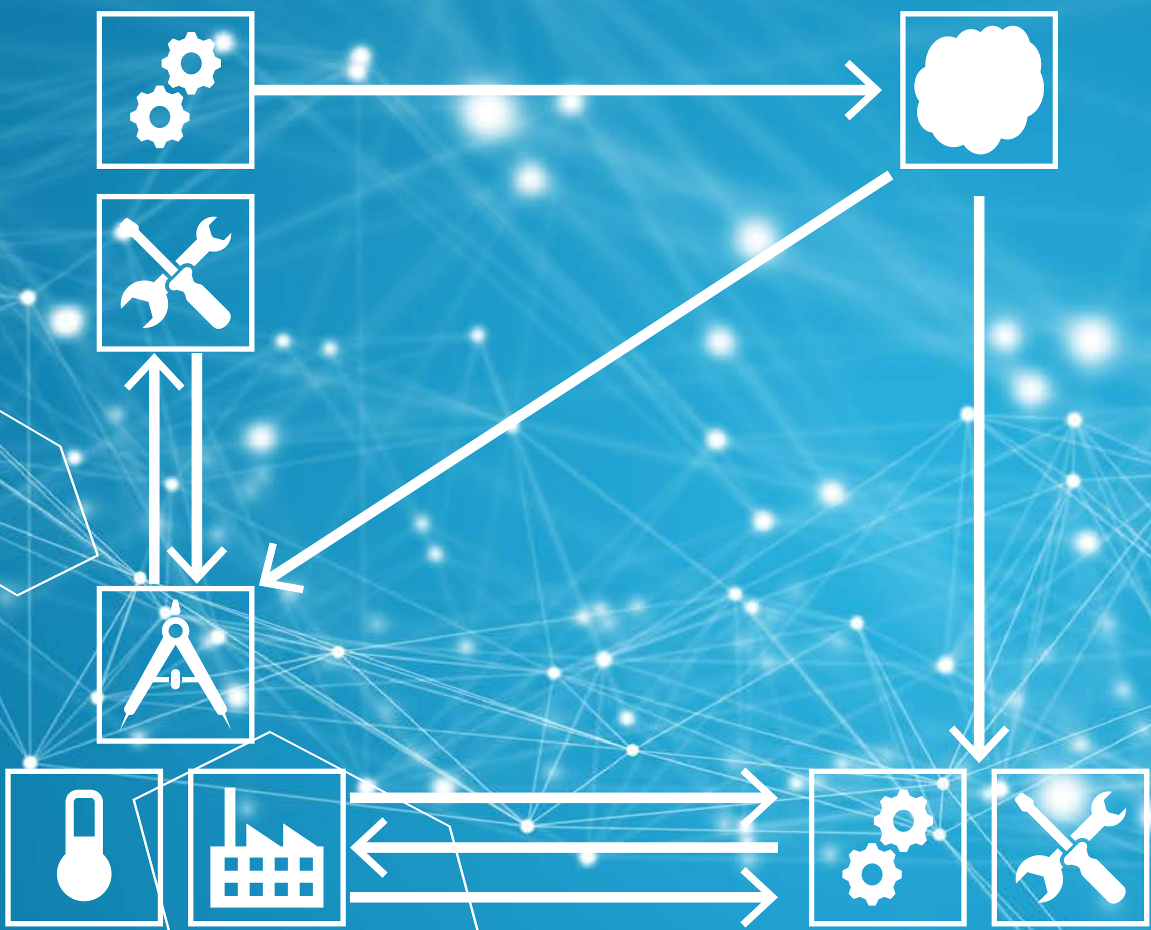
PLATTFORM INDUSTRIE 4.0

RESULT PAPER



Digital business models for Industrie 4.0

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1. Executive Summary

Through Industrie 4.0, Germany has created a globally recognized brand. Numerous countries have built their strategies for the transformation of production on German standards. For example, Industrie 4.0 has inspired China to seek an "initiative to completely enhance Chinese industry" with its 'Made in China 2025' plan. In addition, 20,000 publications about Industrie 4.0 have been published in German-speaking countries alone since 2014, with well over 100,000 published internationally.[1] Authors include ministries, scientific and research institutions, academies, associations, companies, consulting firms, trade unions and foundations. A remarkable achievement!

Since the start of the initiative in its current form in 2015, the discussion in Plattform Industrie 4.0 has primarily focused on the following components of an appropriate response to the digitalization of production: standardization, technology, security, legal framework conditions and the future of work. The debate initially focused on the digitalization of companies' internal production processes ("smart factory"). Now, in the context of changing value creation, business model innovations are increasingly coming to the fore as key distinguishing features of competitiveness. The steering committee of Plattform Industrie 4.0 therefore recommended the establishment of a new working group on 'Digital Business Models in Industry 4.0'. The working group was officially launched in March 2018.

Where does the group's focus lie? Business models are the foundation of entrepreneurial success. They embody the corporate mission statement and corporate strategy, and are the basis for investment decisions and organizational management.

The combinatorial effects of technology and industry trends are triggering increased interest in business model architectures. **Value creation is increasingly shifting from production to data-based services. Platforms play an increasingly important role in the orchestration of processes and business partners.** The corresponding exponential increase in the importance of data and services ("smart services") in value creation forces companies to critically reflect on their traditional business models and assess their future viability, however successful they may be at present. In the discussion, it is assumed more and more that competition no longer lies solely between products or process excellence, but rather between business models.[2] Key challenges in developing sustainable digital business models include building a supportive ecosystem, scaling the business model, assessing and monetizing data, and issues around platform governance.[3]

Core to successful business strategies is increasingly a value proposition to the customer that addresses their respective needs in a personalized way.[4] Real-time analysis of products' operational data enables services to be tailored to fit customers' circumstances and needs. Models such as 'as-a-service' or 'pay-per-use' enable the provision and billing of services according to the availability ('pay-per-hour'), productivity ('pay-per-piece') or functionality ('pay-per-feature') of the respective service.[5] Depending on the context, this results in a variety of options for designing data-centric business models that promise significant added customer value beyond the actual core of the service.

In addition to well thought-out business model architectures in different value creation networks, a number of politically created framework conditions significantly

1 Keyword search using Industrie 4.0 on Google Scholar (last accessed on 22 January 2019).

2 Gassmann, Oliver/Frankenberger, Karolin/Czik, Michaela (2013): *Geschäftsmodelle entwickeln. 55 innovative Konzepte aus dem St. Galler Business Model Navigator;* Munich.

3 There are different institutions that provide companies with support as they transition to the digital world, including guidelines and training programmes. These include the Mechanical Engineering Industry Association (VDMA), Fraunhofer IMW, PAiCE AG 'Cooperative business models for digital platforms', GEN-I 4.0, SmartFactory KL etc.

4 Dr Wieselhuber & Partner GmbH/Fraunhofer Institute for Manufacturing Engineering and Automation IPA (eds.) (2015): *Geschäftsmodell-Innovation durch Industrie 4.0. Chancen und Risiken für den Maschinen- und Anlagenbau;* Munich: 47.

5 Dr Wieselhuber & Partner GmbH/Fraunhofer Institute for Manufacturing Engineering and Automation IPA (eds.) (2015): *Geschäftsmodell-Innovation durch Industrie 4.0. Chancen und Risiken für den Maschinen- und Anlagenbau;* Munich: 35.

influence the success of digital business models as external factors. These include issues such as a sufficient capital base to finance growth in existing or new business areas. The availability of talent, the regulatory framework, and geo-trade policies can promote, or indeed hinder, the success of digital business models. There is a call to action in this regard, since restrictions on data traffic are currently increasing.[6] In addition, suitable legal frameworks for the use of data, as well as basic concepts or methods for the monetary and strategic evaluation of data, must be developed in order to make them tradable as an independent asset. Other important framework conditions are set by tax and accounting policy. The accounting standard IFRS16, which came into effect on 1st January 2019, changes leasing accounting and can reduce the attractiveness of 'as-a-service' models.[7]

MISSION STATEMENT

Understand mechanisms
Analyze and classify the building blocks and mechanisms of digital business models in the manufacturing industry.

Show opportunities
Identify the opportunities and challenges of digital business models and dynamic value networks.

Give recommendations
Provide guidelines for policy and industry to harness the potential of digital business models and to design dynamic value creation networks.

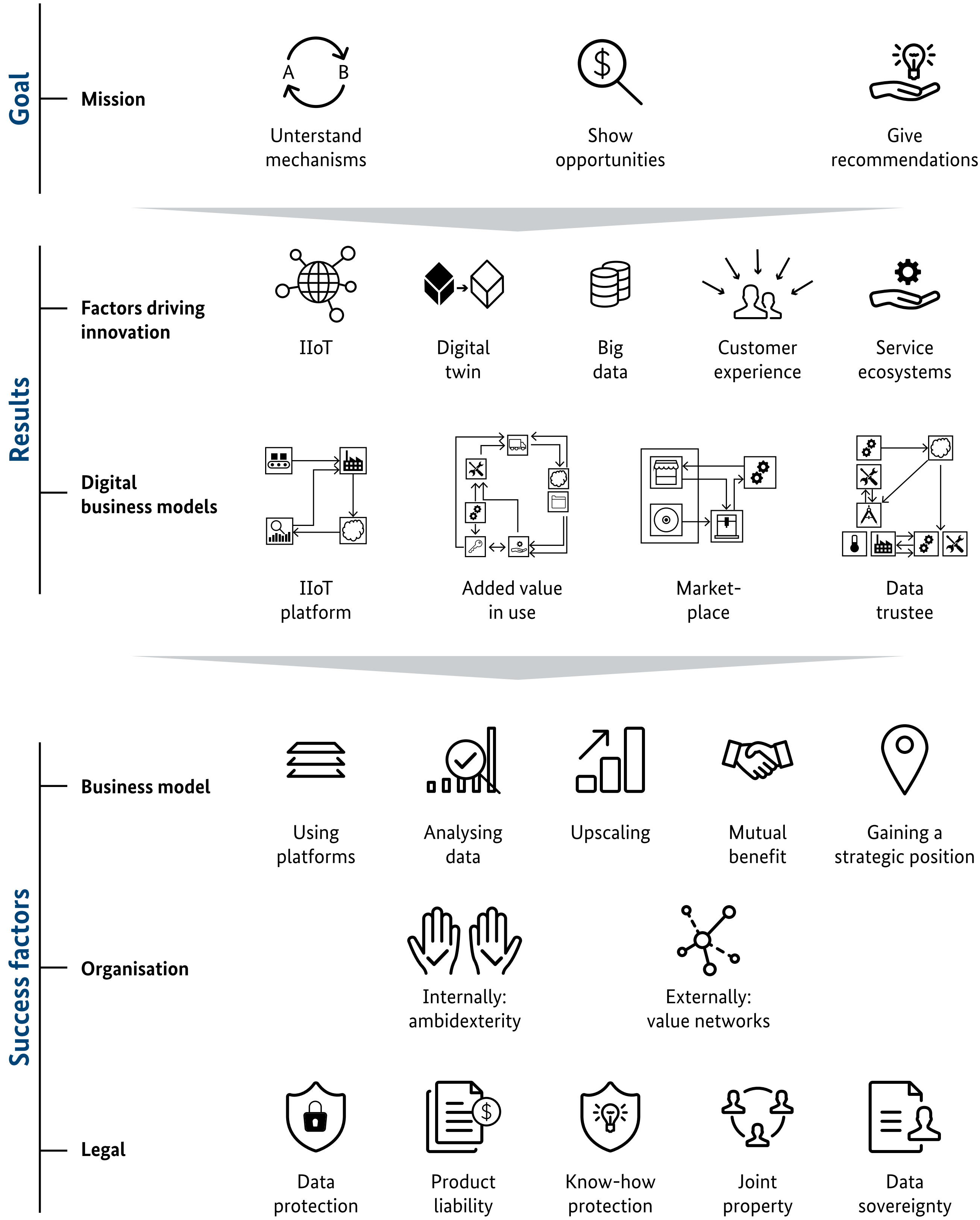
The working group has set itself the goal of understanding the architectures and dynamics of digital business models and providing recommendations for action in this complex and highly dynamic situation (see Mission Statement). In this first comprehensive report from the group, the topic is considered holistically: we analyze the drivers of digital business models, as well as issues around organization, legal framework conditions and economic benefits. At the heart of the report is an analysis of value creation networks in 22 practical examples (see appendix for list). However, it should be emphasized that this collection does not claim to be exhaustive and, in particular, does not constitute a special distinction for the named practical examples.

A key finding of this analysis is that digital services cannot be provided by one company alone. Cleverly orchestrated value creation networks, in which each partner wins, are the key success factor for digital business models.

6 Cory, Nigel (2018): *Cross-Border Data Flows.* Presentation of 3 May 2018. http://www2.itif.org/2018-gmu-cross-border-data-flows.pdf?_ga=2.65697193.643963749.1543490110-2035318496.1525173417 (29.11.2018).

7 Schmitt, Julia (2016): IFRS 16. *Neue Leasingbilanzierung ändert alles.* https://www.finance-magazin.de/finanzabteilung/bilanzierung/ifrs-16-neue-leasingbilanzierung-aendert-alles-1371581/ (29.11.2018).

Figure 1: Digital business models for Industrie 4.0



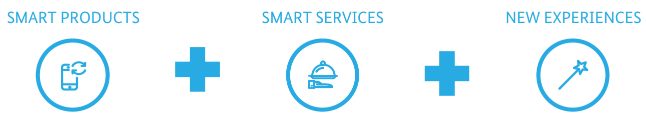
Source: Plattform Industrie 4.0

2. Factors driving digital business models in industry

2.1 Key features of digital business models

In order to win the global race for data-driven business models and create new value propositions, data needs to be assessed and made commercially viable. What's key is that we extend our focus from just products and production to operations that incorporate data-based services. The formula for this is: smart products + smart services + new experiences (see fig. 2).

Figure 2: Formula for the success of digital business models



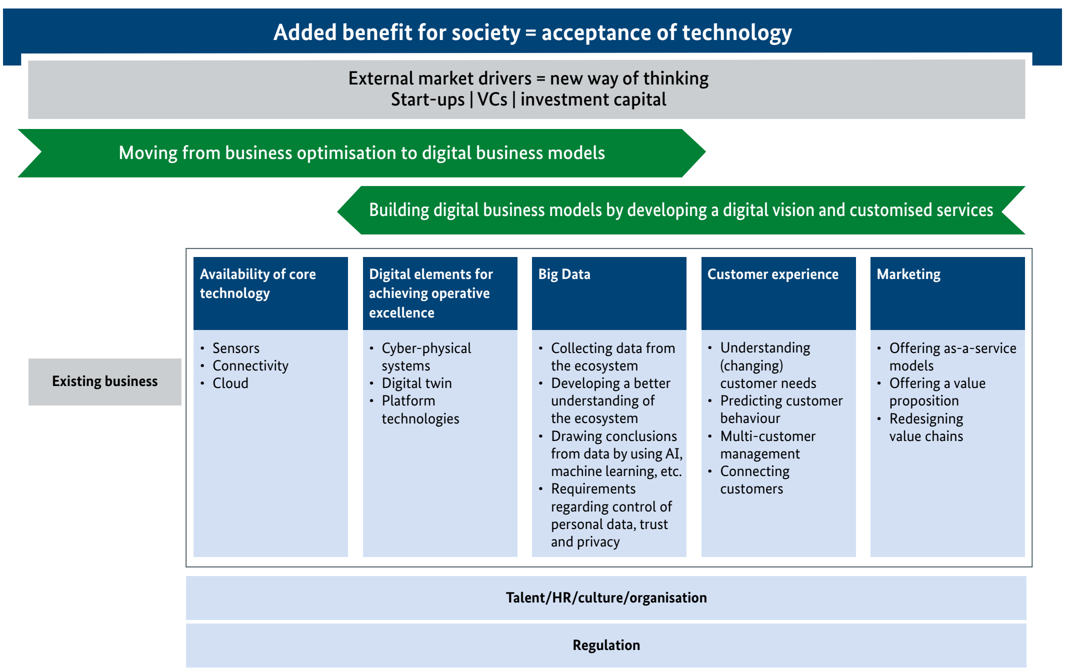
Source: Frank Riemensperger, accenture

There are a number of factors that influence the development of digital business models (see fig. 3). These include the added benefit that new technologies create for businesses and society, new customer requirements and outside factors such as government regulation and changing corporate cultures. The figure below highlights the most important factors driving digital business models.

2.1.1 Market drivers and new approaches to business in the manufacturing sector

Many US and Chinese companies are successful because they have a high level of capital available. US and Asian firms take higher risks compared to their German counterparts – a fact that should lead German companies to rethink their approach. The global share of corporate venture capital investment in overall venture capital investment is growing.[8] These investments are made to safeguard an existing technological edge or to access new and more agile forms of management. Investment on the US market continues to be considerably higher than that on the European market. European companies need to explore new ways of using investment capital and take higher risks if they want to keep up with the learning curve of other countries in terms of new key enabling technologies and ensure that they do not fall behind in the race for market dominance.

Figure 3: Factors driving digital business models



Source: Plattform Industrie 4.0

8 KPMG Enterprise (eds.) (2017): *Venture Pulse Q2 2017. Global analysis of venture funding.* https://assets.kpmg.com/content/dam/kpmg/de/pdf/Themen/2017/venture-pulse-report-q2-2017.pdf (31.01.2019).

2.2 Drivers and enablers of digital business models

Successful digital business models make use of leaps in technological innovation to market new value propositions (see fig. 3).[9] Companies need to use an ambidextrous approach: they need to optimise their existing business whilst at the same time developing a digital vision that places a strong focus on the individual needs of different groups of potential customers.

2.2.1 Availability of core technology

The development of digital business models is being driven by the rapid technological development and the increasing level of interconnectedness of machines, people, products and logistics. By using modern information and communications technology, different sets of data can be combined, allowing companies to monitor and align different processes from one central place. More and more technical systems use sensors, providing valuable status data in real time. The industrial internet of things (IIoT) – which combines different sets of status data in a central network – serves as the basis for the smart monitoring and operation of machinery and processes. Falling costs allow for the greater and scalable use of IIoT technology and cloud capacity.

2.2.2 Digital elements for achieving operative excellence

New technologies provide manufacturers with new opportunities and room for developing innovations that help make products more efficient across the entire lifecycle. Digital twins or cyber-physical systems can be used to create a digital image and collect all of the key lifecycle-related information.[10] Status data collected in real time helps detect irregularities at an early stage, increasing the efficiency of maintenance work. But the potential for industry does not end there. By connecting different pieces of machinery and allowing these to communicate with one another, industrial processes can be controlled remotely, leading to better utilisation of manufacturing capacity. Going forward, companies will be able to use digital twins along the entire value chain – from design and engineering all the way to operation. Companies seeking to make use of the benefits described require platform solutions that allow different sets of data to be combined.[11]

2.2.3 Big Data

Smart products create large amounts of data. The question that many companies are faced with is how they can collect and harness these large amounts of data. Being able to store, analyse and effectively use the data will become a key concern for all industrial companies and a determining factor for their success. This includes not only data from the company's manufacturing site, but also data collected from product users. In order to offset the necessary investments, companies need to build new business models that are based on smart services.

As the importance of data as the basis for developing smart services grows, solutions for sharing and trading data are needed. Data marketplaces can be a potential solution. They store data in a way that is in line with data autonomy and privacy rules and make the data available to authorised user groups whilst complying with high security standards.

One key tool for creating value from data will be artificial intelligence (AI). AI can learn from large sets of data and facilitate pattern recognition, component design and the handling of customer enquiries. AI is also an important tool for new market participants who are changing the terms of competition in their favour. Certain software firms for example, that have considerable expertise in the field of AI, are challenging established automotive companies in the race to develop the driverless car.

9 Engels, Gregor/Plass, Christoph/Rammig, Franz-Josef (eds.) (2017): *IT-Plattformen für die Smart Service Welt. Verständnis und Handlungsfelder* (acatech DISKUSSION); Munich.

10 Schulze, Sven-Olaf/Steffen, Daniel/Wibbing, Philipp/Wigger, Tobias (2017): *Digitalisierung der Produktentstehung. Die Automobilindustrie im Umbruch* (OPPORTUNITY); Büren.

11 Plass, Christoph (2018): *Wie digitale Geschäftsprozesse und Geschäftsmodelle die Arbeitswelt verändern.* In: Maier, Günter W./Engels, Gregor/Steffen, Eckhard (eds.): Handbuch Gestaltung digitaler und vernetzter Arbeitswelten. Springer Reference Psychologie; Berlin/Heidelberg.

SMEs can use AI to reduce scrap and downtime in manufacturing, avoid overproduction by better predicting demand, and slash costs for handling customer enquiries.

Companies are already analysing large sets of data to better understand their customers. For example, user data can provide insights into how and when the customer uses the product. This information is crucial for designing new business models.

2.2.4 Focusing on customer experience

As companies improve their ability to better understand and predict customer behaviour, they can adapt products and services to their customers' needs. However, this information is more than a boost for business. Today's customers expect companies to provide customised solutions. The focus is no longer on the product, but on providing a solution that solves the customer's problem. Customers no longer ask for a specific product (for example an aircraft engine), but for a particular outcome to be achieved consistently (for example the ability to fly). This means that customers' buying criteria are changing.

Today's customers are networking and communicating with one another, strengthening their position. They also expect personal contact and customised solutions. As the lines between different groups of customers become increasingly blurred, companies need to adopt a multi customer-management strategy. They need to be ready and willing to learn to understand different types of customers and their individual needs and provide customised solutions.

Placing a strong focus on delivering added benefit is key. **Companies which are able to quickly and accurately identify how to create added benefit for their customers will gain a competitive edge.** Developing an in-depth understanding of the customers' needs helps companies design and market products in a way that optimises the total customer experience, taking into account both the technical and the emotional dimension.[12]

2.2.5 Marketing

Interconnectedness means greater complexity – a fact that is also reflected in many companies' business models. Many companies generate revenue from intelligently managing or positioning themselves in a particular value network. This means that companies need broader strategies and learn to understand market participants who are located outside their core market segment.

Going forward, companies will need to place a stronger focus on redesigning value networks, not least because using platform business models requires them to work more closely with their competitors. Companies need to adapt the way they think towards a vision of an interconnected industry that provides profitable value propositions.

The trend towards as-a-service models – where companies sell the outcome a product provides rather than the product itself – reflects the greater demand for value propositions. As-a-service models mean lower investment costs for customers. Their financial risk is reduced and all responsibility – including, for example, the appropriate maintenance of the product – lies with the manufacturer. Manufacturers also benefit, because they can collect and analyse larger amounts of data on the use of their machinery. This helps them to considerably reduce the down-times of their machines and ask customers to pay more. They can also obtain a better understanding of the behaviour of their customers and anticipate how the customer experience can be improved. **Companies need to understand that a focus on providing added benefit for customers also means that all action needs to be geared towards making things less complicated for customers.**

There is also a trend towards ever shorter product and services cycles, which is particularly due to the fact that the development of these products and services is increasingly aided by IT.[13] This means that it becomes more and more important for companies to identify customer needs and customer groups as early as possible and quickly build sustainable business models. Companies aiming for long-term success in a constantly changing market need to recognise

12 Berry, Leonard L./Carbone, Lewis P./Haeckel, Stephan H. (2002): *Managing the Total Customer Experience.* In: MIT Sloan Management Review 43 (3).

13 Eggers, Justus (2016): *Produktentwicklung mit Lieferanten.* In: Jung, Hans H./Kraft, Patricia (eds.): Digital vernetzt. Transformation der Wertschöpfung. Szenarien, Optionen und Erfolgsmodelle für smarte Geschäftsmodelle, Produkte und Services; Munich: 71-88.

customer needs fast and quickly respond to these needs by developing profitable business models. Adopting a structured approach for recognising customer needs and developing the business models that can serve these needs is an important step. Business model templates – consistent, recurring combinations of business model components – can provide some first guidance for choosing a business model that suits a company's product and service portfolio.[14, 15] An in-depth analysis of one's value network is the next step. The next chapter sets out a systematic approach for describing these value networks in an easy-to-understand manner, using practical examples and the value scenarios derived from these.

14 Gassmann, Oliver/Frankenberger, Karolin/Czik, Michaela (2013): *Geschäftsmodelle entwickeln. 55 innovative Konzepte aus dem St. Galler Business Model Navigator;* Munich.

15 Heinz Nixdorf Institut Universität Paderborn (eds.) (2017): *Mit Industrie 4.0 zum Unternehmenserfolg. Integrative Planung von Geschäftsmodellen und Wertschöpfungssystemen;* Paderborn.

3. Analysis of practical examples

3.1 Motivation

We have selected, evaluated and systematically analysed 22 real-world practical examples of digital business models from the German industrial sector to better understand the driving forces underlying digital business models and in order to identify key elements and mechanisms associated with these. This analysis also includes practical examples that, ultimately, have not proven to be commercially viable. The list of examples provided here should not be considered as exhaustive, nor was it our intention to highlight these.

Key objective of this analysis is to encourage companies to evaluate their business model and to familiarize them with the mechanisms shared by all digital business models and the business-critical and strategic aspects related to their design.

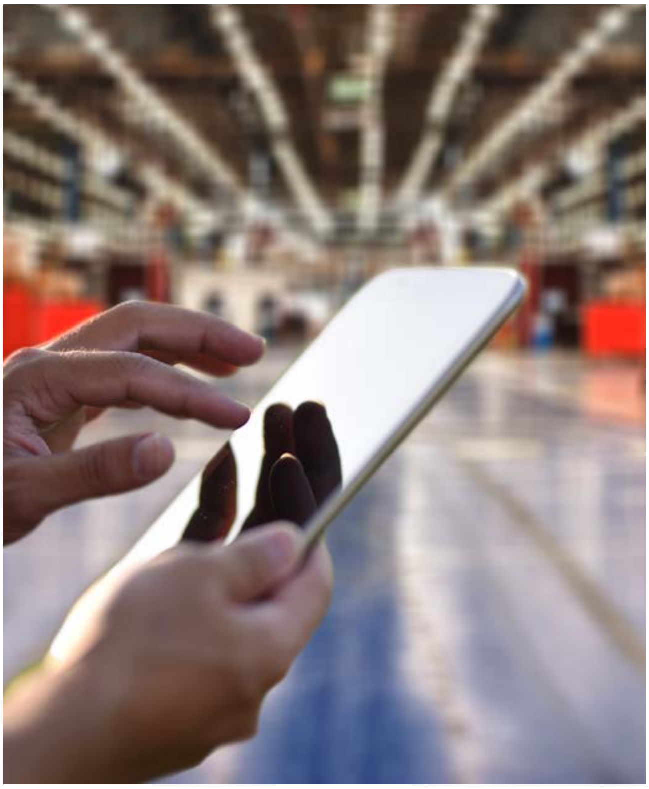
3.2 Methodology

We have identified four key value network scenarios with each of them exemplifying the key characteristics of a particular group of use cases. It is important to note that this analysis is only a first step and cannot be considered as comprehensive.

Each of them is based on a value network that is characterised by the following aspects:

- The nodes within a value network illustrates the role of the company.
- The lines within a value network illustrate the relations between different roles related to value creation.
- A company can have several roles within one value network. If this is the case, the same colour is used to highlight these roles in the graphs.

Additionally, we describe the business model of each individual company within a particular value network, based on the St. Gallen Business Model Navigator, by answering the following four questions:

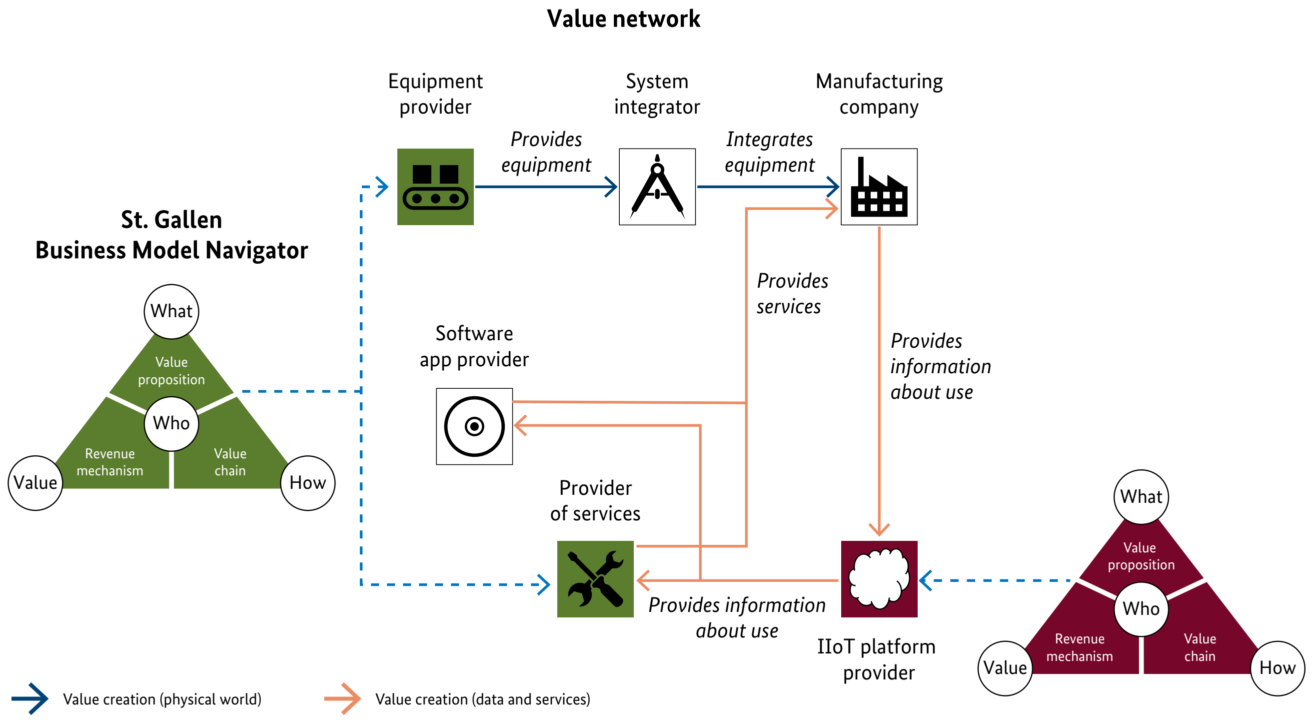


- **Customer:** Who are the target customers of the company?
- **Value proposition:** What does the company offer the customers?
- **Value chain:** How does the company, together with other partners, create this product or service?
- **Revenue mechanism:** How does the company create value in the form of revenue?

In order to be able to distinguish business model innovation from traditional product and process innovation, we define business model innovation if there is a significant change in the way a company answers at least two of these four questions. In the graphs below, answers that have changed significantly are highlighted in green.

The graph below explains the concepts of value networks and business models:

Figure 4: Analysis of business models within a given value network based on the St. Gallen Business Model Navigator
The analysis is preliminary and not representative and will be continued in the future



Source: Plattform Industrie 4.0

3.3 IIoT platform provider

3.3.1 Definition

An IIoT platform provider is a business whose purpose is to run an IIoT platform. An IIoT platform is a technical system that has the following capabilities:

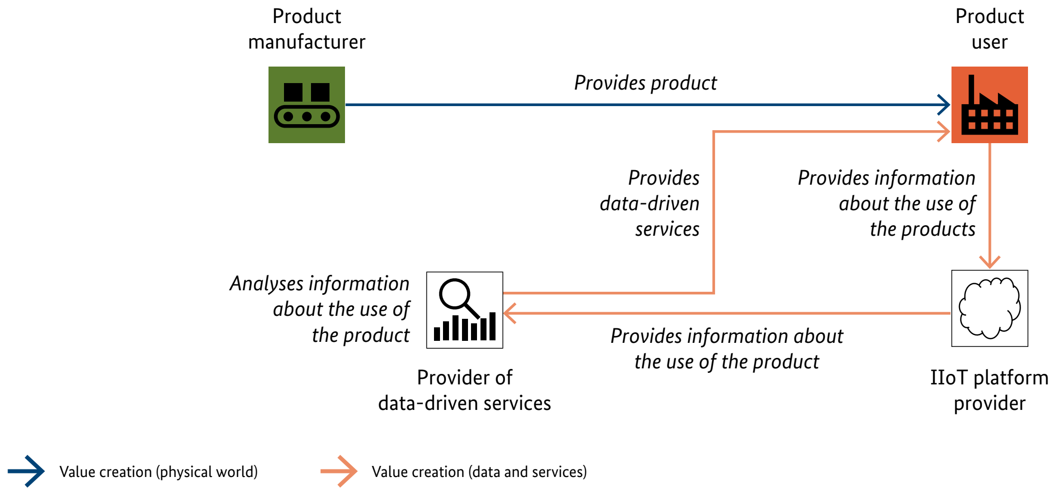
- It collects information about the use of (physical) things (sometimes called assets) that are installed, used and operated in a wide range of different contexts and can make this information available for further processing.
- Users can create IIoT applications.
- It can analyse information that has been collected and use this information to provide data-driven services.

3.3.2 Value network

The use of IIoT platforms is usually based on the value network shown below. Manufacturers not only want to sell a product to the user, they also want to collect information about the use of the product across its entire lifecycle so they can tap into additional sources of revenue by offering data-driven services and also obtain feedback on how to improve their product. IIoT platforms help with the technical implementation.

A comparably large number of our examples relate to IIoT platforms. In a number of these examples, there is one company that serves as the IIoT platform provider; the company manufacturing the product often also serves as the provider of the data-driven services. If the business of a company is to run a platform and it becomes part of the value network, we would consider this company being part of the platform economy. There are other practical examples where the product manufacturer develops or commissions the development of its own IIoT platform and also runs it itself. However, these practical examples are not discussed in this chapter.

Figure 5: IIoT platform provider value network



Source: Plattform Industrie 4.0

3.3.3 Practical example

Calvatis, one of the leading Detergent Suppliers in the world, was asked by one of its large customers in the Food & Beverage industry to supply dispensing units and the cleaning detergents for its washing lines, with a central monitoring and control system. This system is required to (i) regularly and closely monitor and document the process parameters of the washing lines; (ii) help optimize the resource usage: water, energy, detergents and food ingredients; and (iii) provide the solution on the cloud, so all results are readily available and can be accessed from a central location. Calvatis chose Siemens MindSphere providing secured end-to-end solutions for connecting devices, storing data and developing and running applications on a managed service platform. MindSphere helped Calvatis to optimize resource usage and to achieve a 10 percent reduction in downtime and a six percent reduction in the use of cleaning fluid. This also enabled Calvatis to offer additional value-added services to its customers.

3.3.4 Changes in the business models

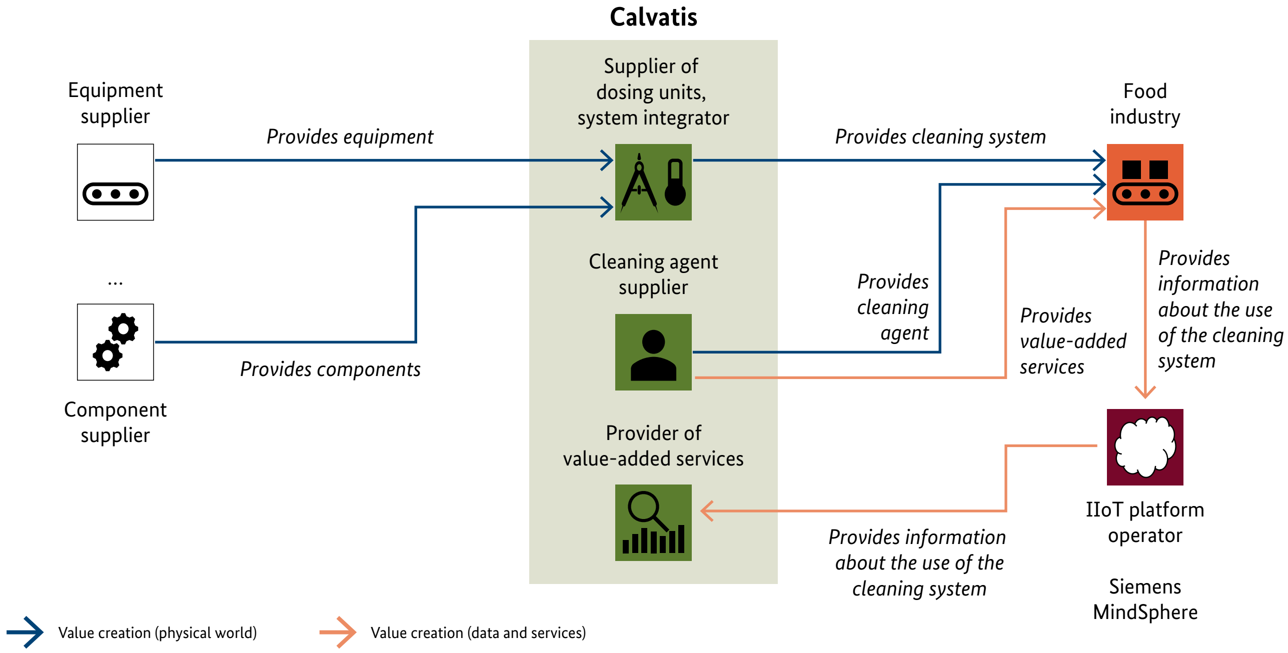
The changes in the companies' business models can be summarized as follows:

- Siemens is the IIoT platform provider of MindSphere. Siemens provides a new value proposition and a new revenue model for its client base orchestrating manufacturers and users of the product in a value network.
- The cleaning agent supplier also continues to target the same customer. However, by offering data-driven services, it creates a new value proposition and a new revenue model and includes a new partner – the IIoT platform provider – in the value network.
- For the meat-processing company, the only thing that changes through the inclusion of an IIoT service provider is the value network.

3.3.5 Summary

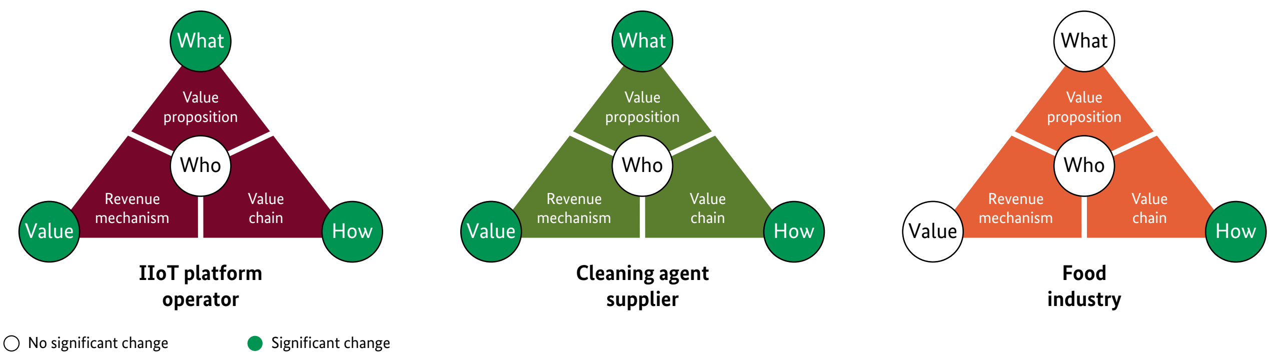
- **Value proposition:** The IIoT platform provider provides its customers with high-performance infrastructure they can use to provide data-driven services. This allows customers to focus fully on their core business.
- **Value chain:** As many of the different practical examples use IIoT platforms, the IIoT platform provider will likely be part of a wide range of different value chains. It will therefore try to create an ecosystem that helps it integrate as many partners as possible into these value chains.

Figure 6: Value network for the practical example: IIoT platform for optimising the use of cleaning agent



Source: Plattform Industrie 4.0

Figure 7: Changes in the business models for the practical example: IIoT platform provider



Source: Plattform Industrie 4.0

- **Revenue mechanism:** The IIoT platform provider charges its customers a fee related to the use of the platform, taking into account in particular the number of pieces of equipment connected and the volume of the data that is transmitted and analysed.

3.4 Value adding services in operation

3.4.1 Definition

The term value adding in operation looks at a business model from the perspective of the customer. A manufacturer sells a product (generating one-off revenue for the manufacturer) to a third party (who becomes the owner of the product). The owner allows another company (service provider) to generate value through this product. The service provider ensures that the end customer (user of the product) can use the product at all times. The end customer's main benefit is that he can outsource activities that aren't part of his core business.

3.4.2 Value network

In the following table, two practical examples are explained in terms of the underlying value networks. The value networks include several roles, all of which contribute to and benefit the network:

Table 1: Roles within the value network

Roles	**Practical example 1** – Tire-as-a-Service	**Practical example 2** – Equipment-as-a-Service
Product user	Fleet operator	Producer
Service provider (orchestrates the service)	Service provider (Michelin Solutions)	Equipment manufacturer (Bosch)
Product manufacturer	Tire manufacturer (Michelin, Continental, ...)	Equipment manufacturer (Bosch)
Maintenance network for the product	(Manufacturer's or external) maintenance network	Equipment manufacturer (Bosch) or external maintenance service providers
Owner (buys and leases)	Service provider (Michelin Solutions)	Finance company (Munich Re)
IoT hardware integrator	Telematics provider	IoT platform provider (Bosch and others)
IoT solution provider	Software firm + cloud provider	IoT platform provider (Bosch and others)

Source: Plattform Industrie 4.0

3.4.3 Practical examples

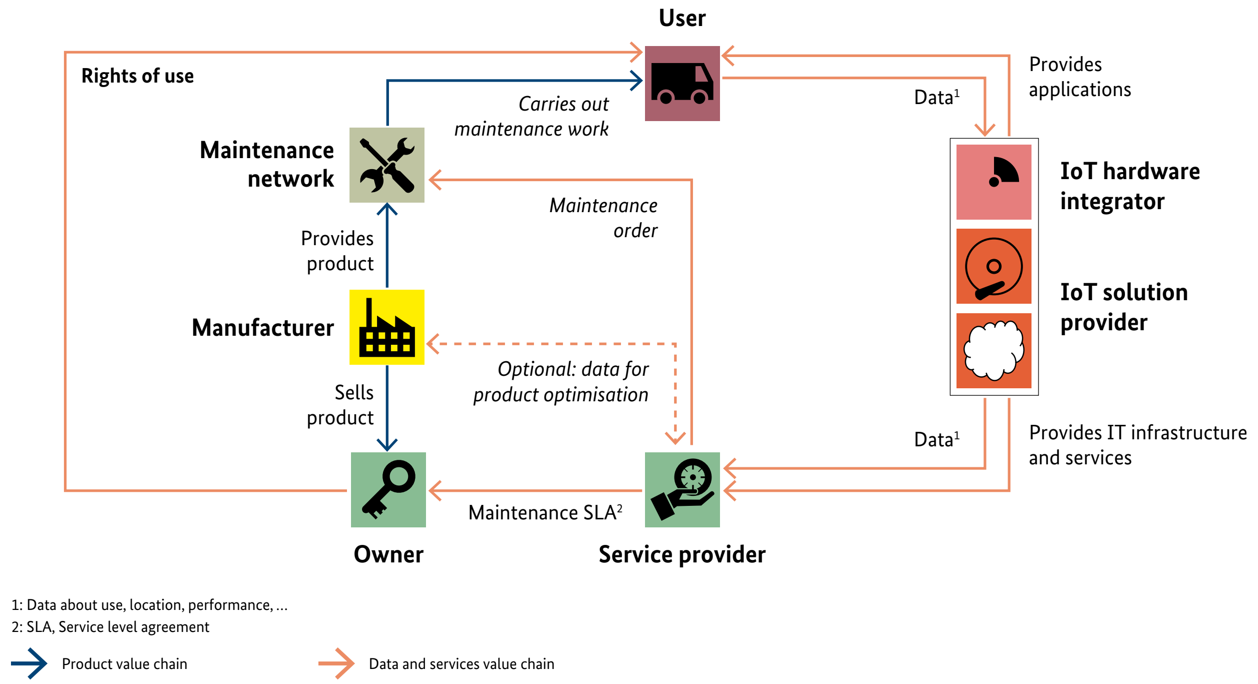
Practical example 1 – Tire as a Service

A tire manufacturer sells tires to a service provider, who leases these to a fleet operator. In contrast to practical example 2, the company who is the owner also serves as the service provider. The service provider ensures that the fleet operator (user) is provided with fully functional tires as a service and with extensive tire management services. The owner and service provider coordinate the procurement and installation of the tires and monitors their condition. The owner and service provider use a maintenance network to provide maintenance services. The network allows the installation of tires from several different manufacturers. The work is commissioned directly by the owner and service provider who monitors the condition of the tires remotely using an IoT platform. The data on the cloud-based IoT platform is analysed by the owner and service provider and is used for invoicing and for coordinating service provision.

Practical example 2 – Equipment as a Service

The equipment manufacturer sells the product to a finance company (owner) who leases the equipment to the producer, charging a fee. In order to ensure that the service is used and priced in line with the terms of the contract, and that the equipment is properly maintained and repaired, the equipment is linked up to an IoT platform. The service provider is responsible for carrying out maintenance and repair work and for providing spare parts. The finance company can access the data that is stored on the IoT platform remotely, which allows it to better assess the extent to which the equipment is being used. This allows a pay-per-use pricing model to be used, whereby the user only pays for the time he actually uses the equipment. It also allows the user to be provided with additional financial and warranty services.

Figure 8: Value network for practical example 1 – Tire-as-a-Service



Source: Plattform Industrie 4.0

3.4.4 Changes in the business models

The changes in the companies' business models can be summarized as follows:

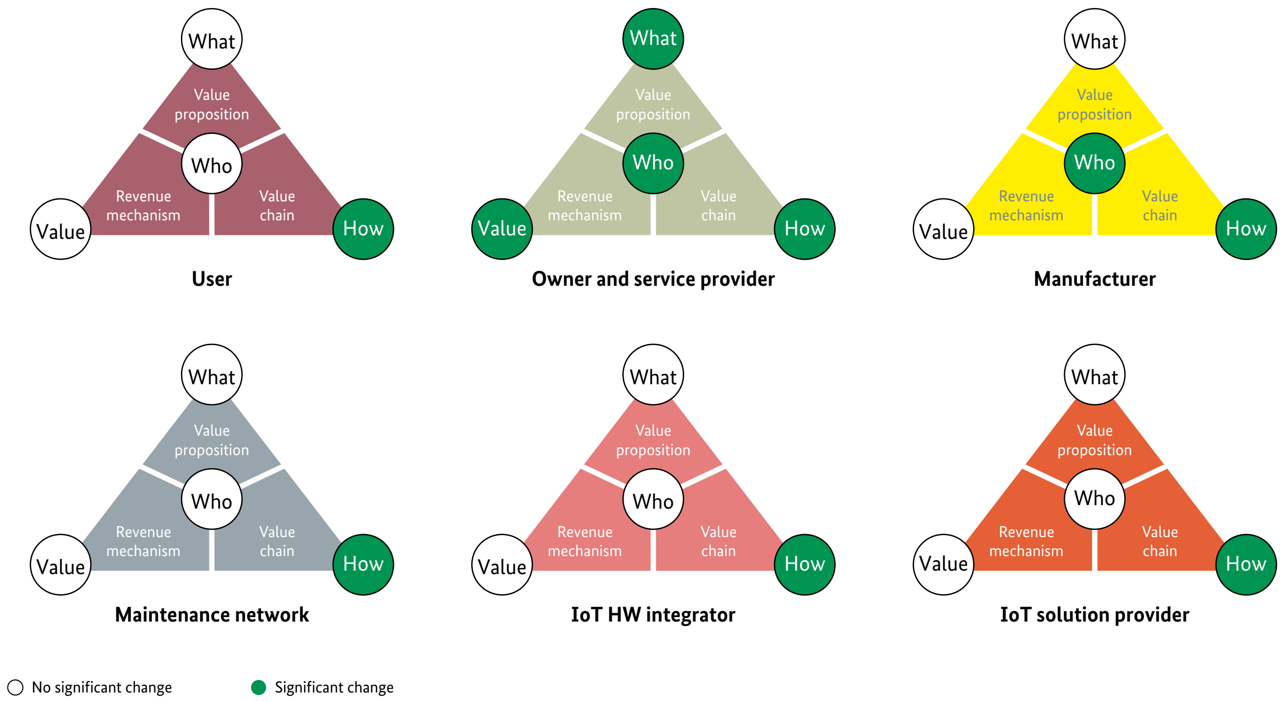
- The user (fleet operator) is integrated into a new value chain. Instead of buying the actual tires for the fleet, the fleet operator acquires a value proposition promising fully functional tires.
- The owner and service provider positions itself as a new player in the market and includes additional companies in a value chain he coordinates.
- The service provider becomes the manufacturer's main customer.
- The service provider commissions all workshop services, which are provided via the maintenance network.
- The IIoT hardware integrator and the IIoT solution provider allow data about the use of the tires to be exchanged between the user and the service provider.

3.4.5 Summary

In the practical example Tire as a Service, the role played by the owner and service provider – who is providing the added value in use – can be summed up as follows:

- **Value proposition:** The owner and service provider provide the user with added value in use by providing it with a wide range of tire management services.

Figure 9: Changes in the business models for practical example 1 – Tire-as-a-Service



Source: Plattform Industrie 4.0

- **Value chain:** The owner and service provider position itself as a new player in the market and creates a new value network for companies that are already active in this market. He orchestrates both the physical activities and the data flow.

- **Revenue mechanism:** The owner and service provider charges the user a fee that is based on the actual use of the service. The revenue generated from this is used to pay the other player in the value network.

3.5 Marketplace

3.5.1 Definition

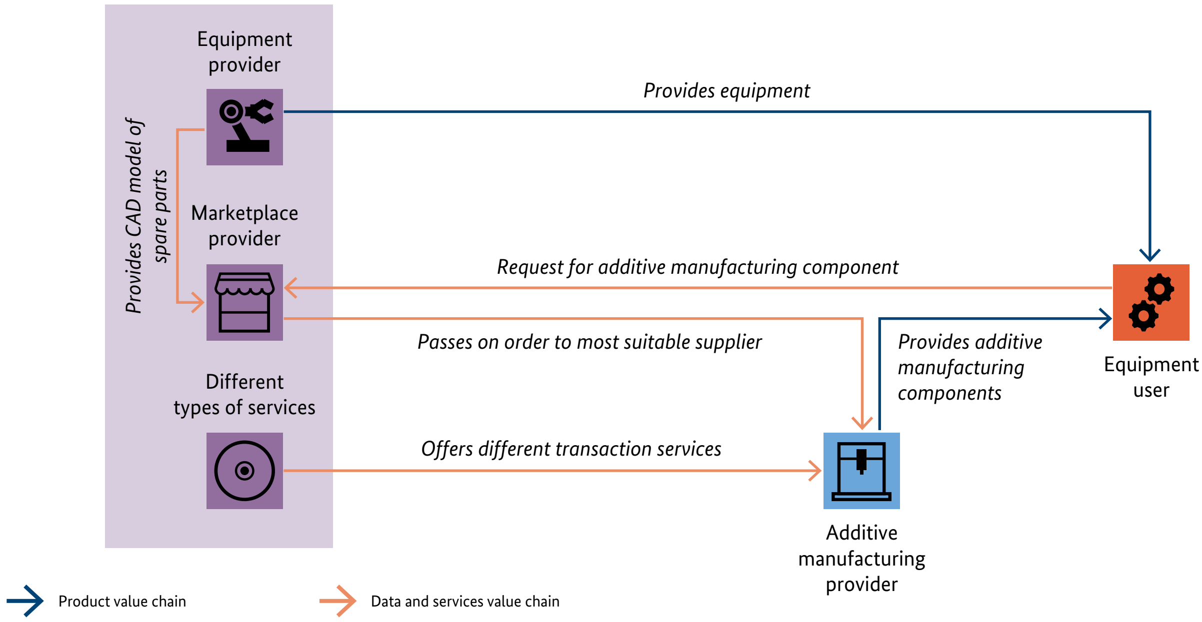
A digital marketplace coordinates supply and demand to facilitate transactions (two-sided market). We can distinguish between open and closed marketplaces. Open marketplaces are open to all service providers, whilst closed marketplaces are subject to a pre-selection of suppliers by the marketplace provider – in some cases, the provider might even be the only supplier on the platform.

A key success factor for a digital marketplace is critical mass on both sides of the market. It will only be worthwhile for the supplier to be active on the marketplace if there is sufficient demand. And the marketplace will only be able to attract sufficient demand if there is sufficient number of suppliers to choose from. Once achieved, network effects begin to work. As these are self-reinforcing, the market, from then on, basically grows by itself.

Marketplace providers offer information and search functions, service provision, invoicing and assessment mechanisms. They provide these by themselves or via an external service provider. Access to and use of the services is subject to a fee.

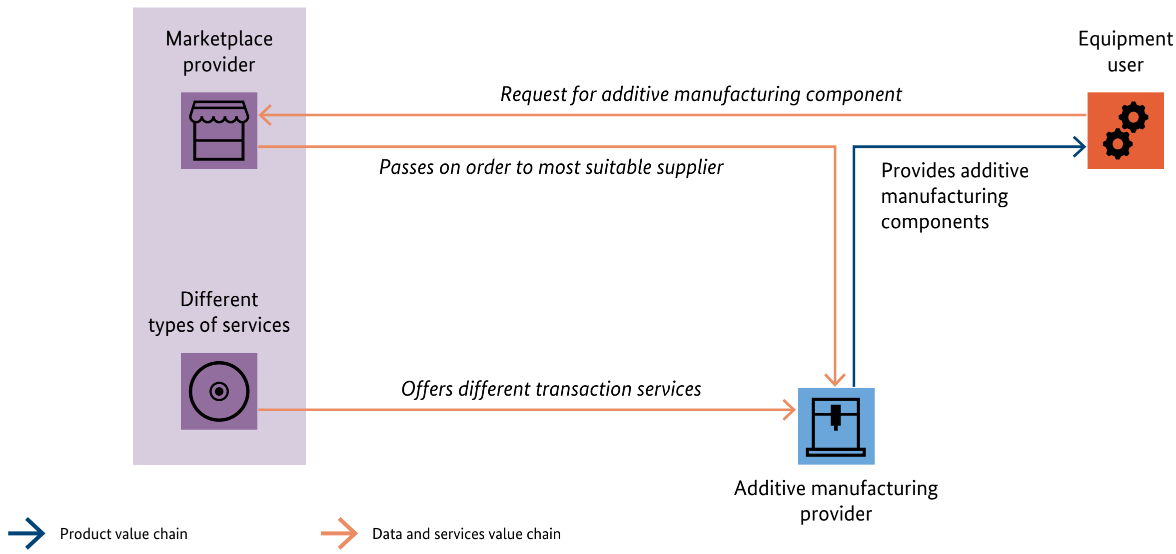
3.5.2 Value network

Figure 10: Closed marketplace value network



Source: Plattform Industrie 4.0

Figure 11: Open marketplace value network



Source: Plattform Industrie 4.0

3.5.3 Practical examples

Closed marketplace

Graph 10 illustrates an example of the distributed production of spare parts through additive manufacturing. This value network is based on a platform that is operated by company DMG Mori as a closed marketplace. Once a spare part has been ordered via the platform, the platform automatically selects the additive manufacturing contractor who is able to produce the part and who is located most closely to the party that has placed the order. The platform provides both the specifications for the spare part and the additional services that are needed to complete the transaction (for example certification, invoicing). The platform provides DMG MORI with a wide range of new business model opportunities. Going forward, the company could use the platform not only for itself, but open it up to other equipment manufacturers to run it as an open marketplace.

Open marketplace

3YOURMIND is a start-up that offers software platforms which help companies and 3D service providers optimise additive manufacturing processes and therefore harness the full potential of additive manufacturing. Digital workflows link up teams and production sites, optimise equipment utilisation rates and allow informed decisions to be taken on production-related issues. 3YOURMIND offers both a cloud-based platform and a platform that can be hosted in-house, which allow the entire additive manufacturing process to be managed efficiently.

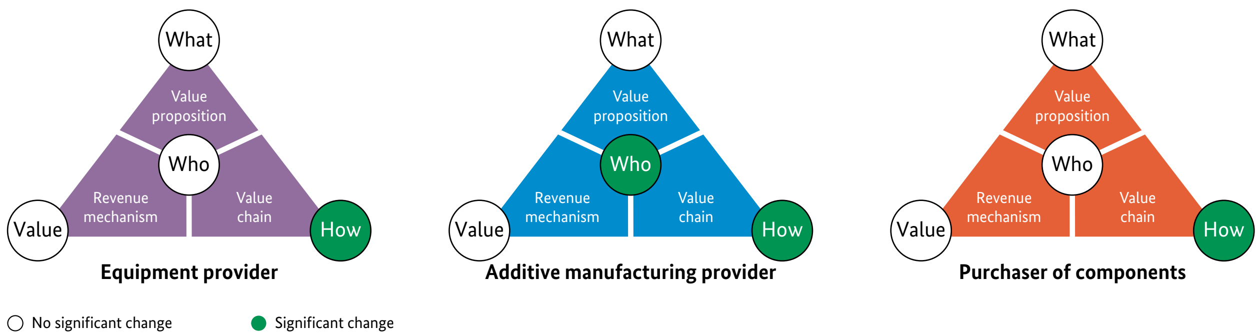
The Enterprise platform gives users access to a network of (in-house and external) suppliers providing different types of additive manufacturing devices, allowing on-demand additive manufacturing. 3YOURMIND is positioning itself as an open additive manufacturing marketplace provider.

The eCommerce platform helps additive manufacturing service providers to run their own shop that customers can use to order the 3D models they would like to have printed. Price calculations, feasibility assessments and printing optimisation can all be done via the platform. It also allows users to access information about orders and the production stage.

3.5.4 Changes in the business models

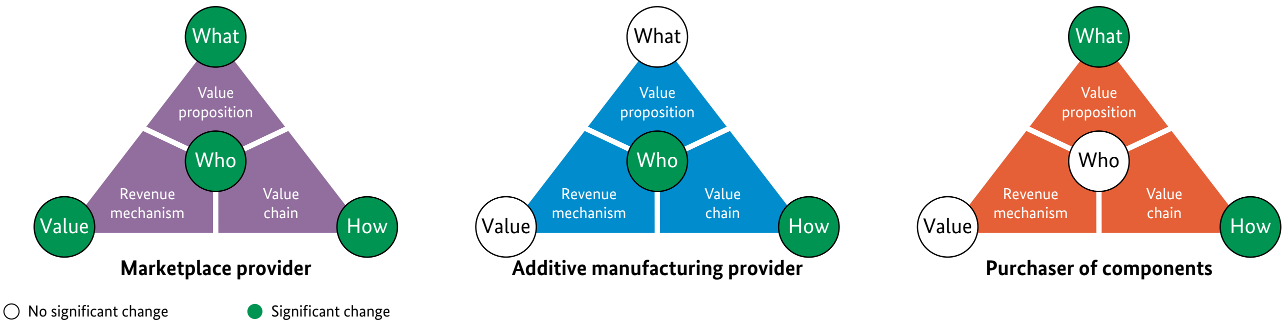
The changes in the companies' business models can be summarized as follows:

Figure 12: Changes in the business models in a closed marketplace
Practical example: DMG Mori



Source: Plattform Industrie 4.0

Figure 13: Changes in the business models in an open marketplace
Practical example: 3YourMind



Source: Plattform Industrie 4.0

3.5.5 Summary

- **Value proposition:** The marketplace helps to improve delivery times, improves the availability of parts, leads to better equipment utilisation rates and reduces transaction costs. In addition, those buying components in an open marketplace have a better opportunity to offer more 3D components and therefore position themselves in a market segment that had previously remained closed to them.

- **Value chain:** Marketplaces help match supply and demand. Open market-places also help further optimise network effects on the demand-side.

- **Revenue mechanism:** The marketplace provider can charge a fee for using the marketplace and/or market its software (e.g. as a pay-per-use model).

3.6 Data trustee

3.6.1 Definition

The data trustee model enables trading of data. Traditional value networks, which have predominantly been based on physical products, are enhanced in order to allow the aggregation, anonymisation and analysis of data from a wide range of different sources and companies and the monetisation of this data. In these value networks, data trustees play a key role as a neutral platform. Companies that provide part of their data to a data trustee not only receive money for this; as a customer of the data trustee, they can also gain access to a more extensive data-base that may even contain pre-analysed data and can exchange data with other companies in a secure and standardised manner.

3.6.2 Generalised value network

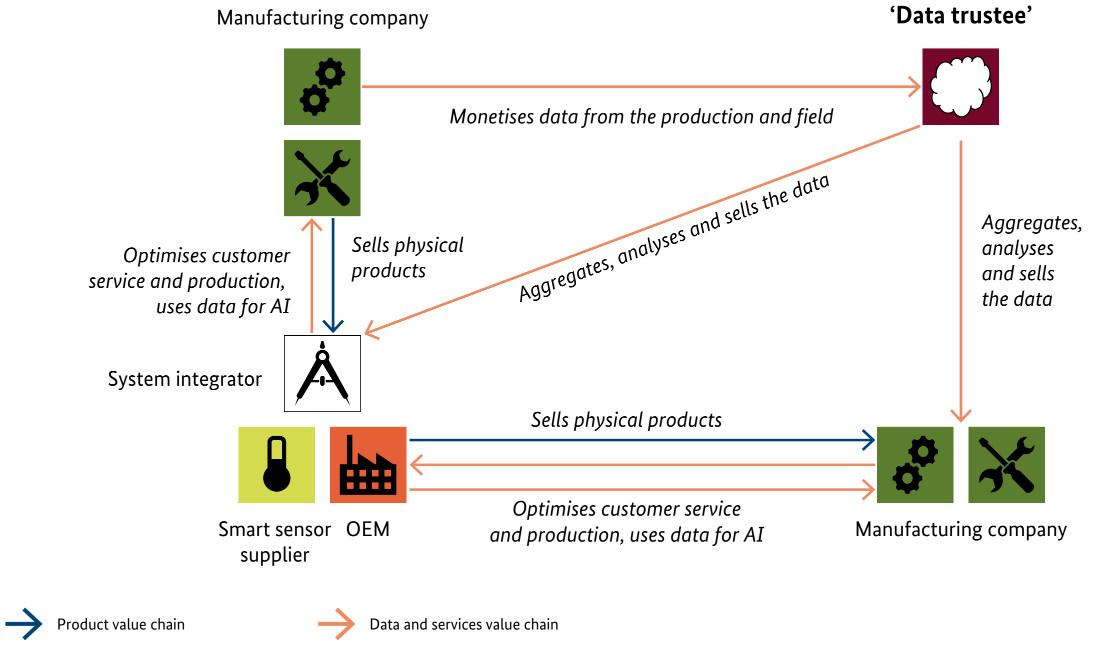
What is the value proposition and revenue model for different types of business relations?

- **Manufacturing companies/OEMs:** Customer, production, field and company data is secure through a neutral party and can at the same time be monetarised, enhanced by adding data from external sources, and used for the company's development or for other purposes. The manufacturing company supplies and monetarises the data. At the same time, it is a customer of the data trustee. This means that the same companies take on different roles in different situations.

- **Data trustee:** The data from one company is combined with additional data across supply chains, continents and existing business relations. The data trustee provides a neutral platform, assesses the quality of the data, takes care of IT security, and ensures that the terms regarding data use are complied with. He is thus paid a fee to ensure that companies maintain control over their data and that the data is anonymised. This means that the data trustee enables transactions and business models that would otherwise have been unprofitable or unfeasible and in doing so helps make the market more efficient.

- **System integrator, smart sensor supplier, original equipment manufacturer:** Data trustees help companies obtain data for optimising their customer service, training AI systems, expanding their product portfolio, improving efficiency, optimising production and/or R&D in a cost-efficient manner as they no longer need to store and analyse the data themselves.

Figure 14: Data trustee value network

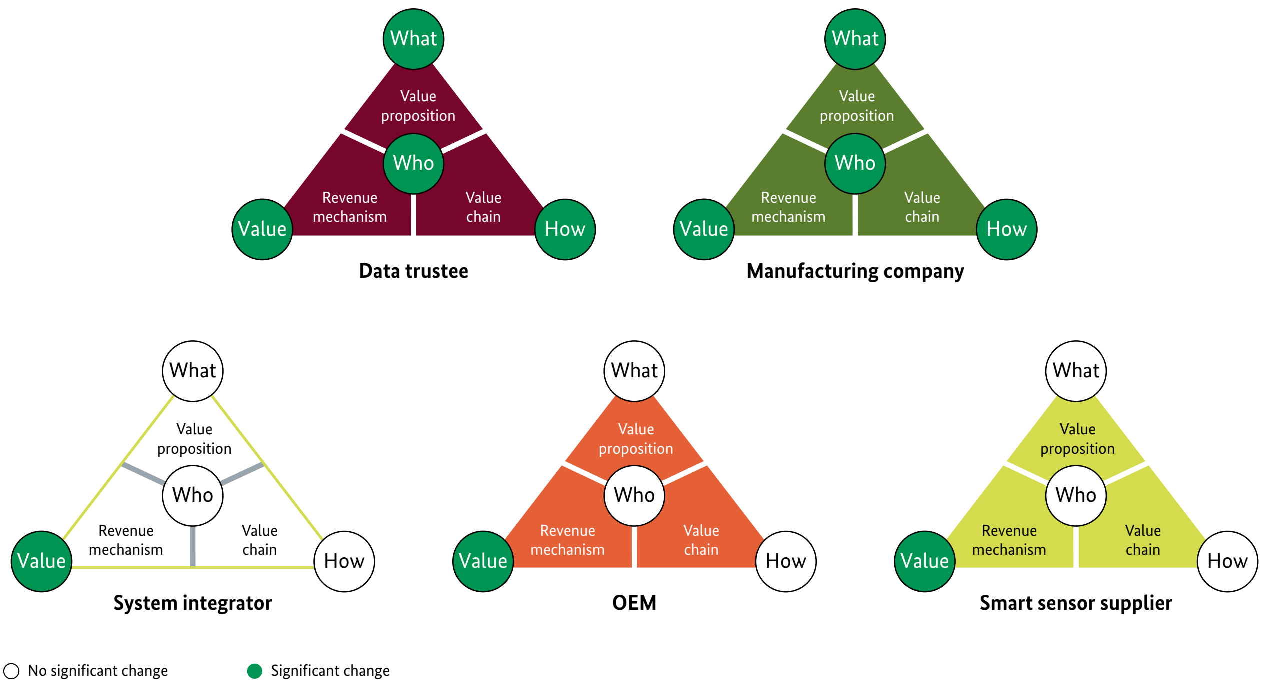


Source: Plattform Industrie 4.0

3.6.3 Changes in the business models

The data trustee establishes itself as a new market player with an entirely new business model. In contrast, the manufacturing company significantly changes the way it generates value as it combines existing physical products with services. The manufacturing company may even opt for a contracting model, selling not the product itself, but rather the value generated by the product. Capturing relevant data for optimising products or using additional data for research and development becomes even more important. These services are based on data, which help to not only broaden the value proposition, but also to gain more knowledge about one's customer base. In the past, many component manufacturers knew nothing at all about where these components were installed or how these were used, but data trustees may be able to provide component manufacturers with this kind of information. System integrators, original equipment manufacturers and smart sensor suppliers can broaden their value proposition towards customers and existing suppliers. This means that the most significant change is an increased value proposition.

Figure 15: Changes in the business model related to data trustees



Source: Plattform Industrie 4.0

3.6.4 Practical example

A number of first projects are currently being launched, for example at TÜV Süd. TÜV SÜD has launched the TÜV SÜD Data Trust Center – the first cooperation project between TÜV and IBM. "The Data Trust Center will serve as a data trustee, providing secure, neutral and unbiased access to data on modern and highly automated vehicles", CEO of the Mobility Division at TÜV SÜD Patrick Fruth says. For this purpose, data from different vehicle manufacturers can be collected on the platform neutrally and access to this data can be provided to other parties such as service providers, insurance companies and authorities. Vehicle owners and/or vehicle manufacturers need to consent to or authorise the use of the data before it can be used. The Sealed-Cloud technology developed by Uniscon – which has been part of TÜV SÜD group since August 2017 – is used to ensure that the data is stored, processed and transmitted in a reliable and secure manner and that data protection rules and regulations are complied with. Using this technology ensures that the unencrypted data that users store or process on the platform cannot be accessed by others, not even by the platform provider.[16]

Other practical examples for this type of value creation scenario (or variations of it) are Munich Re's data trustee model for accident-related data, Deutsche Telekom's Data Intelligence Hub (DIH) and Airbus' Skywise Platform. In addition, the International Data Spaces Association (IDSA) is also worth mentioning; it has created a standardised reference architecture (of which several exist) for this type of value creation scenario which is used, for example, by the DIH.

3.6.5 Summary

- **Value proposition:** In this type of value creation scenario, the key player will certainly be the data trustee. One question that needs to be answered in this context is whether a neutral monitoring body – like an auditor – is needed to monitor this process. It also remains to be seen as to whether and to what extent B2C platform trends can be transferred to this platform scenario and whether the success of B2C platforms can be repeated in the B2B area.

- **Value chain:** As we take a close look at the new value creation models that are being created, we see that products and services can no longer be clearly separated from one another. This is another key element of this type of value creation scenario. Data, and therefore to some extent services, are no longer a mere addition to a physical product, they become products in themselves.

- **Revenue mechanism:** The question as to whether this value creation scenario will be successful hinges on whether the data can be made available for everyone at fair and attractive prices. Do we need central or perhaps even governmental mechanisms to determine the value of the data? How can SMEs in the manufacturing sector determine the price of the data they generate – in general or based on use or value added? Most importantly, the value of data needs to be assessed systematically and extensively and monetarised accordingly.

3.7 Initial findings and recommendations on building digital business models

The ambition is to provide companies not only with an overview of the digital business models that exist, but also with guidance as they build their own digital business model – which is a key task for any entrepreneur. As the four value creation scenarios analysed indicate, it is critical to have a clear value proposition and/or position oneself strategically within a value network. In addition, the value creation scenarios also provide an insight into the business-critical role and mechanisms of value creation networks, which need to be taken into account and factored in as companies build a digital business model. The following points – listed in logical order – need to be highlighted:

16 TÜV SÜD (2018): *TÜV SÜD und IBM vereinbaren Kooperation.* Press release of 18 July 2018. https://www.tuev-sued.de/tuev-sued-konzern/presse/pressearchiv/tuv-sud-und-ibm-vereinbaren-kooperation (31.01.2019).

- **Structural changes in value networks:** In each of the four value creation scenarios , we can see a new player establishing itself in the value network – a player who is either providing a **platform** (IIoT platform provider, marketplace, data trustees) or whose business model is largely based on the use of a platform (added value in use).

- **Optimisation of an existing value creation process:** In the three value creation scenarios that are shaped by platform providers, we can find platform **users** who are considerably expanding their original business model. In some cases, there is a significant change in the way users answer several of the questions of the St. Gallen Business Model Navigator, which is a sign of **business model innovation**. These business model innovations lead to an **optimisation of existing value chain processes** on the side of the customer. This optimisation of existing value chain processes on the side of the customer can also be found in the platform-based 'added value in use' scenario.

- **Data use and analysis:** Important elements in the value chain scenarios described include the **collection** of **information on the operation and use** of products, which is done based on a bilateral contract **detailing the terms and conditions for using the data and analysing the information**. The data that is collected and analysed is then used to help the user improve his/her use of the product and help the provider tap an additional source of revenue while the product is already in use and obtain information on how the product can be further improved.

- **Scalability of the business model:** The **scalability** of a business model is a key factor determining whether a platform provider can successfully establish itself in the value network. In some cases, the purpose of the platform is to help the user offer his/her customers a new value proposition. Every company needs to weigh very carefully whether they should set up their own platform (as exemplified by the new player in the 'added value in use' scenario) or whether they should use an existing platform (as shown by the supplier of cleaning agents in the 'IIoT platform provider' scenario).

- **Added value for all players involved:** The new value networks will only be successful on the market if all of the **market players involved** are able to generate **additional value** or are at least be able to maintain the market position they held under their previous business model.

- **Strategic positioning in the value network:** It is therefore crucial for a company to attain a **robust**, clear and undisputed **position** in the new value network in the medium and long term in terms of the value added it creates. This means that companies need to continuously scrutinise and develop their business model, not least in terms of the **role they play in the value network**.

- **Complexity and knowledge intensity in industrial value networks:** The value networks that exist in the manufacturing sector are usually much more complex than those in the B2C sector and require in-depth knowledge of the relevant sector. These value networks very often require specific systems integration in order for them to be built up and operated. Consequently, self-reinforcing network effects are more difficult to achieve in industrial B2B platforms – or take more time to be achieved with impact on both pace and cost of growth.

4. The impact of digital business models on business organisation

Companies seeking to grow by adopting a digital business model need to make changes to their business organisation. Two different approaches exist: the first one is digitising production (Industrie 4.0), which creates a more distributed structure. Digitalisation means that information is distributed throughout the entire company and decision-making becomes more decentralised. This process of decentralisation therefore takes the organisational changes related to automation and new ERP systems to a new level. In contrast to this, digitalisation in the context of smart services development means creating central organisation units to develop and implement the ideas around smart services (e.g. connectivity, platforms). This represents a change away from previous tendencies that promoted decentralisation as a factor driving growth in the services sector.[17]

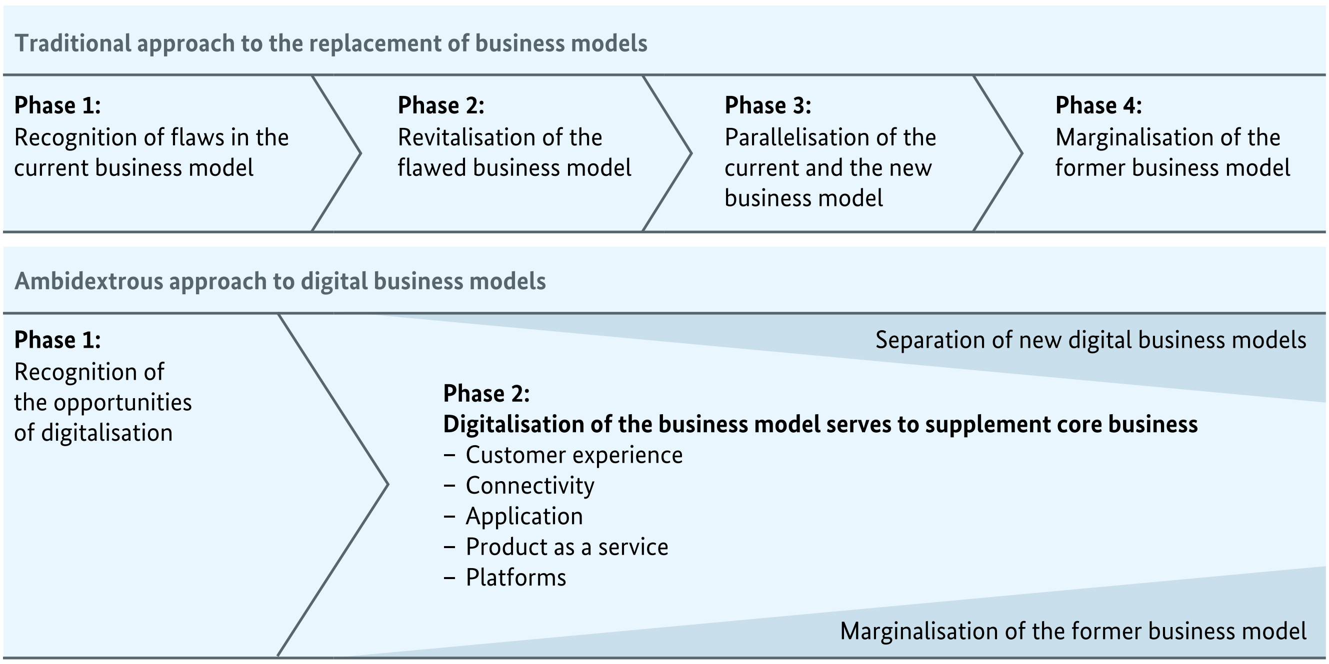
Trying out new digital technologies encourages companies to harness the opportunities opened up by digitalisation and use new digital business models to grow. In industrial companies whose core business consists of products and services, growth is not generated by following the traditional approach to business model innovation. According to this approach, existing business models are fully replaced and marginalised by new digital business models. There are four phases: 1) recognition of flaws in the current business model, 2) revitalisation of the flawed business model, 3) parallelisation of the current and the new business model and 4) marginalisation of the former business model. In industrial companies, a phase in which the opportunities of digitalisation are recognised is followed by a phase of complementarity, in which companies supplement their core business through the digitalisation of their business model. There are only very few cases where the existing business model is completely replaced or marginalised by a digital business model.

4.1 Paths to growth via digital business models

Complementarity can be achieved, for example, by focusing on the paths of customer experience, connectivity, applications, product-as-a-service and platforms.

Companies can use and combine different digital technologies to create a new customer experience and stand out from their competitors. By connecting their products, com-

Figure 16: Traditional versus ambidextrous approach to digital business models



Source: Plattform Industrie 4.0

17 Fischer, Thomas/Gebauer, Heiko/Fleisch, Elgar (2012): *Service business development: Strategies for value creation in manufacturing firms;* Cambridge.

panies obtain data on product maintenance and use. This data can then be used to develop smart services for describing, diagnosing, predicting and preventing defects. By applying this to developing applications, companies obtain data for optimising customer processes. Companies which sell a product 'as a service' no longer sell their products and services individually, but ask customers to pay for the use of their products and/or a particular outcome. Companies can collect data about the product lifecycle and analyse this data in a targeted manner in order to ensure that these revenue models are profitable. Companies can establish platforms for storing, sharing, interpreting and analysing data. Platforms enable companies to offer data-centric services.

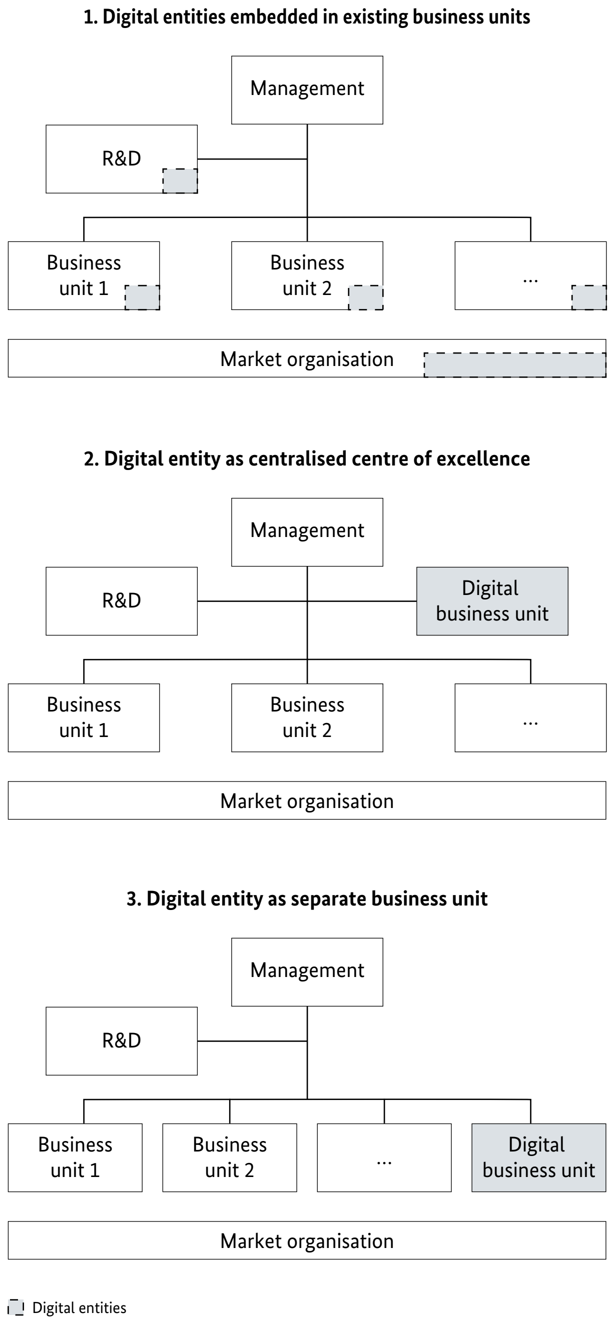
4.2 Approaches to promoting organisational ambidexterity

In order to ensure that the core business and the digital business model are compatible, companies require organisational ambidexterity. Organisational ambidexterity allows companies to be both efficient (by exploiting what is already there) and innovative (by exploring something new) at the same time.[18] Organisational ambidexterity includes both internal (structural and contextual) and external elements.

As a first step, companies need to implement structural ambidexterity. Structural ambidexterity refers to the creation of dual structures, with different organisational units being set up to handle both digitalisation and the core business. As the level of structural ambidexterity rises, three different ways to implement the digital entity can be distinguished: 1) Integration in an existing business unit, 2) central centre of excellence, and 3) separate business unit (see fig. 17).

By integrating digital activities in existing business units, the level of duality in the organisational structures remains limited. As a result, many companies have moved to setting up a central centre of excellence for implementing digital

Figure 17: Implementation of organisational structure



Source: Plattform Industrie 4.0

18 O'Reilly III, Charles A./Tushman, Michael L. (2011): *Organizational ambidexterity in action: How managers explore and exploit.* In: California Management Review 53 (4): 5-22.

activities. For example, Zeiss set up a digital centre of excellence in Munich. This centre helps pool the knowledge of all experts in one place and create a modern and agile environment in which new digital solutions for customers can be designed, developed and marketed in close coordination with the Zeiss business units. An important part of this work is establishing the Adamos platform. Ericsson has gone one step further. The company has established Digital Services as a separate business unit that has responsibility for profits and losses. Voith's approach is somewhere halfway between a centre of excellence and a separate business unit. Its Digital Ventures unit pools expertise in automation and IT and combines it with broad knowledge in hydropower, paper machines and propulsion technology. It serves as an incubator, pushing the development of new digital products and services. It takes the lead on digital innovation and the development of applications for new markets and is charged with developing and managing the company's existing core business and new digital activities.

Setting up separate units for digitalisation can provide an initial boost for digital business model development. Later on, companies can reintegrate the separate units into their existing business units. This helps ensure that the core business and the digital business remain compatible in the long term. This is what automotive supplier ZF has done

Table 2: Ways to implement organisational ambidexterity for individual growth paths

	Ambidexterity		
	Internal		External
	Contextual	*Structural*	*External*
Customer experience	• Employees who have contact with customers are given room to come up with ideas for digital customer experience	• Separate (temporary) innovation teams	• App developers, lead users for testing and enhancing apps
Connectivity	• Sales employees use incentives to convince customers of the benefits of connectivity • Innovation teams charged with developing connectivity solutions involve sales employees.	• Separate sales channels for smart services based on the connectivity of the products • A centralised team for delivering smart services based on the connectivity of the products	• Cyber security companies, specialists for connectivity solutions
Applications	• Encouraging employees to think about how customer processes can be optimised	• Separate sales channels for marketing applications • A centralised team charged with the development and implementation of the applications	• Software specialists, consulting firms focusing on customer processes
Product-as-a-service	• Marketing of product-as-a-service solutions and using product life cycle costing as part of sales and customer management activities	• Dedicated key accounts teams for marketing product-as-a-service solutions	• Financing partners, insurance for covering financial risks
Platforms	• Giving managers room to try out new ideas for platform-based business models in industrial companies	• Separate unit (centre of excellence or business unit) for platform development	• Cooperation with cloud solution partners. • Giving partner companies specific tasks in the development and implementation of the platform

Source: Plattform Industrie 4.0

with its ZF Data Lab. ZF Data Lab used to be a separate unit that focused on creating value based on big data, machine learning and artificial intelligence. It worked with other business units to develop and implement digital solutions. After the successful conclusion of a number of projects, ZF Data Lab was integrated in ZF's existing research and development unit.[19]

Structural ambidexterity is followed by contextual ambidexterity in-house and external ambidexterity. Contextual ambidexterity refers to the management of dual activities within the three structures described and depending on the situation. One example for this is the 80/20 rule, where employees from embedded business units dedicate 20 per cent of their working time to working on digitisation-related issues, which do not form part of their day-to-day work. External ambidexterity refers to dual business networks, in which companies build partnerships with other companies that specifically focus on either digitalisation or the core business.

Contextual ambidexterity ensures that there is dialogue and cooperation between the core business unit and the digital unit. In the case of the ZF Data Lab, this dialogue and cooperation focuses on 'promising areas'. As the goal of ZF's Data Lab is to create new innovations based on data analysis, contextual ambidexterity was first implemented in the divisions generating the largest amounts of data. Since the finance, logistics, marketing, sales, production and quality units generated large amounts of data, it was of particular interest to establish data science pilot projects here. The ZF Data Lab also appointed a dedicated officer charged with managing relations with the different business units. The employees working in these units and in the ZF Data Lab can move freely between different core business contexts/activities and the digital unit.

External ambidexterity provides companies with access to external elements that are needed for growing the digital unit. Some companies use a network of partners to promote the Adamos platform. Within this network, innovations are being created by developing, enhancing and adapting ideas. By working together on the development of applications in areas where they face similar challenges and customer requirements, the partners can implement digital business models more quickly and cost-efficiently. The partners in the network can serve as Adamos partners, enabling partners and technology partners.[20]

As companies implement internal (structural and contextual) and external ambidexterity, they need to take into account different growth paths. Ideas for implementing different structures are listed in Table 2.

19 Goby, Niklas/Brandt, Tobias/Neumann, Dirk (2018): *How a German Manufacturing Company Set Up Its Analytics Lab.* In: Harvard Business Review.

20 Adamos partners include the users of the Adamos IIoT platform, plant and equipment manufacturers and component manufacturers. Enabling partners offer dedicated Adamos enabling packages that help define, develop and implement digital solutions. Technology partners provide technologies and are responsible for identifying and developing the most relevant requirements of the industries. Serving in such a role means going far beyond core business-related partnerships; it is an activity that needs to be developed on top of the core business.

5. What legal framework do we need?

The implementation of digital business raises a number of legal issues. The sections below provide an overview of the current state of play in different fields of law based on the systematic analysis carried out by Working Group 4 (Working Group 'Legal Framework'). They are to provide readers with a broad overview of the subject. For more detailed information about the legal issues touched upon here and additional fields of law, please consult the publications of Working Group 4.

5.1 Civil law

Digital business models are so new that no specific rules and regulations have been devised for them just yet (for example for dealing with electronic declarations of intent, service descriptions and risk distribution), making it necessary for robust contractual terms and conditions to be developed. **The current legal framework has been geared towards declarations of and agreements between persons, not machines**. However, in the opinion of Working Group 4, the existing rules and regulations governing declarations of intent and contracts provide a clear-enough legal framework for cases where such declarations or contracts are drafted by a machine. The Working Group recommends amending the General Part of the German Civil Code such that it also accounts for these cases, in order to prevent legal uncertainties.

When it comes to the law on general terms of business, however, regulation from lawmakers is needed. German courts are increasingly applying Sections 308 and 309 of the German Civil Code (Prohibited clauses in standard business terms) not only for B2C but also B2B transactions. More flexible rules are needed in order to adequately account for innovative business models which do not correspond to the traditional types of contracts provided for under the German Civil Code. Lawmakers should therefore ensure that businesses engaging in B2B transactions can set effective contractual obligations for one another without being too heavily restricted by the provisions in the law on general terms of business. However, protecting small and medium-sized enterprises (SMEs) against abuse of market dominance continues to fall inside the realm of anti-trust and competition law rather than contract law.

5.2 Product liability law

The available provisions of tort law are sufficient to appraise most Industrie-4.0-related product liability cases under civil law. This also applies to cyber attacks that are carried out by persons outside a particular company.

The current regulatory framework is also sufficient to deal with cases where it is unclear whether the damage was caused directly by the product or a failure in the product's environment (for example caused by an intelligent periphery). Should there be an increase in the number of cases of defective products in which the exact cause of the defect remains unclear and should the rule under German law which requires bringing proof that the damage was indeed caused by a particular product be considered a disadvantage, imposing strict liability rules – which do not require finding fault or proving that the product caused the damage – on agents in the environment of the product would have to be discussed. The same considerations need to be made in cases where artificial intelligence is involved. In Germany, accidents at work in which the cause of the accident cannot clearly be attributed to an agent involved in a particular part of the process are covered by the employer's liability insurance association.

However, in cases that involve damage to property or damage to persons who are not employees of the company, the current legal framework can reach its limits. Lawmakers might have to start thinking about modifying liability law in a way that accounts for such cases.

5.3 Data protection law

Personal data enjoys special protection under German law. Digital business models therefore need to be designed in such a way that they ensure the protection of personal data. Special caution needs to be taken in cases where different sources of data are combined and where these allow for the profiling of individuals, meaning that the data can be traced back to individual persons. **Rules for anonymising and pseudonymising data in a secure manner are needed to ensure that the great variety and large amounts of data and secondary data can be used for flexible value creation in Industrie 4.0.** In order to make it easier for platform operators, aggregators and intermediaries – which would need to be defined more specifically in law – to conform to data protection rules, lawmakers could adopt a framework that abandons the out-dated rules on the contracting of data processing whilst at the same time protecting the key elements of transparency in processing, data security and portability by introducing certificates. One of the key challenges in this area is the question as to how data protection rules can be harmonised globally.

5.4 Protection of know-how

As the creation, use and analysis of business and machine data become increasingly complex and automated, issues related to the protection of know-how are gaining importance. This has to do with the fact that companies using cloud services, predictive maintenance, condition monitoring, contractors for data processing or simply operating machines are becoming increasingly connected. A large part of production data is currently not attributed to a particular legal entity, nor is it protected under the current legal instruments.

The EU Directive on the protection of undisclosed know-how should be implemented as quickly as possible across the EU and in a harmonised manner in order to create a unified framework for the digital transformation of the economy and Industrie 4.0 in Europe. However, as the Directive is implemented, the confidentiality requirements which need to be met under the Directive to ensure the legal protection of know-how should not be set too high. For example, if two Industrie 4.0 partners conclude a confidentiality agreement, this should be sufficient to meet the requirements. Considering the current situation, lawmakers should refrain from restricting contractual freedom for the purpose of enhancing confidentiality. This would give the parties to a contract the opportunity to determine bilaterally or multilaterally what they want to protect and how they want to protect it.

IT security solutions can make a considerable contribution to protecting know-how. Export controls on products that use encryption technology to provide IT security should provide for sufficient flexibility and be handled homogeneously across Europe.

5.5 Data sovereignty in the context of Industrie 4.0

The analysis and assessment of machine data holds great potential for the creation of new business models. This means that machine data can be a key source of business value and fundamentally change the way value is created. This raises the question as to the necessity of and possibilities for providing legal protection for this data. There are currently no specific rules or regulations governing the attribution of machine data to a particular legal entity (data sovereignty). Current rules and regulations do not provide for any comprehensive, absolute right to a certain piece of data per se. Depending on their kind, different constellations of data, however, are already and often indirectly protected by a combination of different national and international pieces of legislation (copyright law, patent law, database law, commercial and business secrets, data protection law, criminal law etc.). **What is striking is that, often, legal protection for an individual piece of data is conferred to this data depending on its meaning, rather than to the data per se.** Take an individual item of sensor data such as '18 degrees Celsius', for instance, which, without a specific context, is treated as a fact of nature and therefore not protected by law. However, if a timeline indicating various changes in temperature is saved and is linked to a measurement point on a particular installation, this data takes on contextual meaning that could also represent a business or commercial secret, for example. This shows that, as a general rule, the extent to which machine data is protected will depend on the context in which it is found.

Considering all this, the question is whether a new law is needed that clearly attributes machine data to particular market participants as if the former were property. However, it is doubtful whether rules and regulations – which are rather abstract – can provide a lasting and satisfying solution for dealing with the innumerable constellations related to the attribution of data. As there are different sectors and regulated areas which each come with their own particularities under competition law, the aspects of data access, access rights and data portability are taking on an important role. As we build a data economy that is based on an open and innovation-orientated legal tradition, there is close interaction between these aspects and data sovereignty and the protection of data domains. By setting out property rights for individual data or exclusivity rights that are similar to property rights, this could be undermined. As we cannot yet foresee which new business models will be developed, attributing data in a rigid manner and in a way that protects the interests of particular entities could hamper innovation and contribute to the fragmentation of global markets. Intervention by the legislator on behalf of certain 'data stakeholders', beyond the principles set out in existing legislation, court rulings and legal theory, risks automatically affecting the economic freedoms and equal opportunities of other stakeholders. This could go on to prevent European business from developing the type of new business models of which it is hoped that they might generate growth and a competitive advantage over other world regions, e.g. in the field of data analysis. **Instead of rigidly assigning property rights or access rights for data to particular market participants, lawmakers should rather provide a framework in which companies are better able to conclude their own contractual agreements on these rights.** In order to strengthen contractual freedom in the B2B sector, more flexibility should be provided for in the law on general terms and conditions of business so as to better account for this issue in the use of standard contract forms. There is strong awareness in the industrial sector of the need to protect sensitive business data. Over the past decades, this awareness has led to the widespread adoption of largely standardised confidentiality agreements and agreements restricting use of data within the industrial sector. This is a good basis for the market to regulate itself when it comes to the development of agreements on long-term data use. Companies that are involved in exchanging machine data will therefore conclude usage agreements for this data or will incorporate clauses regulating such usage into their contracts. This option would not require any legislation assigning legal rights to machine data as if this data was property. Should the market develop in a way that leads to its domination by a number of data monopolies or data oligopolies, this would have to be addressed using competition law. However, there is not yet any sign of this kind of market concentration based on data exclusivity in the industrial sector.

5.6 Competition law

The development of more hybrid products and of markets that function without monetary payments in the context of Industrie 4.0 mean that the use of the traditional competition law instruments for market definition and the determination of abuse of market dominance are reaching their limits. In Industrie 4.0, market shares and market dominance are changing more quickly between different companies than in the traditional industrial sector, and with the rise of the platform economy, new questions around the abuse of market dominance have emerged. However, as intervening in an interconnected world risks stifling innovation, calls for statutory regulation have remained rather restrained. Competition authorities and the courts should be given room to find even more refined solutions based on the amended Act against Restraints of Competition. As no market failure has yet been shown and inflexible statutory regulations seem inadequate for taking proper account of the dynamic development of the data markets, adopting sweeping, new cross-sectoral rules on data access under competition law would be premature. When it comes to the ability of competition law to address 'colluding algorithms' in a time where machine-to-machine communication is growing, current legislation should be sufficient to deal with algorithmic behaviour, provided that it is clear that the algorithm is merely being used as a tool to execute a human intention. However, this may necessitate the introduction of requirements for the implementation of technical safeguards and monitoring systems for computer-based competitive behaviour. **It would make sense for competition authorities to issue guidelines providing information about the rules of conduct that platform and systems operators and users need to abide by.** A new General Block Exemption Regulation for horizontal cooperation should be developed in order to provide legal certainty for those engaging in the various new forms of cooperation

– including cooperation with competitors – for example in manufacturing, procurement, sales, standardisation and development. Even though digital platforms can lead to monopolistic or oligopolistic market structures, the existing law should be sufficient to prevent abuse of market dominance. In contrast to many B2C segments, the B2B platform market cannot be considered a mature market just yet. Lawmakers should ensure that they do not adopt regulation that would subject European companies to rules that put them at a competitive disadvantage to their American or Asian competitors, which are not subject to such regulation and can grow freely in their home markets until they achieve a critical mass.

5.7 Conclusion

In order to create an environment that is conducive to digital business models, only minor modifications to the existing legal framework are needed. Harmonising the legal framework internationally is key to ensuring that German companies do not suffer any competitive disadvantage. In addition, a balance needs to be struck between regulatory action that promotes innovation and that which inhibits it. Taking into account the dynamic development of many sectors, contractual agreements between business partners seem more suitable than statutory regulations, which are more rigid.

6. Summary and outlook

For a very long time, digitalisation within the manufacturing sector has focused on optimising the existing business. Today, digital business models have become key to setting one's business apart from the competition. These digital business models focus on providing new value propositions based on the use of smart products. The question is no longer whether a train can be operated, but whether the train is on time. **These value propositions are created by combining smart products with related services which are based on the data that is generated in real time during the operation of the product.** In a future not far from now, we will be able to use artificial intelligence to process this kind of operating data. This will lead to the development of a completely new era of value creation and to higher shares of profits and market shares being created from data-driven business models.

The availability and lower cost of core technologies such as cloud computing and sensors and the possibility to combine these with big data and digital elements (such as digital twins, platforms) serve as the basis for this development. However, using these technologies requires changing how a business is organised. New organisational capabilities are key for adapting technology and implementing the new business models. Focusing on two things at the same time (ambidexterity) therefore becomes a key quality that every company needs to have. Legislation provides the overall framework for business. Here, a careful balance needs to be struck between regulatory action that promotes innovation and action that inhibits innovation. Taking into account the dynamic development of many sectors, contractual agreements between business partners seem more suitable than statutory regulations, which are more rigid. There is great economic potential to be harnessed, not least for Europe.

In today's world, competitiveness can no longer be achieved by a single company working alone. **Cleverly orchestrated value creation networks, in which each partner wins, are the key factor that lead digital business models to succeed.** This does not mean however that every company needs to build their own platform or that Europe needs to respond to the creation of each new US or Asian platform by creating their own. Among the most important subjects that are currently being discussed are the extent to which European platforms and data markets need to be interoperable.

What are the next steps? Working Group 6 will look into the subjects of organisation, data and up-scaling in order to develop recommendations for policymakers.

List of the practical examples that have been analysed

For the analysis of the practical examples, the Working Group has received information, some of which has not yet been authorised for publication. Among the practical examples that have been analysed were:

- 365 FarmNet (Claas)
- Collaborative Operations Center (ABB)
- Cooling as a Service (Siemens)
- Data Intelligence Hub: Interoperabler und industrieübergreifender Datenmarktplatz mit angeschlossener KI Werkstatt [Interoperable and cross-sectoral data market place and associated AI workshop] (Deutsche Telekom)
- Datentreuhänder [Data trustees] (TÜV SÜD)
- Digitale Plattform für industriellen 3D-Druck [Digital platform for additive manufacturing in industry] (3YOURMIND)
- Druckluft as a service [Compressed air as-a-service] (Boge)
- Enabling Collaborative Learning of Worldwide Production Networks (Siemens)
- Equipment as a Service (Bosch)
- Fernmanagement von Ladeinfrastruktur für Elektrofahrzeuge [Remote management of electric vehicle charging infrastructure] (ABB)
- Greater Product Performance Insights (Siemens)
- Multichannel Möbelangebot [Multi-channel furniture offerings]
- MachIQ
- Optimization of Consumables (Siemens)
- Optimization of Leasing Services (Siemens)
- Performance Analysis (Siemens)
- Smarte Komponenten im Schienenverkehr [Smart components in railway transport]
- Tire as a Service (Michelin Solutions)
- Virtual Fort Knox

Additional examples have been analysed but cannot be mentioned here by name.

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