undoubtedly open up all kinds of possibilities, the growing volume of data also poses new challenges. The trend towards personalised decisions is becoming increasingly important. In the medical context, this translates into personalised and precision medicine. However, personalised decisions are also set to take on a greater role in the service context. Importantly, decisions will now take the entire context into account rather than being based on just a few factors. This approach is beyond the capacity of human operators and current technological solutions. It requires decisions to be based on complex patterns, with observed decisions and complex contexts forming the basis of decision learning. In the field of self-learning decision support, there is a need for further research with regard to the development of models, methods and tools for analysing the data in complex, real-world environments. It will also be necessary to develop intelligent user interfaces that allow simple problem definition and solving by non-experts.

Differences between software-defined platforms and service platforms

Table 2 uses specific criteria to present an overview of the defining characteristics of software-defined platforms. These are contrasted with the key features of service platforms, allowing a clear distinction to be drawn between the two layers.

3.2 Service platforms: the business integration layer

Business models on service platforms

The establishment of service platforms in digital ecosystems opens up a variety of new opportunities for **innovative business models**. In the consumer services sector, the disruptive impact of digital technology has fundamentally transformed entire industries. Established companies have been forced to adapt their business models, while new businesses have achieved market success by providing innovative solutions. Companies like Amazon and Google have created service platforms through which they provide a wide variety of services. However, it is not essential for a company to run its own service platform in order to take advantage of the potential they can offer its business. Even using someone else's service platform opens up huge opportunities to provide new services, tap into new markets and reach a wide target group. As demonstrated by the examples mentioned above, even small and medium-sized enterprises can unlock new markets by positioning themselves e.g. as providers of knowledge-intensive services. Service platforms can thus act as multipliers for the range of services a company provides. There is a fundamental distinction between business models that are merely based on the use of service platforms and those that are based on operating them.

The provision of digitally enhanced services is at the core of the business models that **make use of service platforms**. Potential innovations can include the development of new, data-based services, service bundling, the incorporation of new partners and new, more efficient service delivery methods.

Actors can independently provide individual **data-based services** such as data analysis or failure prediction models, use them to enhance existing services or establish themselves as integrators. Integrators provide **service bundles**, e.g. repairs, transport, medical treatments or insurance that are digitally enhanced using smart services and delivered through a network. This allows the user's implicit requirements to be identified and served.

The opportunities offered by the **incorporation of new partners** are not confined to the provision of integrated services. Examples such as the much-discussed mobility providers Uber and Doc2Doc illustrate what can be achieved by integrating communities in order to increase the range of services a business can provide. A company's need to build and maintain its own comprehensive range of services can be reduced by bringing in the community as and when required. The incorporation of new partners with know-how from different industries can lead to new solutions. There is further potential for innovation at the process level. Smart services can be used to **automate process steps and enrich them with information**. This allows faster service delivery that is tailored to the user's individual needs. It is essential to ensure that the necessary data can be easily accessed and is available in the required quality.

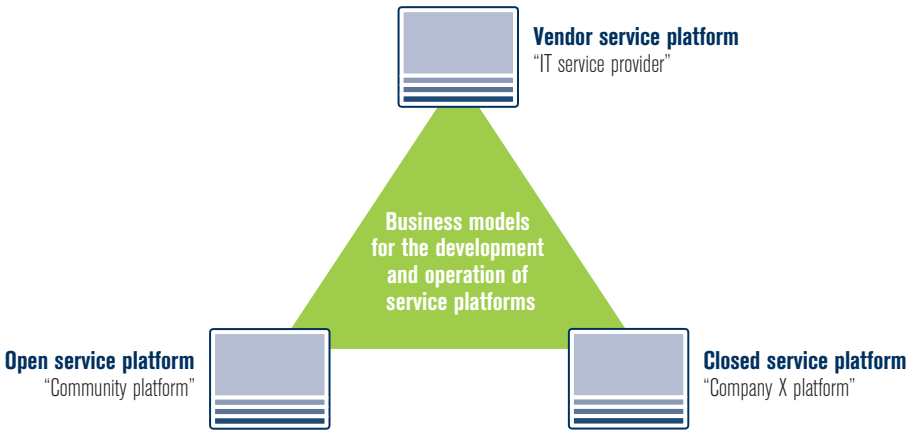
As far as **service platform operator models** are concerned, a distinction can be drawn between the operation of only the infrastructure, i.e. the technical hosting side, and the operation of the service platform at an organisational level. In the former, the availability and use of a technological infrastructure lies at the heart of the value proposition, whereas the latter involves the provision of business functions that can be employed by the digital ecosystem's actors to build their own services. The value proposition thus goes beyond merely providing the technology and includes e.g. the provision of access to individual smart services and the use of pre-defined generic and specific enablers.

Chapter 3.1

A variety of different **billing models** may be employed depending on the business context. Charging for data-driven business models may be based on transactional billing, a fixed price for individual services or a flat rate for the use of service platform functions and access to data. Other flexible pricing models will become established that reflect the value-added provided to the user and the relationship between supply and demand, together with marketplace mechanisms for trading goods, services and data. In addition to traditional monetisation methods, new trading models based on fungible assets will emerge, e.g. for trading production capacity, access to transport or participation in knowledge building. Within communities, for example, it will also be possible to use virtual currencies based e.g. on the amount of data and information that participants contribute and use, as well as digital currencies.

The nature of the service platforms themselves is closely linked to the business models in the digital ecosystems built upon them. Three fundamental types of service platform can be identified based on the associated operator and business models (see Figure 12):

Figure 12:
Service platform business models



Source: Siemens, Saarland University, FIR/WZL/IPT RWTH Aachen University

Individual companies who build closed platforms. The company creates the platform and is responsible for running it at both the technical and organisational levels. It is up to the company whether or not it decides to involve any other partners. Alternatively, **a third party such as an IT service provider can build service platforms**. The third party vendor is responsible for building and potentially also operating the technological infrastructure. However, the operation of the platform remains in the hands of the company buying the third party's services and is executed along the same lines as in the closed service platform model. The key difference lies in the respective business models. The IT service provider makes its money from building the platform, not from operating it. **Open service platforms** are open to the participation of other actors. They simply provide a core of basic technology and functions that can be used by various different actors and expanded with additional functions.

The Hubject service platform: A Europe-wide electric mobility ecosystem

The charging infrastructure operator models that emerged during the pre-market phase for electric mobility (that began in 2009) were predominantly standalone proprietary solutions. As a result, there is still no inter-regional charging infrastructure network capable of supporting comprehensive, customer-centric business models. Suppliers in the electric mobility market are faced with the challenge of enabling interoperability between existing charging stations by connecting the different charging station management systems to each other.

Since 2012, Hubject GmbH has been operating as a neutral intermediary in order to develop a cross-sectorial service platform (known as the "eRoaming-Plattform") for connecting charging infrastructure and mobility service providers throughout Europe. Hubject is a joint venture between the BMW Group, Bosch, Daimler, EnBW, RWE and Siemens.

Its goal is to facilitate and grow the business models of the companies connected to the platform using a standard contractual framework and a single technical interface. Charging stations connected to the platform carry the "Intercharge" compatibility logo which serves to build customer confidence in public charging stations' ability to provide customer-friendly access. Minimum technical and commercial standards ensure that the participating mobility providers and charging station operators are connected to each other simply and efficiently. In addition, the initiative has developed an open IT interface protocol known as the "Open InterCharge Protocol" (OICP), that has been available free of charge to the relevant market players since March 2013 and facilitates the technical connection of different IT systems to each other. The ecosystem's actors use the protocol and Hubject service platform to provide each other with services such as electric vehicle charging billing information and point of interest information (POI) about the participating charging stations.

The Hubject initiative serves to demonstrate the principles of efficient networking in the smart mobility context as well as the requirements for M2M networking via service platforms, an approach that could also be used to network different actors e.g. in vehicle-to-grid, smart grid, local public transport and car-sharing business models. Since Hubject was launched, a constant stream of partners from across Europe have been signing up to the platform, although the fact that the company is a consortium of six major German enterprises did cause some unease in other European countries, particularly during the initiative's early stages. The target group of the burgeoning ecosystem is not restricted to the major energy companies and OEMs but also includes medium-sized enterprises and start-ups in the IT, automotive and energy industries. During the rollout

of the platform, Hubject soon learned that providing a neutral, generic service platform is one of the key success factors for connecting very different actors to each other. The business and pricing models established by the partners through the platform are not influenced by the platform solutions or hampered by competing services. Instead, connecting different business models to each other simultaneously creates more competitive pressure, meaning that the relationship between the actors in the ecosystem is characterised by "coopetition", i.e. a mix of cooperation and competition. The ecosystem contains more than 130 partners, including startups such as Plugsurfing and Ubitricity, regional providers such as Stadtwerke Leipzig and automotive manufacturers such as BMW. Over the course of the past three years, it has enabled the Berlin-based joint venture to raise awareness and win over hearts and minds with regard to issues such as efficiency, data protection and data security in the field of electric mobility.
Since it was established, Hubject has been able to actively promote the efficient networking of a wide variety of actors via a service platform. It has done this by engaging in a dialogue, particularly with stakeholders such as Germany's National Electric Mobility Platform (NPE), but also with the international eMI³ organisation and through international cooperation with partners from the automotive, energy, technology and mobile communications industries.

Uses and potential of service platforms

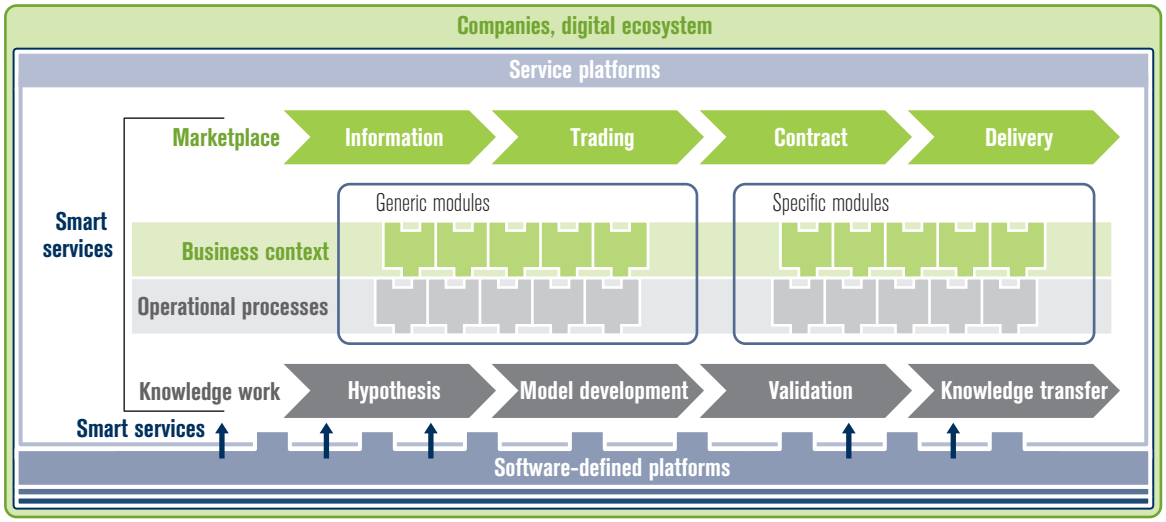
Service platforms underpin digital ecosystems and represent their business systems. They create the conditions for Web-based business models where digital and physical services are combined dynamically to produce smart services. They provide the IT platform for the development and implementation of the smart services that are built upon them, as well as stipulating the framework (rules, standards, processes and interfaces) that makes it possible for standalone, intangible services to be configured, traded and delivered via the platform. Whereas the software-defined platform layer collects and integrates data before consolidating it into information, service platforms represent the business model. The interface between the two layers takes the form of services that are used at the service platform level to configure and optimise services and to foster knowledge building by using data.

Uses of service platforms

Service platforms can be categorised based on what they are used for. Their uses range from the establishment of digital marketplaces – where the focus is on trading tangible and intangible goods – to platforms aimed at facilitating knowledge work. The boundary between these two categories is fluid and various hybrid forms may be established in the future.
Chapter 2

In the service platform-based **marketplaces** that are emerging recently, the focus is on trading goods. Depending on the service platform in question, the goods being traded may include tangible goods (spare parts, hardware, etc.), services (maintenance, repairs, etc.), capacity (additional staffing, transport, or manufacturing capacity, etc.), as well as both data (technology data, user data, operator data, etc.) and software (diagnostic tools, apps, algorithms, etc.). Fungibility is a key requirement, especially for trading intangible goods. Fungible assets are categorised by the class of asset to which they belong rather than individually,

Abbildung 13:
Service platform modules



Source: FIR/WZL/IPT RWTH Aachen University/Saarland University

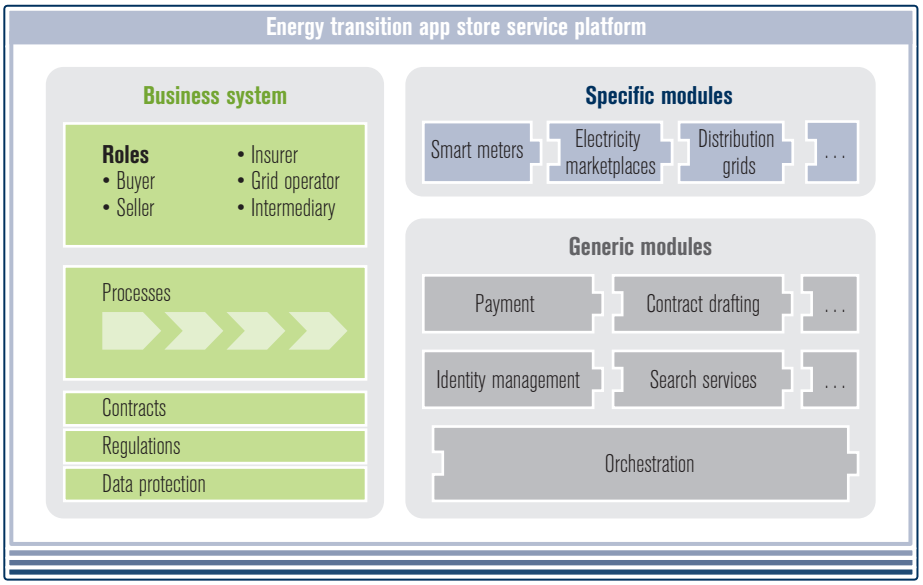
meaning that they can be substituted by an identical quantity of other assets of the same class. Fungibility is underpinned by model-based approaches where the focus is on models as opposed to physical objects. By using data-driven evaluation, analysis and decision-making processes, these models can gradually be optimised or even optimise themselves over the course of time. In use, a key factor is the employment of data-based services that make it simpler to search for the right services to meet the customer's needs and configure these services based on the user's context. When employing such models, it is important to ensure efficient and targeted service delivery that takes account of changing circumstances.

In **collaboration platforms**, the focus is on interdisciplinary, cross-functional and cross-company cooperation. The principal goal is to generate, use and share knowledge by facilitating exchanges between individuals and organisations. (Field) data can be used to build knowledge by developing and validating or refuting new hypotheses about cause and effect relationships. Data-based descriptions of particular situations enable new patterns to be identified, for example regarding failure behaviour in manufacturing systems or how best to target the deployment of fertiliser on farmland. The knowledge acquired in this way adds to current theories and can be fed directly into existing services and learning materials for the development and use of knowledge. Collaboration platforms provide a variety of means for building and managing communities, e.g. for open innovation and crowdfunding initiatives, expert networks or customer service.

Knowledge marketplaces are a hybrid form of the two service platform types described above. Collaboration between several different organisations – e.g. departments, companies, etc. – allows knowledge to be built up, exchanged and traded. One potential application scenario involves cross-company benchmarking where data-based comparisons of the performance of individual processes or organisations are carried out with the aim of identifying and sharing best practices. One way that companies might pay for this service is by making their own data available to it.

The use of service platforms promises a number of **potential benefits**. In the future, value creation in digital ecosystems will increasingly occur in value networks instead of traditional value chains. Service platforms will

Figure 14:
Example of a service platform architecture framework for an energy transition app store



Source: FIR/WZL/IPT RWTH Aachen University/Saarland University

enable ad-hoc configuration and orchestration of the value networks needed to facilitate collaborative service delivery. In addition to identifying the right partners based on quantitative and qualitative criteria, this will involve bringing in autonomous partners from anywhere in the world to contribute their own individual experience and expertise. This will afford SMEs in particular the opportunity to position themselves as specialist providers of specific components of the value-added process. Wide-ranging, cross-sectorial cooperation in a digital ecosystem thus allows the scope of what is provided by a service to be increased and tailored to users' individual needs in a targeted manner. Smart services make it possible to automatically register and take account of the contextual and environmental information that is relevant to the business system (smart data), allowing value networks to be effectively established and efficiently configured on service platforms.

The widespread availability of digitally-enabled products that generate data continuously throughout their life cycle enables data-based representation of certain aspects of reality that can provide the basis for smart services. The integration and refinement of these huge quantities of data on software-defined platforms allows the contextual and environmental information that is relevant to the business system to be automatically registered and taken into account on service platforms. Smart services can be effectively created based on the current context and can be configured efficiently by drawing on stored information about the business system.

Data-based services are used to provide details of any potential alternatives for the performance of a service, e.g. with regard to the selection of the optimal time to perform maintenance work or the route for a transport service. The real-time data generated by the digitally-enabled products that are active within the ecosystem is used to enable intelligent, situation-based and adaptive selection of the best alternative based on the currently available knowledge.

In the field of knowledge work, service platforms have considerable potential for generating new knowledge by using data to develop and validate or refute hypotheses. Real data about how products are used or how their users behave allows patterns to be identified and cause and effect relationships to be detected. Knowledge can be built up more quickly through case-based learning using the abundance of use cases that are becoming available now that there is a critical mass of digitally-enabled products.

An architecture framework for service platforms

This section will describe the architecture framework for service platforms. Service platforms are built on and implemented via software-defined platforms and networked physical platforms. In other words, the service platforms provide the "what" of a Smart Service Welt, whereas the underlying platforms and infrastructure provide the "how". Consequently, the service platform hosts the communication, business and legal structures that are realised via technical and physical services and products. Service platforms can therefore be described as the business integration layer.

The **environment** in which the ecosystem built on the service platform exists provides the overall framework or **business context**. Basic rules in the form of legislation, regulations, contracts and data protection standards create the framework for cooperation on service platforms. Business contexts that can be at least partly automated are of particular interest. Those parts that cannot be automated are performed manually through conventional administrative functions and services.

The service platform provides the organisational structure for the business context in question. Roles are assigned that determine the rights and responsibilities of the individual actors, creating a framework for trouble-free cooperation. People or smart products may perform these roles. In both instances, the role-holders are assigned rights and responsibilities with regard to the performance of services. If a role-holder's rights and responsibilities match those that are required in order to use a service, then that service may indeed be used by the role-holder. Services are accessed by role-holders within processes via defined Service Access Points. By taking contextual information into account, smart services can be adapted to meet the requirements of their current use. This requires a service engineering function on the software-defined platform that allows services to be adapted at runtime in distributed service environments. Information about the relevant business context is also taken into account when adapting a service, for example to ensure compliance with the regulatory framework of the location where the service is being delivered.

In addition to the roles that are already established today, such as manufacturers, suppliers, users and experts, the new role of the **intermediary** will also be created. Intermediaries employ data and information obtained from the use of third-party products and processes to provide new services. Intermediaries provide enablers that lie in the gaps between the value-added elements of various other actors and enable their integration into a closed value chain. As neutral intermediary he can balance the interests of different stakeholders, and creates a win-win situation everybody involved. However, intermediaries can also attempt to seize control of value-added control points so that they are the ones who ultimately write the new ground rules.

As long as it is authorised for wider use, the knowledge that intermediaries obtain from one customer relationship can be applied in the appropriate form to another customer relationship, thus contributing to global optimisation across different customers. Other functions performed by intermediaries could include quality assurance, developing new business relationships and clarifying the relevant legal requirements. The intermediary's role is not confined to a single actor – several competing intermediaries can exist within an ecosystem.

The service platform also provides the necessary **operational processes** for the business context in question. Process chains are configured from the sub-processes required to deliver the service. Smart services support the selection and configuration of the relevant process steps using process tool kits, enabling (semi) automation of individual processes.

Generic and specific service platform modules

This section describes a variety of service platform modules in order to provide a concrete illustration of the generic and specific service systems. While specific modules can only be used for a single application, generic modules can be used for several different ones. The boundary between specific and generic modules is fluid, just like the boundary between the use of service platforms as a marketplace and for knowledge work. It is therefore not necessary to distinguish between the different modules at this point. The key is to select and

where necessary adapt the relevant modules for the specific business context in question (see Figure 14).

Generic modules

Generic modules can be used for more than one business system. For example, general logistics services can be employed both for cars and for delivering parcels. However, if a service plays an important role in differentiating a business system, this service must be specifically tailored to the needs of the application. Just as with open source software, generic modules that are made available free of charge may acquire the characteristics of common property. Examples of generic modules include the following:

- **Identity and access management:** The purpose of identity management is to ensure that any actors active on the platform, be they people or objects, can be uniquely identified and assigned roles. An actor's identity will determine which role they are assigned. Provided that sufficient (background) information is available, this can be done automatically by a service. One possible approach might involve the use of tokens that are processed independently of other attributes such as personal attributes (Attribute-based Access Control, ABAC).

Access management regulates the conferral of rights to use services via the service platform. Use rights are defined based on general service platform rules, industry-specific conventions, applicable contracts and the role assigned to a given actor.

- Certification and qualification: The long tradition of certification and qualification for physical products is now being extended along similar lines to incorporate digital products.
- **Billing and payment:** This module employs a combination of usage data and the agreed payment methods to initiate the billing procedure. Depending on how the service is configured, automatic settlement of any accounts payable may also be possible through other financial services.
- **Pricing:** This module supports price setting between two or more negotiating partners. Conventional and more dynamic pricing methods may be employed.
- **Moderation and mediation:** Collaboration via service platforms requires compliance with basic communication and (data) exchange rules. As a result, a neutral moderator is needed in order to mediate any disputes.
- **Contract drafting:** This module provides general and industry-specific standard contracts as a basis for contract drafting. In addition, experts can be brought in to draft individual contracts and new standards can be generated. The structured information provided when drafting a contract can be used as a basis for other services such as pricing or billing and payment.
- **Legislation and regulation:** This module contains the statutory and regulatory frameworks that need to be taken into account when trading goods or engaging in knowledge work (e.g. contract and antitrust law and questions relating to liability and professional associations). Depending on their complexity, some areas such as contract law may lend themselves to standard automation.
- **Orchestration and choreography services:** The service infrastructure's orchestration and choreography services play a key role by supporting the dynamic adaptation of smart service systems to the changing conditions of the business context and the organisational structure and operational processes. In order to support the vision of the Smart Service Welt, these infrastructure services must be specified as non-proprietary services.
- **Incentivisation and incentive systems:** As a rule, experts are only prepared to come on board and share their knowledge because they have calculated that it is in their own interest to do so. Intrinsic motives are not the main reason why employees, colleagues or friends give away information and share their proprietary knowledge. Instead, the motivations for participating in platforms and sharing knowledge on them are reciprocity, improved status, financial reward, the hope of future successes, etc. As a result, a knowledge market needs to provide an incentive system and ensure targeted incentivisation of the people whose

knowledge constitutes the market's life blood. In order to create an attractive platform it is necessary to employ approaches ranging from simple rankings and contribution ratings to awarding privileges such as exclusive access to certain knowledge sources.

- **Project management:** Project management supports cooperative project development and implementation. The focus is on in-house and cross-organisation coordination of resources and functions within the team or community.
- **Communication:** A communication service is indispensable in order to enable the platform visitors, members and moderators to speak to each other. New knowledge can only be generated by exchanging information and existing knowledge. It is important to distinguish between synchronous communication (e.g. chats or instant messaging solutions) and asynchronous communication (e-mail, blogs, etc.).
- **App store:** The app store provides access to a wide range of different apps. The platform uses smart searches to help find the right service solutions. The development of new apps is also supported.
- **Portal:** The portal acts as a personalised home page for individual users. In addition to details of upcoming events, it provides an overview of current tasks and project-related information for knowledge workers. Up-to-date, user-specific information (e.g. based on the user's behaviour or their registered/identified fields of interest) is also provided via newsfeeds or activity streams.
- **Contact management:** The contact management module manages existing contacts and identifies new ones, particularly experts who may be able to help with a specific problem. In addition, an in-/out-of-office agent helps to ensure that people are contacted promptly. Dating agency-style algorithms can be used to optimise the process of searching for and bringing together experts.
- **Shared-X** (desktop, workplace, folders, documents): Shared-X functionality enables unstructured data (especially documents) to be accessed and shared. Smart searching makes it easier to find related content.
- **Analysis and results library:** The analysis and results library stores the results of previous analyses so that they can be used again. The results library is thus an important module for knowledge management and generation.
- **Directory and search services:** Directory and search services support searching and re-searching for information. In addition to tagging and bookmarking, service platforms also support voting and ranking functions that enable quality assurance to be carried out by the community, for example. Individuals' contributions and knowledge can thus be evaluated and rated.
- **Logistics:** Logistics management supports the organisation and performance of transport services. The service helps select the right partners for the type of goods requiring transport. The execution of the transport service can be optimised e.g. by using up-to-the-minute traffic data (e.g. data about how fast traffic is moving, hold-ups, road closures and through-road restrictions).
- **Customs:** The customs module supports platform users who wish to transfer tangible and intangible goods internationally. Data about the nature and value of the goods in question is called up and analysed in terms of the applicable regulations, in order e.g. to comply with labelling regulations or calculate any customs duty that may be due.
- **Insurance:** The insurance module supports the addition of insurance services. Various possible insurance packages are pre-configured based on the underlying business context and added either manually or automatically, depending on the user, in order to provide insurance for transactions, for example.
- **Notary services:** This module supports the certification of all types of legal transactions. It is activated whenever a transaction needs to be certified by a notary. It is important to guarantee the independence of the organisation or individual responsible for this module.

Specific modules

In contrast to the generic modules, specific modules can only be used in a specific field of application. This

is because they facilitate the specific requirements of a particular sector, meaning that they can only be used in other fields of application if they are substantially modified. Examples of specific modules include:

- **Process toolkit:** The process toolkit provides reference processes. These may involve industry-specific business processes, but may also only contain best practices. The goal of the toolkit is to make it as quick and simple as possible to configure value networks at the operational process level, ideally using a drag and drop function. Furthermore, the pre-defined processes contained in the toolkit can provide a starting point for creating new smart services.
- **Data analysis:** The data analysis module uses data to enable detailed analysis of specific situations. The user receives service-based support with data preparation and integration. The data analysis is based on a range of analysis techniques and algorithms. Users can choose to have the results displayed via a variety of preset output and display formats. As well as static data analysis, support is also provided for the analysis and evaluation of continuous data streams.
- **KPI suite:** The KPI suite consolidates data into key performance indicators and displays the results. It does this by drawing on existing models and KPI systems. New data, e.g. with regard to default values or cause and effect relationships, can be automatically adapted by the system.
- **Model builder:** The model builder supports the construction, parameterisation and validation of models. This allows hypotheses e.g. with regard to cause and effect relationships to be tested and validated or refuted. In addition, models support decision-making by providing representations of real situations, allowing different alternative scenarios to be assessed.

The application viewpoint on platforms

This section will use the example of condition monitoring and health information and forecasting for manufacturing equipment as described in the use case "Smart Production Services I" to illustrate the basic applications of the software-defined platforms described in Chapter 3.1 and the service platforms described in Chapter 3.2.

In this example, the smart product is a large drive of the type used in opencast mines, rolling mills or cement mills. The large drive is to be monitored in order to enable early detection of any damage to its bearings so that preventive maintenance work can be undertaken, thus minimising any disruptions to production. To this end, different types of information about the drive's condition are continuously monitored, e.g. load profile, temperature, vibrations, etc.

In order to generate the **smart data** required for this application using the software-defined platform, it would be possible, for example, to use the "Big Data Mining & Streaming Analytics" generic enabler for performing the basic data analysis, the "Data Analysis for Optimised Systems Use" architectural pattern for diagnostics and forecasting and the "Asset Management" service bundle for managing the drive's data over the course of its service life. The "Plug & Automate" architectural pattern can be used to integrate information from the drive with the relevant IT systems. In addition, the "Secure Identity Management" architectural pattern would be a suitable means of managing different parties' access rights to the various types of information about the drive.

Programming work is carried out in order to encapsulate the generic enablers, architectural patterns and service bundles described in this example in the form of **smart services**.

Specific modules are then realised at the service platform level. In this example, the specific modules in question are the "Data Analysis" module for analysing the content of the drive's data, the "KPI Suite" module for processing and displaying the results, and the "Model Builder" module for the construction, parameterisation and validation of the drive's specific diagnostics and forecasting model. These specific modules would need to be configured.

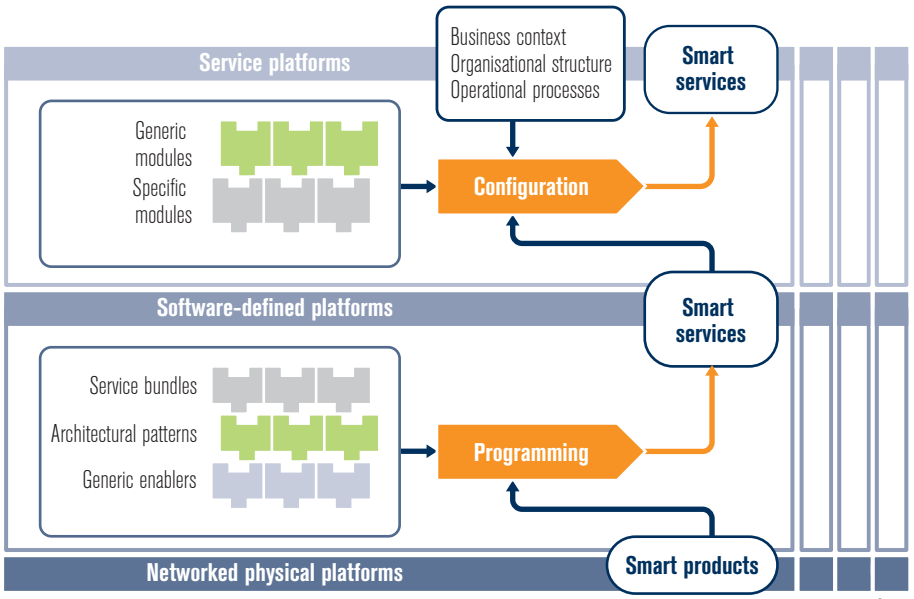
In addition to the specific service platform modules referred to above, this application would also require the generic modules "Identity and Access Management", "Billing and Payment", "Pricing" and "Contract Drafting". In a **configuration step**, the following actions are performed by connecting the smart services:

- Configuration of the "Access Management" generic module based on the business context, organisational structure and operational processes. This automatically ensures that access is only possible for the intended business context.
- Configuration of the "Billing and Payment" and "Contract Drafting" generic modules based on the business context, organisational structure and operational processes in order to enable automated billing and payment based on the registered contractual data.
- Construction of an (initial) model for the "Pricing" generic module and the "Data Analysis" and "KPI Suite" specific modules using the "Model Builder" generic module. This enables data analysis, data preparation and price-setting to be automated.

Once this has been done, **smart services** can be provided and used for the business context in this example, i.e. "Condition Monitoring and Health Information and Forecasting for Large Drives". In other words,

specific data analyses can now be performed for the large drive, the corresponding KPI suites can be produced and the services that have been delivered/used can be invoiced and paid for.
The diagnostics and forecasting model for the large drive may be refined and developed during operation of the smart services. This requires the appropriate reconfiguration of the service platform's generic and specific modules and will also usually necessitate some reprogramming of the smart services with the aid of the software-defined platform's generic enablers, architectural patterns and service bundles.

Figure 15:
Digital infrastructure engineering



Source: Siemens 2014

3.3 Security strategies for the Smart Service Welt

The Smart Service Welt requires complex networking of numerous decentralised components via the Internet. These exchange large quantities of data, including some sensitive user data – it is not possible to provide a smart service that is tailored to an individual customer's wishes, preferences and current knowledge without having access to information about that customer. Privacy protection, IT security and data protection are therefore key to the success of the Smart Service Welt.
⊃ Chapter 5

The Smart Service Welt poses new challenges for data protection, data security and IT security. In a variety of ways, service providers connect services and products that form part of the critical infrastructure to other IT systems via the Internet. Since this occurs without the infrastructure operators having any meaningful influence over or knowledge of what they are doing, the result is a critical infrastructure "as full of holes as a Swiss cheese". There is thus a need for a seamless, end-to-end security architecture covering all four layers of the layer model. From the transport layer provided by the technological infrastructure to the networked physical platforms, software-defined platforms and service platforms, there can be no security vulnerabilities for potential attackers to exploit in the Smart Service Welt. A vulnerability in any one of the layers would corrupt the entire service, causing the end customer to lose their all-important confidence in the service proposition. In the Smart Service Welt, it is therefore essential to ensure comprehensive security management with proactive protection mechanisms for everything from hardware, firmware and software to mobile communications and cloud services. Endpoint security is no longer enough on its own in the Smart Service Welt. Security strategies for the Smart Service Welt must place particular emphasis on the software-defined platform and service platform levels. Both layers have interfaces with external users of the services they provide. In the case of software-defined platforms, these external users are generally service platform operators, whereas for service platforms they are the end customers. In order to avoid jeopardising personal data protection when carrying out the necessary user modelling, it will be necessary to create new privacy protection models that use new, flexible protection profiles in order to juggle the requirements of both informational self-determination and individual service profiles.

Partly due to the country's history, many people in Germany are especially sensitive about the possibility of their data being misused. The business community also has high expectations with regard to IT security, data protection, cyber sovereignty and risk prevention. Coupled with the reliability and safety-consciousness of German engineering, this particularly cautious attitude can underpin the development of a new generation of high-quality IT security solutions for the demanding German market. This would provide German-made smart services with a unique selling point that would make these security solutions sought-after global exports, enabling Germany to become a leading supplier.

Trust and security

Trustworthy and secure platforms are of fundamental importance to the establishment of digital ecosystems. Although, like any other technological system, Smart Service Welt applications can never guarantee absolute security, they can nonetheless attain a very high level of security. While there is nothing new about this situation, the IT industry has tended to lack transparency in communicating it. Many IT security providers (e.g. of firewalls and antivirus software) have claimed that their solutions can provide customers' IT systems and services with "100% security". Service providers are also often happy to paint this overly optimistic picture of IT security because they do not wish to scare their customers. We know, however, that these claims are unrealistic, not least because of the continually changing nature of the attacks. The paradigm of relative safety that comes at a price – albeit a price worth paying – has already been established for many years in other industries such as the machine and plant engineering sector. This is in part due to the fact that high standards are often a statutory requirement. There is an acceptance that relative safety standards

can be evaluated in a largely objective manner. The same applies to security in the ICT industry – it is necessary to accept that there are many areas where it is only realistically possible to achieve relative security. The open, relative safety standards based on objective criteria that are used by other industries could serve as a model in this regard.

In view of the rapidly changing context, new and **proactive security systems** are required. These are already being developed by researchers but have yet to be implemented in practice. The heterogeneous nature of the different virtualised systems that come together on software-defined platforms makes them more vulnerable than traditional Web applications. As a result, they require new technologies and trust models. New trust models are also needed for service platforms.

However, developments should not be confined solely to the technical aspects. Swift action is also needed to include the organisational structures of the future Smart Service Welt. The relevant technologies such as secure smart meters – some of them German-built – already exist today. But many users have not yet grasped the seriousness of security. There is little point in security strategies that prevent data from being accessed directly on the technological side, for example, if there are workarounds that allow the same data to be acquired illicitly e.g. through the cloud. One key challenge will therefore be to raise awareness both of new security threats and of existing security solutions.

People will only keep carrying out attacks if it pays them to do so. In addition to developing the relevant security technologies, one pragmatic approach would therefore be to make the transaction costs for attackers high enough to deter them from carrying out cyber-attacks even if it is still technically possible for them to do so. Research into the business and economic aspects of organised cybercrime is still in its infancy. However, a knowledge of these aspects is key to the establishment of permanent deterrents in the Smart Service Welt. Cyber-attacks can be effectively reduced by negating the "business models" behind them and in particular the profitability of the stolen data.

A smart service's **security** is dependent on numerous aspects throughout the long chain of user end systems. A variety of different components are orchestrated to create smart services while each component entails its own security risks. Existing IT security technologies are often still not widely used because many businesses continue to believe that the costs resulting from a cyber-attack are likely to be lower than the investment required to prevent one. The first step must therefore be to create a **culture of security** in the market. A high level of overall security throughout the market can only be achieved by ensuring the security of all the links in the chain, all the service components and the entire hardware and software life cycles. After all, if one of a product's smart components is tampered with at the manufacturing stage, this could subsequently make the whole product vulnerable to attack during use, potentially compromising entire infrastructures and digital ecosystems. In terms of the manufacture of smart products in the context of Industrie 4.0, this means that it will, for example, be necessary to drive efforts to deliver integrated IT security throughout the product life cycle.

Smart service solutions are reliant on the cloud computing infrastructure. There is an urgent need for certification in this area, especially for backdoor-free solutions. The first few initiatives have already started to appear, ranging from self-declaration and voluntary commitments to the "IT security made in Germany" quality mark and the relevant certification authorities. While this could provide a competitive advantage in the EU context, the US market still has a requirement to build in backdoors. Current initiatives that only certify trusted cloud services once every two to three years are not enough in the face of a constantly changing environment. Instead, the aim should be to make it possible for the different actors to test the cloud system's functionality and security on demand, whenever they like. To this end, it will be necessary to differentiate between those security criteria that can be automatically accessed and those that cannot. It will also be necessary to define the minimum technical specifications that must be met in order to comply with the relevant security criteria. Dynamic (automated) certification could be supported through a "certificate-

ready" approach where the relevant extension interfaces are integrated into the generic enablers at the design stage. The financial services sector deals with similar issues already and directs intensive efforts with regard. The "Trusted Cloud" technology programme of the Federal Ministry for Economic Affairs and Energy (BMWi) addresses the question of how to (re-) establish trust in cloud services, particularly among SMEs. This issue, which is of fundamental importance to the Smart Service Welt, also involves questions relating to the security and protection of business secrets and legal compliance.

Established methods can be employed to identify many security issues at the earliest stages of product and service development so that they can be addressed by design. All too often, however, it is not until failings in security functionality start to threaten a provider's business model that they finally make the necessary investment in IT security. Moreover, there are some types of misuse that cannot be identified and prevented until the product is actually in use. It is important to understand that although security should be incorporated by design, it is not a static property that will remain forever unchanged after the point at which a product or service is delivered. Accordingly, dynamic update points should also be incorporated by design in order to enable automated updating of all system components at any time. This is a challenge that has yet to be solved, especially at the level of the technological infrastructure and networked physical platforms.
The smart service infrastructure's connected modular structure means that not all of the security mechanisms need necessarily be implemented at the level where the security vulnerability exists or where the misuse is occurring. It is, for example, extremely costly to implement comprehensive authorisation mechanisms at the level of the technological infrastructure or networked physical platforms. Instead, the management and verification of access rights can be delegated to the software-defined platform level where it can be implemented much more easily. Close cooperation between the different platform levels with regard to security mechanism implementation can help to deliver a cost-effective and user-friendly overall solution.

Trust, which is built on the security of the digital platforms, is another aspect that will be key to the establishment of digital ecosystems in the Smart Service Welt. It is not just the technical properties of smart products and services that should possess a high and verifiable level of security – the systems used to search for, select and rate them must also be trustworthy. For example, it is necessary to ensure that advertisers or other commercial interests cannot fake the user ratings given on online platforms. Specific smart services should therefore be developed to provide reputation systems for service certification.

Trustworthiness and security must be constantly reviewed as circumstances change. It may be possible to help build users' trust in the individual platform components of the Smart Service Welt through appropriate **adaptive trust testing and management**. This approach uses a trust model to simulate and test security attacks, providing a kind of **"stress test" for smart service ecosystems**. This type of stress testing not only serves to objectively measure the trustworthiness of specific system components but also heightens awareness of the fact that it really does pay to invest in IT security and trustworthiness. Just as in any other part of the economy, trust management is a requirement for doing business for any length of time in an open market. Trust service providers such as SCHUFA already provide established trust models in the analogue world. Similar models could be implemented in the digital world. While trust does make it easier to do business, it cannot guarantee 100% secure identities. Trust service providers could take on a new role in the Smart Service Welt by assessing whether or not identities are genuine and monitoring them to ensure that communication with them is secure.
In Germany, business processes in the analogue world are underpinned by a sound and reliable legal basis where the rules governing the behaviour of natural and legal persons are clearly defined. The establishment of the Smart Service Welt will be facilitated if these established identities can be successfully carried across to the digital world. However, as well as people and institutions, the components of the Smart Service Welt will also need identities that can be verified and authenticated. One solution could

be to employ hardware modules, such as those known from bank and access cards. They contain secure elements that can be used by several different security token issuers at the same time. In order to noticeable increase the user's ability to control his identities and transactions, and to build confidence, solutions for authentification and identity wallets can make use of these hardware moduls. KIARA is an advanced middleware for the Internet of Things, Data and Services that has already been developed as part of the EU's FIWARE-PPP. In addition to performance, it also focuses on the reliable implementation of pre-defined security policies based on requirements and guarantees. However, futureproof identity management mechanisms will also need to be developed for other real-time applications.

"Resilience by design": a new security paradigm

Given the inevitable relativity of security, it is important to ensure that at least the critical parts of the IT infrastructure are designed to be resilient as well as secure. **Resilience** research distinguishes between four fundamental phases: protection (i.e. conventional IT security), detection of successful attacks (using Intrusion Detection Systems, IDS), stopgap measures (i.e. emergency or stopgap operation and, if necessary, isolation of the affected parts of the network) and healing (i.e. neutralising the intruder, rectifying the relevant security vulnerabilities and returning the system to normal operation). A dynamic "by design" approach is even more important for resilience than it is for conventional IT security. One important aspect of resilience in the stopgap measures phase, for instance, is the implementation of "diverse redundancy" whereby the stopgap functionality must operate in a fundamentally different manner. This contrasts with purely structural redundancy, where there is an extremely high risk of the same attack pattern also being used to attack the stopgap network. In addition, new approaches are required in order to improve attack detection systems. Firstly, there should be a greater focus on detecting attacks that have already succeeded rather than solely on ones that have not yet occurred. And secondly, significant advances in distributed IDS systems are required, since cyber-attacks are sometimes carried out via botnets that have commandeered millions of computers all over the world.

Security versus privacy?

It is necessary to forge a public consensus in order to dissipate the tension that exists between IT security and privacy – while there can be no privacy without security, comprehensive security can compromise the protection of private data. European regulations such as the right to informational self-determination, data minimisation and anonymisation impose serious limitations on big data analysis, for example. These questions must also be addressed and solved by engaging in a broad dialogue with the public. A further complication is that privacy cannot be assessed using a linear approach. In other words, merging two data sets that are in themselves only moderately critical can nonetheless create a combined data set that is highly critical. It should be up to smart service users to decide for themselves who should have access to their use data. This ensures that they have sovereignty over their data, but means that they will often have to weigh up the potential risks of the smart services against their direct and indirect benefits. For instance, the value-added of a digital mapping service that promises to provide an extremely detailed picture of the current traffic situation is entirely dependent on large numbers of users allowing their current location to be tracked.

To ensure that users are empowered to decide which smart services they are willing to sacrifice their privacy for, it is essential to provide transparency regarding how their data will be used, as well as to raise awareness of the value of privacy. Usability is key to creating the transparency needed in order to find a balance between privacy and security, enabling "security through clarity". It might be possible to put this principle into practice by reducing the complexity of smart services, keeping interfaces lean and simple and ensuring clear system modularisation. Pre-defined security setting profiles could also help to reduce complexity.

At CeBIT 2015, the Federal Ministry of Education and Research (BMBF) launched the first edition of a special prize for "Usable Security and Privacy" that recognises particularly user-friendly security and privacy solutions for IT systems. The Smart Service Welt has a particular need for solutions that are suitable for everyday use by end users who are not IT experts. These

solutions should be easy to use and easy to understand with a minimum of effort on behalf of the user. Even if these measures cannot guarantee the highest possible level of security, they nonetheless serve to increase the relative security of mass market applications if high numbers of users make use of the security mechanisms in question (e.g. automatic message encryption that requires no action on behalf of the user). It will be necessary to incorporate research findings from the fields of cognitive science and the sociological study of different media in order to develop smart user interfaces and user-friendly security and privacy solutions. Accordingly, the BMBF has also established the forum "Privatheit und selbstbestimmtes Leben in der digitalen Welt" (Privacy and Self-Determination in the Digital World). This interdisciplinary platform will develop new strategies and solutions for guaranteeing privacy and informational self-determination. The forum is working towards a contemporary, interdisciplinary understanding of the role of privacy using a mix of technical, legal, economic, humanities and sociological approaches.

The ideas competition "Forgetting on the Internet" that was jointly organised by the Federal Ministry of the Interior and acatech stimulated a broad discussion of the pros and cons of the unlimited and irrevocable availability of information in the digital age. The competition, which concluded in May 2012, provided digital natives with the opportunity to outline numerous innovative solutions in the three categories of "heightening awareness", "methods and rules for handling data" and "the technology of forgetting". These solutions are also extremely relevant to the Smart Service Welt. Following on from this competition, acatech carried out a project on Internet privacy that showed how in order to create security and trust on the Internet it is necessary for technology, the regulatory framework and the public to work in concert.

The three BMBF-funded security competence centres CISPA (Saarbrücken), EC Spride (Darmstadt) and KASTEL (Karlsruhe) are developing long-term IT security strategies and carrying out the corresponding research projects in order to find solutions to current and future challenges. However, the fight against cybercrime will remain an ongoing challenge in the Smart Service Welt and research and competence centres and traditional cybercrime authorities will not be enough on their own to win this battle. The establishment of special agencies acting as operational security centres would constitute an important first step in the right direction. These would use the latest research findings to actively avert attacks on the nation's critical infrastructure and economy and bring cybercriminals to justice. Germany should develop efficient, civilian cyber-attack monitoring and defence centres along the lines of the ones that are already operating in the US and Japan.

Detailed recommendations for digital platforms

Formulation of an integrated research agenda on "digital platform technologies"

Digital platforms provide open runtime environments for smart services. **Software-defined platforms** are dependent on the underlying networked physical platforms and technological infrastructure and provide their services domain-neutrally via semantic service descriptions to the service platforms built on top of them. **Service platforms** underpin digital ecosystems and represent their business systems. They provide the framework needed for the development and implementation of the smart services that are built upon them.

The Smart Service Welt Working Group recommends:

- An **integrated research agenda** should be drawn up in order to review the **current state of research and technology for digital platforms and their enablers and modules** around the world, identify the key risks and acceptance issues and formulate a research road map that sets out clear priorities.

- Future digital ecosystems will require an **extremely flexible, multifunctional toolkit of enablers and modules** for their digital platforms in order to reduce the cost of building the platforms and make them more attractive to use. Further research is needed in the following key research areas:
  - Whilst other areas are also important, there is a particular need **at the software-defined platform level** to develop **enhanced enabler technologies** in the following five areas:
    1) Highly scalable systems, real-time processing and development environments
    2) Security, safety and resilience by design
    3) Data security, data protection and user-centric rights management by design
    4) Introduction of semantic modelling and making it suitable for everyday use
    5) Analysis techniques for transforming data into information that adds value as a basis for creating service business models.

    In this context, particular attention should be paid to the findings and developments delivered by the Future Internet PPP initiative (e.g. FIWARE).

  - **At the service platform level**, although other areas are also important there is a particular need for further work in the following areas:
    1) Further development of businesses' organisational structures and operational processes, corporate culture, values, etc., so that they are ready to work in digital ecosystems and on service platforms
    2) Communication of best practices regarding contracts, access rights, value of information, IT security, risk analysis, clarification of legal questions and liability
    3) Development of business models for operating platforms and investigation of their impact on the ecosystem and its actors
    4) Development of business models for providing smart services via platforms and investigation of their impact on the ecosystem and its actors
    5) Development of requirements and models for trading based on fungible assets, e.g. data as a currency

- IT security, data protection and data security must all be prioritised in order to create **trust and acceptance** in the Smart Service Welt. It will be necessary to develop proactive security systems and data security and protection strategies and demonstrate that they can be deployed cost-effectively.

- In order **to ensure economic and scientific progress in the Smart Service Welt** and further enhance Germany's competitiveness in digital ecosystems, it will be necessary to implement support measures that have a wide-ranging and lasting impact and that achieve a **multiplier effect, especially for SMEs. Transfer and competence centres** are one such instrument. In the short term, they can drive the migration of user industries to digital companies, e.g. by increasing the digital maturity of SMEs in an applied, problem-oriented and systematic manner using flagship projects to demonstrate the viability and benefits of the change. At the same time, competence centres also facilitate the scientifically sustainable development of enablers and modules by bringing together scientific expertise to ensure that, in the medium term, research results translate into new and innovative digitally-enabled products and services. In addition, measures should be developed to raise awareness regarding the opportunities and threats and to build confidence. A **guide to building and using digital platforms** should also be produced.

- The basic information and communication technologies have become so affordable that products of almost every description are now digitally compatible and upgradeable. The use of these technologies is thus no longer optional and has become an integral part of new solutions – their widespread use all over the world is already a reality today. Regulation and standardisation of how smart products connect to digital platforms will therefore have a particularly important role to play. Germany should **lead the way in establishing these standards and regulations**.

4 The organisational dimension: cultural change in businesses and in the workplace

4 The organisational dimension: cultural change in businesses and in the workplace

In order to build profitable digital ecosystems companies will need to open themselves up to the outside world, act dynamically and engage in new forms of cooperation, cross-sectoral collaboration and alliances. The creation of these ecosystems must be driven by the goal of finding the best possible solution to serving users' individual needs in a given situation through the integration of smart products and smart services. When setting up smart service business models, it quickly becomes apparent that the objective can only be achieved through a **network of partners from different companies and industries**. The only way of seamlessly putting together smart services that users want and believe to be feasible is through collaboration. All the actors in a digital ecosystem have their own subjective value-added targets based on different users' needs – it is thanks to their participation in a value network that they have the opportunity to achieve these goals. It is primarily up to the platform operator to act as a trusted intermediary and ensure fair competition so that all of the actors in the ecosystem can pursue these opportunities. This is essential if the intermediary is to be accepted by users for any length of time.

Businesses in Germany and throughout Europe, especially those with a product-centric strategy, need to understand the transformation that is taking place. The potential of the Smart Service Welt lies primarily in the implementation of disruptive, cross-sectoral business model innovations. This understanding runs counter to the prevailing view that digital technology's principal use is to optimise companies' own processes and services within existing value chains. **Incremental adjustments do not constitute an adequate response** to the disruptive impact of the Smart Service Welt. Indeed, sticking to traditional ways of doing business is likely to prove an extremely risky strategy. The example of Uber illustrates this point. Taxis were transformed into smart products almost overnight as a result of the sensors contained in their drivers' mobile devices (smartphones, etc.). Drivers and taxi companies suddenly found themselves forced to accept the conditions of a foreign service platform operator that is not even part of the taxi industry. In the medium term, local taxi companies are set to become surplus to requirements – they have lost their value chains' control points to the platform operators. Similar trends are now a realistic prospect in practically every area of the economy. Indeed, they are already occurring in some instances, for example the banking sector. However, the Smart Farming Services and Smart Logistics Services use cases show how German SMEs have already launched initiatives to establish themselves as B2B service platform operators and secure control over the digital control points through cross-company collaboration.

⇨ Chapter 2

Businesses must transform as quickly as possible

German businesses have no time to lose. Particularly in the consumer market, there are already numerous service platform operators with a global presence with whom countless users come into contact every day. These operators are trusted by their users and have high levels of investment capital at their disposal. The global race to integrate smart products and smart services is already well and truly underway and will be won and lost over the next few years.

⇨ Chapter 1

In this context, pilot groups provide an approach that can deliver valuable guidance. They can be set up rapidly in order to test beta versions of smart services at both the data and service levels.

Application-based experiments help to demonstrate how digital ecosystems can secure a company's core business whilst also offering them new opportunities to add value. This requires the implementation-oriented development of smart services in interdisciplinary, cross-company networks (see Figure 16). **Connected digital pilot groups** comprising e.g. data scientists, software and product developers, customer-facing employees, users (especially tomorrow's users), partners

and futurologists are set up in order to identify tomorrow's needs, analyse them and translate them into smart service business models.

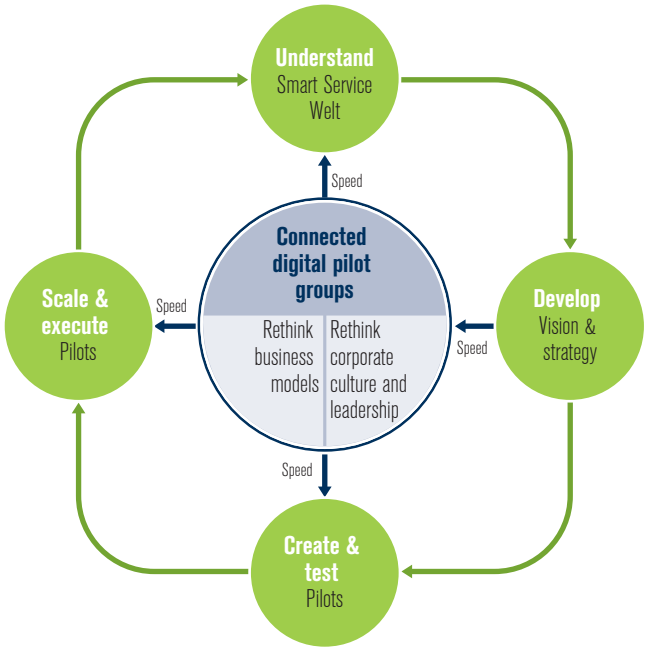
Businesses need to implement structured cultural change

Cultural shortcomings such as a lack of imagination and failure to recognise the importance of certain issues on behalf of senior executives and supervisory boards, poor communication between IT experts and non-experts and failure of IT developers to think in terms of profitability are among the key factors hampering successful implementation of organisational transformation in the Smart Service Welt. These failings manifest themselves in the fact that, for example, digitisation is often treated simply as a means of cutting costs, as well as in the fact that sales representatives often fail to market services and products together and that few users are currently prepared to pay for supplementary services. Another obstacle is the predominantly critical attitude towards data-driven business models that currently exists in the mass media. It is thus evident that various key in-house and external stakeholder groups have not yet been adequately involved – the changes appear bewildering for everyone concerned. One approach to overcoming these obstacles is through symbolic interventions by top management. There are already a number of prominent examples where an admission on behalf of senior executives that they "don't have all the answers" has served to "break the ice", allowing the transformation to be seen as a process where "everyone learns together" and thus facilitating and accelerating the development and implementation of disruptive business model innovations.

This type of campaign-style **corporate rethinking** makes it possible to transform a company's culture by involving in-house and external stakeholder groups in smart services in a highly implementation-oriented manner. It has, for example, enabled Axel Springer SE to digitise 80 percent of its business model in just five years and completely reinvent the organisation, although it remains to be seen whether this family business can now take things to the next level and start developing smart services.

Connected digital pilot groups should thus also be understood as an important transformation tool for com-

Figure 16:
Transforming the way businesses are organised to deliver quick wins in the Smart Service Welt



Source: Deekeling Arndt Advisors 2015

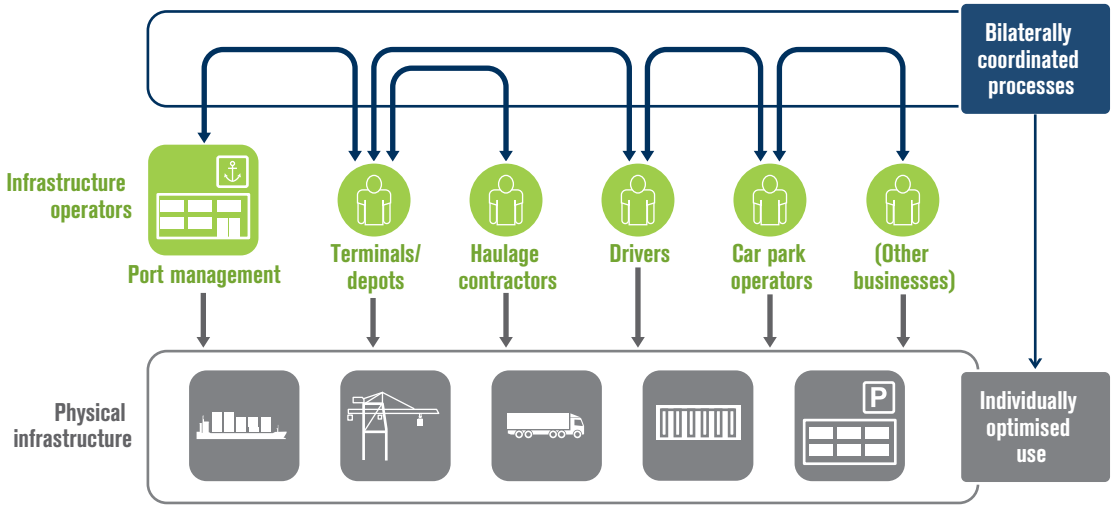
panies on their journey towards the Smart Service Welt. Especially in large enterprises, hierarchical structures constitute a significant obstacle to meeting the requirements of the Smart Service Welt, even though some of these structures may still be necessary. The Smart Service Welt calls for agility, dynamism, transparency, decentralised decision-making, cooperation between different entities and hierarchies and functionally automated management geared towards the creation of value in digital ecosystems.

Companies whose market success is built on high-quality products find it particularly difficult to open up their product-centric business models and embark on the journey towards the Smart Service Welt. These companies require strategic accelerators. The establishment of digital pilot groups provides a useful approach to confront this challenge. The smart service team should be officially launched by management in order to highlight the importance of this process throughout the business. By establishing a pilot group, management is signalling its support for a **culture of experimentation (transformational leadership)** where people receive the licence to make mistakes. The pilot group allows new forms of Smart Service Welt cooperation to be trialled within the business (including beta leadership/culture). A shared understanding and new competencies are developed through trial and error practices. Additional instruments for involving all members of the team help to ensure that this new culture spreads throughout the entire organisation.

Connected digital pilot groups thus constitute the core operational unit for the process of transforming a business, serving to drive rapid implementation of software-defined and service platforms. In this context, the focus of innovation management is less on analysing and assessing the technology itself and more on rapidly enabling useful cross-sectoral smart service business models that are built on this technology.

Digital pilot groups also act as an anchor point for the identification of the company's entire organisation with the results-oriented culture of collaboration employed by software developers (e.g. scrum or kanban project management), as well as driving its aspirations in this regard. The transformation process therefore draws on the repertoire of methods provided by the open innova-

Figure 17:
Traditional collaboration in the port logistics business



Source: T-Labs/T-Systems

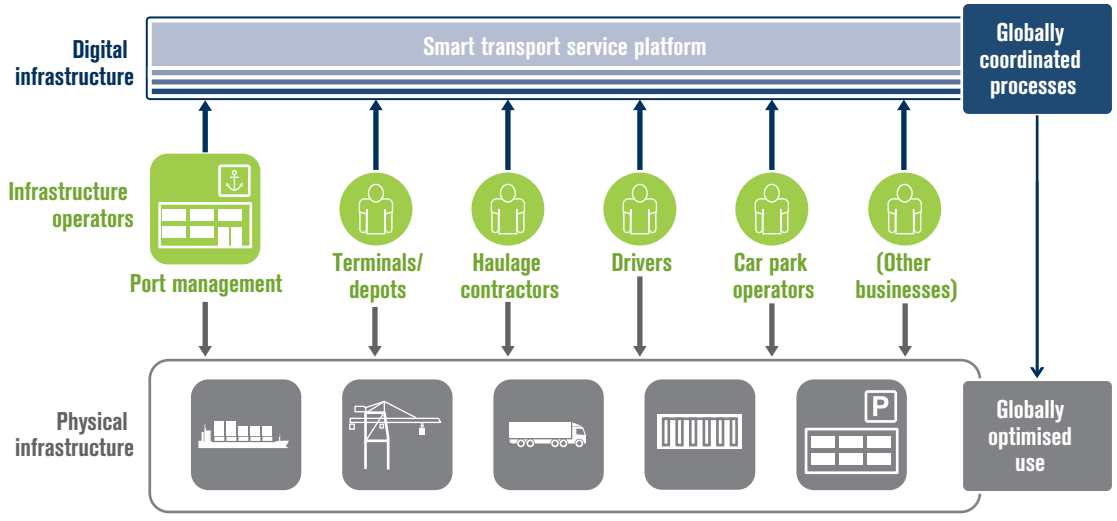
tion and corporate rethinking approaches in order to fulfil the requirements of collaborative business organisations in digital ecosystems.

Illustrating the paradigm shift in the way businesses are organised: the example of Smart Logistics Services

This section uses the Smart Logistics Services use case (see p. xx) to illustrate the transformation in the way businesses are organised. In the port logistics business, the port operator would traditionally assign jobs to the haulage contractors via verbal communication. The haulage company's dispatcher would then pass the job details on to the HGV driver who would subsequently transport the goods to their destination (see Figure 17).

However, some ports are already experimenting with a new form of collaboration. In its role as vendor platform operator, the port operator provides the port's businesses and the logistics service providers not only with a physical infrastructure but also with the digital infrastructure that delivers information logistics support for the collaboration between them and thus also serves to optimise use of the physical infrastructure. The commercial operation and marketplace function of the service platform constitute an addition to the port operator's business model and therefore need to be reflected in its organisational structure. There are also wide-ranging impacts for the various actors in the digital port ecosystem. By using both infrastructures in tandem, the haulage contractors are able to enhance the quality of the dispatchers' and HGV drivers' job content. The relevant information about the physical infrastructure is sent online direct to the HGV driver's cab by the platform operator. By coordinating with the dispatcher, the drivers can then intelligently combine this information with operational information in order to optimise the way they perform their work. This enables operational processes to be organised more flexibly – the drivers are now freed up to perform additional value-added activities. They are no longer forced to sit around waiting because of a lack of transparency in the logistics chain. The technology makes them less dependent on information provided by their supervisors, affording them greater autonomy. At the same time, the enhanced process efficiency means that the dispatchers no longer have to worry about the details of controlling the precise movements of individual drivers. Their job could in fact become increasingly obsolete as the level of automation grows.

Figure 18:
Close collaboration with other parties on the smart logistics service platform



Source: T-Labs/T-Systems

Information from operating processes is fed into the digital infrastructure in the appropriate format (e.g. anonymised data on current vehicle positions) in order to help provide a better overview of current transport and logistics operations. This contributes to more efficient processes both within the port and for the haulage contractors. For this to be possible, however, the management of the haulage company must be willing to share formerly internal company data available in the appropriate format with external users in the digital ecosystem and corresponding platform providers (see Figure 18).

Recognising the opportunities and threats of the Smart Service Welt

Service platforms such as the one described in the Smart Logistics Services example provide companies with a relatively "safe" way of collaborating in order to jointly create value-added. However, it would be a mistake for a company to become a user of one of these platforms without first assessing the opportunities and threats that the smart service business models enabled by the platform economy present for its own business.

Connected digital pilot groups provide an opportunity to realise rapid economic and cultural change within a company's organisation in a properly thought-out and motivating manner. Their findings inform the company's strategic management decisions on an ongoing basis. Thereby, it can make sure that the organisation is constantly in a learning mode, as demanded by the new environment.

The issues discussed below in connection with employment, training and work in the Smart Service Welt should therefore also be addressed by connected digital pilot groups. The pilot groups will need to consult in-house and external experts in these fields in order to develop and implement smart service business models that take into account both the relevant compliance regulations and the particular achievements of the social market economy in Germany and Europe.

Changing the structure of employment: a challenge for work organisation and training

What will the revolution in work organisation described above mean for employment and the way we work? The literature predicts major changes in the structure of employment as a result of Industrie 4.0 and the efficiency gains associated with smart services. In particular, it is expected that there will be a progressive substitution of human labour among certain groups of workers in manufacturing industry. This will be accompanied by automation of certain knowledge-intensive functions as a result of the use of algorithms and intelligent, real-time control systems.

The impact of automation will be felt in the service sector as well as in industry.

One high-profile study[1] predicts that advances in digital technology could threaten almost half of the jobs across 700 different professions in all areas of the US economy over the next ten to twenty years. Extrapolating this study to the European context suggests that the figures for Germany could well be of the same order. The dramatic changes that have already taken place in the music industry, banking sector and mail order business can be expected to affect other industries such as healthcare and logistics in the near future. Experience and knowledge can be modelled by software and statistics, while automated statistical techniques and probability calculations can replace human decisions. The changes in business organisation described for illustrative purposes in the Smart Logistics Services use case, for example, show how optimisation of the overall logistics process system through real-time networking, data collection and the use of algorithms will make it possible to forecast traffic flows, leading primarily to the loss of operational jobs. This trend will only be exacerbated by developments in the field of driverless autonomous vehicles.

At the same time, it is also expected that **new jobs and skills requirements** will emerge in connection with the development, administration and supervision of these processes, leading to an increase in employment, especially in areas that require higher skills. These struc-

tural changes in the workplace will pose a number of major challenges with regard to work organisation and in particular training.

In the industrial sector, the **"internal tertiarisation" of industrial work** can be expected to continue – in other words, the importance of direct manufacturing jobs will decline. At the same time, greater weight will be attached to jobs that primarily involve maximising the reliability, safety and security of processes, as well as jobs focused on the creation and dissemination of information and knowledge in accordance with the specific features of the new business models and platforms. This will result in qualitative enrichment of skilled manufacturing jobs connected with the IT integration of different value-added steps and product support services. While all of this does **not herald the demise of industrial work**, what it will mean is a heightened need to address fundamental questions concerning the depth and scope of the new requirements and how to ensure good working conditions and training.

Regarding the service sector, it can be expected that prevailing different forms of work are going to be affected and partially substituted by automation. This is likely to be the case for occupations that are characterised by a high degree of operational work e.g. driving a vehicle, which is going to be automated in the future. First driverless subways prove the possibility of automation as of today. The same applies for knowledge work, when software becomes capable of analysing millions of text components and consequently dispenses the human composition of text, such as quarterly statements of a company or journalistic reports. Finally, interactive work is similarly going to be automated, e.g. work in a call centre where algorithms capture the knowledge pool and combine it with speaker independent, algorithmic speech recognition.

Similarly, it is unlikely that jobs in areas such as design, development consultancy and support will become completely superfluous, at least in the medium term. Moreover, as the use of technology increases, more people will also be needed to manage, control, programme and service this technology. Even though some types of front office work will fall victim to automation, in many service industries it will account for a larger share of the total workload and in some cases its role will change as a result of the interactions that take place on platforms. The establishment of cross-border and even global service platforms will require workers to possess specific skills that enable them to work globally. The growing importance of services and knowledge work (e.g. the significance of software development for smart services) will lead to increased demand for front office and creative work. Creative work will require lifelong learning, since the everyday working environment in the Smart Service Welt will be increasingly characterised by innovation processes. It will be important to make sufficient resources available for **lifelong learning** so that workers can remain employable and businesses can continue to be innovative and successful.

It will be equally important in both industry and the service sector to guarantee the joint development and implementation (by design) of innovative approaches to work organisation and training as new business models are adopted and rolled out. This will be key to ensuring that innovative business models also result in social innovations with regard to working conditions.

The above changes in the way businesses are organised will have far-reaching repercussions for the type of knowledge, capabilities, skills and competencies required by employees as they carry out more and more of their work on collaboration and knowledge platforms. In addition to the technical, business and organisational issues, Germany's ability to develop new business models through software-defined and service platforms and to ensure that these business models remain profitable in the longer term will to a large extent also be determined by whether it is able to develop the right competencies and implement the right training and CPD measures (smart talents).

New requirements for workers

Working in horizontal, interdisciplinary, cross-company and cross-sectoral networks requires a substantially higher degree of **integrative, all-round knowledge**. As

the importance of interdisciplinarity in the workplace and the associated competencies grows apace, specialist niche functions performed within specialised silos will increasingly be accompanied by functions requiring a comprehensive knowledge of the overall context, management skills and the ability to understand the processes involved in other people's jobs. As a result, non-company-specific social and analytical skills will become more and more important. In particular, these will include the ability to think creatively about the context in which one works, different sets of requirements, process logic and the specific characteristics of other participants in the ecosystem (e.g. suppliers, customers, plant manufacturers and operators). Integration skills and the ability to rapidly familiarise oneself with the ways of working and processes of other disciplines will also become increasingly significant.

Since the reorganisation of business structures will break down existing hierarchies, these demands will in future also be **made of different employee and skill groups situated below management level**. Qualities that were formerly required mainly of managers – such as knowledge of the overall context, an understanding of the system and the ability to act and take decisions rapidly – could increasingly also be demanded of middle- and lower-ranking employees. The ability to self-manage and self-organise are also likely to gain in importance.
At the same time, there will be greater demands on inter-departmental decision-making processes within companies themselves, causing communication and decision-making processes to be restructured. **Communication skills** and the ability to work in complex environments will consequently play a greater role.

The transformation of job profiles
In addition to this growing demand for the ability to analyse systems and processes, the increasingly specialised organisation of tasks and functions in collaboration and transaction platforms will also have an impact at the level of employees' concrete, specialised activities. In general, this can be expected to involve the virtualisation and reorganisation of predominantly analogue, non-real-time activities into real-time processes. For example, the ability of service providers, plant operators and machinery manufacturers to establish predictive control and maintenance processes by sharing information in real time will lead to a sharp decline in the number of traditional, reactive repairs. However, rather than causing people to lose their jobs, the resulting process optimisation will instead transform the content of their work and the skills required to perform it. The jobs of these skilled workers will increasingly involve IT-based activities carried out on platforms. **Knowledge of data processing, working with virtual and abstract software architectures and using digital communication and control tools** will all form a key part of the required skill sets.

Tapping into the potential of structural changes
This transformation of business and work organisation in the Smart Service Welt has the potential to deliver positive changes such as providing workers with greater autonomy, improving working conditions and making people's work more interesting. Furthermore, the growing importance of services throughout the economy as a whole – including industry – is indicative of a structural change that will result in a **higher percentage of highly-skilled jobs**. Nonetheless, there are also potential threats associated with higher workloads, precarious employment conditions, increased complexity and more demanding work processes. These are linked to more fluid access to the means of production and the virtualisation and digitisation of operational processes and functions.
It is important to consider how this change in the structure of employment can be shaped in such a way as to ensure good working conditions. Businesses, the social partners and company-level employee representatives will need to work together to find solutions to the major challenges that this will entail. In order to take full advantage of the positive opportunities for employees – and thus ultimately also for businesses –, the **principles of work organisation** in the new business models should be based on the tried and tested, innovation-friendly structures of Germany's co-determination system. If the social partners work together to shape the structural changes in employment, and employees and works councils are also involved in the transformation

process through the relevant company-level co-determination arrangements, then the success of a transformation into the Smart Service Welt will be guaranteed. This will be essential to ensuring social cohesion and inclusive change.

In essence, it will be necessary to adopt an approach to work organisation that takes into account the technical design of the platforms, the shifts in workplace relationships, the transformation in the way businesses are organised and the changes in the required skills.

It will, for example, be necessary to limit the erosion of the boundaries between people's work and private lives by introducing innovative working time arrangements, thus preventing excessive or inappropriate workloads even in work environments predominantly characterised by autonomy and self-organisation. Continuing professional development (CPD) will also be especially important. A forward-looking education and training policy should identify the concrete learning and CPD requirements during the implementation of the platforms so that the appropriate training and CPD provision can be developed.

4.1 Training and continuing professional development

A variety of acceptance issues are arising in connection with the erosion of traditional system boundaries (from devices to business processes) and the accompanying changes in ownership and business models, as well as ever more sophisticated human-machine interactions such as the increasingly comprehensive assistance functions found in cars. In order to resolve these issues it will be necessary to ensure that skilled workers and customers are provided with the relevant training (smart talents). The development of smart services requires the application of first-rate technical know-how to complex service contexts. The efficient and effective development, sale and use of smart services will require the hitherto largely separate worlds of product and service development and procurement to be combined. Training and communication will be two important tools for adequately addressing these challenges.

Priority training areas for the Smart Service Welt

In the Smart Service Welt, there will be a growing demand for a range of priority training profiles and study content:

- Data scientists and data analysts
- Applied statistics and business mathematics
- Data management (extraction, modelling, cleansing, transformation)
- Modelling and creation of taxonomies and semantic systems
- Security strategies for hybrid IT infrastructures (real-time systems and Web-based systems)
- Mobile set-up and retrofitting of manufacturing systems
- Programming and analysis of digital product memories
- Software design and human-machine interaction design
- Postgraduate courses or modules on the use of digital technology in specific industries

Personalised and contextualised CPD

The Internet of Things, Services and Data is transforming the context of and influences on training and CPD processes within businesses.

Indeed, the very process of teaching and learning is changing. Situated learning using sensor data obtained through mobile and wearable computing devices enables new forms of hands-on workplace education and training.

Situated learning can offer unprecedented contextualisation of learning input and output. It also takes account of the individual learner and their particular abilities, interests, professional expertise, competencies and prior education in order to provide a personalised learning process. Personal data on employees' professional and educational backgrounds, together with personality profiles and personal preferences regarding the teaching-learning process ("personalisation") will

all be of central importance in the context of employee training. **Training will increasingly take place in the workplace** – data regarding the specific work situation, individual operation, current task and its goals, and the resources and tools being used will make it possible to relate personalised training to real situations in the workplace ("contextualisation").

It will be easier to produce more realistic learning materials, for example by using recordings of experienced workers demonstrating the correct procedure for in-service training purposes. It will also be possible to use previously captured real sensor data to explain how such data should be interpreted. Particularly in the case of demanding tasks (both during the CPD and during actual work), inexperienced workers should ideally be supported by experienced workers in a kind of coaching system. If no experts are available on site, they can link up with employees via telecoaching (e.g. videoconferencing, screen sharing).

It will thus be necessary to ensure that work is organised in a manner that fosters **learning for all employees**. The research, development and implementation of personalisation and contextualisation in the business environment will call for fundamental insights regarding the user, the didactic and domain models used in the training process, as well as the associated data and data structures and the full range of interactions between them. Specific questions that will need to be addressed include the following: What competencies and professional expertise does the learner possess? What is the goal of the learning process and which learning methods will deliver the best outcome? How do the work situation and current task influence the learning process and its design?

The development and updating of existing training provision within companies in order to enable its personalisation and contextualisation will require smart education services that facilitate modern training and CPD by incorporating the models and data referred to above. SMEs will be able to buy in these services from their providers on demand, using leasing and licensing models. Meanwhile, larger companies will create their own education services and roll them out across the entire business.

It will be important to make sure that the new smart education services do not ignore or compete with established CPD structures and do not exist in isolation from them. Instead, it will be necessary to work with the established institutions such as trainers and in-service training departments with a view to developing existing provision by integrating **smart education services** (e.g. moving from face-to-face training to blended learning). This applies not only to individual companies but also to established education providers such as the chambers of industry and commerce and chambers of trade, which should also develop new education services and business models. SMEs in particular often lack the resources to organise CPD themselves and thus frequently turn to the chambers of industry and commerce and chambers of trade as trusted partners who can help with their employees' continuous professional development. It is therefore important to ensure that the chambers are actively involved in the modernisation of CPD provision.

It will also be of importance to ensure that increased investment in education and enhanced training provision benefits all employee groups. An effort should be made to provide appropriate CPD that prevents the danger of creating a divide between a handful of highly-skilled employees who control the systems and a larger number of less-skilled employees who act as nothing more than cogs in the wheels of smart systems, performing purely functional tasks.

All employee groups should learn how to control the new, complex systems. This will prevent some groups from being excluded because they lack the relevant skills.

Situated support for using smart services

Smart services are tailored to the requirements of individual users. The relevant components are selected from a catalogue of smart products and services before being combined and customised. Particular attention is paid to ensuring that they are suitable for the user's context and that they maximise the benefits to the user.

It is essential that the smart service's user interface should be designed to be simple and intuitive to use. Despite this, **users will still require training** in order to learn how to use smart services and to update their

knowledge. It should be possible to receive this training directly at the time and place of the smart service's use. Ideally, the training should be provided as smart training services accessed directly through the service platform. This will be the simplest way of ensuring that it is automatically adapted and tailored to the requirements of the user's current situation. In principle, the training can employ Web-based knowledge resources but also offer support from human trainers (either face-to-face or remotely). Different training services will be selected when creating a service platform, depending on the circumstances.

Two main forms of training will be necessary: **workplace learning** (support) and **basic skills training** (resembling a foundation course). Workplace learning will be required in situations where the user requests information and support. This may relate to specific operating steps, entire operating procedures, or general concepts and background information. Workplace learning helps to enhance the skills and expertise that the user needs to perform their job. The support provided should be tailored to the specific smart service, the current use and the user's context. The second type of training – basic skills training – is required if the user lacks the relevant knowledge or experience. In this instance, media-based training materials should be available to help them acquire the necessary skills. There are many overlaps between these two types of training. It is therefore important to ensure seamless integration – people should still be able to consult the relevant training documentation in the workplace after they have completed their basic training, whilst practical, context-specific exercises should be supported by the training services even during basic skills training.

While some service platforms will contain integrated training services, specialised training service platforms will also emerge. Ecosystems will develop on these specialised platforms where different providers and users trade training materials, e-learning services and personal support as training services. This will also benefit general service platform providers who will be able to seamlessly integrate these training services into the range of services that they offer the platform's users.

4.2 Work organisation

There are many reasons to suggest that the combination of digital technology and the proliferation of smart services will bring about profound changes in the workplace. As far as employees are concerned, although these changes will entail new challenges they will also provide an opportunity to improve and in some cases perhaps even reinvent the work environment. The goal should be to take full advantage of these opportunities in order to maintain and create good jobs.

There is no question that smart services offer significant potential for rationalisation. Many aspects of digitisation are motivated by the prospect of boosting labour productivity and reducing the amount of labour required to perform a given task. This can either translate into headcount reductions or an increase in the number of tasks that employees are expected to perform. However, it is also true that setting up, operating and servicing the new digital infrastructure can help to protect existing jobs and potentially even create new ones.

The ability of industry to provide customers with smart services that offer complete smart product-based solutions, as well as the quality of those services fundamentally determines the extent to which the jobs created can offset or even exceed the number of jobs lost will be fundamentally determined by whether industry is able to. This will in turn require industrial enterprises to systematically expand their smart service portfolios and make the corresponding modifications to work organisation and content, and in particular to the way their business is organised. Against this backdrop, the creation and use of smart services based on IT, multimedia and cloud technologies can be expected to result in **profound changes in the content and structure of people's work**. Further research is needed to determine more precisely which employee groups are set to be most affected, as well as the likely impact of internal tertiarisation.

In any event, it is clear that the impacts will not be random. The changes to work and employment will be largely determined by how the additional work generated by smart service applications is incorporated within organisational structures and shaped in terms of its quality. In concrete terms, this might involve future service functions being integrated into existing departments. People employed in development or even manufacturing might then find themselves performing customer service functions. In work organisation terms, smart services could thus provide a good opportunity to make **industrial workers' jobs more varied and interesting**. An alternative strategy would involve manufacturing companies establishing special smart service departments, opting for a specialised approach that would have relatively little in common with traditional industrial work and functions. A third option would be to outsource product-based services, leading to fragmentation of the value-added process and value chain.

The questions concerning the likely impact on employment and the quality of people's jobs are especially relevant to the service sector. The significant employment potential of **personal services** in particular has yet to be adequately realised in Germany. Decent working conditions will be essential in order to create good-quality jobs and good-quality services in areas such as healthcare, caring and education. Smart services can also provide support for these types of service, particularly if the service platforms are used to connect sectors that previously had little contact with each other (e.g. logistics and healthcare). The service platforms can also provide employees with personalised services to support them in their work. Especially in areas such as healthcare, however, this does raise a number of ethical and legal issues, regarding e.g. which actors should have access to which data and the extent to which anonymisation provides adequate protection of personal data. Legislation will be required to make data minimisation compulsory and prevent data from being shared with third parties without the user's consent.
⊃ Chapter 5

Reorganisation of work and companies

Finally, the big challenge will be to implement business and work organisation solutions in the Smart Service Welt that enable integrated management of functional and system-related factors, including access to workers and the deployment of employees' skills. This will require more than simply adding in smart tasks, capabilities and skills. Instead, it will call for a comprehensive restructuring of work and operations in which employees' work and training are made more interesting and they are given a relatively high degree of autonomy and ample opportunity to organise their own work. This will enable the Smart Service Welt to usher in a new quality of work in manufacturing industry that is based on and supported by the establishment of new service environments and the associated work environments.
For this to be possible, it will be necessary to ensure that employees have the opportunity to raise and press their demands for good working conditions and more interesting jobs and to feed back their views on innovation-friendly organisational structures to their employers through the relevant worker participation institutions. In many companies, especially larger ones, they are already able to do so. However, start-ups and small software or high-tech firms can tend to be rather wary of such institutions, meaning that many of them do not have works councils. The involvement of employees and works councils provides the best chance of shaping the development and use of service platforms in order to enable improvements to the physical and mental health, performance, training and motivation of the people working with them, thus ultimately also strengthening **businesses' ability to innovate**.
It would run counter to these goals for the workforce to be divided into a group of highly-skilled knowledge workers who develop and administer smart services on the one hand and a group of employees who perform purely functional tasks in traditional administration and production roles on the other (specialisation model). This would result in employees being polarised into two groups. The group of well-trained workers would have more freedom, more interesting work and more autonomy. The employees in the other group would either have no involvement at all with the new functions arising from the development of smart services or would only be given simple, minor tasks to perform. Their previously acquired expertise would become obsolete and

the range of tasks they were required to perform would become more limited, ultimately leading to deskilling. This is hardly the way to go about promoting innovation, nor is it compatible with the goal of good jobs. Moreover, it is not a very promising strategy in a context where the labour supply is shrinking and there is a shortage of skilled labour. In order to prevent this divisive polarisation of the workforce, it will be necessary to provide **comprehensive training measures** for all employees and to organise work in a way that takes account of the potential of all members of a company's staff and is centred around good jobs that help people to develop their skills.

Increasing flexibility of work

Another feature of the changes to working conditions that will increasingly come about as a result of the development and use of smart services is that work processes will become more and more flexible. There is reason to believe that there will be a growing requirement for people to be more flexible in the way they work, learn and interact with customers (be it face-to-face or on a computer). Greater flexibility will also be demanded with regard to working time and the content of people's work. This will provide employees with the opportunity to achieve a better work-life balance. Work will become more mobile in terms of both where and when it is performed. Working from home using only the Internet to interact with one's work colleagues will make it easier for people to combine their family lives with their jobs. On the other hand, it is also possible that work processes, working hours and breaks in cross-company digital ecosystems may be dictated solely by the network's efficiency requirements. This danger is particularly acute where there are no effective cross-company-level worker participation and social partnership arrangements, meaning that employees' interests are not properly represented in the new ecosystems. The growing use of mobile end devices together with trends such as teleworking and cloud computing are causing a shift away from the traditional structures of company-based employment relationships. Within companies, individual jobs are now allocated based on target agreements and are sometimes completed online, away from the actual workplace. In the future, one of the key ch**allenges in terms of work organisation and productivity** will be to strike the right balance between the following considerations: on the one hand, it will be necessary to engage with works councils and the trade unions in order to establish clear boundaries between people's private lives and their working hours or the times when they can be contacted about their work; on the other hand, it will also be necessary to afford employees individual flexibility so that they are able to achieve a better work-life balance, for example.

In some areas of the Smart Service Welt, there is also a tendency to outsource jobs by posting them to **crowdworking platforms**. On service platforms such as Uber and airbnb, providers are often not covered by regulations on working conditions, collective agreements or verifiable quality standards, etc. There is a danger that permanent employees could end up being replaced by low-paid, self-employed precarious workers who are not covered by company health and safety regulations and have no social security arrangements. And the danger becomes even greater when jobs are posted online and can be bid for by and awarded to people anywhere in the world.

Last but not least, both within companies and at a cross-company level, digitisation generates huge quantities of data that include information about the vast majority of work processes. Whilst this data may only be used to optimise processes, deliver efficiency gains and improve working conditions, it could also be employed e.g. to monitor employees' performance, their online activity or even their private lives. Effective regulations and controls must be introduced from an early stage in order to counter this threat of increased employee surveillance.

1 Frey, C. B./Osborne, M. A.: The Future Of Employment: How Susceptible Are Jobs To Computerisation?, working paper, 17 September 2013, Available online at: oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf?inf_contact_key=0618992509141a08491ed57cd55161a4b9c00f457af8bf78ab89e2ece0943416 (accessed: 4.11.2014).

Detailed recommendations for organisation and work

The developments in connection with smart services can be used to promote decent working conditions and provide employees with greater individual freedom. However, this will require government, the social partners, works councils and businesses to actively shape technological developments with a view to creating good jobs. Employees and their company-level representation bodies must participate in and co-determine any changes right from the outset. In addition, measures should be taken to provide employees and users of smart services with targeted training, while the development and implementation of smart education services should also be promoted.

It will be necessary to ensure that the technological and organisational design of the digital platforms, the resulting changes in work and business organisation, the changes in work content and job profiles and the relevant training requirements and measures are all coordinated from an early stage and developed along socio-technical co-design principles. **The guiding principle should be to ensure that people's work is designed in such a way as to guarantee and promote a high degree of autonomy. This should be supported by innovative virtual ways of working at both the individual company and cross-company levels.**
Rather than being focused solely on the efficient creation of smart services, the content of people's work should also be geared towards the goal of good working conditions. The way that work is organised should foster interesting learning, provide all employees with the resources they need to facilitate greater responsibility and autonomy and promote a work environment that is ergonomically designed and suited to the needs of people of different ages. Occupational health and safety standards should be adapted to take account not only of new technologies but also of new forms of out-of-house work. While all existing health and safety rights should be retained, additional needs arising from new forms of mobile working should be identified and the corresponding rights established. The new opportunities for greater flexibility – particularly in terms of when and where work is performed – should be used not only for more efficient value creation but also to enable a better work-life balance in accordance with employees' individual needs. This means that in digital ecosystems, too, employees and their representatives should be involved in work scheduling.

- The participation of employees and company-level representation bodies will be key in this regard. Some aspects resulting from the spread of digital technology (such as Internet use and the times when employees may be contacted outside of working hours) are already regulated by company agreements. However, further company agreements on additional aspects will be required.
- The new challenges will require existing structures to be adapted and **co-determination rights and opportunities** to be expanded. For example, the traditional company-based co-determination system is less well suited to a world where work processes, working time and work content will increasingly be determined by the interactions between several different companies in an ecosystem. Service platform operators and intermediaries should – in close consultation with employees and company-level representation bodies – be required to stipulate compliance with decent working conditions as a key condition for cross-company cooperation. Co-determination rights should be updated and extended in order to ensure that employees' interests are properly represented in all the key types of employment, including cross-company platforms and ecosystems.

- The same principle also applies to the increasingly popular employment forms of teleworking and **crowdworking**. The latter cannot be exempt from labour law. An extension of the co-determination rights of works council and staff council members to include outsourcing and crowdsourcing should be accompanied by further measures to prevent permanent employees with guaranteed social rights from being replaced by self-employed people working under precarious employment conditions.
- **Common standards should be developed for outsourcing work** to self-employed people via crowdworking platforms. These should guarantee fair pay, social protection, compliance with health and safety regulations and co-determination rights. Among other things, this will require the scope of the Workplaces Ordinance to be extended to self-employed people and workplaces outside of companies (e.g. home offices). It will also require the definition of a worker in the law on co-determination to be expanded.
- All employees should be guaranteed the right to informational self-determination, while employee data protection measures must be strengthened and guaranteed by law. It is important to ensure that digital working does not lead to an increase in employee surveillance and monitoring.
- In order to limit the erosion of the boundaries between work and private life, the right to be unavailable and not to respond when contacted outside of agreed on-call hours should be enshrined in the law on working time.
- Individual and collective Internet access, communication and participation rights should be stipulated by law.
- Harnessing the potential of new technologies to boost productivity and create good jobs will require a modern education system that facilitates **lifelong learning**, offering a significantly **wider range of training and CPD opportunities**. At the same time, the comprehensive inclusion of all employee groups should counteract the tendency towards polarisation of the workforce into high-skilled decision-makers on the one hand and low-skilled workers performing purely functional jobs on the other.

In shaping the Smart Service Welt, it will above all be necessary to **develop** company strategies and **reference projects and carry out research** with a view to analysing employment trends, changes in employment structures, work organisation challenges and training requirements so that they can serve the relevant labour policy goals.
The changes to working conditions and the jobs performed by different professions will need to be studied at both the empirical and theoretical levels. The Federal Ministry of Education and Research's recently launched "Future of Work" labour research programme constitutes a first attempt to use developments in the field of smart services to promote labour policy innovations that support good jobs. A number of different aspects urgently require analysis, observation and research:

- Restructuring of value chains and social infrastructures in the workplace. How is the development and use of smart services structured within organisations? This is a key question that has yet to be answered. It embraces questions and challenges relating to **job profiles** in new companies that specialise in smart services, the adjustments that will need to be made by established companies, emerging approaches to the division of labour and in particular how the balance between hierarchy/management on the one hand and autonomy and individual freedom on the other can be readjusted at both the company and cross-company levels.
- Reference studies and model projects should investigate and test which aspects of company and cross-company industrial relations regulations need to be adapted and developed,

especially in view of the trend towards less rigid hierarchies and looser ties to management structures. They should also investigate the conflicts and challenges that this brings about for employees. The research initiatives should seek to identify new forms and ways of strengthening company-level co-determination even in an environment where corporate structures may become increasingly fragmented.

- Model work organisation structures should be developed that are characterised by varied tasks, a holistic approach to work, the promotion of training and learning and extensive scope for employee self-organisation e.g. in terms of managing their own workload.
- **Employment and displacement effects in the structure of different industries** should be analysed in order to identify any necessary social policy measures or training, and CPD needs. It will also be necessary to investigate emerging training and competency requirements, changes to job content and descriptions and the implications for training and CPD.
- Model projects should be initiated to develop **workplace learning methods** that can be supported by smart services (apps, smart devices, wearables, etc.) and drive their introduction and promotion within businesses. This will require testing of self-learning, adaptive systems for providing process-oriented support for the use of smart services, as well as of knowledge, learner and training models. Moreover, processes should be developed for producing learning media by recording real-life work (including sensor data interpretation). In addition, best practice solutions should be identified and publicly disseminated. Further research is also needed on the design of personalised occupational training measures that take account of workers' age, qualifications and learning skills.
- The extent of virtual work organisation and outsourcing via the Internet should be reviewed, the relevant regulatory requirements should be identified and innovative social policy approaches to ensuring material protection and employability (e.g. employee insurance) should be discussed.

5 An innovation-oriented framework – creating a level playing field for Germany and Europe

5 An innovation-oriented framework – creating a level playing field for Germany and Europe

The vision of a Smart Service Welt is already starting to become reality. In Europe, data-driven services are expected to generate a gross value-added of 330 billion euros by 2020. Many business models are still emerging or being developed. Consequently, many of the legal details and potential pitfalls have not yet fully crystallised. Two years ago, for example, no-one would have imagined that a smart service could ever come into conflict with Germany's Passenger Transport Act. Notwithstanding the above, it is already possible to identify the key policy areas that will have a defining influence on the success of smart services. It will be crucial to ensure that these areas have a flexible regulatory framework capable of responding to rapidly evolving requirements. Five key policy areas are outlined below.

Data protection and IT and data security

- **A consistent regulatory framework is required that reflects the new status of data as a commercial asset and component of new value chains.**
- **Data protection and data security are fundamental requirements for the use of smart services. There can be no market for smart services without trust.**

The most important regulatory question concerns the use of data. This applies equally to data processing, liability and ownership. Germany and Europe will need to adopt internationally competitive and compatible regulations on these issues if their businesses are to stand any chance of producing successful exports, growing their market share and adding value through smart services. Ensuring trust in the way that data are used should go hand in hand with promoting innovations and innovative business models. At present, however, the two things are often still at odds with each other and this tension needs to be resolved by engaging in a dialogue with the public. High data protection standards should therefore be guaranteed, not least in order to create a new generation of secure German-built smart services. However, high data protection standards will only provide a competitive advantage if they nonetheless permit an appropriate and practical level of data processing flexibility. Without this, it will be impossible for new data processing technologies, processes and business models to develop successfully in Germany and Europe.

⇨ Chapter 3.3

In the complex Smart Service Welt, the security of data and IT systems will be a critical success factor. As is the case with any other technological system, it is not possible to guarantee absolute security. However, the aim should be to deliver a very high level of security with quantifiable and certifiable indicators that offers a significantly higher degree of protection than current approaches. This concern with security should not be confined to products' technical functionality but should also be firmly anchored in companies' manufacturing processes and organisational structures. In addition to product safety and security, which are often taken for granted by users, other key factors that influence the decision to buy a particular product are user-friendliness, price and innovativeness. However, these factors are not always entirely compatible with the desire for high security standards. As a result, it will ultimately be up to users either to budget for the products they want or to clearly identify their priorities so that market forces and the laws of supply and demand put pressure on suppliers to deliver these products.

Broadband and network infrastructure

- **A high-speed broadband infrastructure forms part of the technological infrastructure that underpins the Smart Service Welt.**
- **The 700 MHz frequency band should be made available as soon as possible in order to improve mobile networks' carrying capacity.**
- **Many smart services will require guaranteed connection quality in order to work properly**

– networks will therefore need to be managed so as to enable different connection qualities.

The universal upgrading of the broadband network is essential for enabling the widespread delivery and use of smart services. There are several core regions in Germany which, although industrial, have a rural structure and currently lack adequate broadband coverage. The German government has set itself the target of guaranteeing nationwide 50 Mbit/s coverage by 2018. Although this is an appropriate and ambitious goal, it can only be a staging post on the road towards the gigabit society.

The implementation of the Smart Service Welt will require a more powerful and diverse network infrastructure. It will need to be capable of delivering fast and flexible mobile performance in order to cover all the application-specific requirements, i.e. communication between people, things, processes, data centres and content. As illustrated by the use cases, the Smart Service Welt is built on a continued increase in interconnectedness. This will far exceed the use of tablets, smartphones and cloud solutions that we are witnessing today. The Internet of Things, Data and Services will generate enormous quantities of data. It is estimated that by 2020 some 6.5 billion people and 30 billion objects will be connected to each other. As a result, the global data volume is expected to increase tenfold compared to 2014. The technological infrastructure will play a system-critical role in the forthcoming transformation of our economy and society. Coordinated action to upgrade it should therefore be taken across the whole of Europe.

Copyright

- **Smart services significantly increase the urgency of finding solutions that enable digital use of copyright material whilst maintaining strong copyright law.**
- **The royalty systems of the analogue age are no longer feasible in the age of the Smart Service Welt.**

In order to support smart services, copyright law should reflect technological developments rather than sticking to principles that are no longer relevant in today's world. Appropriate cross-border copyright regulations are particularly important and will require at least some harmonisation of the relevant national regulations. The European Commission should therefore act swiftly to adopt the necessary reforms in this extremely contentious area so that the legal uncertainty currently surrounding smart services can be resolved as quickly as possible.

Research and innovation policy

- **In order to enable the development of smart services in Germany and allow them to become a successful global export, it will be necessary for industry and the IT community to lay the necessary foundations through joint R&D projects.**
- **To keep up with their international competitors, German businesses will need to increase their R&D spending. Tax measures to promote R&D – such as those seen in Australia, France and Japan – should be rolled out without delay. The first step should be to increase the percentage of government funding for industrial R&D projects.**

Interdisciplinary basic and applied research is a key requirement for innovation and competitiveness. One measure making a significant contribution in this regard is the "Smart Service Welt" technology competition that was launched by the Federal Ministry for Economic Affairs and Energy (BMWi) at the Hamburg IT Summit in 2014. Research policy should focus on the specific strengths of German industry. Germany is fortunate to have both a strong industrial base and a highly innovative IT industry. In order for Germany and Europe to develop the necessary marketable platforms and smart services for export around the globe, it will be necessary for industry and the IT community to lay the technological, organisational, commercial and legal foundations through joint R&D projects. The development of software-defined and service platforms will be espe-

cially important. In the future, service platform operators will control the digital control points and will thus be in a position to determine how the profits are shared out. In order to ensure a prosperous future, Germany will need to develop both its own service platforms and the software-defined platforms that provide their underlying technical basis.

Innovation cycles have become dramatically shorter in the digital economy. At the same time, new players are forcing their way into the market and using their new digital solutions to challenge established suppliers who were previously thought to be untouchable. Recent examples, particularly in the retail trade and the media, illustrate the sheer force and capital intensity of these changes – witness, for instance, the impact of Google in the automotive industry and iTunes and Spotify in the music industry. German businesses will need to significantly increase their R&D spending if they wish to keep up with this fierce and disruptive competition.

Liability and competition

- **Differing interpretations in different European countries of the law protecting consumers against unfair general terms and conditions in contracts, together with a lack of legal clarity on various other issues, could put Germany at a huge disadvantage as the digital revolution unfolds.**

In the Internet of Things, Data and Services, future B2B contracts will increasingly be based on standard terms and conditions. However, one of the defining features of IT-based services is their high level of technical complexity. German providers or those who use German law find themselves at a disadvantage compared to their global competitors. This is due to the legal uncertainty regarding limitation of freedom of contract when using contracts with standard terms and conditions. Meanwhile, even today, German SMEs regularly compete for IT service contracts with US firms (generally via their Irish businesses) whose terms and conditions stipulate a significantly lower level of liability. A typical example would involve disclaimers or limited liability clauses pertaining to data loss in online storage services. These contractual terms and conditions are perfectly valid according to Irish or US law and have in fact become the global market standard. For German providers, however, the legal position is less clear and this has the effect of restricting their ability to price their services competitively. The much-debated trend for companies to move their domicile to a foreign jurisdiction is thus likely to accelerate still further. It is also possible that German companies might increasingly start providing IT services to German customers through other European countries such as Ireland. Another concern is that the legal landscape in Germany could have a negative impact on the ability of German startups to compete and on the attractiveness of Germany as a location for international corporations.

Detailed recommendations for an innovation-oriented framework

Data protection

- A European Data Protection Regulation is currently being negotiated. The Regulation will be a vital element in creating a single regulatory framework for the whole of Europe which will in turn strengthen Europe's bargaining position internationally. The German government should therefore work towards a consensus-based solution and push for a conclusion to the Data Protection Regulation negotiations by no later than 2016.
- Smart services sometimes use data that is highly sensitive from a data protection law perspective, for example in the healthcare and insurance industries. In these areas, there is a particular need for regulations that permit and promote the use of pseudonymised data. Clear regulation can support value creation in the Smart Service Welt without neglecting users' and employees' data protection interests. It will also be important to guarantee the principle that users should retain sovereignty over their data and be able to decide for themselves which data they are prepared to make available to different parties. This will require the development of data protection profiles that can be adapted to different situations. Furthermore, in the medium term it will be necessary to engage in a broad-based dialogue with the public in order to create a culture of privacy and trust with regard to the use of data, as well as the conditions required to make this possible.
- It is hard for members of the public to make an informed decision about whether or not to grant their consent if the compulsory information provided about the details of the data processing is too extensive and detailed to be easily understood, as is often the case with standard terms and conditions, for example. Accordingly, care should be taken to ensure that data protection information is presented in a user-friendly fashion.
- Regulations should be developed for corporations with a view to simplifying cross-border data sharing among organisations belonging to the same group (special regime for corporations). Without prejudice to the right to informational self-determination, clear and practical rules are needed to regulate the sharing of data between companies within the same group so that the same data protection standards are observed throughout. These should take into account how the roles of individual businesses interact with the group's corporate organisational structures and the extent to which the group actually constitutes a single economic entity.
- There are also a number of new "data policy" issues that are not addressed by traditional data protection law. It should not be forgotten that non-personal data also now play a key role in the Smart Service Welt. The volume of this type of data is set to keep rising exponentially as the Internet of Things continues to grow. In contrast to personal data, the protection of this field data is not clearly regulated. Uncertainty regarding the transfer of exclusive use rights to particular individuals or groups touches directly upon the question of whether and under which conditions it should be possible to access, use and make money from such data.
- Supplementary self-regulation instruments should be included as part of a flexible legal framework in order to provide greater legal clarity for businesses and users. In general, self-regulation and co-regulation within an appropriate legal framework offer a useful means of ensuring that abstract regulations are correctly interpreted in practice by pinning down their meaning, explaining them, or other-

wise facilitating their implementation or enforcement. This approach promises to be especially beneficial in the digital economy, where short innovation cycles make flexible and adaptable regulation particularly desirable. The incentives for companies to self-regulate should, however, be explicitly legal in nature. Such incentives might include a significant clarification of the legal situation or a reduction or simplification of the administrative burden.

IT and data security

- In addition to comprehensive security management covering all the relevant components, the security of data transmission and storage against unauthorised access is key to successfully establishing smart services on the market. This in turn requires objectifiable criteria. One possible approach might involve a transparent system for classifying "secure" smart services combined with a trust model (along the lines of SCHUFA).
- It will be necessary to explore ways of strengthening the statutory protection of corporate data (e.g. company and business secrets), for example by providing positive incentives to implement security measures but also by adopting regulatory measures and clarifying liability issues.
- Focal points are needed in order to heighten awareness of security risks and disseminate basic knowledge about secure IT, especially among SMEs. The focal points should provide advice on security issues, as well as indirectly supporting the use of smart services by users. Organisational measures such as IT security management systems and employee training initiatives can also play a valuable role in security architectures. This will require the IT security culture among providers to be strengthened. As manufacturer-neutral platforms, the security initiative "Deutschland sicher im Netz" and the "Allianz für Cybersicherheit" should play a key part in this process.
- It will also be essential to implement technical measures in the form of security requirements for the communications infrastructure (brute force protection, encrypted data transmission, strict authentication standards and backdoor-free solutions) and at the development stage (security and resilience by design, state-of-the-art development). The Smart Service Welt components and platforms should increasingly incorporate dynamic update points by design in order to enable automated updating of all system components at any time. Furthermore, products and services should also meet high usability standards with regard to security. It is up to IT providers and researchers to come up with user-friendly solutions for meeting people's IT security needs.
- The establishment of special cybercrime task forces at regional and national level is a big step in the right direction.[1] It is now important to ensure that the police authorities' willingness and need to cooperate is acknowledged at a policy level so that everyone can work together to provide better protection against cybercrime.

Broadband and network infrastructure

- Mobile data connections will be particularly important for many smart services. It will therefore be necessary to increase the carrying capacity of mobile communications networks. Government can help by freeing up additional frequency bands for this purpose. The 700 MHz frequency band is of fundamental importance in this context. These frequencies should be allocated as soon as possible so that they can subsequently be vacated by broadcasters, allowing their use by mobile communications networks.

- Future 5G networks will provide a solid foundation for a number of additional measures that will be required in the Smart Service Welt. The key performance indicators agreed at European level under the 5G-PPP initiative are a good starting point for delivering the requirements of the Smart Service Welt. For example, the aim is for mobile 5G networks to deliver a thousand-fold increase in capacity compared to 2010. Government must drive progress on the next generation of mobile communications by allocating the relevant frequency bands, supporting research and promoting international standardisation.
- Differentiated solutions with regard to the issue of Net neutrality will be indispensable to the success of Industrie 4.0 and the Smart Service Welt. The aim should be to develop and strengthen the Best Effort Internet whilst at the same time authorising specialised services that guarantee specific connection qualities. A specific transmission capacity or bandwidth, latency, or maximum transmission packet loss rate may be particularly critical to the success of different smart services. It is therefore important that the law should guarantee the commercial freedom of telecoms companies and their customers with regard to traffic management and Net neutrality.[2]

Copyright

- It is in the interests of Europe's digital single market to promote transparent, legally compliant and appropriately reimbursed use of copyright works on the Internet. Copyright collection societies and other rights agencies should declare the rights, works, originators and territories that they administer both transparently and in a manner that can be easily accessed by anyone. The introduction of a registration system should be supported.
- Within Germany, the forthcoming review of the Copyright Administration Act (UrhWG) should require copyright collection societies to grant fair use rights to anyone who requests them. This will be a fundamental factor for enabling fair competition in Germany despite the use of copyright by some parties to establish virtual monopolies. It will also be essential in order to allow the right holders to establish new, Web-based business models. The flow of rights artificially created through deposit mechanisms (Article 11. 2 UrhWG) in the event of a dispute over use rights should therefore be retained until a consensus-based alternative can be implemented. However, it should be possible to apply for a temporary injunction so that the Arbitration Board of the German Patent and Trade Mark Office (DPMA) can review and modify the level of the deposited fees. This will make it possible to establish a fair basis for negotiation, as well as preventing German industry from losing out on potential investments as a result of disproportionate copyright demands.
- The model developed during the 1960s based on conventional photocopiers, where users paid a charge in exchange for their own private copies, is now being superseded by developments in the digital world. There has been a dramatic change in the way right holders market their copyright material. Forms of use such as streaming allow consumers to enjoy music and video anytime, anywhere. Devices can be quickly tailored to customers' wishes thanks to short innovation cycles and are undergoing increasing convergence. A charging system based on the user's device or storage medium no longer makes sense in the age of smart services where Web-based services are merging with physical products and services. Subsequently, there is a need for in-depth

discussion of alternative models that can provide originators and consumers with greater legal clarity and transparency. Attempts to simply tinker with the existing model will amount to nothing more than makeshift emergency repairs to a system that is past its sell-by date and has ceased to be practicable in the digital world. In particular, the introduction of an obligation to deposit reprographic levies would be diametrically opposed to the sensible optional deposit mechanism that currently exists, causing conflicts within the system and potentially also being unconstitutional. This would only make the situation of those concerned even worse than it already is.

Research and innovation policy

- Tax measures to promote R&D should be introduced as soon as possible – the use of such measures has long since been standard practice in countries such as the US, France, Japan and China.
- The percentage of government funding for industrial R&D in joint research projects should be increased.
- The Federal Ministry of Education and Research's successful cluster policy should be continued, cooperation between users and suppliers should be strengthened, R&D programmes should concentrate more strongly on the concerns of industry and there should be a greater focus on delivering concrete market successes.
- Research into participatory production and prosuming as well as the inclusion of users, customers and consumers should be strengthened.
- "Smart service competence centres" should be established where researchers and industry can pilot platforms and smart services in joint flagship projects in order to accelerate the necessary technology and knowledge transfer. Given the rate at which the digital revolution is unfolding, it will be important not to waste any more time than is strictly necessary on creating the relevant structures. The competence centres should therefore be built on top of the existing cluster structures.

Liability and competition

- It will be necessary to verify the compatibility of German law on standard terms and conditions with international IT contracts. The goal should be to harmonise the regulatory framework throughout Europe.

1 In accordance with the resolution of the Standing Conference of the Ministers and Senators of the Interior of the Länder in the Federal Republic of Germany (IMK) of 18/19 November 2010.
2 The ver.di trade union is not in favour of restricting Net neutrality.

About the Smart Service Welt Working Group

Background

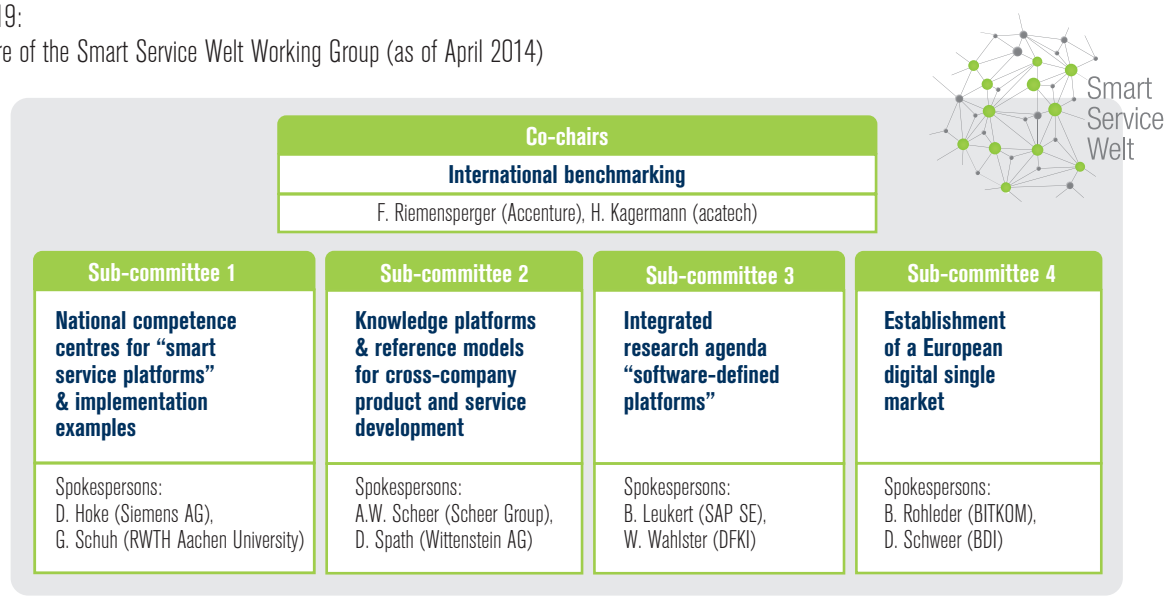
"Smart Service Welt – Web-based Services for Businesses" is a strategic initiative of the German government that was initiated by the "Digital Economy and Society" (formerly "Communications") Promoters Group of the Industry-Science Research Alliance and was subsequently adopted by the German government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

In the coalition agreement of the current parliament, the German government makes explicit mention of the business and research area of "smart services" as a goal in its own right: "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." This strategy also informs the Digital Agenda and the latest version of the High-Tech Strategy: "In view of the potential of smart services, the Federal Government will provide German businesses with support to help them secure full control of the entire value chain and manufacturing processes." The "Smart Service Welt" technology competition of the Federal Ministry for Economic Affairs and Energy (BMWi) was launched as a targeted means of promoting the Smart Service Welt. The Smart Service Welt Working Group sees its work as contributing to the activities of the German government in this area.

The multi-stakeholder approach

The "Digital Economy and Society" Promoters Group of the Industry-Science Research Alliance designated two strategic initiatives in the field of communication: "Industrie 4.0" and "Web-based Services for Businesses". In doing so, the Promoters Group joined various Federal Government initiatives such as the Research Agenda Cyber-Physical Systems (2012) in highlighting the need for further research on embedded systems with a particular focus on the fields of energy, manufacturing and healthcare. The strategic initiative "Industrie 4.0" subsequently went on to address the competitiveness of manufacturing industry in the digital age. Following a successful initial roll-out of Industrie 4.0, the second strategic initiative "Smart Service Welt" is now focusing on the opportunities for businesses arising from both the integration of products and services and the underlying data-driven business models.

Figure 19:
Structure of the Smart Service Welt Working Group (as of April 2014)



The two working groups that developed the recommendations adopted an innovative approach to their work. Representatives from a wide variety of industries, disciplines and sectors came together to help formulate a set of recommendations with the overriding goal of securing Germany's competitiveness. The Smart Service Welt Working Group comprised 140 representatives drawn from industry, the research community, the trade unions, industry associations and government who worked together to develop the Smart Service Welt vision. This make-up answers the call for closer cooperation between different industries and sectors.

The recommendations of the Smart Service Welt Working Group

After submitting its interim report to the German government at CeBIT 2014, the Working Group altered its structure to reflect the report's recommendations. The four sub-committees of the restructured Working Group then carried out further work on the interim report's recommendations under the co-chairmanship of acatech President Henning Kagermann and Frank Riemensperger, Managing Director of Accenture GmbH (see Figure 19).

The final report was drafted jointly by the whole group based on the findings of the individual sub-committees. It will be submitted to the Federal Government at CeBIT 2015. The final report's recommendations are a more concrete and detailed version of the recommendations contained in the Smart Service Welt Working Group's interim report of March 2014. They are intended to provide a basis for the ongoing implementation of the changes needed to create the Smart Service Welt.

Further information:

Reports of the Smart Service Welt Working Group:
acatech.de/smart-service-welt

BMWi technology competition "Smart Service Welt":
smartservicewelt.de

German government's High-Tech Strategy:
hightech-strategie.de

Smart
Service
Welt