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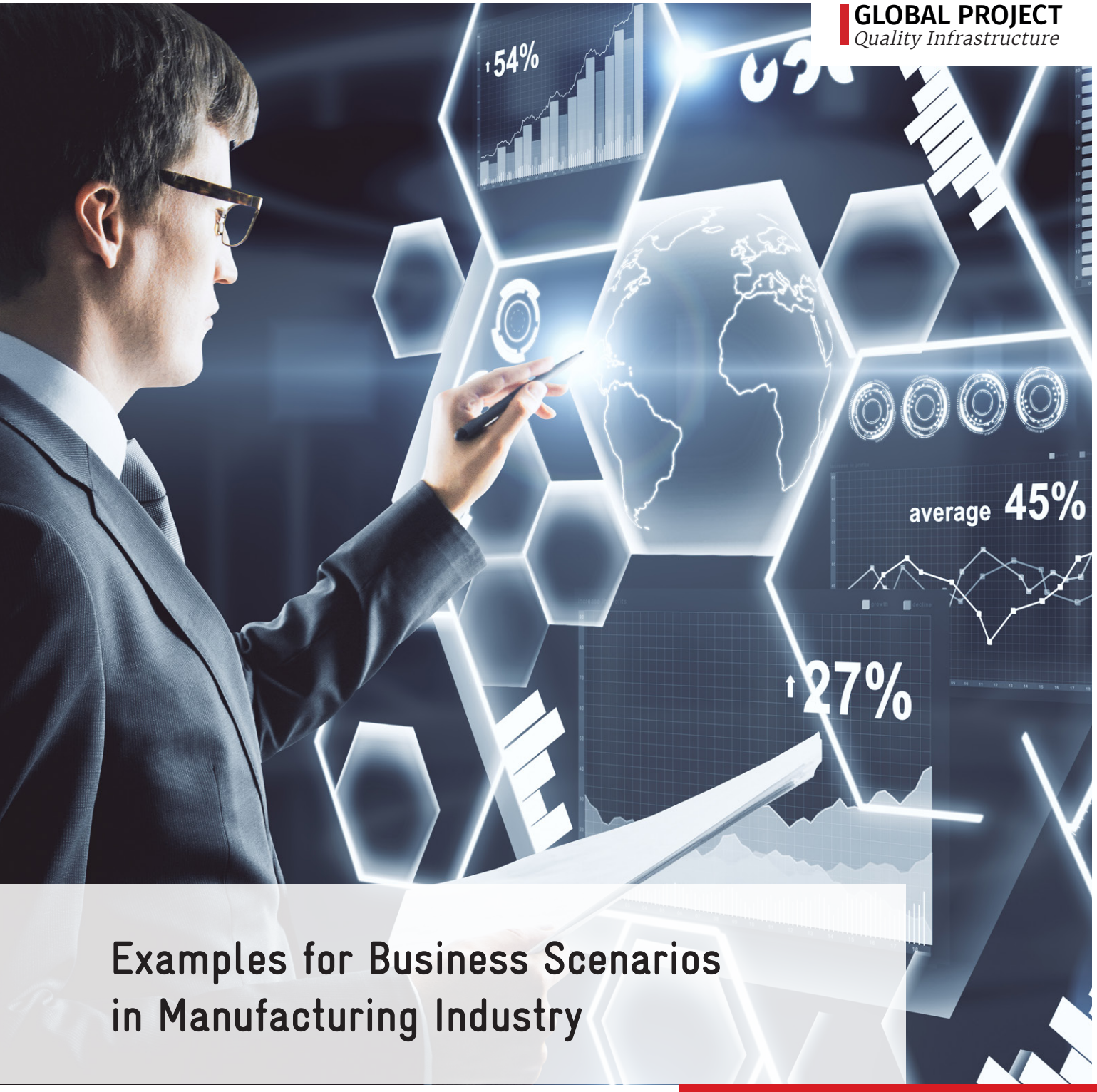

Examples for Business Scenarios in Manufacturing Industry

STANDARDIZATION COUNCIL INDUSTRIE 4.0

PLATTFORM INDUSTRIE4.0

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Contents

Introduction

Background

This report is a result of the cooperation line "Use Cases and Applications" in the context of the Sino-German Sub-Working Group Industrie 4.0/Intelligent Manufacturing (SWG I4.0/IM). The overall objective of the SWG I4.0/IM is to discuss standardization aspects focusing on Germany and China in order to intensify and deepen the Sino-German cooperation by defining concrete issues and steps to be taken.

The objective of the cooperation line "Use Cases and Applications" is to analyse business strategies and customer needs in the manufacturing industries manifested by concrete customer projects. The findings are compiled in so called "use cases", which are based on well-known best practices, e.g. the Industrial Internet Reference Architecture (IIRA), see [1]. These "use cases" facilitate a common understanding of markets, trends, drivers, concepts and solutions and then serve as basis to articulate requirements for standardization aspects.

Common Understanding of "Use Cases"

The term "use case" has a diverse range of meanings, see [2]:

- A "use case" in the sense of a business scenario, in which, in accordance with business model logic (e.g. business canvas), business relationships within a value-added network are described.
- "Use cases" in the sense of general understanding as to how a technical system is viewed in the context of its application. It is used to describe the interaction of a technical system with actors (such as other technical systems or humans). This is the understanding of the term "use case" in the cooperation line "Use Cases and Applications".
- "Use cases" in the sense of specific projects.

The cooperation line "Use Cases and Applications" initially focused on (technical) "use cases" in the sense of a description how a technical system is viewed in the context of its application. Therefore, three best practice examples were prepared together, see [2].

After completing these three best practice examples, it was decided to deal more closely with "use cases" in the sense of business scenarios and therefore to create a collection of business scenarios.

Objectives

The purpose of this document is to describe the analysed business scenarios. The document claims that the preparation of the individual business scenarios is generally understandable for people who are familiar with the fundamental value creation processes in the manufacturing industry. The document should also illustrate the variety of how digitization in the manufacturing industry can impact the design of business models. Feedback to this elaboration is highly welcome.

Methodology

Like the preparation of the best practice examples according to the usage viewpoint, we also used the Industrial Internet Reference Architecture (IIRA), see [1], as a basis for the preparation of business scenarios. We further detailed the business viewpoint proposed by the Industrial Internet Consortium (IIC), see [2]. Our conceptual approach is fully aligned with the methodology proposed by the working group "Digital Business Models" of Plattform Industrie 4.0 to analyse practical examples, see [3].

Description of Business Scenarios

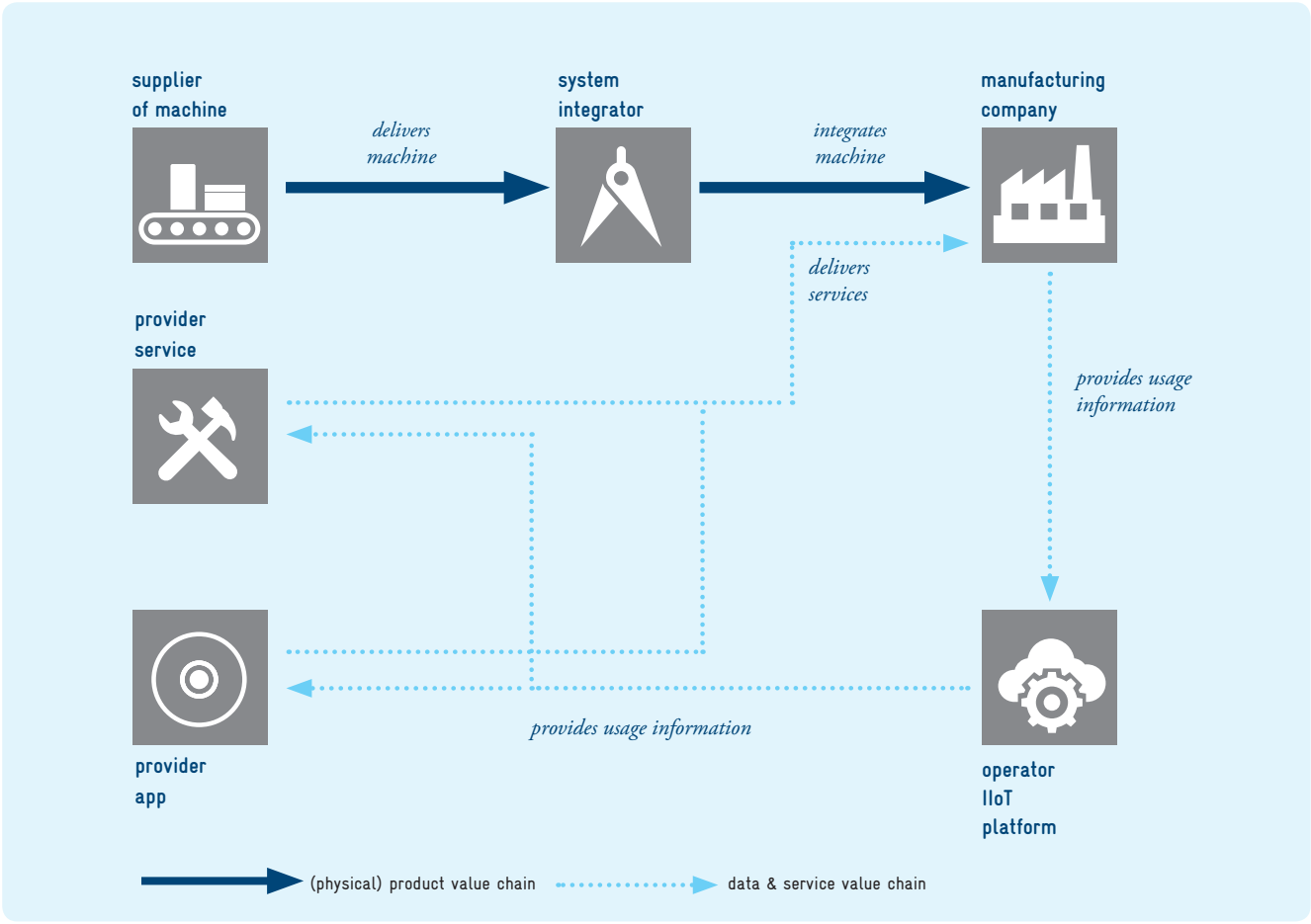
The starting point for the analysis and documentation of a business scenario is the description of a value network. An example of a value network is illustrated in Figure 1.

Figure 1: Description of value networks (illustration)

A value network is a directional graph consisting of nodes and edges. The nodes of the graph are business stakeholders and the edges of the graph are business relationships. Each node represents a business role and comprises a description of the underlying business model. Each edge represents a value proposition of a supplier to a customer.

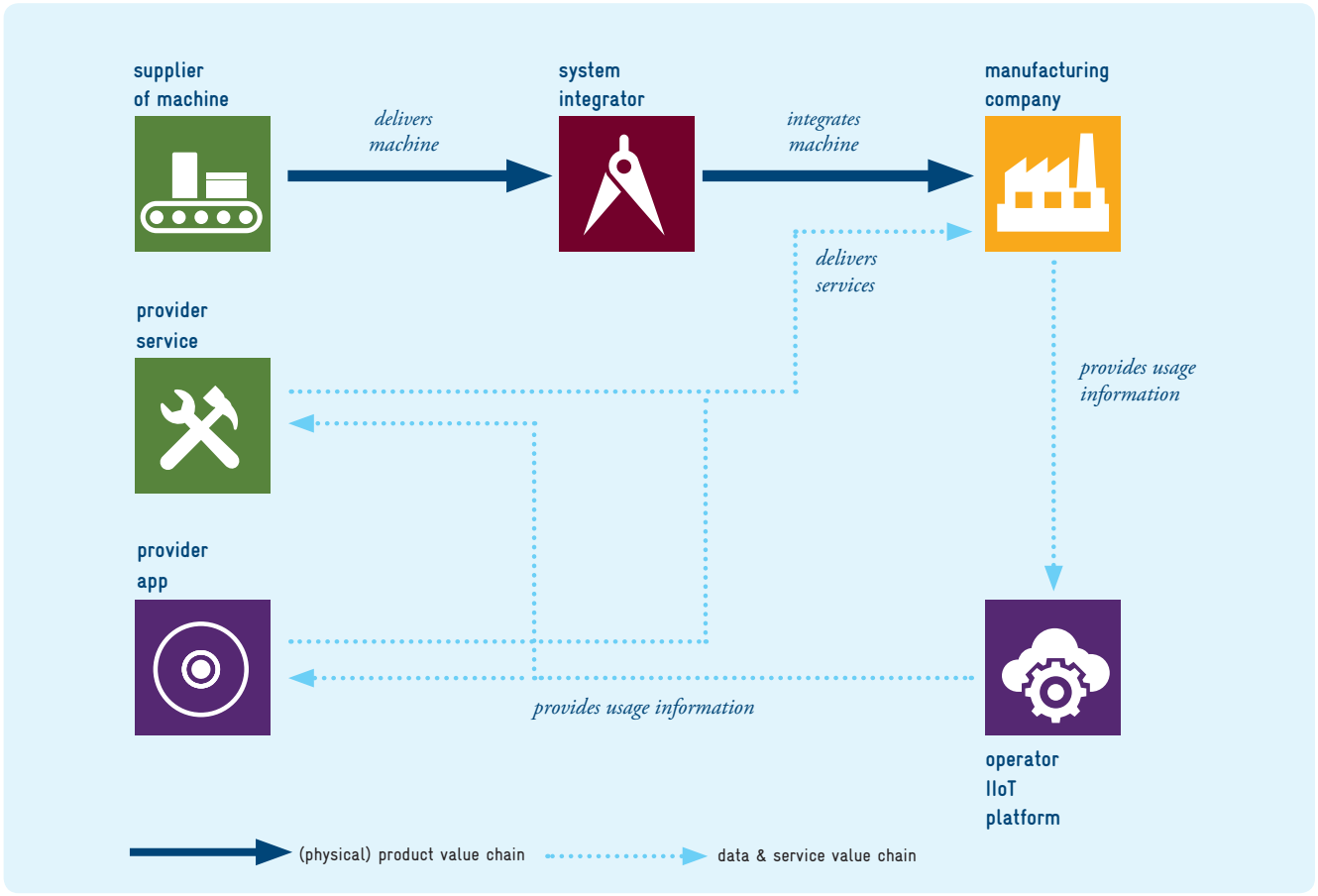
In order to make the change, which is to be expressed by a business scenario, clear, it is useful to compare the (intended) future value network with the current value network.

In a next step, the individual business roles in a value network are assigned to enterprises, because business roles are assumed by enterprises (legal entities), see Figure 2 for illustration. This is done by highlighting the business roles in colour, whereby each enterprise is represented by a specific colour. Note that an enterprise may assume several business roles, thus, busi-



ness roles coded by the same colour are implemented by a single enterprise[1].

Figure 2: Implementation of value network by different enterprises (illustration)



The business model for each enterprise is then described by using the St. Gallen Business Model Navigator method. This method is based on a magic triangle with 4 dimensions, see Figure 3:

- Who (customer): What are the target customers of the enterprise?
- What (value proposition): What is the offering of the enterprise to the customer?
- How (value chain): How does the enterprise produce the deliverable?
- Value (revenue mechanism): How does the enterprise create revenues?

In order to distinguish business model innovations from product or process innovations at least two dimensions should be involved in a significant way. For more details we refer to [4].

1 Business roles coloured in white represent different enterprises assuming exactly one business role but will not be considered in more detail in the description of the business scenario, because these business roles do not contribute to the core of the business scenario.

Figure 3: St. Gallen Business Model Navigator

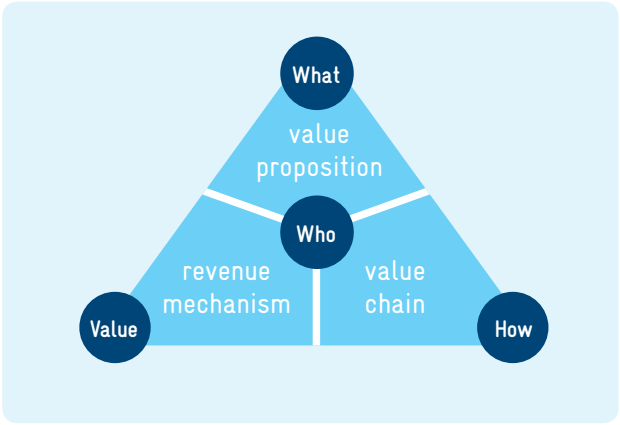
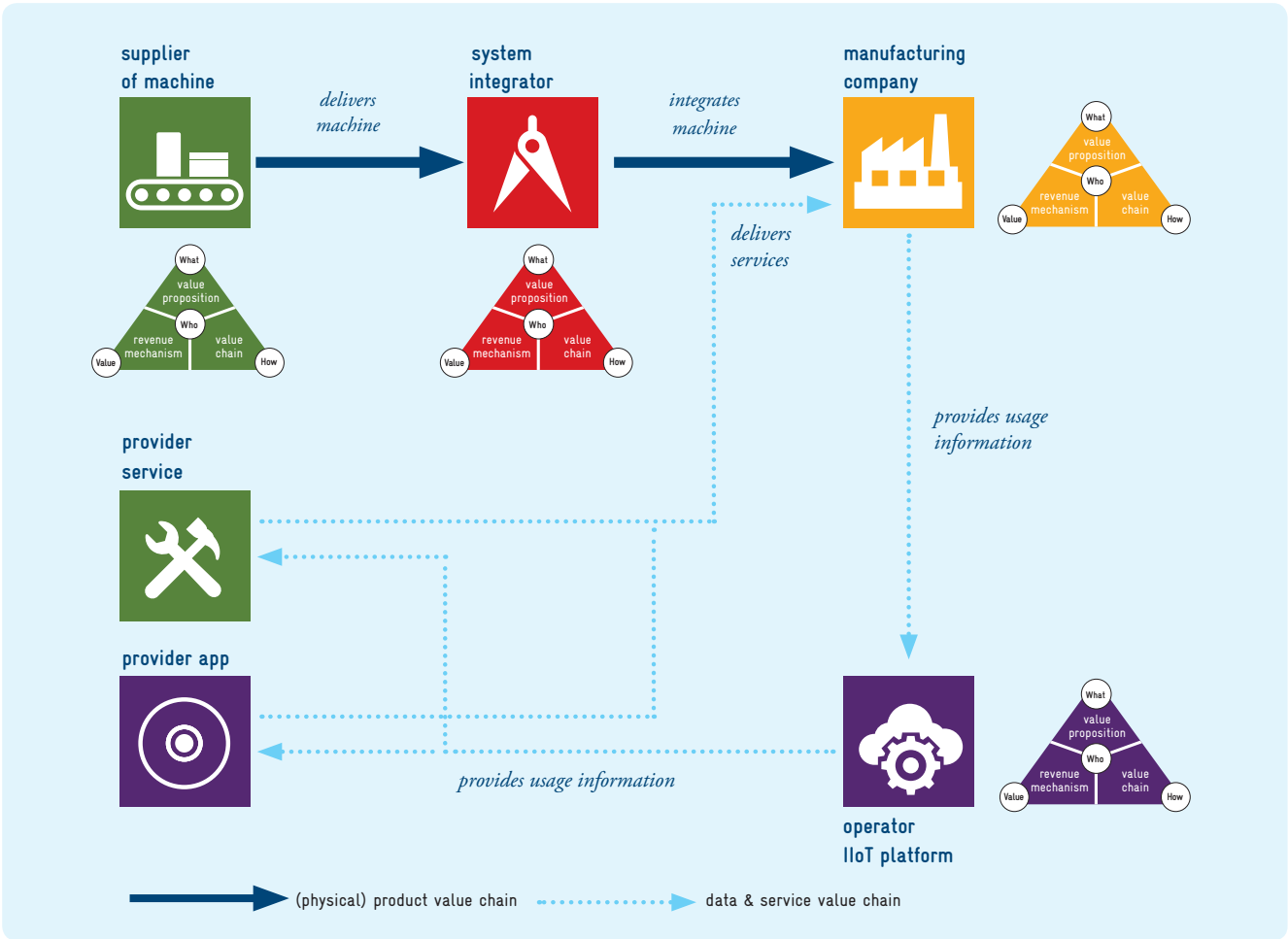


Figure 4 illustrates the association of the description of the business model to the enterprises involved in the considered value network.

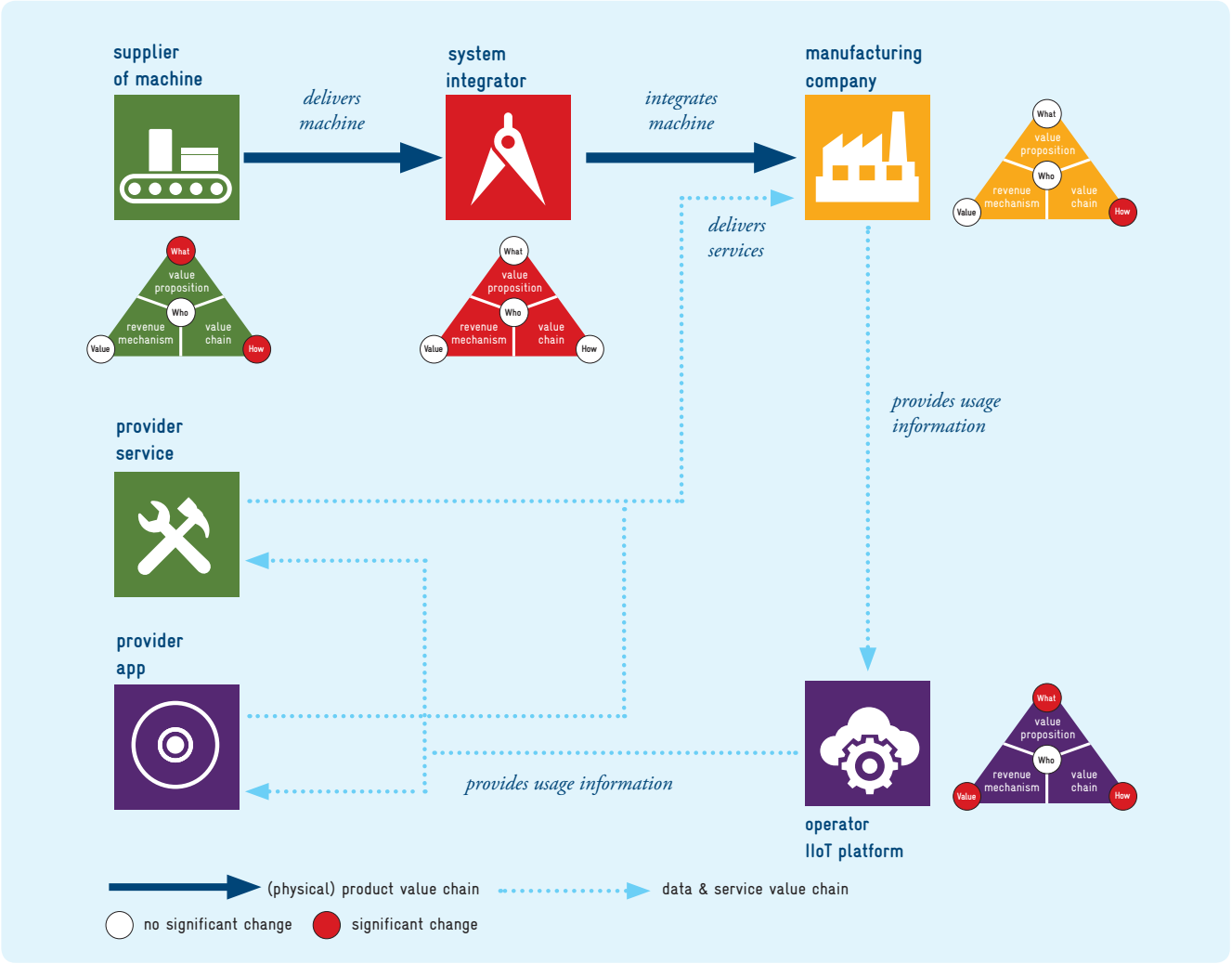
Typically, traditional companies are integrated in the value network[2], but possibly also new companies. In a final step for each enterprise involved in the value network , it is indicated how the business model will change based on the considered business scenario: for each dimension addressed by the St. Gallen Business Model Navigator it is described whether there is a significant change or not, where "significant" means that the considered dimension is addressed in a different approach. Examples for significant changes are addressing a new market segment, integrating a new business partner in the value chain or a recurring usage-based payment instead of a one-time payment. Note that the assessment whether a change is "significant" is to a certain degree a subjective assessment. Figure 5 illustrates the result of the analysis and documentation of a business scenario.

Figure 4: Business models of enterprises involved in the value network (illustration)



2 with exception of the white coloured enterprises

Figure 5: Business model innovation of enterprises involved in the value network (illustration)



Collection of Business Scenarios

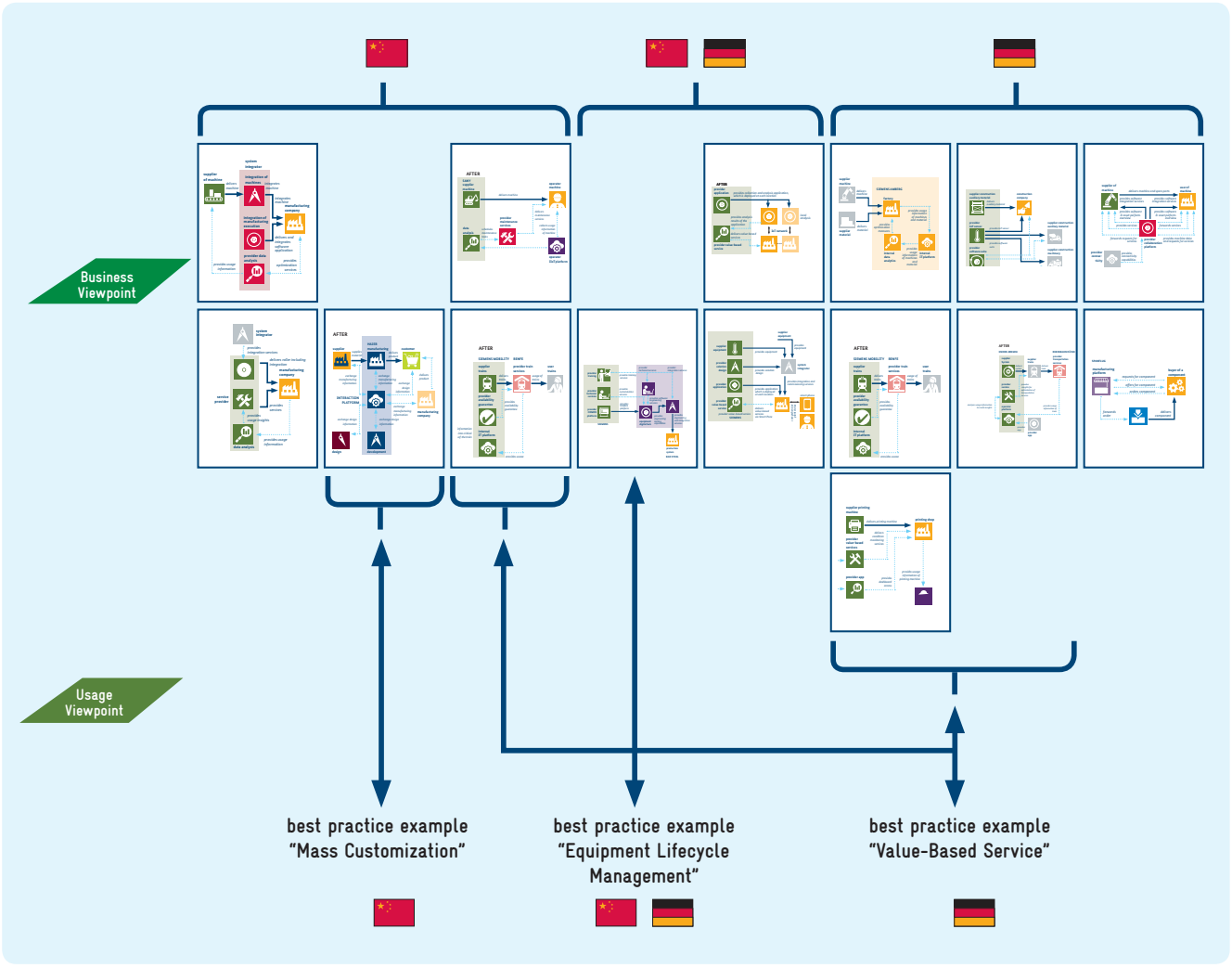
The cooperation line "Use Cases and Applications" initially collected these examples independently and prepared them according to the methodology explained. The results were then presented and sharpened in common meetings until a mutual understanding was achieved by all participants. It should be noted that in the case of the more complex examples, several meetings were necessary, since not all the experts necessary for the discussion of the content were always present.

No selection guidance was given regarding the examples to be selected. It was only ensured that for each Use Case that the cooperation line "Use Cases and Applications" had previously prepared in the form of best practice examples, see [2], at least one business scenario was prepared.

Overview of Analysed Examples

Figure 6 shows an overview of the various business scenarios that are described in the following chapters. Figure 6 also shows the relationship between the business scenarios and the best practice examples according to [2]. Note that for some of the business scenarios there is no description according to the usage viewpoint and that several business scenarios are described for the best practice example "Value-Based Service".

Figure 6: Overview of analysed business scenarios



Examples CN

Data Services in Bearing Manufacturing

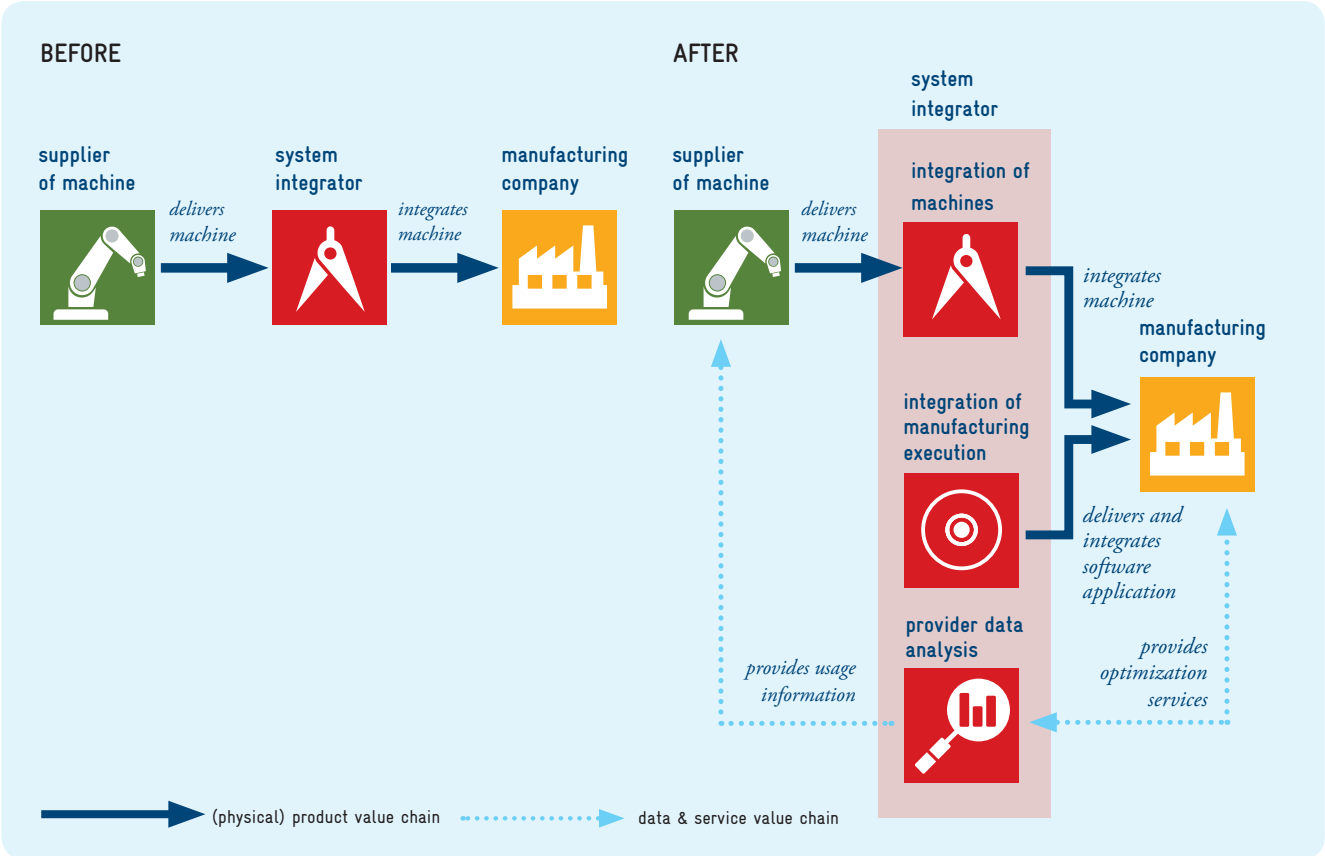
In China, there are regions where many small manufacturing companies are located, all producing the same or similar product or part, e,g. bearings. Due to the complexity of the used machines, these companies are generally unable to make optimal use of their machines. They also lack appropriate IT solution to optimize the execution of the manufacturing processes.

The local system integrator, who has supported the companies by integration services to build their manufacturing systems, takes advantage of this. In addition to the physical integration of the machines, she now also offers a software application that helps the manufacturing companies to optimize the execution of their manufacturing processes. At the same time, this software application is used to collect information under users' permission about the usage of the individual machines.

The system integrator offers the information about the usage of the machines in the form of optimization services to the individual manufacturing companies, but she also offers performance information (under permission of users) to the suppliers of the machine.

As the local system integrator focuses business in the specific region and performs various regular services on site conveniently, there is no need for a powerful IT infrastructure to collect the information about the usage of the machines. Since the profiles of the individual manufacturing companies are very similar, she can provide a very specific and therefore powerful software application for all these manufacturing companies.

Figure 7: Value Network



Value Proposition

The manufacturing company benefits from optimized manufacturing processes, for example improved tool management or lower cost for raw material based on more efficient order scheduling.

The supplier of the machine benefits from information that she can use to optimize the machine.
The system integrator benefits from new revenue streams based on her new offerings:

- Delivery of software application
- Provision of optimization services
- Provision of usage information

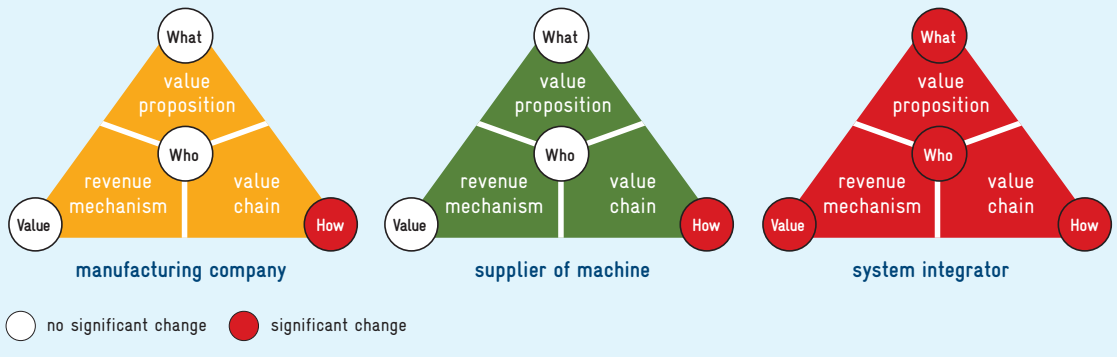
Revenue Mechanism

- The manufacturing company pays for the software application and optimization services.
- The supplier of the machine pays for the provision of usage information
- The system integrator must pay for the development of the software application and optimization services.

Business Model Innovation

The business model changes of the companies considered in this example can be summarized as follows:

Figure 8



The business model of the manufacturing company does not change in a significant way. The company will continue to sell the same product (bearing) to the same customers. Also, the revenue mechanism does not change, even if payments for the new optimization services are necessary. The value chain changes because of the use of new software application and the optimization services offered by the system integrator.

The business model of the supplier of the machine does not change in a significant way. The company will continue to sell the same product (machine) to the same customers. Also, the revenue mechanism does not change, even if payments for the new usage information offered by the system integrator are necessary. The value chain changes because of the provision of usage information offered by the system integrator.

The business model of the supplier of the system integrator will be innovated: The customer changes, because now also the supplier of the machine is his customer. By offering the new software application, optimization services and usage information she changes her value proposition and her integration into the value network. The revenue mechanism changes because of additional revenue streams for the software application. Typically, the revenue mechanism itself for the new data-based services is the same as the revenue mechanism for the physical services in the past (in the sense of revenues for services).

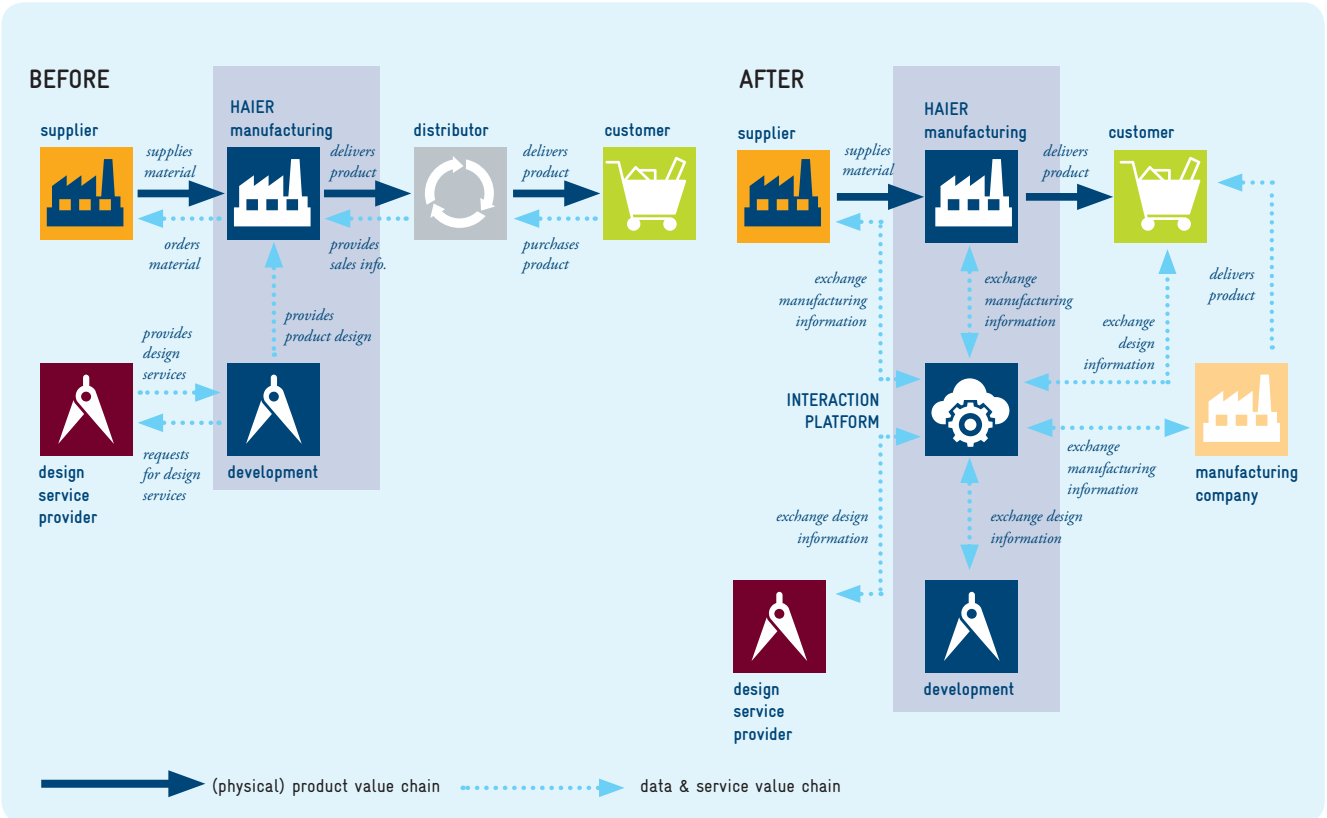
Haier: Platform COSMOPLAT for Mass Customization

Haier has developed an interaction platform COSMOPLAT, on which a customer can articulate the individual requirements for individual products. Driven by these individual requirements, Haier – could be in collaboration with some external design service providers – creates a product design and offers it to the customer. In the event of ordering this individual product by the customer, Haier will provide through COSMOPLAT the necessary production documentation to corresponding manufacturing departments (internal) or companies (external), integrate their supplies into the individual product and deliver it to the customer directly (instead through distributors). Furthermore, it is possible that some manufacturing companies manufacture the entire individual product and deliver it directly to the customer.

By systematically collecting customer needs through COSMOPLAT, Haier can optimize the entire production network. Based on interaction and cooperation of customers and designers the relatively open needs of customers would converge to a possible order (designing the right product under limited cost). Based on the interaction and cooperation of various manufacturing companies the manufacturing of the ordered product will be executed in an effective way (manufacturing the product right). COSMOPLAT is therefore positioned as an interaction platform for the mass production of individualized products ("mass customization").

The interaction platform COSMOPLAT supports to collect and merge various information from the customers, designers, suppliers and manufacturers and making them work simultaneously as much as possible. Thus, the interaction platform COSMOPLAT has capabilities to support for example communities, idea management, demand forecast and product design.

Figure 9: Value Network



Value Proposition

Haier offers different interaction platform services to and coordinates the value creation processes of the different stakeholders (customer, design service provider, supplier and other manufacturing companies). Haier benefits from the improvement of its own production including the entire supply chain (for example reduction of delivery time and lower inventory cost) based on the various information consolidated in the interaction platform. Haier benefits from being able to give more types of products to increase customer stickiness and from the popularity of a brand with "mass customization". In addition, Haier benefits from an optimization of its design and engineering value creation processes.

The supplier benefits from a beforehand evaluation and optimization of the supply and needs of materials. By this, a supplier could hold lower inventory and benefit from a possibly higher price for an order due to rapid supply to the manufacturer. The design service provider benefits from early understanding and convergence of customer needs by participating in community interactions on the interaction platform.

Other manufacturing companies (than Haier itself) benefit from a new channel of interactions with more customers by the usage of the interaction platform. The customer benefits from the realization of its individual demand based on a deep integration into the overall value network.

Revenue Mechanism

Haier pays for the development and operation of the interaction platform and gives encourage and rewards to design service providers and suppliers to participate in the usage of the interaction platform in advance. Haier pays the suppliers for the manufacturing services delivered and the design services providers for the delivered design services.

The supplier pays for the participation in using the interaction platform when they need to get specific rights or functions.

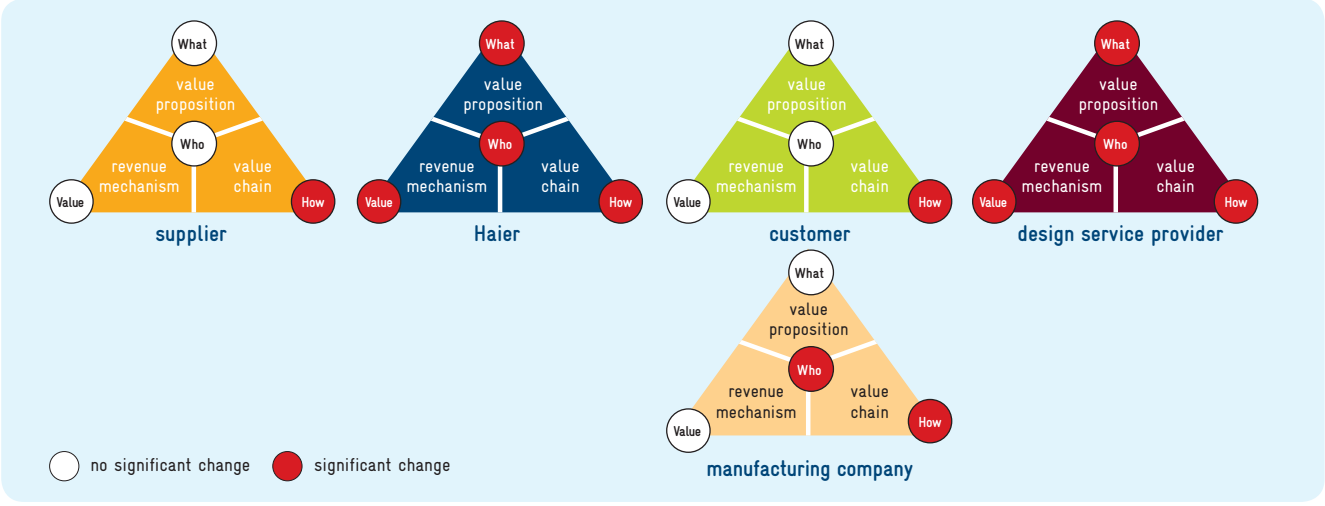
The design service provider – typically a small company – also pays for the participation in using the interaction platform to get more resources. Other manufacturing companies pay for the integration into the interaction platform according to their own requirements and for the participation in using the interaction platform.

The customer pays Haier or other manufacturing companies for the delivery of the product according to his individual requirements. The customer does not need to pay for the customized design proposed via the interaction platform.

Business Model Innovation

The business model changes of the companies considered in this example can be summarized as follows:

Figure 10



The business model of the suppliers does not change in a significant way. The suppliers will continue to sell the same product (supplied parts) to the same customers (manufacturing companies) following the same revenue mechanism. The value chain is optimized because of a closer and more transparent integration of the own resources based on the usage of the interaction platform.

The business model of Haier will be innovated: the original end customer remains the same, but the distributor is excluded from the value network and thereby the original end customers are now direct customers of Haier. In addition, Haier also has the other manufacturing companies as new customers. The value proposition is extended by new services offered by the interaction platform to the various stakeholders. In addition, Haier now offers products satisfying the individual needs of their customer. The value chain is also changing, as based on the interaction platform a completely new value network will be established. Obviously, Haier has extended the revenue mechanism by new revenue streams generated from the offering of services of the interaction platform.

The business model of the design service provider will be innovated: the value proposition could be extended to a value proposition to guide customers and to support with converging the needs. Consequently, the revenue mechanism is expanded. The design service provider extends the addressed customers through the usage of the interaction platform. The value chain is changing because of the usage of the interaction platform.

The only change for the customer is the way of being involved in the value network.

The business model of the other manufacturing companies will be innovated as well: the companies will continue to sell the same products following the same revenue mechanism. But they extend the customers through the usage of the interaction platform and the value chain is changing because of the usage of the interaction platform.

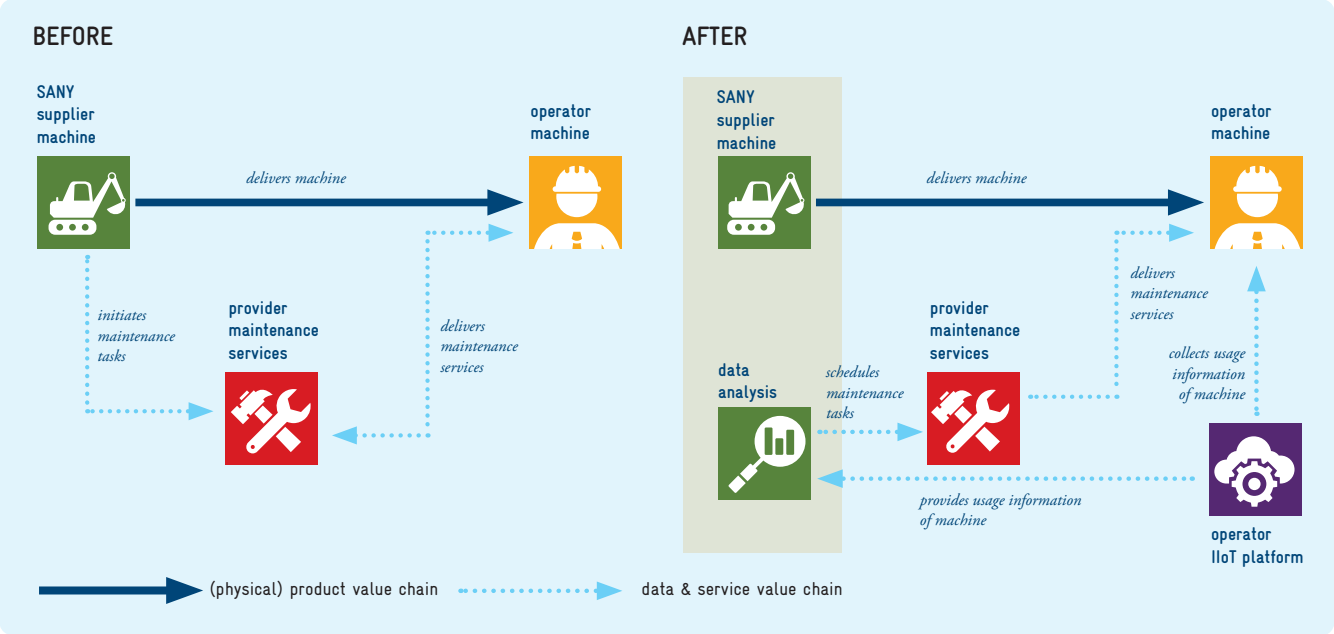
SANY: Maintenance Services based on Platform

SANY is one of the largest construction machinery manufacturers in China, with millions of machines in the world being used by various operators. The construction machinery is mechatronics, mobile, and generally used under different environments. As a result, the after-sales service of machinery has always been one of the problems.

SANY has been exploring a service-based platform to support remote machinery operation and maintenance. An independent company was set up to operate the platform. The platform would cooperate with SANY to provide market analysis and service support. As a crucial part of this example, the platform would collect maintenance data from sensors in machinery, dispatch signals or alarms when coming across an unexpected situation and give support of information when SANY provides rental service.

The new ecosystem would enable users to get a quick response, lower cost of spare parts and give the machinery more capabilities. Specifically, platform operators can serve as the backbone of service, manufacturers could improve their machinery based on history data and could also rent machinery to customers with a continuous status assessment. The company offering maintenance services would have a more rapid and efficient service by calling and scheduling based on information provided by the platform operator.

Figure 11: Value Network



Value Proposition

The supplier delivers the various machinery and improves the quality of after-sale service based on the information of maintenance. Based on the new value network, she could also provide rental services under support of data except for selling machines.

The operator of IIoT platform is the enabler for the optimization of service and cooperates with the supplier of machines to analyze the data. She provides powerful IT infrastructure and services for both supplier and operators of the machines.

The provider of maintenance services, who sometimes is part of the supplier of machines, provides more proactive service which leads to lower costs for spare parts (because parts are replaced only if needed) as well as reduced time and employees for maintenance.

The operator of machine (End User) benefits from an optimization of maintenance service and a quick response in the case of a breakdown. Besides, she can improve her ability to deliver her construction services due to a reduction of unplanned downtime.

Revenue Mechanism

The operator of machine pays for the delivered machine and necessary services (or for rental time and usage as agreed in the contract).

The supplier of the machine pays for the use of the IIoT platform and charges for maintenance when users want to get service from SANY.

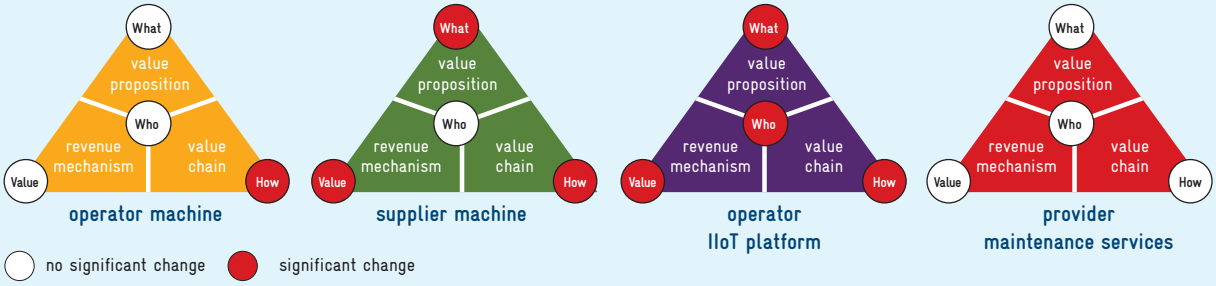
The operator of the IIoT platform charges a usage-based fee from SANY, which depends on the number and level of connected machines and the services provided.

The provider of maintenance charges a service fee.

Business Model Innovation

The business model changes of the companies considered in this example can be summarized as follows:

Figure 12



The business model of the operator of machine (End User) does not change significantly. She continues to operate machines with the help of new tools and maintenance service and thereby optimizes her internal value chains and integrates the operator of the IIoT platform into her value chain.

The business model of SANY will change in a significant way and will result in a business model innovation: SANY continues to sell the same products to the same customers following the same revenue mechanism and traditional value chain. But SANY can offer rental services to the same customers, which results in a new value proposition and new revenue mechanism. In addition, the value chain is extended when SANY has to cooperate with the operator of the IIoT platform in order to optimize the maintenance services offered to the end users and to receive possible additional revenues along the life-cycle of the machines.

As a new member of the value network, the operator of the IIoT platform provides a new value proposition to new customers with a new revenue mechanism. The value chain is changing because of the usage of the IIoT platform. The business model of the provider of maintenance services does not change; she continues to sell the same services to the same customers following the same revenue mechanism and value chain.

CRRC: Global Remote Service for Electric Locomotives

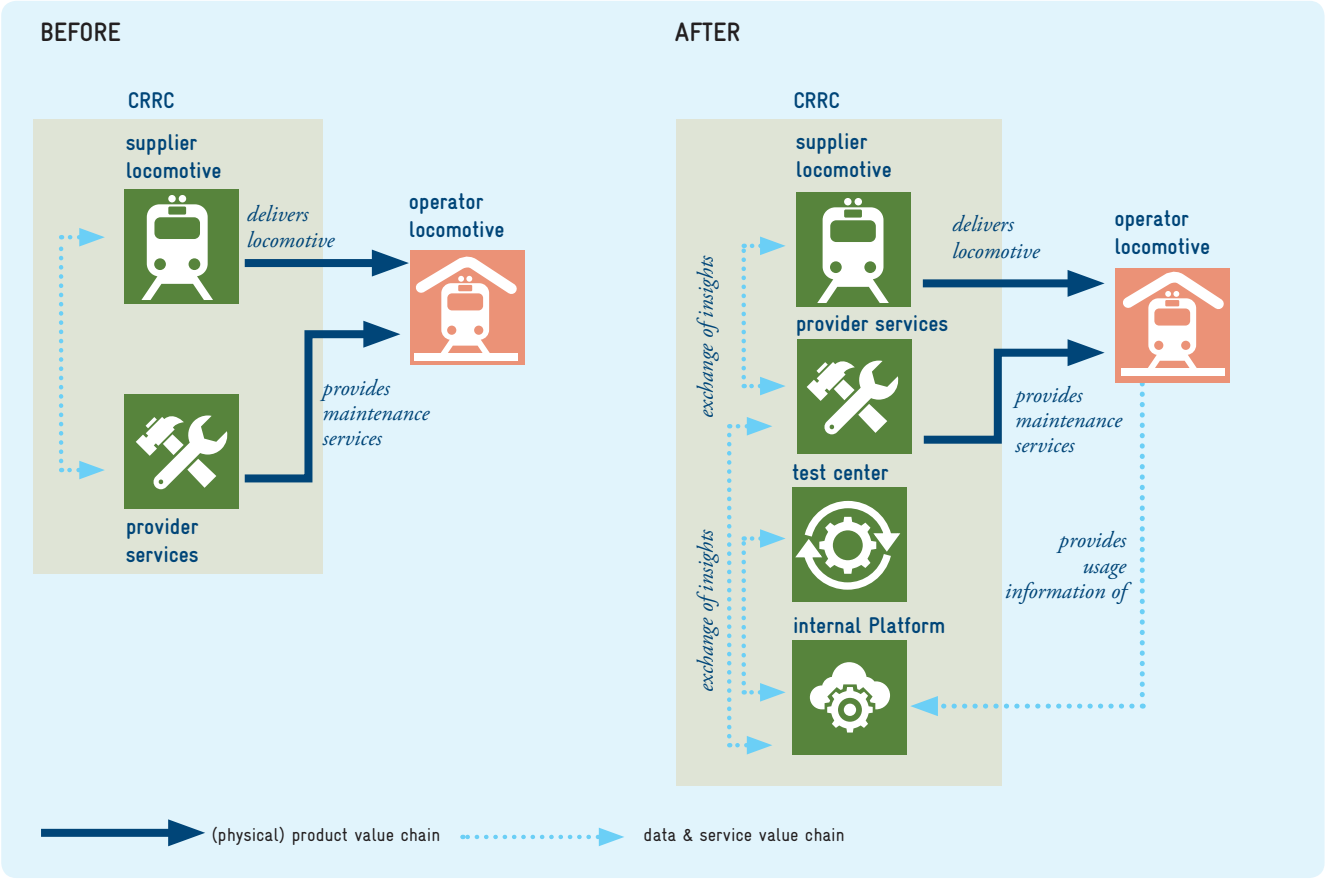
CRRC sells products (electric and diesel locomotives) overseas while the maintenance services rely on the localized enterprise and team. It is a complex and time-consuming work to analyze delivered locomotives and provide the proper solutions to operators of locomotives. Meanwhile, it is difficult for the various local teams to obtain the same level of maintenance quality.

To solve this problem while improving experience accumulation, CRRC has established a test center based on an internal platform to collect and analyze data for maintenance with mechanism models for locomotives. Therefore, CRRC can improve the service provided to the operators of locomotives to ensure high maintenance quality and efficiency under limited cost.

The test center is responsible to maintain various mechanism models of locomotives, analyze operational data based on models which combine mechanical, electrical and kinematical aspects.

The platform is responsible for processing lifecycle operations and maintenance data of each locomotive and provides necessary information to the test center.

Figure 13: Value Network



Value Proposition

The operator of a locomotive benefits from a more precise status evaluation of the locomotive so that she can optimize her operations with lower costs.

The supplier of locomotives (CRRC) provides the locomotives and retains an internal collection and analysis of usage information to keep the locomotive more trustworthy. In addition, the supplier of locomotives provides more valuable services based on models and accumulated data.

Revenue Mechanism

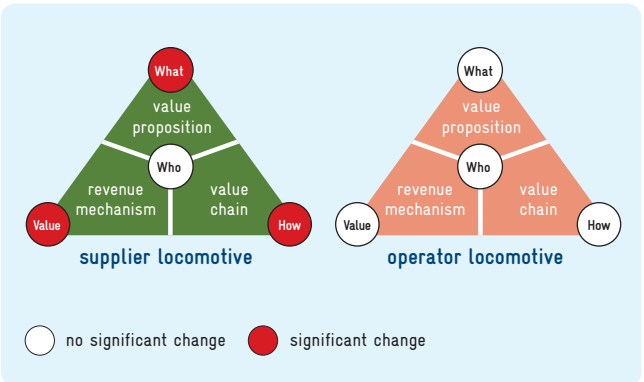
The operator of locomotives pays for the locomotive and its maintenance services.

The supplier of locomotives pays for the establishment of the test center and internal platform and charges fees under new cooperation contracts with the operator of locomotives.

Business Model Innovation

The business model changes of the companies considered in this example can be summarized as follows:

Figure 14



The business model of the supplier of locomotives will be innovated: The customer does not change, but the value proposition is extended by more valuable services. The value chain is changed due to the collection of usage information and the supplier of the locomotives receives additional revenue streams along the lifecycle of the locomotives. Nevertheless, the revenue mechanism itself (in the sense of revenue for services) and the structure of the value chain (in the sense of new partners in the value chain) do not change.

The business model of the operator of locomotives does not change; She continues to sell transportation services based on the operation of locomotives, and can focus on transportation service, delivery and reducing the effort needed to keep the locomotives available. Furthermore, the dispatching of running locomotives will get simplified and more precise.

BAO Steel Roller

Rollers in the steel industry have a long lifetime. The market for system integrators in this environment is largely limited to brownfield projects. The service for rollers is usually carried out by the operator of the steel mills, but the execution of these activities is increasingly too expensive for the operator and therefore no longer economical.

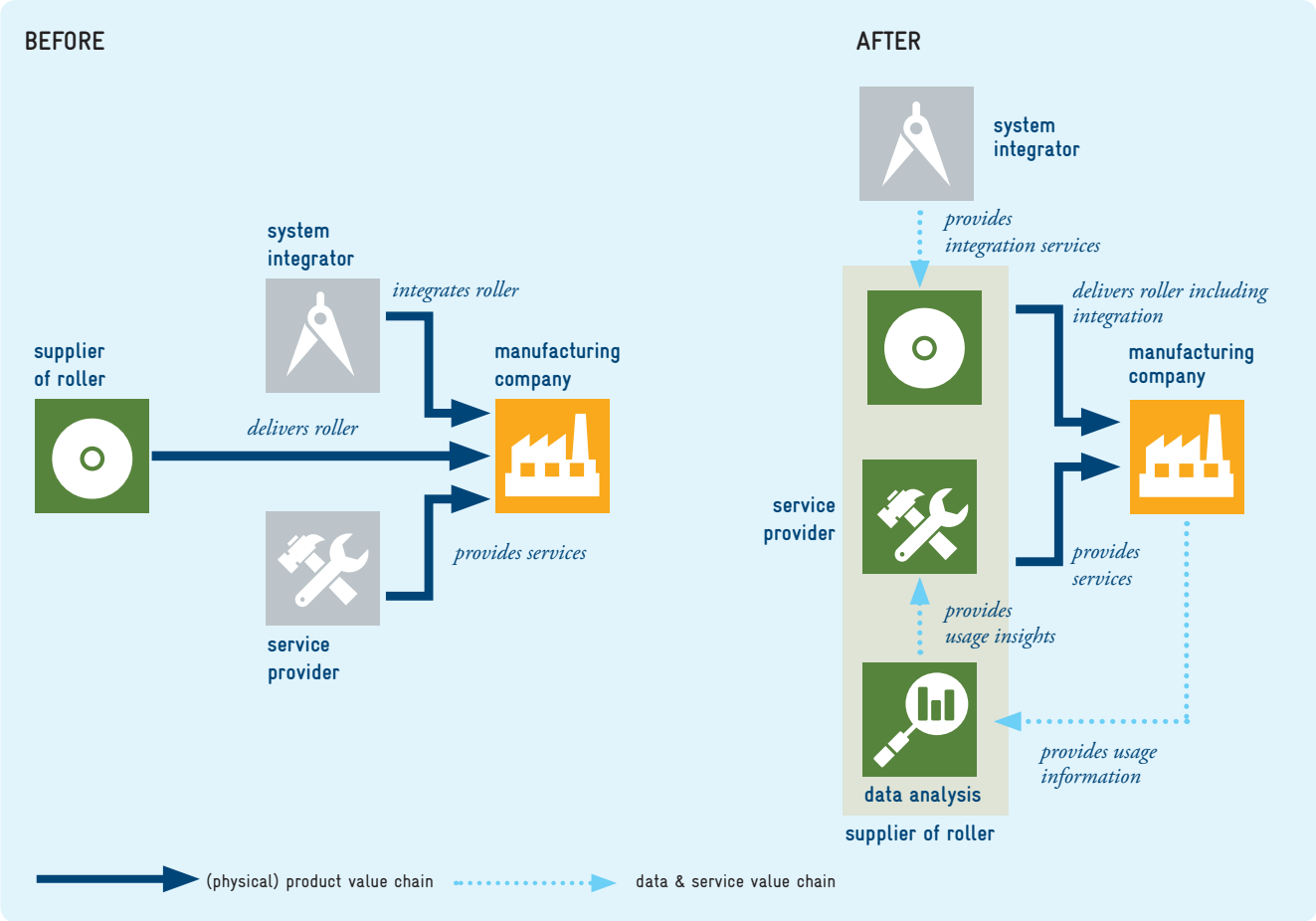
The supplier of the roller wants to offer services over the entire life of the roller, to compensate for the falling sales. In addition to taking over traditional service activities, she also wants to offer more as-a-service models. Instead of selling a physical roller based on a one-time payment, she generates a continuous revenue stream based on, for example, the length of steel produced.

In order to create such business opportunities, certain technical prerequisites are necessary or purposeful. Therefore, the following measures were considered in the underlying example:

- The supplier of the roller extends the roller to a "smart" roller with the aim of enabling automatic and precise oil injection, thereby making important service processes more efficient. For this purpose, a RFID transponder is embedded into the side surface of a roller to provide a unique identifier for each roller. The identifier can help to inject oil for the right roller and record operation data for each roller without mistakes. By integrating the RFID readers into the control system of the rollers, reliable reading performance in a complex metalflections environment is guaranteed and the automatically generated data can be integrated into higher-level manufacturing execution systems. This solution can be extended so that the oil injecting is performed automatically by a robot. Even predictive maintenance for the roller can be performed.

- The described technical concept of extending a roller by real-time and localization information stored on the "smart" asset (for example, status, degree of utilization, record of maintenance) can be used for other purposes during the service: at each process step information is read and recorded so that extensive documentation of the service activities can be generated. As a result, the maintenance record can be implemented easily serving as base, e.g. for intelligent and high-efficiency spare parts management.

Figure 15: Value Network



Value Proposition

The supplier of the roller upgrades the scooter with technical features so that the necessary maintenance and service processes at the manufacturing company can be optimized, for example by automating activities that were previously performed manually. In addition, the supplier of the roller also takes the responsibility for the system integration for the roller.

This can be expanded to the extent that the supplier of a roller takes over the service or even offers the roller as-a-service instead of selling the physical rollers and thereby capital expenditures of the manufacturing company can be converted into operational expenditures.

Revenue Mechanism

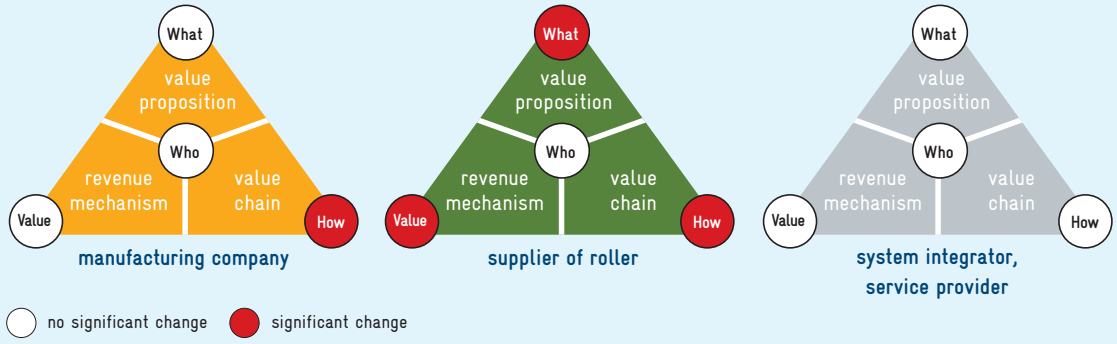
The supplier of a roller finances the development of the technical features, which will be integrated as extension into the product. This investment must be covered by the corresponding service contracts.

In the case of an as-a-service model, the manufacturing company pays for the concrete usage of the roller, which is calculated on a performance base according to the underlying service contract.

Business Model Innovation

The business model changes of the companies considered in this example can be summarized as follows:

Figure 16



The manufacturing company does not change its traditional business model. They will continue to sell the same product to the same customers based on the same revenue mechanism. Based on the offering of the supplier of a roller they optimize their internal value chains; the value chain changes in a structural way since the system integrator and service provider are integrated in another way into the value network and the manufacturing company provides usage information of the roller to the supplier of the roller.

The business model of the supplier of the roller will be innovated: The customer does not change. As the supplier of the roller offers the system integration and service of the roller, the value proposition changes. Furthermore, the revenue model changes, because the supplier of the roller no longer receives a one-off payment for the roller, but instead settles payments for the services performed, possibly performance based. Also, the value chain changes in a structural way, because the supplier of the roller provides the system integration and services of the roller.

The system integrator and service provider do not change their business model. However, the system integrator is now commissioned by the supplier of the roller but continues to perform the same technical activities. If necessary, the service provider may still be commissioned by the supplier of the roller to carry out specific service activities. Some of the service provider's tasks could also become automated.

Examples GER CN

Data Analysis on Security Situation

The manufacturing plants of BAO Chemicals are widely located at 6 sites in China with a historically grown heterogeneous IoT network. Thus, it is a challenge, to guarantee a safe operation of the manufacturing plants, especially ensuring security of the combination of IT and OT, because specialized and up-to-date know-how is necessary.

To address these challenges, Siemens offered BAO Chemical a supporting service to ensure industrial security based on a comprehensive solution:

- Assessment of the sites' IoT networks and structure of the sites' automation systems
- Development of an individual collection and analysis application
- Deployment of the collection and analysis application at each manufacturing location of BAO Chemical, collecting data traffic and logs in the local IoT network and analysing this data traffic and logs for anomalies that indicate intrusion attempts into the IoT network and the data itself
- Providing the analysis results of the application to BAO Chemical to initiate suitable internal actions as well as to Siemens for a more detailed remote analysis

Based on the more detailed remote analysis Siemens offers new valued-based services. This includes proposals for system upgrade solutions, which are done on a regularly basis, and proposals for an advanced security situation awareness of BAO Chemical in case of a business opportunity.

The collection and analysis applications could connect to the Siemens Cyber Defense Center localized in Suzhou or in near future to Siemens MindSphere to further improve the remote analysis offered by Siemens.

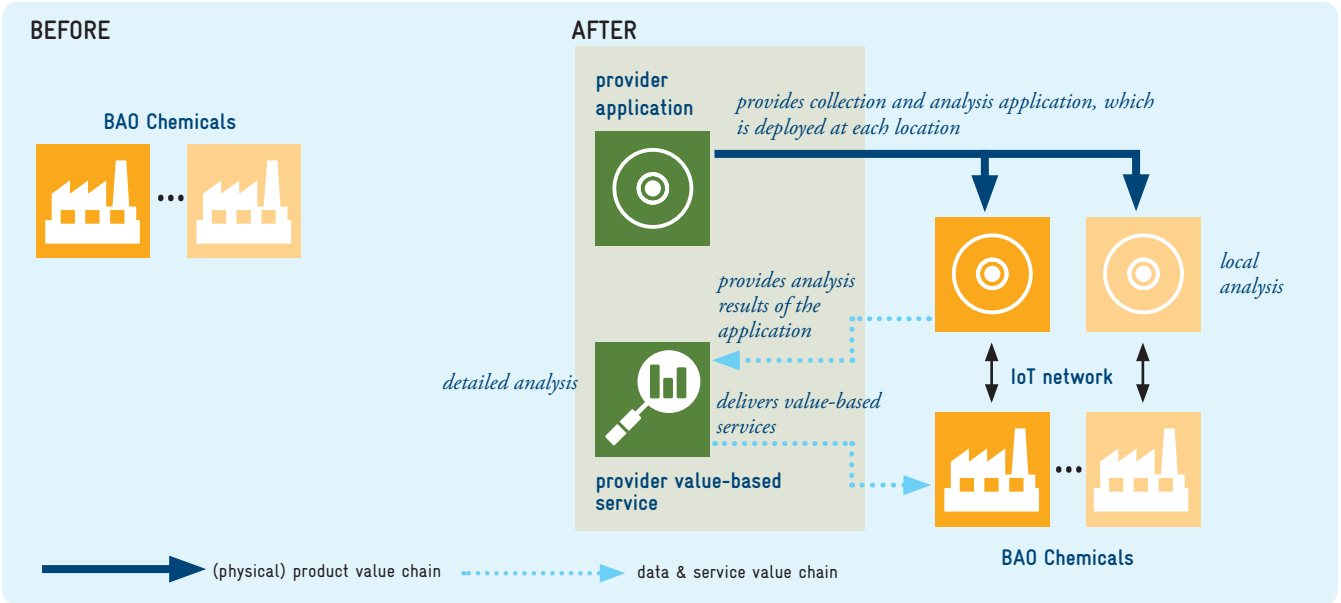
Value Proposition

Siemens offers an individualized closed-loop service to BAO Chemical based on analysis – service – value-add generation. Thus, BAO Chemicals benefits from an optimization of the internal value chains.

Revenue Mechanism

BAO Chemicals pays for the development and installation of the collection and analysis application (once) and the delivered new value-based services (over the time).

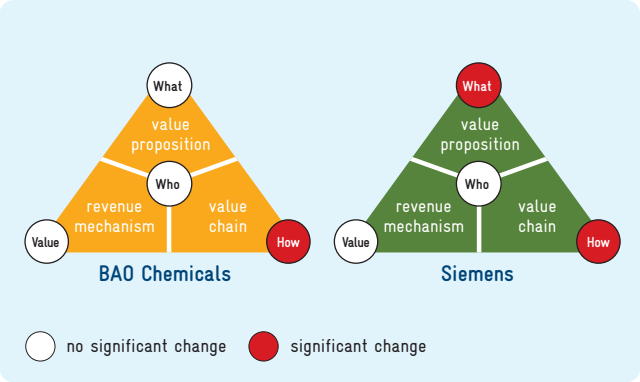
Figure 17: Value Network



Business Model Innovation

The business model changes of the companies considered in this example can be summarized as follows:

Figure 18



BAO Chemical does not change its traditional business model. They will continue to sell the same product to the same customers based on the same revenue mechanism. Based on the offering of Siemens they optimize their internal value chains; the value chain changes in a structural way since BAO Chemical provides analysis results to Siemens for a detailed remote analysis.

The business model of Siemens will be innovated: The customer does not change. Also, the revenue model does not change, because it is based on the same principles as traditional services offered by Siemens. But Siemens offers a new individualized service to BAO Chemicals, thus, the value proposition changes. Also, the value chain changes in a structural way, because of the detailed remote analysis executed by Siemens.

Remote Maintenance and Data Analysis of Gas Leakage Detection

BAO Steel Power Generation (BAO Steel PG) must strictly satisfy safety regulations in the gas area. They want to improve their operation and maintenance processes, which are currently executed in specific areas manually. Therefore, they request for suitable remote maintenance applications and services to reduce the on-site manpower and for automated guidance and control to execute the on-site activities on time. They intend to use digitalization technologies to enable routing reporting and to guide junior engineer on-site to accumulate experience.

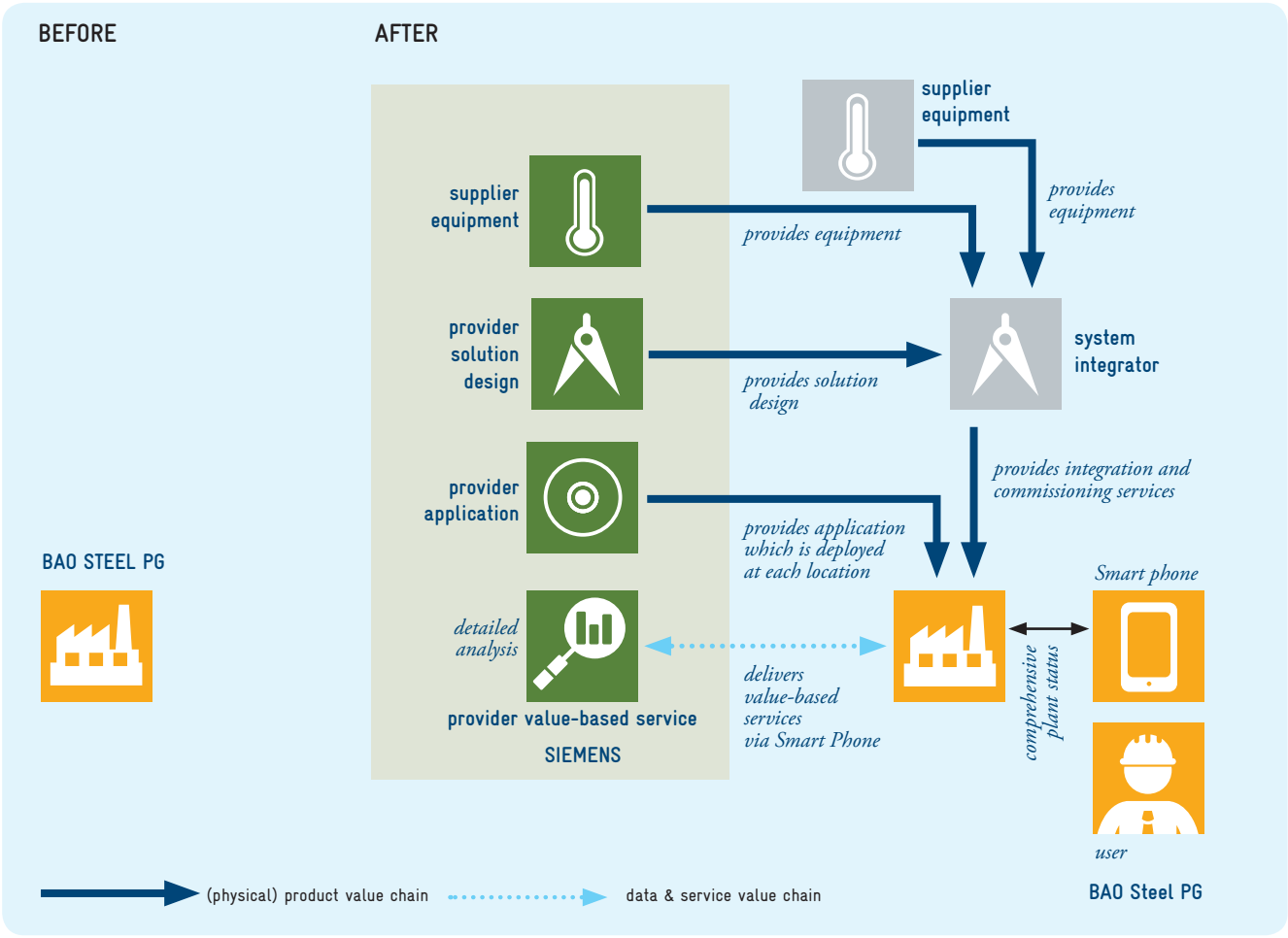
To address these challenges, Siemens offered BAO Steel PG support to ensure safety in the gas area based on a comprehensive solution:

- Gas leakage detection in form of a total solution of hardware and software comprising digital visualization technology to avoid hazardous situations (highest priority) and an interface to the cloud and knowledge storage to ensure an easy connection and access with mobility function.
- High efficiency maintenance delivered as a value-based service to save costs by efficient routing of inspection activities, remote based multiple site support and supervision by top experts of Siemens and provision of a standard trouble shooting library as reference for pre-maintenance decisions.

In the near future these applications could connect to Siemens MindSphere to further improve the operation and maintenance processes of BAO Steel PG. Furthermore, the applications will entail additional selling of Siemens hardware and possibly system integration services.

The necessary system integration and commissioning services are executed by an external system integrator, who also integrates third party equipment.

Figure 19: Value Network



Value Proposition

The system integrator offers the integration and commissioning of the solution designed and offered by Siemens into the various systems and processes of BAO Steel PG.

Siemens offers an individualized closed-loop service to BAO Steel PG based on analysis – service – value-add generation.

Thus, BAO Steel PG benefits from an optimization of the internal value chains.

Revenue Mechanism

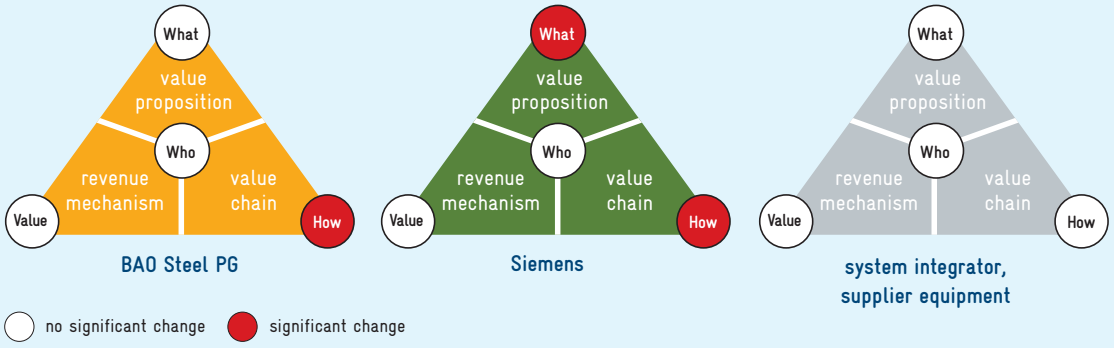
BAO Steel PG pays the system integrator for the specific integration and commissioning services, for example hardware and software (once) and in addition the value-based services provided by Siemens (over the time).

The system integrator pays Siemens for the requested equipment and solution design.

Business Model Innovation

The business model changes of the companies considered in this example can be summarized as follows:

Figure 20



BAO Steel PG does not change its traditional business model. They will continue to sell the same product to the same customers based on the same revenue mechanism. Based on the offering of Siemens they optimize their internal value chains; the value chain changes in a structural way since BAO Steel PG integrates new value-based services delivered by Siemens into its value chain.

The business model of Siemens will be innovated: The customer does not change. Also, the revenue model does not change, because it is based on the same principles as traditional services offered by Siemens. But Siemens offers a new individualized service to BAO Steel PGs. Thus, the value proposition changes.

Furthermore, the value chain changes in a structural way, because new value-based services are being integrated into the value chain.

There are no changes in the business model of the system integrator and the supplier of equipment.

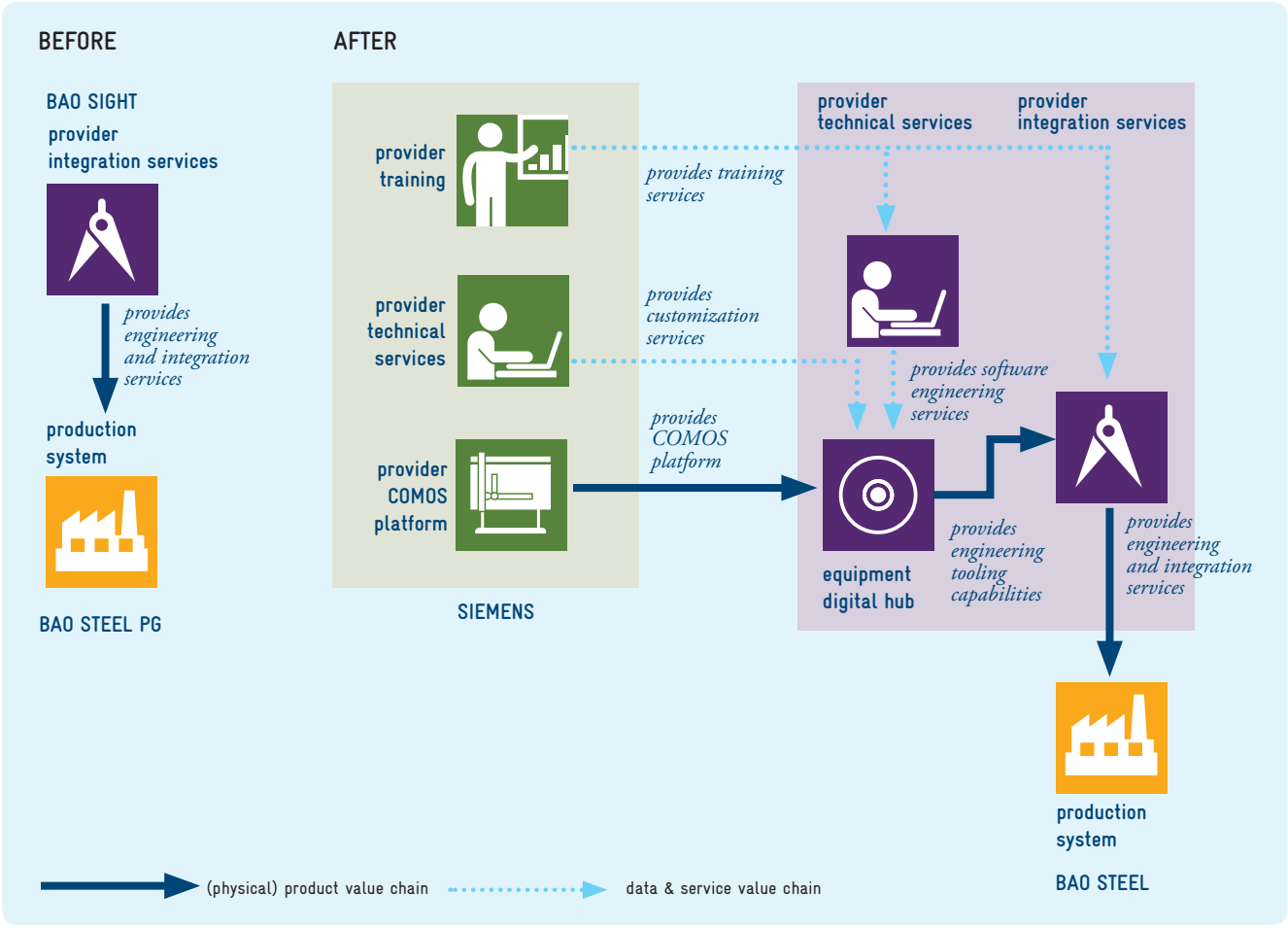
Equipment Lifecycle Management Project (Sub-project of BSG214.0)

Engineering of industrial plants is a complex task. Individual requirements of an operator of an industrial plant must be implemented in the context of a customer project. Therefore, a provider of engineering and integration services strives to constantly optimize the engineering processes and methods. A key lever for optimizing engineering processes and methods is the effective use of a powerful engineering tool environment.

In this context BAO Sight introduced the COMOS platform from Siemens, which is the scope of this example. The introduction of the COMOS platform had the following technical and organizational implications for BAO Sight:

- COMOS is a platform that can be customized for specific use in engineering projects. BAO Sight has therefore developed the "equipment digital hub" based on the COMOS platform. The "equipment digital hub" is an engineering environment that BAO Sight internally provides to the various engineering projects so that the projects can be executed efficiently and effectively.
- The development of the "engineering digital hub" was jointly carried out by BAO Sight and Siemens. For this purpose, Siemens has offered BAO Sight customization services for the COMOS platform.
- In order to be able to carry out the customizing of the COMOS platform as well as the use of the "equipment digital hub" efficiently and effectively, BAO Sight was coached based on appropriate training services offered by Siemens.

Figure 21: Value Network



Value Proposition

BAO Sight benefits from optimization of the internal value creation processes, for example, the equipment lifecycle management.

Siemens offers software tools as well as customization and training services for these software tools to enable customer using and integrating these software tools into their IT landscape.

There are no changes in the value proposition between BAO Sight and BAO Steel.

Revenue Mechanism

There are no changes in the revenue mechanism of Siemens, BAO Sight and BAO Steel.

Business Model Innovation

The changes of the business models can be summarized as follows:

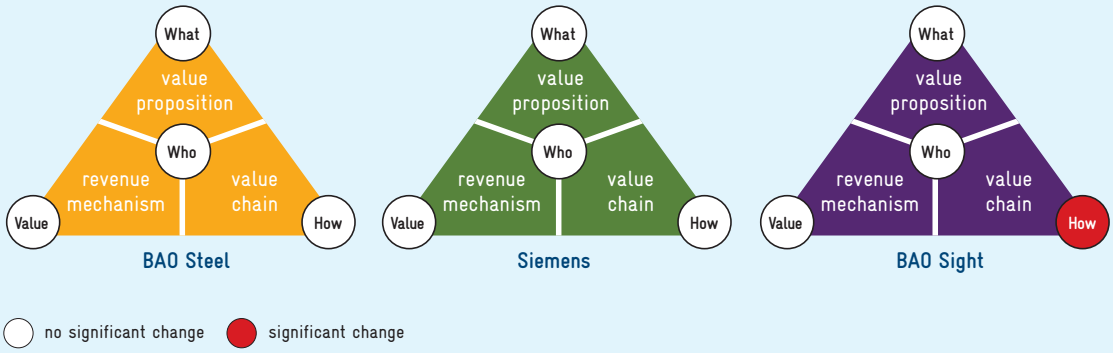
The business model of BAO Steel does not change: BAO Steel continues to sell the same products to the same customers following the same revenue mechanism and value chain.

Also, the business model of Siemens does not change:

Siemens continues to sell the same products and services to the same customers following the same revenue mechanism and value chain.

The business model of BAO Sight also does not change. BAO Sight continues to sell the same services to the same customers following the same revenue mechanism. The internal value chain is optimized because of the usage of the "equipment digital hub".

Figure 22



Examples GER

Perfection and Productivity at Siemens Plant Amberg

To be successful with a product like programmable logic controllers in the world market, quality is an absolute must. Therefore, Siemens Plant Amberg implements a relentless pursuit for perfection. By this, the production equipment and the entire supply chain have been increasingly connected over the years. The information collected is analysed in a consequent way using data analysis techniques. Improvement measures are initiated based on the analysis results. The result today is a quality rate of 99.9989%.

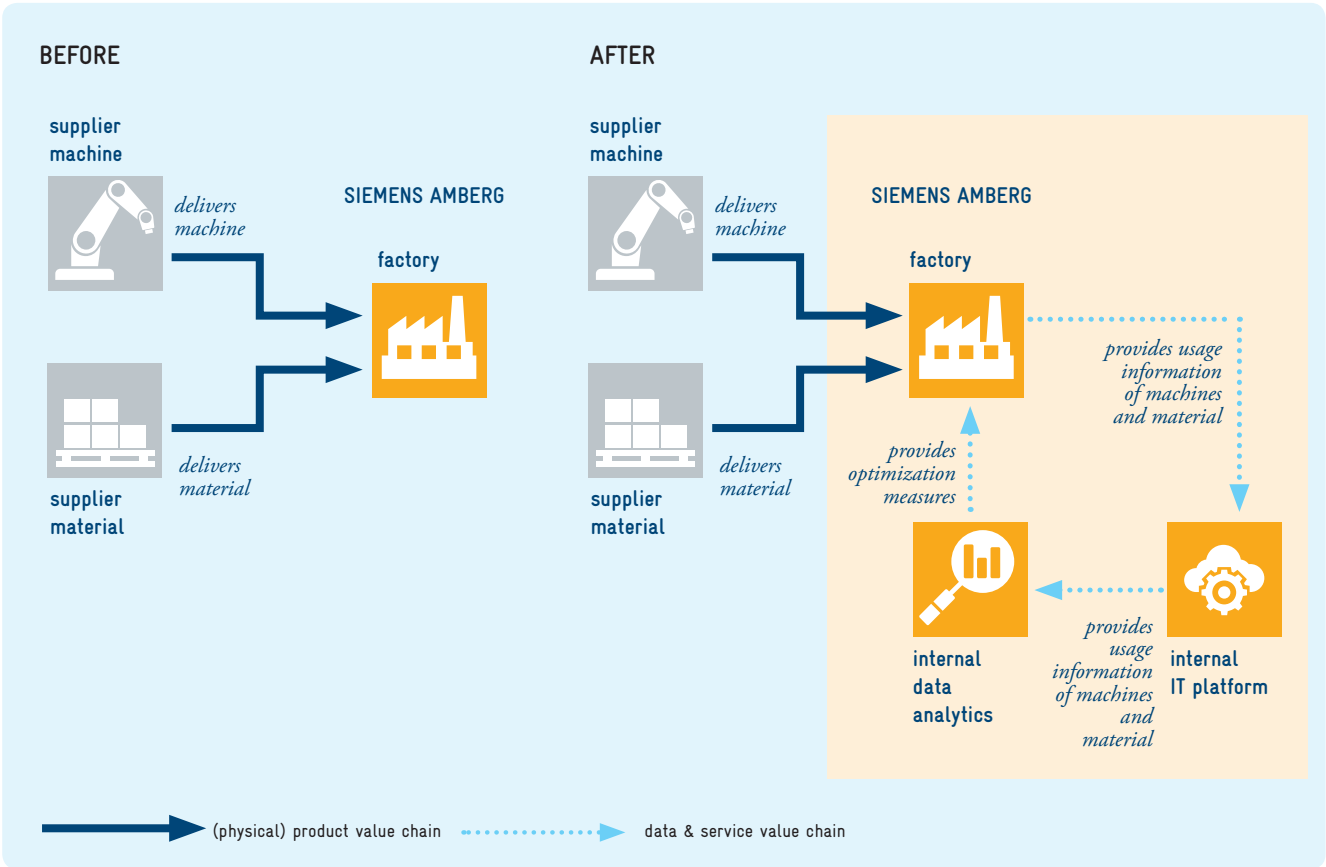
Value Proposition

This example addresses an improvement of the internal manufacturing and supply processes without changing the product offered to the market.

Revenue Mechanism

This example addresses an improvement of the internal manufacturing and supply processes without changing the revenue mechanism with respect to the product offered to the market.

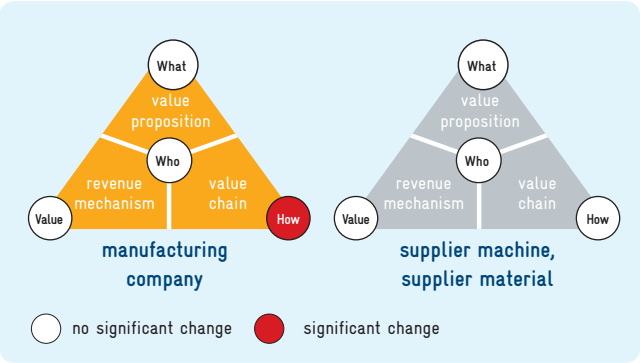
Figure 23: Value Network



Business Model Innovation

The business model changes of the companies considered in this example can be summarized as follows:

Figure 24



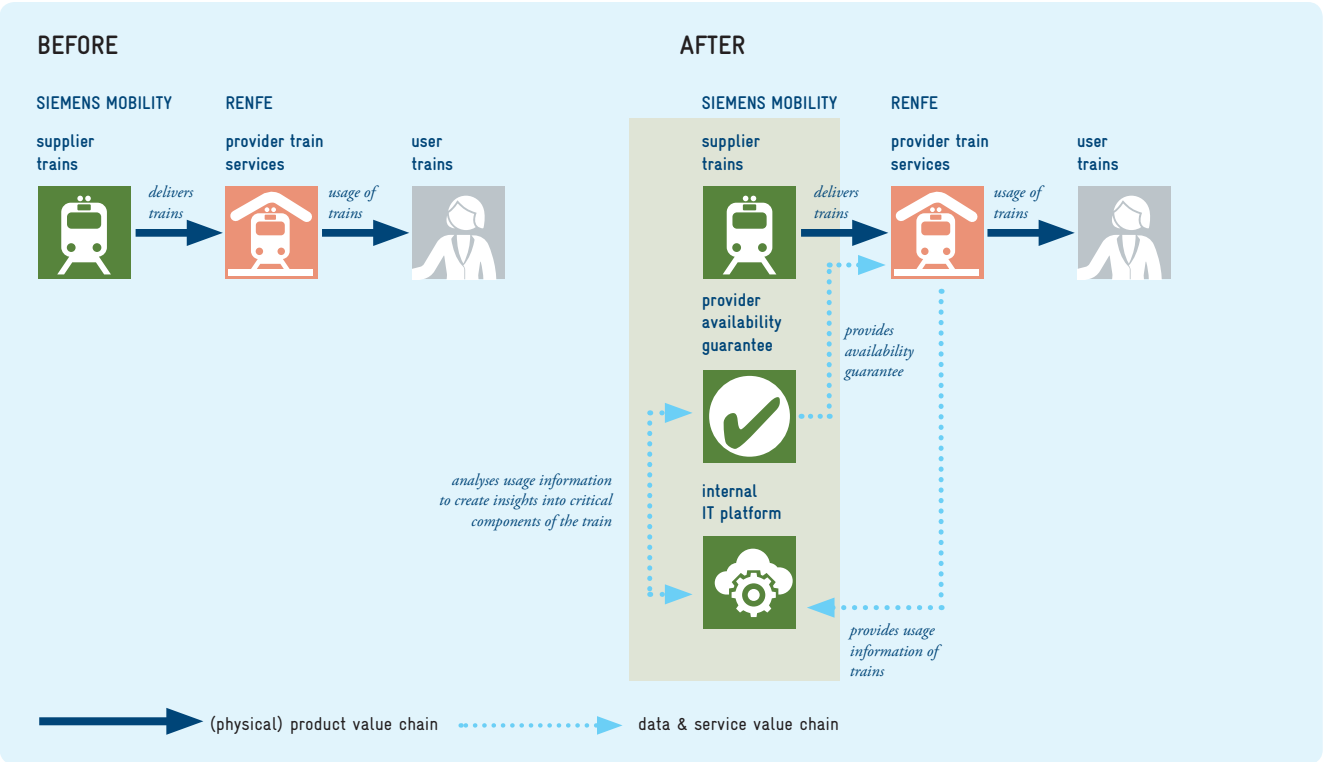
The business model of the manufacturing company does not change. The manufacturing company continues to sell the same products to the same customers following the same revenue mechanism. The value chain is optimized and changes in its structure because of a closer integration of the various suppliers. Furthermore, the business models of the suppliers of machines and materials do not change.

Availability Guarantee for Train Services

Siemens Mobility has delivered 26 high-speed trains for the Madrid – Barcelona – Malaga line to the Spanish railway company Renfe, concluding an agreement to guarantee availability of the trains. Passengers are compensated by Siemens Mobility for delays of more than 15 minutes resulting from technical defects of the trains. Siemens analyses sensor data from critical components for predictive maintenance to guarantee these availabilities.

The result is a punctuality rate of 99.9%. Due to this and the change from aircraft to rail the passenger volume has increased by 60%.

Figure 25: Value Network



Value Proposition

The provider of train services benefits from an increased availability of the trains and passes this on as a value proposition to the end-customers, the users of the train.

The supplier of trains provides the trains including an internal collection of usage information of the trains and offers an additional availability guarantee covering delays resulting from technical defects of the trains.

Revenue Mechanism

The provider of train services pays once for the delivered trains and periodically fees for the availability guarantee.

The supplier of trains pays for the development of the trains, availability services, the development, installation and operation of the internal IT platform and reimburses the user of the trains for delays resulting from technical defects of the trains.

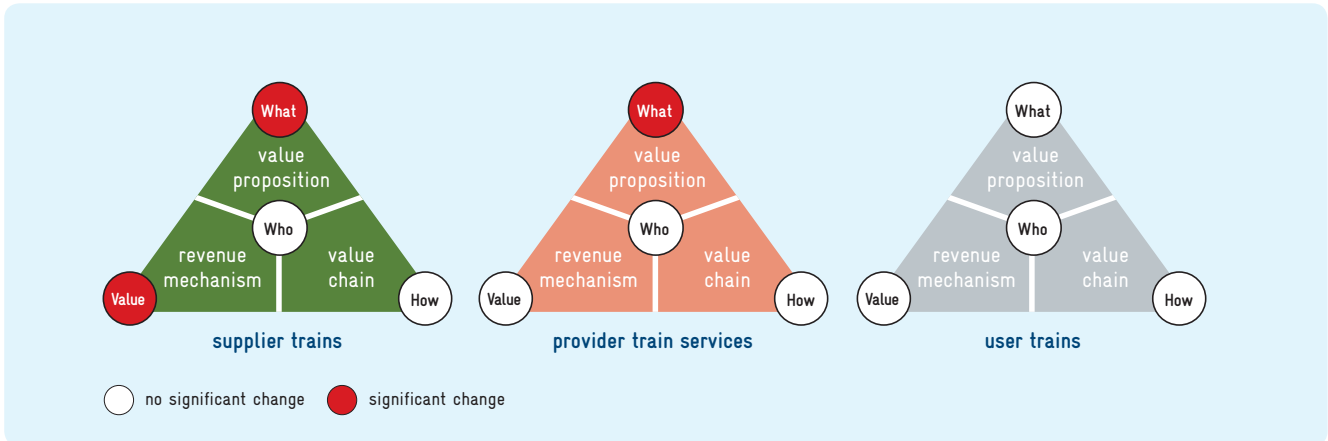
Business Model Innovation

The business model changes of the considered companies can be summarized as follows:

Figure 26

The business model of Siemens Mobility is innovated: The customer does not change, but the value proposition is extended by the availability guarantee. The value chain is changed due to the connection of the trains to collect usage information and the supplier of the trains receives additional revenue streams along the life of the trains. The change in the value proposition is of a structural nature. The change in revenue mechanisms is also a structural change because the additional value proposition will strongly influence the internal structure of the new revenue mechanism.

The business model of the provider of train services does not change significantly. The provider of train services continues to sell the product transportation service, but now with improved punctuality including compensation for delays. This is a structural change in the value proposition. By attracting flight customers, the provider of train services expands its clientele; one could even argue that this is a structural change. There is a shift in the revenue mechanism from CAPEX (less investment in the purchase of the trains) to OPEX (additional payments for the availability guarantee), but no fundamental structural change. The value chain is optimized through the additional availability guarantees but does not change in its basic structure from the point of view of the provider of train services.



For the user of trains business model considerations are not applicable.

Digital platform iCOM of Knorr-Bremse

This example is based on a press release from October 25th, 2018, Link. Rheinbahn Düsseldorf equips vehicles with digital platform iCOM from Knorr-Bremse

- iCOM implemented in three Rheinbahn Dusseldorf vehicles
- iCOM is a central data hub and monitors the conditions of vehicles
- Basis for predictive and cost-effective maintenance

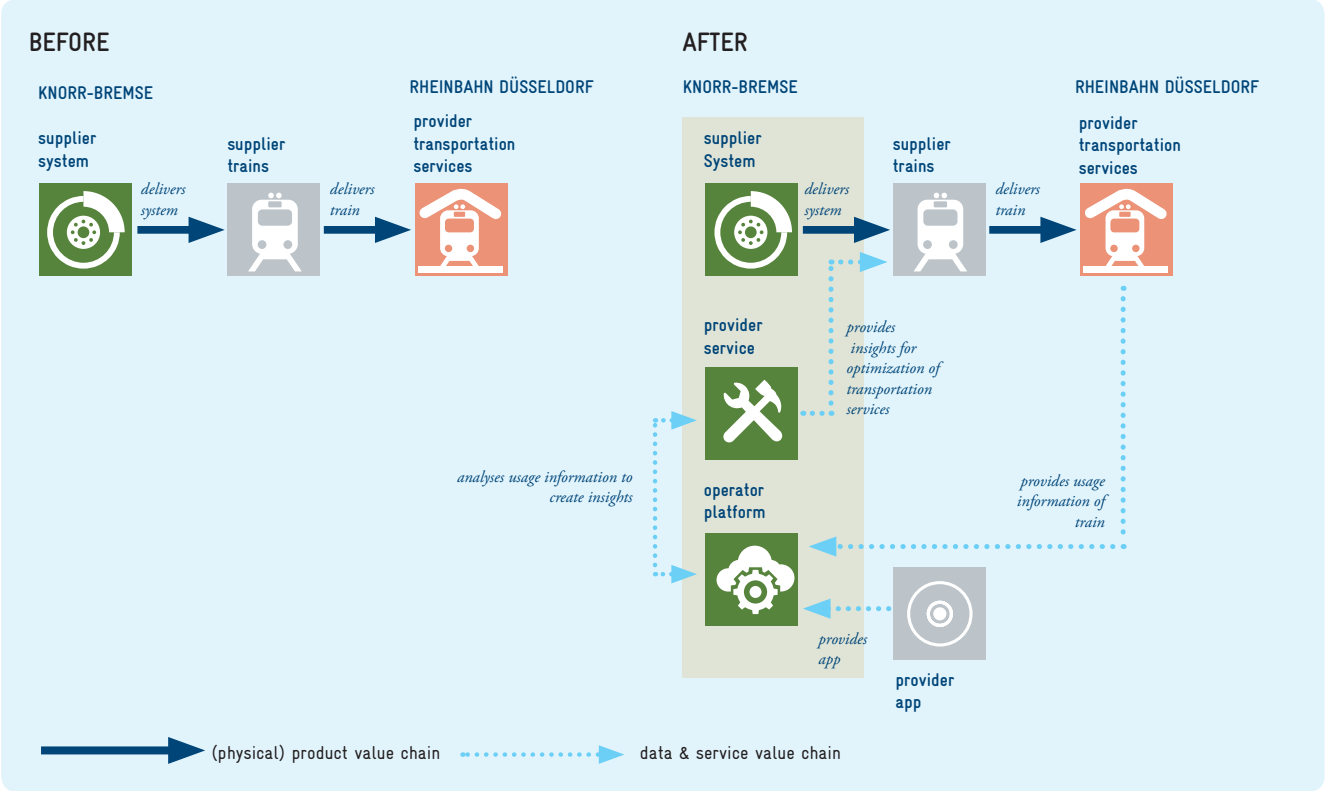
In June 2018, the Düsseldorf transport company Rheinbahn implemented the iCOM digital platform from Knorr-Bremse, world market leader for brake systems and a leading provider of subsystems for rail and commercial vehicles. Rheinbahn will be able to realize better maintenance efficiency of the rolling stock fleet as well as lower downtimes and costs on currently three vehicles equipped with iCOM.

Knorr-Bremse and Rheinbahn in Düsseldorf started their joint project iCOM in January 2018. Following this, Knorr-Bremse equipped the light rail vehicles delivered between 2006 to 2012 with the digital platform. Rheinbahn in Düsseldorf received software and hardware for the radio-based data delivery from light rail vehicles into their workshops. iCOM, the central data hub, monitors the condition of vehicles and helps operators to introduce more predictive and cost-effective maintenance (predictive maintenance). This will give Rheinbahn more transparency concerning the current operation of their vehicles and possible problems can be registered early.

Based on the online transmission from the moving trains an improved organization of factory services, a higher vehicle availability and a reduction of operating costs can be achieved. The project in this area is also groundbreaking because of the close cooperation between fleet operators and component manufacturers. The customer proximity of Knorr-Bremse RailServices leads here via iCOM to the operational safety of the rolling stock and decreasing operating costs.

At the workshops of Rheinbahn, data sets are received online that enable sound judgments on maintenance, repair or replacement of components. The resulting benefits, such as cost avoidance at an early stage, initially arise on the preventive side. The vehicle failure can be avoided by preventive maintenance. Conversely, the scheduled maintenance in fixed mileage or time intervals maintenance can be postponed, for example, to adjust the replacement of vehicle parts to the actual degree of wear of the components. This optimizes the idle times of the vehicles. Other data help analyze and assess the function of components that consume energy, which means that interventions deliver better maintenance services at the right time, resulting in greater efficiency.

Figure 27: Value Network



Value Proposition

The provider of transportation services benefits from an optimization of the transportation services offered to the end-customer, for example improved operational safety of the rolling stock fleet, lower operating costs and higher efficiency through timely maintenance services.

The supplier of the braking system provides in addition to the braking system, which is typically delivered to the supplier of trains, capabilities to collect usage information of the trains. She delivers this information to the provider of transportation services so that the provider of transportation services can use this information to optimize her transportation services.

Revenue Mechanism

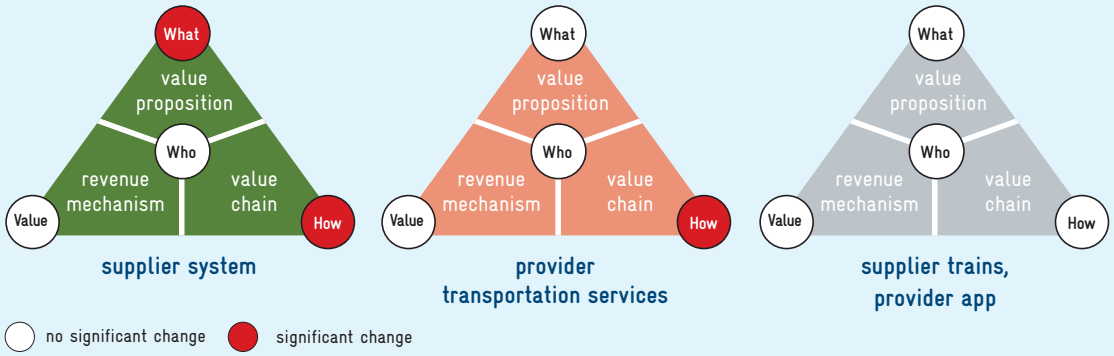
The provider of transportation services pays for the trains and in addition for the insights delivered by the supplier of the braking system.

The supplier of the braking system pays for the development and operation of the iCOM platform and typically for the connection of the vehicles to iCOM.

Business Model Innovation

The business model changes of the companies considered in this example can be summarized as follows:

Figure 28



The business model of the provider of transportation services does not change significantly. The company will continue to sell the same product (transportation services) to the same customers. The revenue mechanism does not change, even if payments for the new delivery of insights of the usage of the trains are necessary, because provider of transportation services already paid for services during the life of the braking system in the past. The value chain changes because of the integration of the platform iCOM into the data value chain.

The business model of the supplier of the braking system will be innovated. The customer does not change, but the value proposition is extended by the delivery of insights of the usage of the trains. The revenue mechanism does not change, because the supplier of braking systems was already paid for services during the lifecycle of these systems in the past. The value chain changes due to the integration of the platform iCOM into the data value chain.

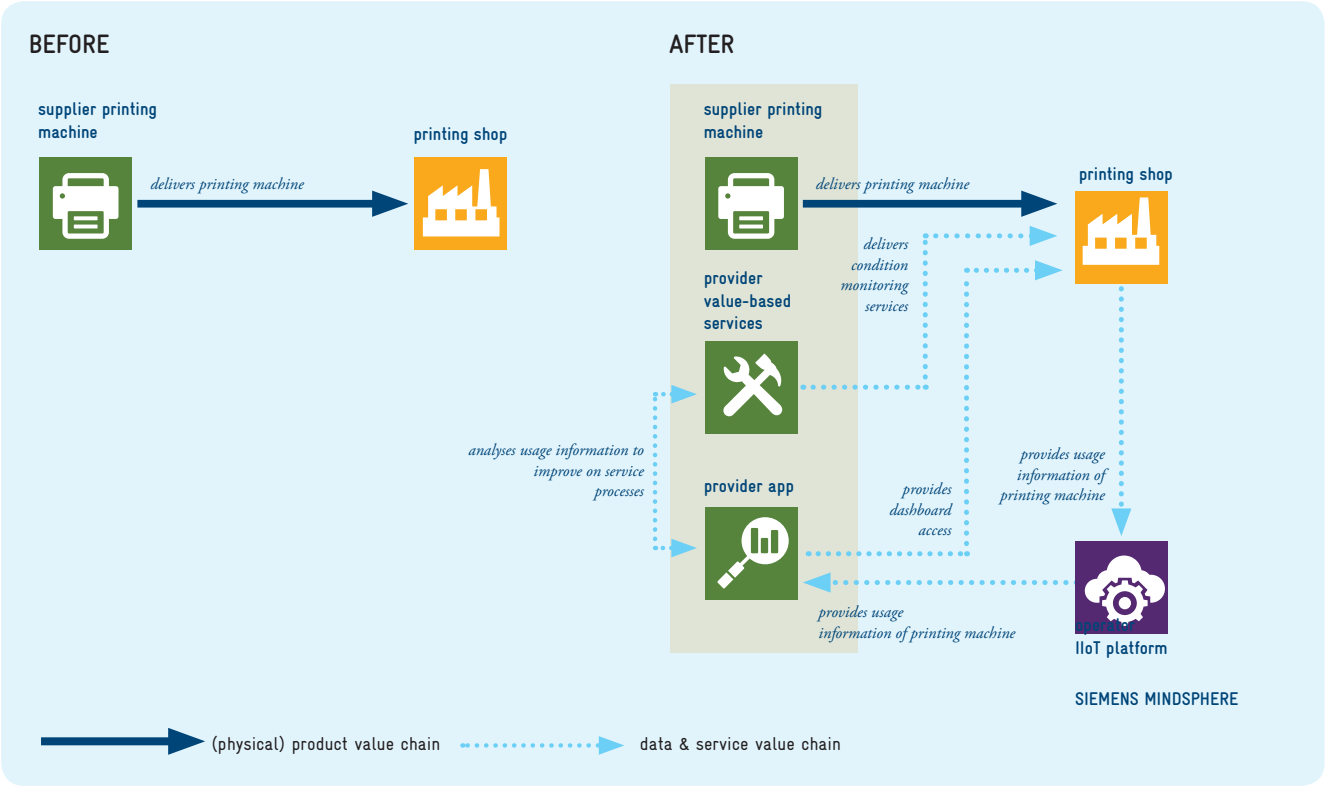
The business model of the supplier of trains and the provider of apps do not change in this scenario.

Cloud-Based Fleet Management for Printing Machine Provider

A medium-sized supplier of machines for the printing industry has been selling machines over the last years to customers all over the world. In the event of a fault, the operators of these machines were dependent on the supplier of the machine intervening on-site, because remote access to the machines has not been discussed. So far, the supplier of the machine also has not had the capabilities to set up an adequate remote access to the machines supplied by him in terms of cost/benefit. Using Siemens MindSphere, she can now implement such a remote access. In addition, she has the option of automatically monitoring the machines distributed worldwide via a software application.

In this way, the supplier of the machines can optimize the service provision to her customers. She expects a 20% increase in remote fault clearance. Furthemore, an additional revenue stream can be established by subscription fees for automated condition monitoring services.

Figure 29: Value Network



Value Proposition

The printing shop benefits from an optimization of its production processes. It can improve the ability to deliver due to reduction of unplanned downtimes of the printing machines.

The supplier of the printing machines delivers the printing machine and optimizes her own service delivery process based on the remote access to the printing machines. In addition, the supplier of printing machines offers condition monitoring services. Thus, she extends her portfolio by value-added services.

The operator of the IIoT platform is the enabler for the optimization of the service delivery process and the offering of valued-added services. The operator of the IIoT platform provides a powerful IT infrastructure. By this, the user of the IIoT platform can focus on its core competence.

Revenue Mechanism

The printing shop pays for the delivered printing machine and the condition monitoring services.

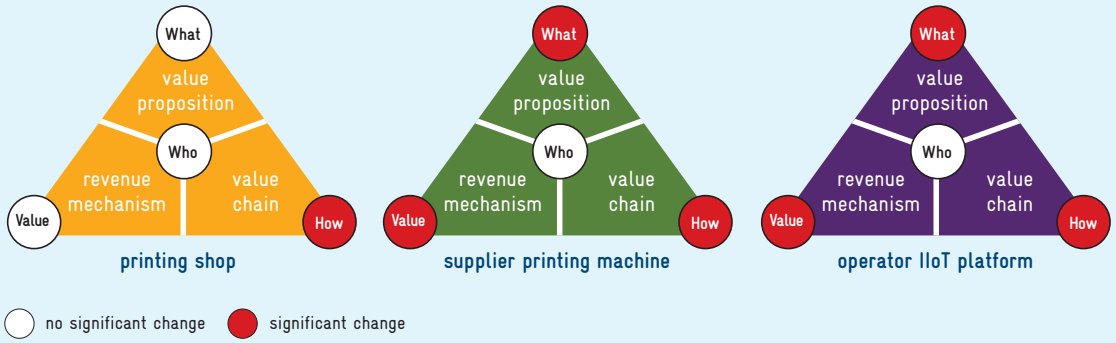
The supplier of the printing machines pays for the use of the IIoT platform.

The operator of the IIoT platform charges a usage-based fee, which typically depends on the number of connected machines and the amount of transmitted information.

Business Model Innovation

The business model changes of the companies considered in this example can be summarized as follows:

Figure 30



The business model of the printing shop does not change in a significant way. The company will continue to sell the same product (printed media) to the same customers. The revenue mechanism does not change, even if the payments for the monitoring services and maintenance for the machines will change. The value chain is optimized regarding the maintenance of the machines and changes in a structural way because of the integration of the operator of the IIoT platform into the value network.

The business model of the supplier of the printing machines will be innovated: The customer remains the same, but the value proposition is extended by new condition monitoring services. The value chain is also changing: the service delivery process is optimized and the operator of the IIoT platform is now a new partner in the value chain. Furthermore, the revenue mechanism changes: Besides new revenue streams based on the subscription fees for the condition monitoring services additional payments to the operator of the IIoT platform for using the IIoT platform are necessary.

In this specific example, Siemens, as the operator of the IIoT platform MindSphere, addresses the same customers as in the past, but offers a new value proposition with a new revenue model. Basically, IIoT platforms are used in many different use cases. Therefore, the operator of an IIoT platform will use an ecosystem approach to integrate as many partners as possible into these value chains.

Construction Industries

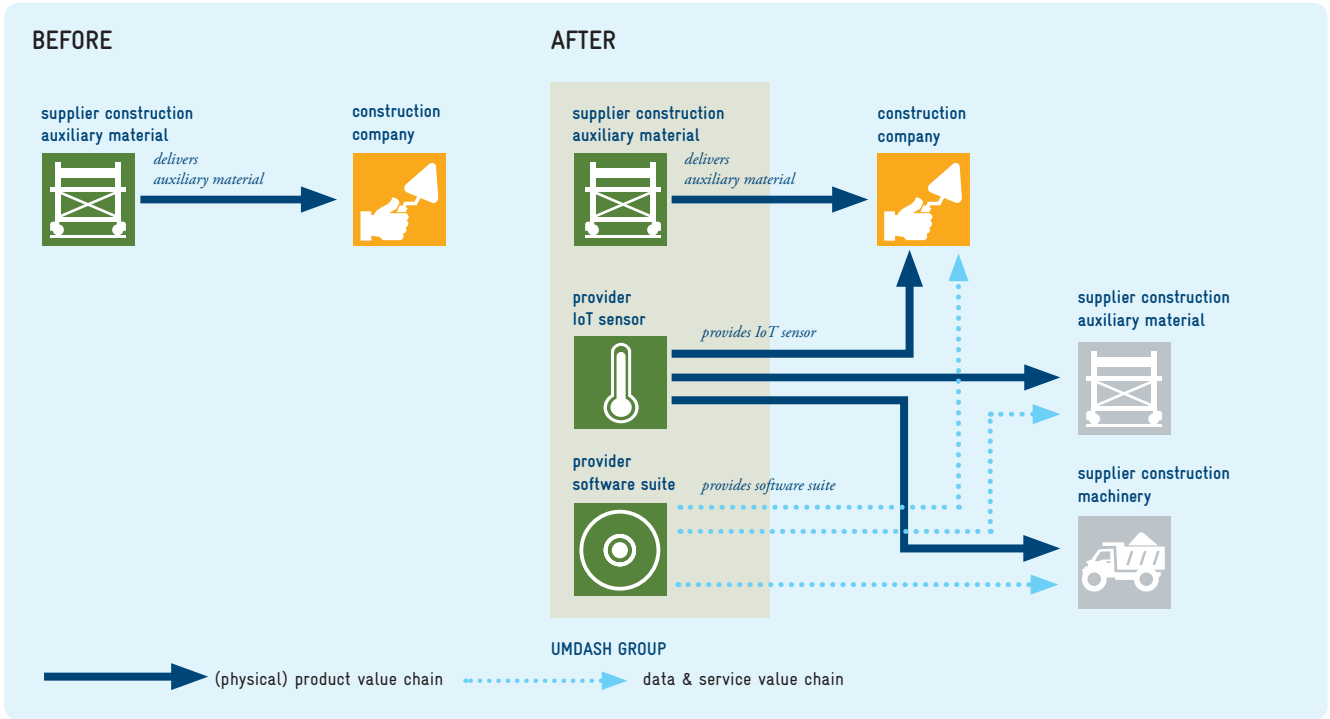
This example is based on information published at Link.

In the future, construction processes are being developed from today's concept of construction at site to industrial construction with exact turnaround times and as-build quality. This example focuses on the build phase of the building lifecycle (invest, plan, build, operate, demolish). Umdash Group as a supplier of construction auxiliary materials has developed a software suite in a spin-off company. In a first step, the actors in the build phase will be offered software services, which will increase the efficiency at site to industrial process levels. The software suite enables all actors to exchange process and asset data and the user of the software suite can orchestrate the value chains in this phase. Umdash Group materials itself uses the software suite and wants to achieve an increased proportion of leasing with significantly better efficiency. For this purpose, she uses IoT sensors in her construction auxiliary material to get more transparency of the value chains.

Specifically, the software suite "Digital Construction Intelligence" – based on the motto "You can only manage and optimize, what you measure" – offers the following capabilities:

- "Digital Construction Site" to digitize the site and boost productivity. This includes the optimization of the building process with a takt planner app for site managers and foremen getting field data from the site based on IoT-sensors to deliver additional as-is real time data. The transparency makes it possible to identify potential for improvement. A significantly (6–15%) more productive construction site with proactive execution of teams, material flows and workflows can be achieved.
- "Site Monitoring Tool" enhances transparency and enables increased outcomes. This includes real-time monitoring of the building progress for construction companies, building owners, developers and planners. Higher margins due to improved competitiveness, risk management and best-practice construction execution can be achieved.
- "Learning Construction Process" to improve the processes through data insights. This includes data analytics for a sustainable increase in productivity and margin as well as the identification of waste reduction potentials for lean construction. Higher margins due to more knowledge in pre-development, transparent risk management and transparent execution can be achieved.

Figure 31: Value Network



Value Proposition

Umdash Group offers an IoT Sensor, which is easy to install and then provides, for example, temperature or location information. The connectivity will be implemented via the base station on construction site, which includes a local weather station. Furthermore, the respective software suite is offered as well. Within this, the optimization of construction site planning is offered. This is supported by the software suite and monitoring of technical processes is possible via the IoT sensor (for example, temperature history during a curing process). Umdash Group offers optimization of asset management via the IoT sensor (for example, tracking construction auxiliary materials or construction equipment).

Revenue Mechanism

Umdash Group pays for the development of the software suite as well as for the IoT sensors, including their installation in its construction auxiliary material.

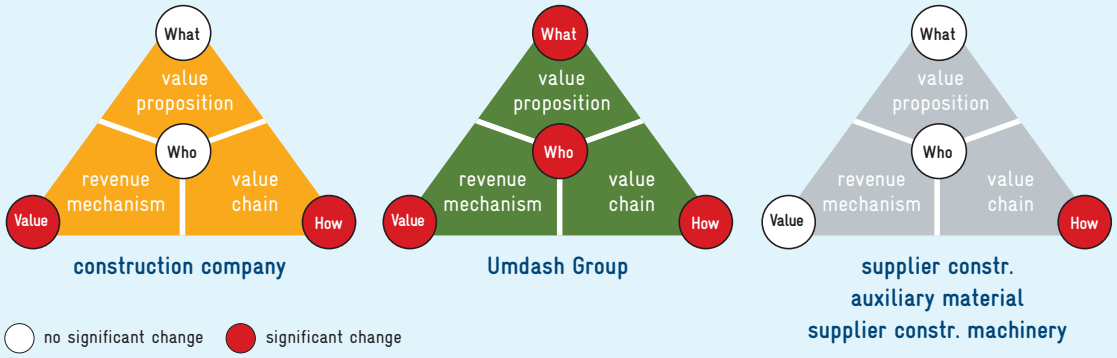
The construction company pays for the software suite a fixed share of the total construction volume. This share is smaller than the promised cost savings resulting from the use of the software suite. The cost savings have been contractually guaranteed.

The other supplier of construction auxiliary material and supplier of construction machinery pay for the delivered IoT sensors (including the installation in the construction auxiliary materials and construction machinery) and the use of the software suite.

Business Model Innovation

The business model changes of the companies considered in this example can be summarized as follows:

Figure 32



The business model of the construction company will be innovated: The customer and the value proposition remain the same but the value chain is changing: the internal processes are optimized and – depending on the concrete situation – Umdash Group may be a new partner in the value network. The revenue mechanism of the construction company changes significantly since they pay a fixed share of the total construction volume and, as a result, do not need to take certain risks into account when calculating with respect to their customers, because these are taken by the UMDASH Group.

The business model of the Umdash Group will be innovated: The Unmdash Group addresses new customer segments. They not only deliver their new offerings (software suite and IoT sensors) to construction companies, but also to their competitors (other supplier of construction auxiliary materials) and supplier of construction machinery. Umdash Group extents its value

proposition by offering a value-based service based on performance contracting by guaranteeing cost savings, but Umdash Group additionally offers IoT sensors and a software suite. Umdash Group extends the revenue mechanism by being paid for guaranteed cost savings and finally the value network changes in a structural way because the construction company is integrated differently into the value chain, especially regarding the tracing of the guaranteed cost savings.

The business model of the other suppliers of construction auxiliary material and the suppliers of construction machinery does not change in a significant way. These companies will continue to sell the same products and services to the same customers. Furthermore, the revenue mechanism does not change, even if the payments for the software suite and IoT sensors are necessary. These companies will optimize their internal value chains and the overall value network changes in a structural way due to the integration of Umdash Group into their value network. But these companies can of course develop and innovate their business model based on the offerings of the Umdash Group.

Collaboration Platform

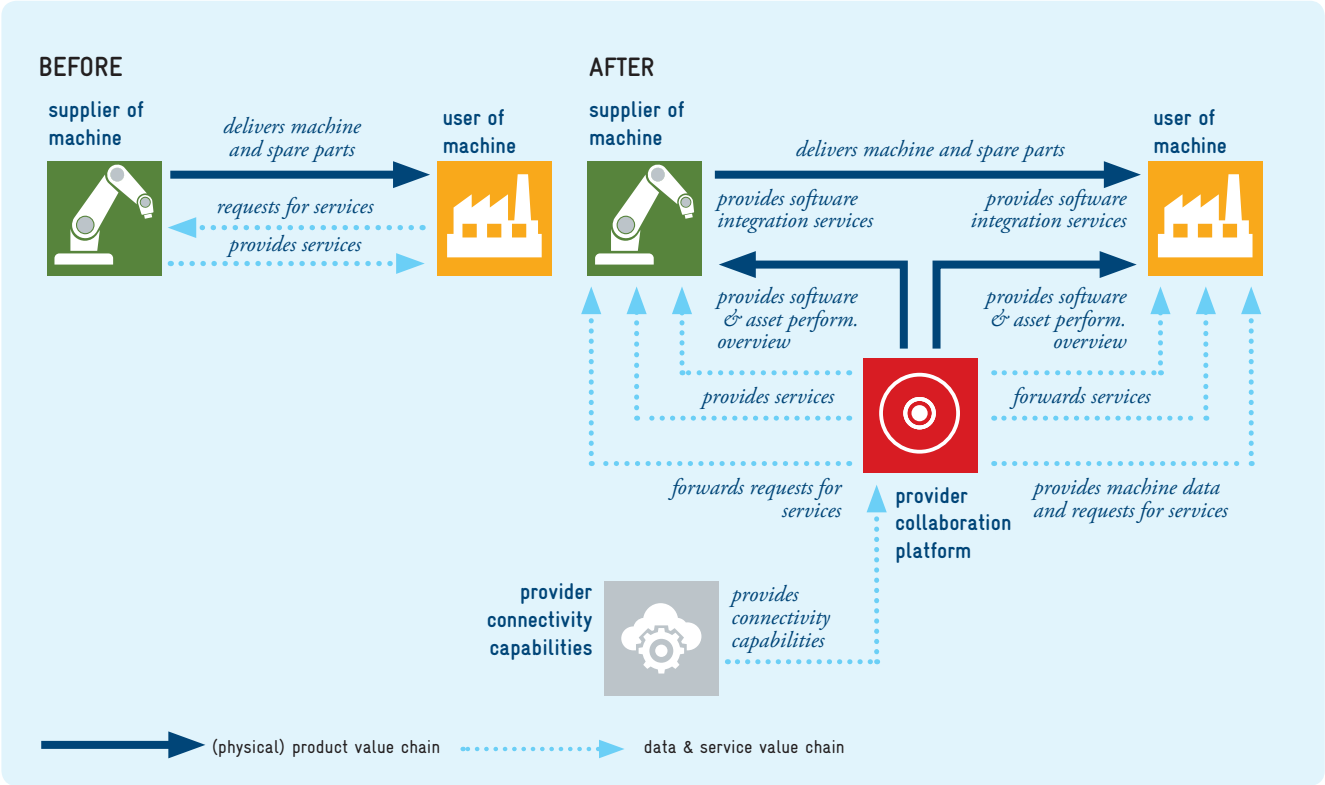
This example is based on the offering of a software platform enabling industrial equipment suppliers. A possible frame for implementation could be machine suppliers that want to collaborate with their end users/ customers/ machine users regarding the delivery and consumption of equipment maintenance and performance management services within a cybersecure, neutral and brand agnostic ecosystem.

Most industrial end user own equipment from different equipment suppliers. With increasing digitalisation by equipment suppliers, they are confronted with having to access multiple portals to receive necessary services to keep their plant running. The vision of the software platform provider is to create an open platform, enabling the industrial end user to connect digitally to multiple equipment suppliers using one common infrastructure.

Therefore, the software platform provider offers two dedicated but interconnected software products, one for industrial end users and one for the equipment suppliers, in a software-as-a-service business model:

- The offering to the equipment supplier is a cloud-based software suite capable of powering the entire services activities of typical machine builders including eCommerce for spare parts and supplies, digital goods as well as service contracts, remote technical support via chat and video calling, field services, and IIoT-based remote monitoring and predictive analytics services.
- The offering to the industrial end users is a cloud-based, mobile ready tool for plant maintenance teams to perform traditional maintenance activities including scheduled, preventive and reparative maintenance, spare parts purchasing and inventory management as well as compliance reporting. Furthermore, the tool enables them to progressively modernise their processes, introducing IIoT-based remote monitoring, predictive analytics for equipment performance as well as spare parts stocking and to connect with external suppliers to purchase parts, supplies, and services such as cleaning and repairs. The key benefit for industrial end users is that the software integrates easily with existing ERP systems to make the management of data seamless with their accounting and purchasing processes.

Figure 33: Value Network



Value Proposition

The supplier of machines receives software for efficient management of services and sale of spare parts. This software facilitates access to information about the condition of his machines installed at the customer.

The machine user can centrally collect usage information from machines of different supplier and contact the supplier in the same environment to request services.

The collaboration platform provider offers software and integration services. The software can be integrated into existing processes and software solutions.

- The collaboration platform provider acts as an independent facilitator and brand-agnostic arbitrator, enabling machine suppliers to offer all their services to all their customers; and users of the machines to consume services from all their machine suppliers without having to leave their existing work processes to do so.
- Each individual party can be confident that the stored data on the collaboration platform as a result of their activity will not be exposed to either their suppliers, their customers or their competitors in ways that may undermine their business. However, at the same time, by aggregating data with their peers, they still harvest the benefit of creating enough right and usable data to enable predictive intelligence that benefits all parties symmetrically.

Revenue Mechanism

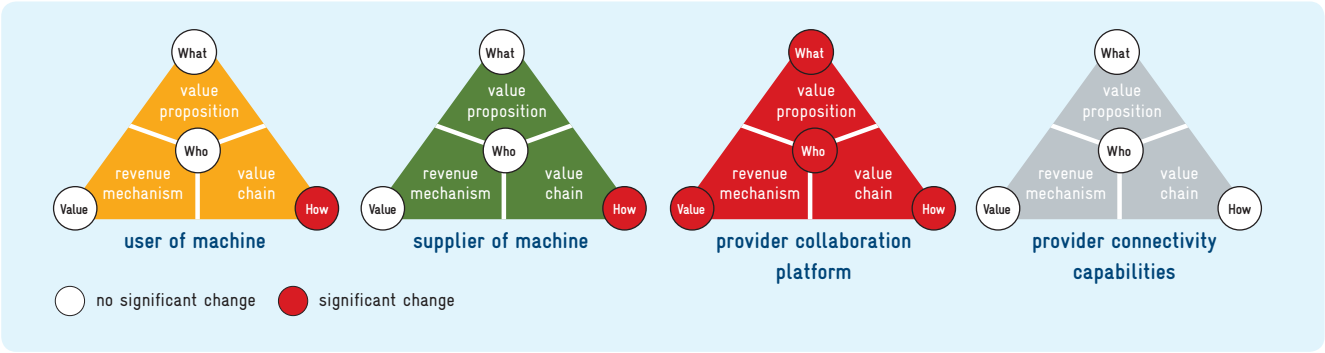
The supplier of machines pays an annual usage fee for the software. The price has fixed and additionally variable components, based for example on the number of transactions.

The user of machine pays an annual usage fee for the software and optionally for the use of special features. The collaboration platform provider pays for the development of the software and is paid for integration services.

Business Model Innovation

The business model changes of the companies considered in this example can be summarized as follows:

Figure 34



The business model of the user of a machine does not change in a significant way. The company will continue to sell the same products to the same customers. Furthermore, the revenue mechanism does not change, even if the payments for the use of the collaboration platform will be necessary. The value chain is optimized regarding the maintenance of the machines and changes in a structural way due to the integration of the provider of the collaboration platform into the value network.

The business model of the supplier of a machine also does not change in a significant way: The company will continue to sell the same products and services to the same customers. Also, the revenue mechanism does not change, even if the payments for the use of the collaboration platform will be necessary. The value chain is optimized regarding the provisioning of services for the machines and changes in a structural way because of the integration of the provider of the collaboration platform into the value network. Note that the collaboration platform enables the supplier of the machine to offer new value-based services in the future.

The provider of the collaboration platform is a new company. Therefore, the customers, value proposition, revenue mechanism and value chain are indicated be change in a significant way.

The business model of the provider of connectivity capabilities does not change based on this scenario.

Manufacturing Platform for Turning and Milling

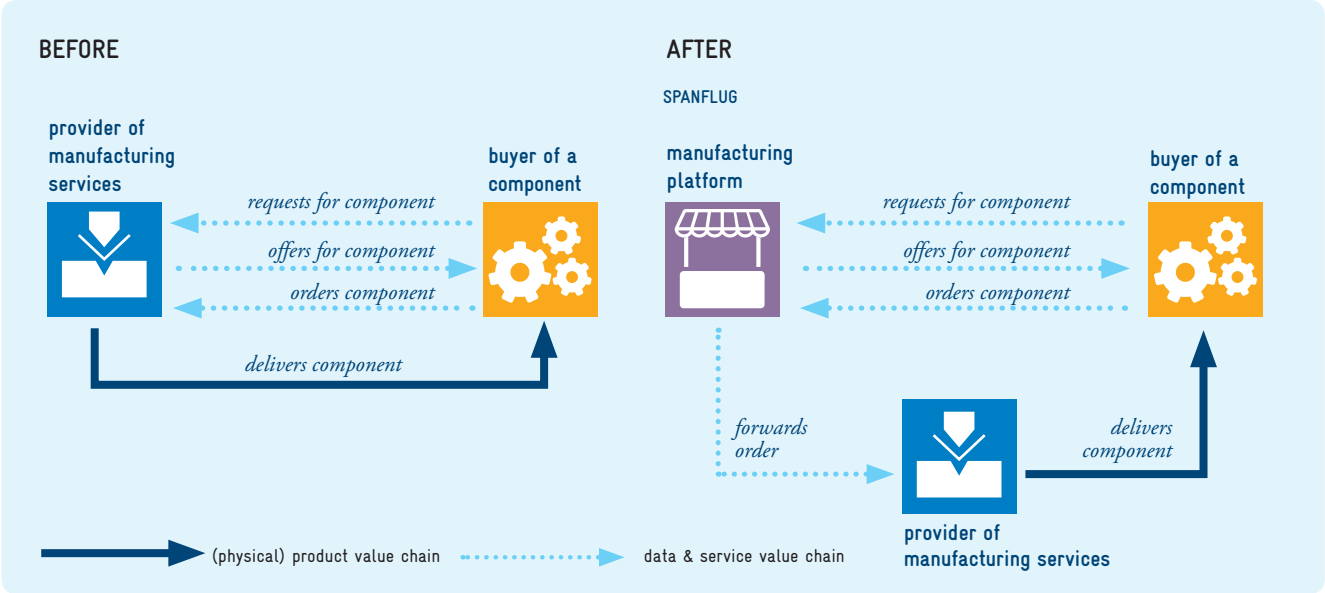
This example is based on information published at Link.

Spanflug is a manufacturing platform offering an online shop for the procurement of turned and milled parts. An interested party provides a CAD model for the component to be produced. On this basis Spanflug creates an offer within an extremely short time (~ 1 minute, depending on the size of the component), by this the component can be ordered immediately at a desired delivery date from 10 working days. Spanflug arranges a supplier with available capacity for the component.

Spanflug's manufacturing partners are manufacturing service providers with different specializations in terms of part size, quantity, materials and area of application. The production takes place exclusively in Germany. Each company is audited before being included in the supplier network. In addition, Spanflug monitors the quality of the executed orders regarding delivery reliability and customer evaluations. The registration and use of Spanflug is free for a manufacturing partner.

There are no auctions on Spanflug, but Spanflug arranges the orders, and the manufacturing partner can accept or reject an order. After the delivery of the components, the manufacturing partner issues an invoice to Spanflug, which is then paid by Spanflug. Spanflug takes over the risk of a payment default.

Figure 35: Value Network



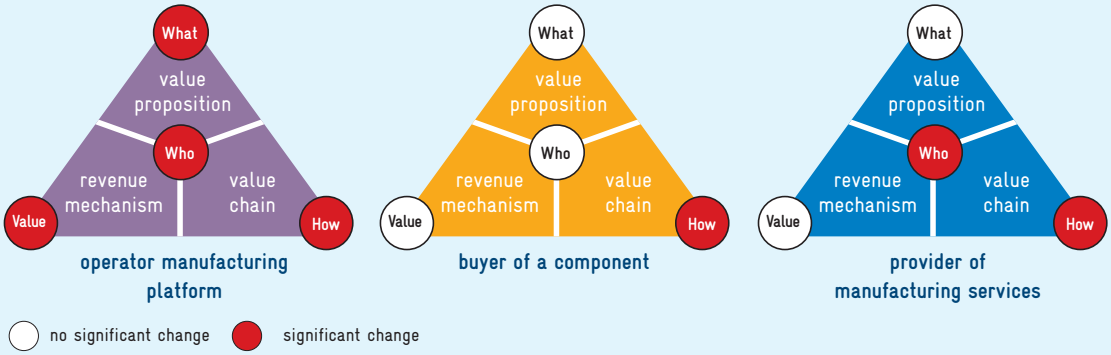
The calculation of an offer price is free of charge and the use of this service is not binding. Calculated parts can be ordered through the online shop with a few mouse clicks. Spanflug guarantees the fastest way to order turned and milled parts, at fair prices, in high quality and on time delivery.

Value Proposition

Because the pricing is done by an algorithm, the operator of the manufacturing platform will be able to respond almost immediately to requests from potential buyers of a component. Spanflug claims that the prices are marketable. During the onboarding of a manufacturing service provider, the operator of the manufacturing platform clarifies that the production processes and production capabilities of a manufacturing service provider are prepared for corresponding inquiries.

Thereby, brokered contracts for the manufacturing service provider are economical. The operator of the manufacturing platform takes over the full technical and business risk regarding compliance to the requirements of potential buyers of a component.

Figure 36



The buyer of a component requests for a component needed using the online shop. He benefits from fast offerings of the online shop and – in the case of an order – a takeover of the complete transaction through the manufacturing platform.

The provider of manufacturing services receives orders via the manufacturing platform and thereby benefits from additional orders without any sales effort.

Revenue Mechanism

The operator of the manufacturing platform is paid for the production and delivery of the produced component. He does not receive any fees for brokering or providing an offer.

The buyer of a component pays the operator of the manufacturing platform for production and delivery of the component.

The provider of manufacturing services is paid by the operator of the manufacturing platform to produce the component.

Business Model Innovation

The business model changes of the companies considered in this example can be summarized as follows:

The operator of the manufacturing platform is a new player with a new business model in the value network of manufacturing industries.

The business model of the component's buyer will not be innovated: The company will sell the same products with the same value proposition to the same customers and applies the same revenue mechanism. The buyer can source components faster and more efficiently which is a major benefit especially when sourcing individual parts or small batches. By this, she is enabled to speed up prototyping and development as well as the production of customer specific solutions. Due to the use of the manufacturing platform, the value chain of the buyer will change structurally.

The business model of the provider of manufacturing services will be innovated: The company provides the same value proposition and does not change the revenue mechanism, but the company has the operator of the manufacturing platform as an additional customer and changes the value network because of the connection to the manufacturing platform.

Conclusion

The application of the methodology proposed by the working group "Digital Business Models" of the Plattform Industrie 4.0 has proven to be very practical in our view. This methodology helps to understand the business idea precisely. The subsequent documentation of the business idea is "straight forward" and effortless.

We suggest that the next step should be a consolidation of the business scenarios. However, we got the impression that the elaborated examples in this document are not representative for business models in the manufacturing industry that are enabled by digitalization. In this respect, other communities should be convinced to prepare business scenarios following the used methodology in order to consolidate the business scenarios at some suitable time.

References

[1] The Industrial Internet Reference Architecture Technical Report, Link
[2] Guidance "Use Cases and Applications", Link
[3] Digital business models for Industrie 4.0, Link
[4] The St. Gallen Business Model Navigator, Link

Abbreviations

CAD	Computer-aided design
CAPEX	Capital expenditure
CN	China
ERP	Enterprise-Resource-Planning
GER	Germany
IIC	Industrial Internet Consortium
IIoT	Industrial Internet of Things
IIRA	Industrial Internet Reference Architecture
IT	Information Technology
OPEX	Operational expenditure
RFID	Radio-frequency identification
SWG I4.0/IM	Sino-German Sub-Working Group Industrie 4.0/Intelligent Manufacturing

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