

WORKING PAPER



Benefits of Application Scenario Value-Based Service

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Content

Objectives	3
Application Scenario VBS – Value-Based Service	5
Sub Scenario Condition Monitoring Services	7
Stakeholder and Vision.....	7
Values and Experiences.....	7
Key Objectives.....	8
Fundamental Capabilities.....	8
Sub Scenario Machine and Process Optimization Services	11
Stakeholder and Vision.....	11
Values and Experiences.....	11
Key Objectives.....	11
Fundamental Capabilities.....	12
Sub Scenario Production Scheduling Services	13
Stakeholder and Vision.....	13
Values and Experiences.....	13
Key Objectives.....	14
Fundamental Capabilities.....	15
References	17



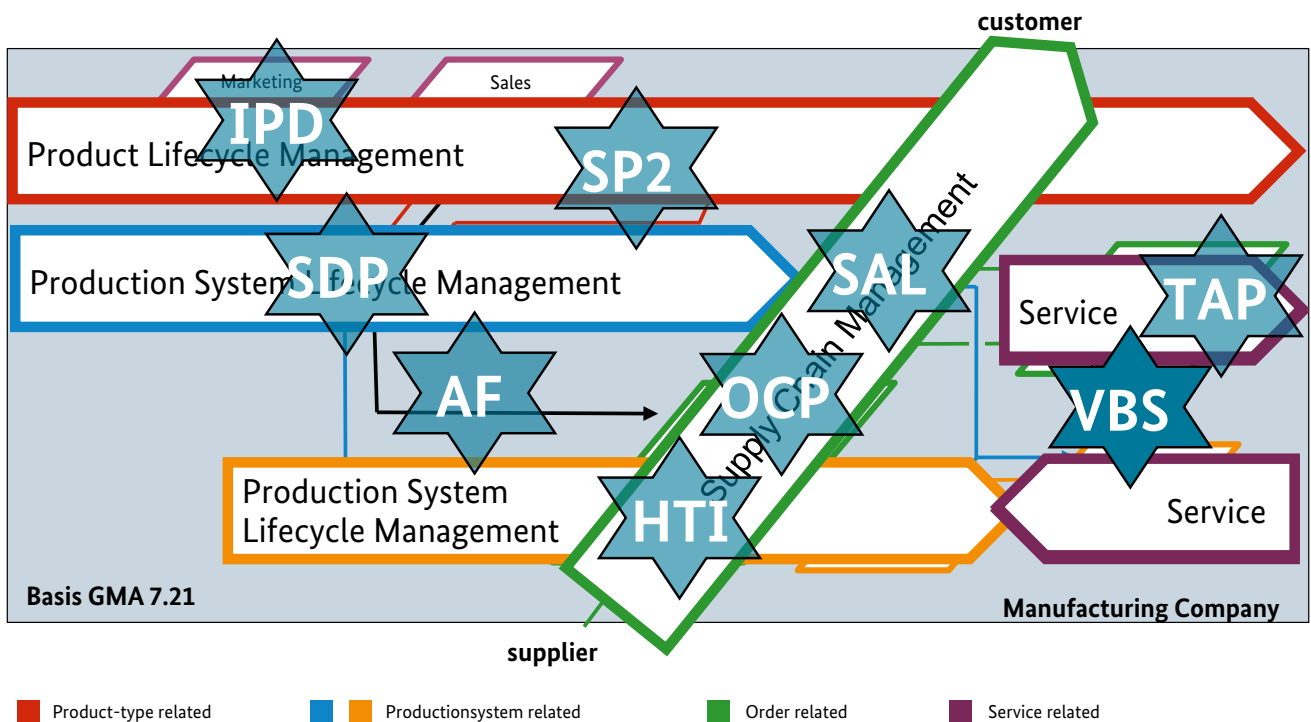
Objectives

The application scenarios, see Figure 1, [1], and [2], describe how German industry perceives its digital future. They show which innovations – in technology, work organization, law and society – German industry wants to utilize on its way to this digital future. However, the application scenarios also indicate areas posing major challenges and questions, for example standards, research, security, legal framework and labor, and thereby provide a common framework for the Plattform Industrie 4.0 Working Groups.

Various discussions have repeatedly expressed the desire to further detail the description of the application scenarios and to work out the benefits for the stakeholders concerned. However, due to the complexity of the topic and the available resources, this cannot take place in the width, but only on the basis of selected representative examples.

For this reason, such a detailing was elaborated as an example for one application scenario, namely VBS – Value-based

Figure 1: Application scenarios of Plattform Industrie 4.0



Service, see [3]. Specifically, three sub scenarios were developed to illustrate the broad use of this application scenario. The sub scenarios are based on real offerings and business cases but have been anonymized. These three sub scenarios do not claim completeness, many further sub scenarios are possible. It was important to illustrate the wide range of different value-based services as well as the wide range of different value-added network and business models of the affected business stakeholders. Also we emphasize to consider an end-to-end view from a customers' perspective.

There are different ways to describe the benefits. One possibility is an orientation on the business canvas model, see [4]. But to improve the common understanding between the Plattform Industrie 4.0 and the Industrial Internet Consortium, we have decided to use the business viewpoint of IIRA, the Industrial Internet Reference Architecture of the IIC, see [5], for the description of the benefits. Therefore, the description of the individual sub scenarios follows a common structure:

- **Stakeholder and Vision:** Here we describe in the form of a hypothesis a future value-added network. The main business stakeholders needed to implement the sub scenario are taken into account.
- **Values and Experiences:** Here we describe the central value proposition of the supplier to the customer. In part, these suppliers have to rely on value propositions of sub supplier. To preserve the focus we do not detail the value propositions of the sub suppliers.
- **Key Objectives:** Here, a concrete business plan should be sketched. Since all activities of the Plattform Industrie 4.0 are precompetitive, we focus in this context on principal mechanisms only.
- **Fundamental Capabilities:** We structure the fundamental capabilities according to the involved stakeholder. In addition to the capabilities we discuss the main interests of the stakeholder.

Application Scenario VBS – Value-Based Service

Today typically a product provider delivers a product to a customer and does not have any feedback from the usage of his product by the customer. The application scenario VBS – Value-Based Service is based on the innovation hypothesis that in the future delivered products will be connected to a service platform, data from the usage of the product by the customer will be fed to the service platform, and based on the usage data a service provider can offer data-driven value-added services to the customer. Figure 2 illustrates the participating stakeholder, the underlying value network, and the new information flow from the customer to the service platform as the basis for new value-based services. For more details we refer to [3].

Figure 3 shows the typical functional breakdown structure of a service platform. The various sub systems of the service platform and associated engineering-services can be provided by additional stakeholder, but in this paper we do not detail the underlying value network with respect to these aspects.

- We assume that the applications of the application layer are operated by the service provider. May be that the applications have been developed by a specific development-services provider.
- The infrastructure and development environment of the platform layer could be provided by specific infrastructure, tool, and library provider to the platform operator.
- There may be specific engineering-service provider for connecting products to the service platform via the connectivity layer.

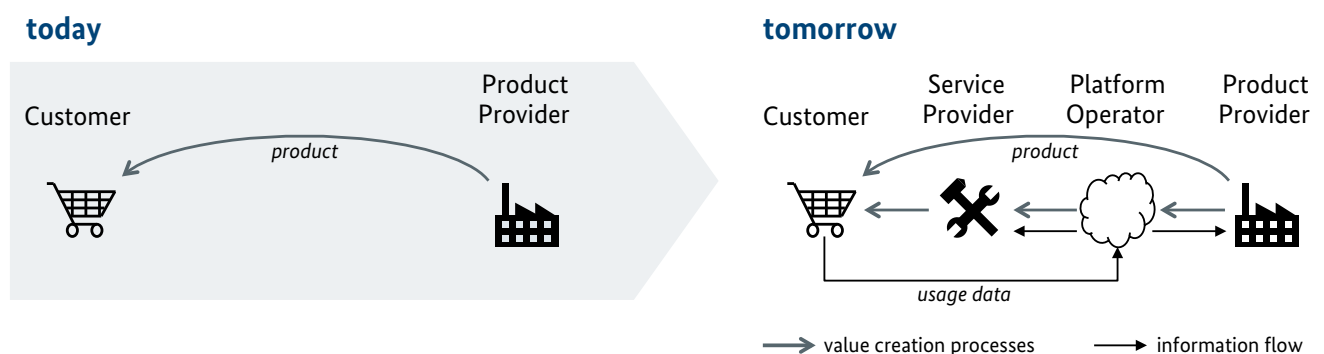
For this document, we expand the value-network of Figure 2 to include other stakeholders. In doing so, we also adapt the terms of the roles in the value-network. We focus on manufacturing industries and here we consider only specific value-based services, namely value-based services to improve the usage of machines. As illustrated in Figure 4 the products according to Figure 2 are machines and the customer according to Figure 2 is the operator of machines:

We introduce the additional business role of the development of the value-based services. This does not necessarily have to be done by the provider of the value-based services, but can be purchased by the provider from another business stakeholder.

In addition, we also introduce the business role of the development of the service platform, since this can also be offered by another business stakeholder. A service platform may include systems, such as the infrastructure or a development environment, as shown in Figure 2, provided by additional business stakeholder. We do not consider these additional business roles as part of our three sub scenarios, because they are of secondary importance from the customer's point of view.

Typically, in some value creation steps system integrators are involved. This applies in particular to the connection of the machines to the service platform¹. We do not consider these business roles in this paper. These business roles have no major impact on the business models of the main stakeholder in Figure 4. Their value proposition follows the same principles as today.

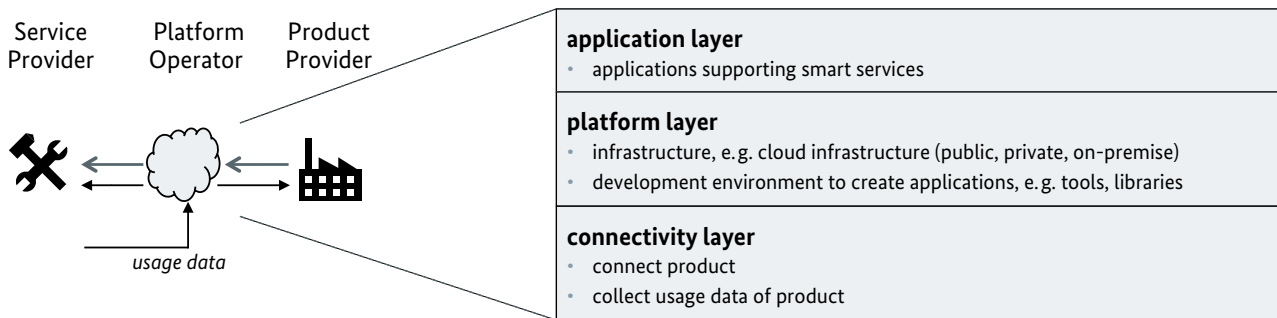
Figure 2: Value-network of application scenario VBS – Value-Based Service



Plattform Industrie 4.0

¹ We postulate that a “real” plug & produce of machines will not be reality in the coming years.

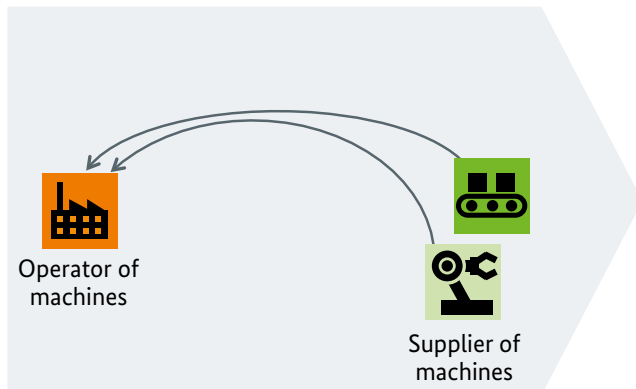
Figure 3: Functional breakdown structure of service platform



Plattform Industrie 4.0

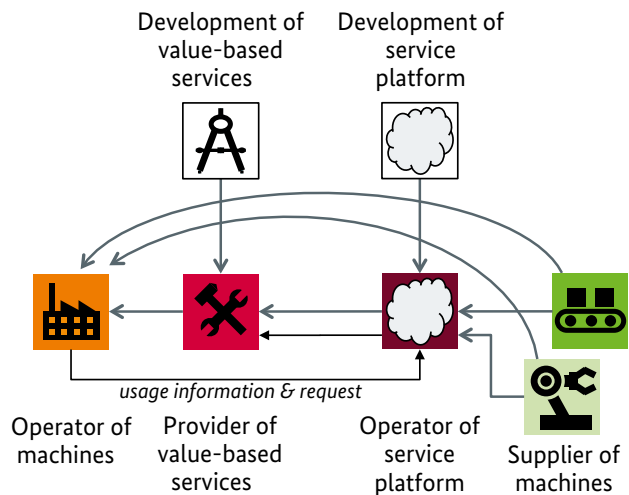
Figure 4: Usage of application Scenario VBS – Value-Based Service

today



Plattform Industrie 4.0

tomorrow



In discussing the benefits and the business models, we focus on the core of the application scenario, namely the interrelationships between the machine operator, the provider of value-based service, and the operator of the service platform. As already mentioned, other partners providing supporting products and services have to be taken into account for a comprehensive consideration of the application scenario, but this is of subordinate importance to our considerations.

The following three sub scenarios are organized along two different dimensions in order to show the complexity of this application scenario:

- Different value-based services with respect to the content in the context of the use of machines. Specifically, we consider condition monitoring services, machine optimization services, and production scheduling services.
- Different responsibilities of the business stakeholders involved in the value network to provide the specific value-based services.

The two dimensions are independent of each other and the different manifestations can be combined. However, we focus in the discussion of benefits less on the specific value-added services, as in organization of the value network by the different business stakeholders and how benefits are created for each individual business stakeholder.

Sub Scenario Condition Monitoring Services

Here, the value-based service considered is a condition monitoring service provided by the supplier of the machine to the operator of the machine.

This description of this sub scenario is an excerpt of the results elaborated in the working group “modeling example” of GMA Technical Committee 7.21 “Industrie 4.0 – Terms, Reference Models, and Architecture Concepts”, see [6].

Stakeholder and Vision

In this sub scenario the role of the provider of value-based services is implemented by the supplier of the machine. We assume the establishment of a new stakeholder, i.e. the operator of a service platform, who delivers and operates a service platform, see Figure 5.

Values and Experiences

The operator of the machine can increase its efficiency because of early detection of faults and the supplier of the machine system can take advantage of new offerings and business models.

Experiences

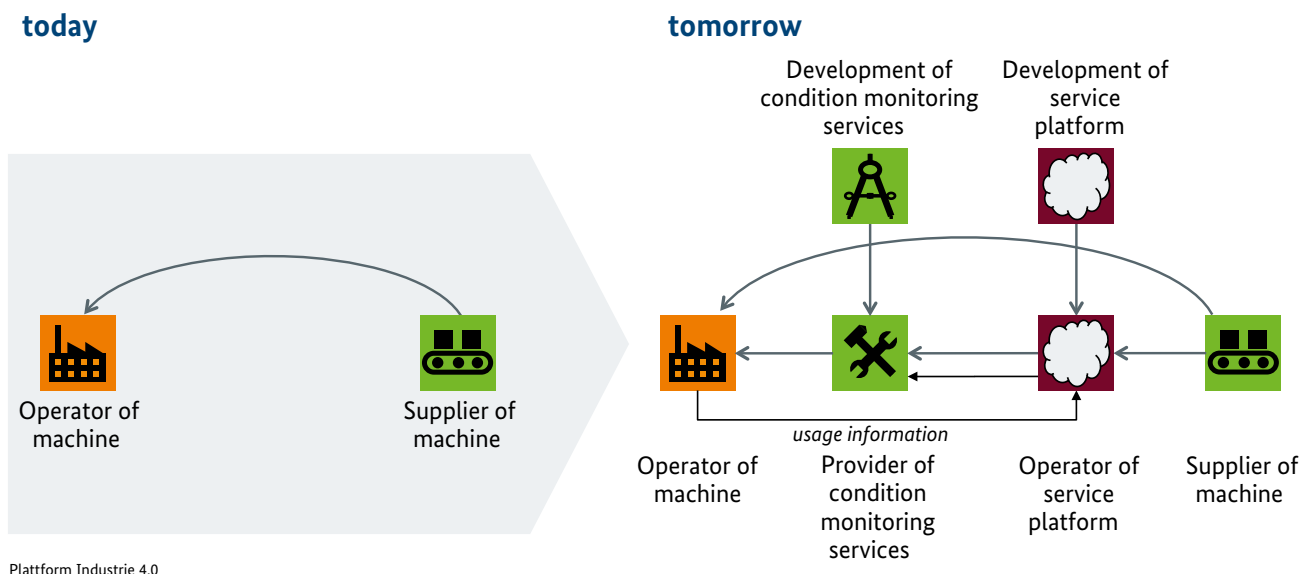
Generally the operator expects optimized usage of his machines. But he typically does not have the subject matter expertise for realizing this value for (unplanned) events. Therefore he requests for higher availability of the machines. On the other hand, the supplier of the machine could offer higher availability if he has access to usage and health information for his machines. In analyzing this information he can offer condition monitoring services to increase the availability of his machines. In addition, the supplier of a machine could offer and bill the manufacturing services of the machine to the operator based on usage.

Values for the Operator of the Machine

The condition monitoring services of the supplier of the machine contribute to early fault detection and rapid fault isolation and therefore result in higher availability of the machine and the entire plant. In addition the operator saves maintenance expenses and resources.

In the case of continuous data access by the machine supplier the operator could take advantage of longer warranty periods for the machine offered by the supplier of the machine.

Figure 5: Value network of sub scenario “condition monitoring services”



In the long-term the operator could even lower investment costs (“capex”, capital expenditures) through leasing the machines with usage-based billing, i.e. “machine as a service” (“opex”, operational expenditures).

Values for the Supplier of the Machine

The supplier can offer new condition monitoring services, e.g. the prediction of failures and downtimes of the machine, and based on the knowledge of the usage of the machine he can offer new availability and warranty models.

The supplier gets transparency about its own fleet of machines. This knowledge can be fed back into the design and engineering to improve the machine and can be used to offer new process benchmarking services to the operators.

In the long-term the supplier could offer and bill for manufacturing services of his machines based on usage. Furthermore, deep knowledge on utilization of his machines in his customers’ applications is an enabler to optimized machine selection and allocation.

Key Objectives

In this section we focus on the principal revenue mechanisms as shown in Figure 6.

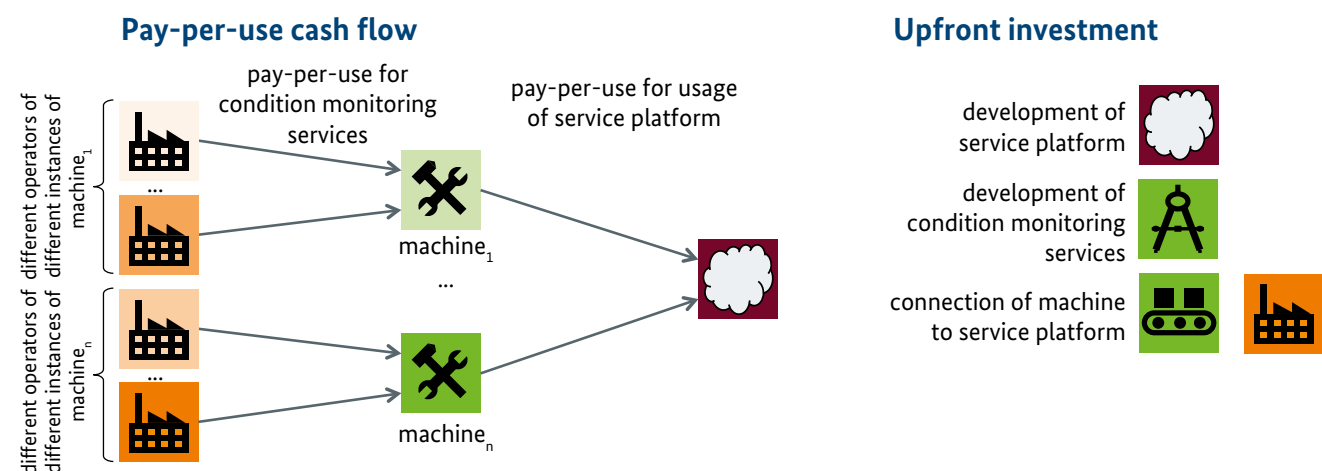
The operator of a machine will pay for the new condition monitoring services from the supplier of the machine. Various business models are possible including adequate gain and risk sharing models. The supplier of the machine will pay, on a pay-per-use basis, for his usage of the service platform. Various business models are possible depending on the number of connected machines, the amount of usage data over time, and the use of basic analytic capabilities provided by the operator of the service platform.

The operator of the service platform will amortize his upfront costs for development, and the running costs for operation of the service platform, over all suppliers of machines using the service platform. The development of the condition monitoring service is an upfront investment of the service provider. The connection of a machine is a one-time process; it must ultimately be amortized on a case-by-case consideration.

Fundamental Capabilities

We focus on a migration scenario, where an existing plant will be effectively modernized in the sense that new condition monitoring services will be available to the operator of the machine.

Figure 6: Principal revenue mechanisms



Perspective of the Operator of the Machine

The operator of a machine is ready to invest only if he has appropriate benefits and amortization, i.e. the operator of a machine has primary interests in automation, reliability and quality, but to be competitive in the market the supplier of the machine and provider of condition monitoring services and the operator of the service platform have to offer specific capabilities creating additional benefits for the operator of the machine.

As a consequence, the operator of the machine does not request specific additional machine capabilities in the initial negotiations with the suppliers of machines, but when presented with enhanced value propositions hopefully he will use the new condition monitoring services offered by the supplier of the machines.

The operator of the machine has the following interests:

- From a strategic business point of view he is not willing to pass on any competitiveness relevant information to anybody else, i.e. the operator of machine will define which information about his production is passed on to others.
- From a financial point of view he wants to optimize his cash flow. For example, the operator could request for a pay per use model for the machine.
- From a customer and market point of view he wants to guarantee the ability to deliver his own products (availability objectives) and to guarantee satisfaction of his customers (quality objectives).
- From a technical point of view he wants to monitor the machines with regard to quality guarantees, availability guarantees, etc. to avoid unforeseen downtime of the machines. He is interested in increased productivity through better use of the machine. He also wants to increase productivity through better planning.

Perspective of the Supplier of the Machine and Provider of Condition Monitoring Services

The supplier of the machine is the “driver” with respect to creating a compelling value proposition for the operator of the machine by providing new condition monitoring services, but he relies on an operator of a service platform.

The supplier of the machine and provider of condition monitoring services has to provide the following fundamental capabilities:

- The supplier of the machine will offer new condition monitoring services. He will evaluate usage information of the machine in order to draw conclusions based on his knowledge of the machine. He will sell these findings to the operator of the machine in the form of new services.
- The supplier of the machine will offer manufacturing as a service. He will offer and bill manufacturing services of his machines based on the usage of the machine by the operator. This requires transparency of the usage of the machine.

The supplier of the machine and provider of condition monitoring services has the following interests:

- He wants to be a reliable partner for his customers, i.e. he will try to address and resolve all objections voiced by the operators of his machines. He does not want to lose the direct customer contact to a service provider or an operator of a service platform.
- He evaluates and selects an enabler in form of a service platform, to which all of his worldwide located machines can be connected. The service platform has to provide the capability to collect usage information and the ability to evaluate the asset data intelligently (or let the supplier evaluate intelligently). He will request for reliable data, i.e. that manipulation by a user or third party is not possible.
- He will request for a new contractual framework with his customers, because the responsibilities between machine provider and operator of the machine are now different. The supplier will not take on risks due to improper use of his machines by the operator.
- He is interested in a feedback of lessons learnt on the usage of the machines to his internal product management and development to initiate improvements of the machine.
- He has a strong interest that the structure of the data collected is neither transparent to the operator nor to the operator of the service platform. The collected data probably formally belongs to the operator, but the data structure is protected by IP.

Perspective of the Operator of the Service Platform

The operator of the service platform is the “driver” with respect to lowering the total service cost for the supplier of machines. He wants to offer capabilities that the supplier of machines can develop and offer new services. He wants to connect as many products (e.g. machines) as possible to his service platform.

The operator of the service platform has to provide the following fundamental capabilities:

- He has to provide the capability to (easily) connect a product (e.g. machine) to the service platform.
- He has to guarantee connectivity and availability of the service platform to collect (usage) data from products (e.g. machines) located all over the world.
- He has to provide usage data of products (e.g. machines) to the provider of services.
- He has to provide basic applications and capabilities for visualization and analysis of data.
- He has to guarantee security to all stakeholders involved.

The operator of the service platform has the following interests:

- He wants to be established in a new business role for the market.
- He wants to connect as many products (e.g. machines) as possible.

Sub Scenario Machine and Process Optimization Services

The objective in this sub scenario is to operate the individual machines at their optimum operating point in a dedicated production environment. For this purpose, a machine optimization service is developed and used, which provides the necessary technology and tooling parameters to adjust the machines.

Stakeholder and Vision

With respect to the cross-company value network the existing value chains do not change. There is no involvement of new business partners in the core value-added process with regard to the application scenario VBS – Value-based Services. In this respect, the benefit – in contrast to the other two sub scenarios – is fully realized within and for the company under consideration.

Values and Experiences

In this sub scenario we only have to consider the combined role of “Operator of machines, Provider of machine optimization services, and Operator of service platform”. The other stakeholders in Figure 7 play a subordinate role with regard to the business model and cross-company benefit discussion.

With regard to values and experiences, there is no difference in this sub scenario compared to the actual situation. The concrete benefit is mainly driven by the potentials of the technologies used in the service platform and the concrete value-based services. To determine the benefits in a specific case is often challenging, nevertheless, is not the focus of this document.

Therefore, this sub scenario describes an incompany technology and process innovation and the benefits are realized based on the same value network as before.

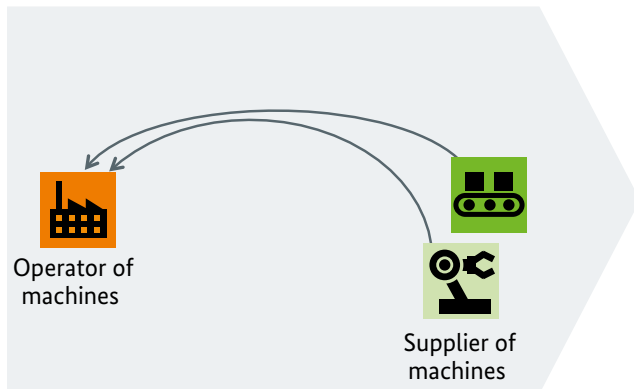
Large companies often follow this approach. They purchase – possibly using system integrators – the required IT systems and services and then operate the IT systems and services themselves. Thus, this sub scenario binds a lot of capital and requires (additional) competencies; typically a smaller company cannot afford this.

Key Objectives

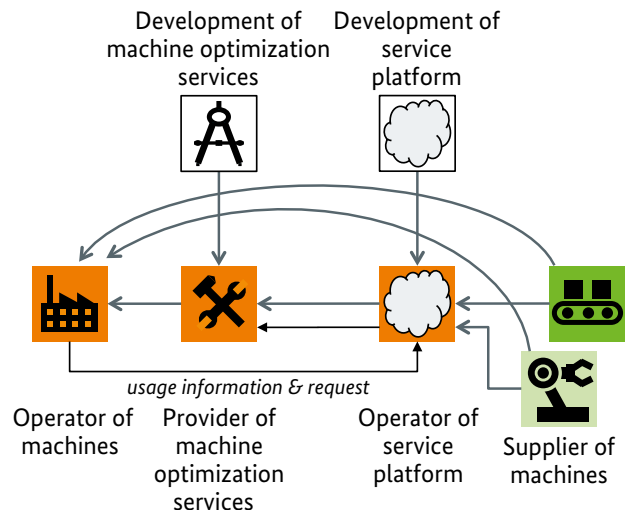
As already mentioned, the benefit is generated within a company for the company itself. A discussion of principal cross-company revenue mechanisms is not necessary.

Figure 7: Value network of sub scenario “machine and process optimization services”

today



tomorrow



Fundamental Capabilities

In this sub scenario a company wants to realize the potentials of (new) technical possibilities and the design of business processes for itself, while keeping as far as possible all processes and information under its own control. This strategy leads to build up deep technology knowledge and thus potential core competencies.

The company has the following capabilities:

- The company has to assess the potential of new technologies interrelated to the machine optimization services and how these technologies can be used for its own benefit.

- The company has high investment requirements for the installation and the operation of the service platform and the development and supply of the value-based services.

The company has the following interests:

- The company wants to keep the operational processes and the related information affected by the innovation under its own control.

Sub Scenario Production Scheduling Services

The objective of this sub scenario is to guarantee an optimal utilization over all machines. In contrast to the two other sub scenarios, this sub scenario is not concerned with an individual machine, but the entire set of machines of a given production site. Typically, the overall optimization of the machines is out of scope of the supplier of the individual machines. Furthermore, this sub scenario focuses on capacity and scheduling planning purposes, in contrast to the preceding sub scenario focusing on technology optimization.

Stakeholder and Vision

The task of production scheduling is usually too complex to be executed manually by the operator of the machines, especially in small and medium sized companies or production sites. Therefore, we assume the establishment of a new stakeholder, i.e. the provider of production scheduling services. We also assume that neither the operator of the machines nor the provider of production scheduling services want to operate their own IT infrastructure, therefore another new stakeholder, i.e. the operator of a service platform, enters the playing field, see Figure 8.

Values and Experiences

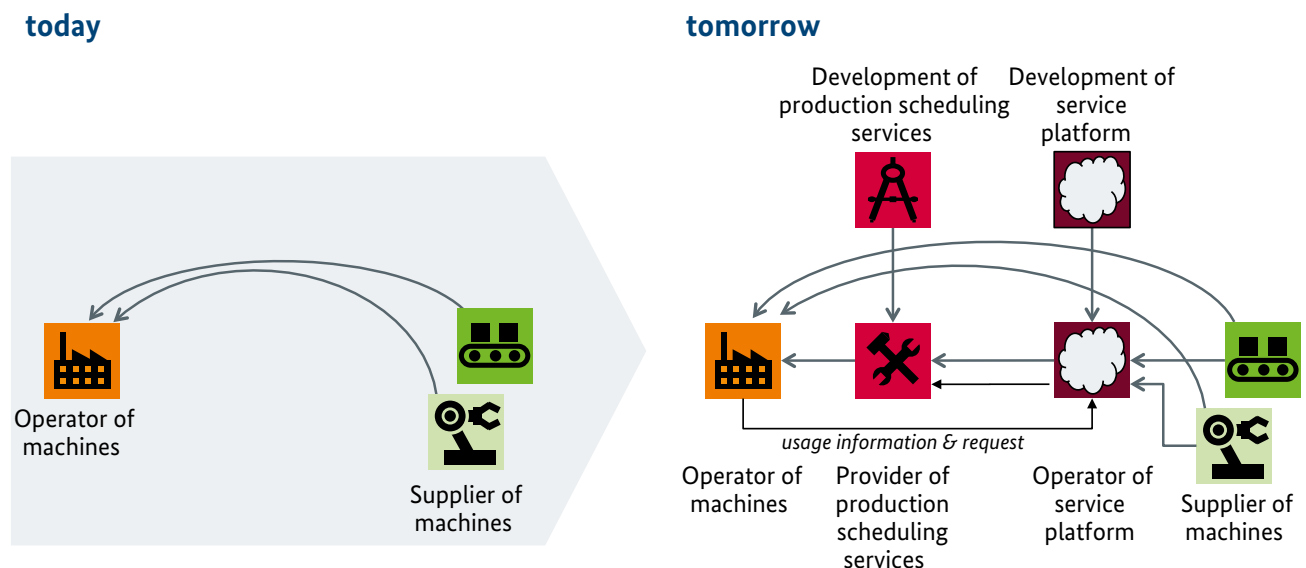
The operator of the machine can increase operational efficiency because of an optimal usage of his machines. The provider of production scheduling services is able to offer services to a market that is difficult for him to be addressed, and the operator of the service platform wants to establish himself as a broker between the operator of the machines and the provider of production scheduling services.

Experiences

Generally the operator expects optimized usage of his machines. But the task to optimize the utilization of the machines is complex, which usually cannot be performed manually by the operator of the machines. Thus, he requests for support by appropriate production scheduling services. To use such services two preparatory basic engineering-tasks are necessary:

- The underlying software must be customized according to the specific machine topology, i.e. the layout. This is a more conceptual task usually executed by the provider of production scheduling services.

Figure 8: Value network of sub scenario “production scheduling services”



- The machines must be connected with their specific capacities and capabilities to the production scheduling algorithm. But usually neither the operator of the machines nor the provider of production scheduling services has this subject matter expertise.

The operator of the service platform comes into play because, on the one hand, he ensures the connection of the machines. In addition, typically neither the operator of the machines nor the provider of the production scheduling services want to operate their own IT infrastructure and wish this to be taken over by the operator of the service platform. The operator of the service platform therefore positions himself as a broker between the operator of the machines and the provider of production scheduling services.

Large companies often follow a different path here. They purchase the IT systems and services via system integrators and then operate the IT infrastructure themselves, see sub-scenario “Machine Optimization Services” or its extension to production scheduling services.

Values for the Operator of Machines

The operator can take advantage of the production scheduling services to improve the utilization rate of his machines. Thus, he increases his operational efficiency.

Values for the Provider of Production Scheduling Services

The provider of production scheduling services can offer the data-driven service on demand based on a pay-per-use model. This reduces the entry barrier for the use of the data-driven service by manufacturing companies and thus opens up a market that has been difficult to address. So far, only larger companies are usually willing to make the necessary high investments.

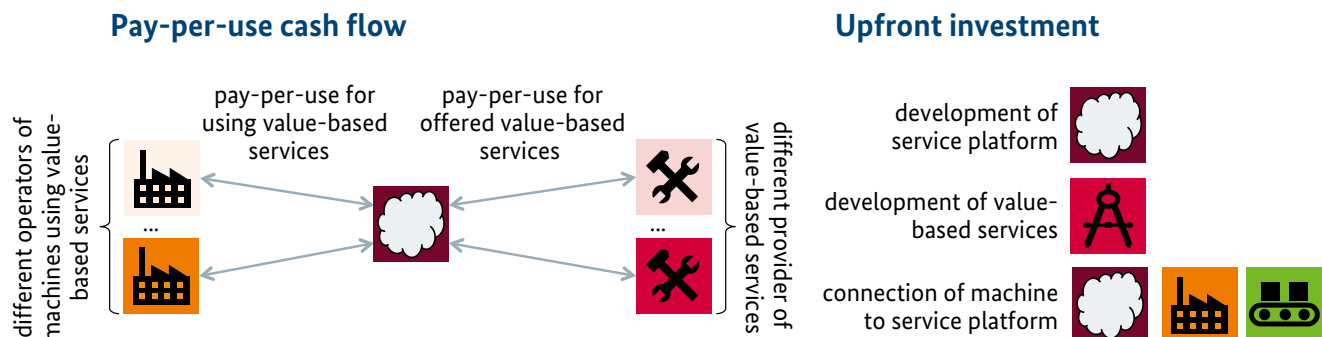
Values of Operator of Service Platform

In contrast to the sub scenario “Condition Monitoring Services”, where the provider of value-based services shapes the future value network, in this sub scenario the operator of the service platform shapes the future value network. He positions himself in the form of a broker as a new player in the value network and thereby also occupies the interface between the operator of the machine and the provider of production scheduling services

Key Objectives

In this section we focus on the principal revenue mechanisms as shown in Figure 9.

Figure 9: Principal revenue mechanisms



The operator of a machine will pay for the new production scheduling services provided by the value-based service provider, based on a pay-per-use model. Various business models are possible including adequate gain and risk sharing models. He does not pay directly to the provider of value-based services, but to the operator of the service platform. The operator of the service platform remunerates the provider of value-based services for the general offering and the specific offered services based on a pay-per-use model. In addition, he charges the operator of the machines and the provider of value-based services for the usage of the service platform based on a pay-per-use model.

The operator of the service platform will amortize his upfront costs for development and the running costs for operation of the service platform over all suppliers of machines and provider of value-based services using the service platform. The development of the production scheduling service is an upfront investment of the service provider. The connection of a machine is a one-time process; it must ultimately be amortized on a case-by-case consideration. The following models for a sponsoring of the connection of a machine to the service platform are conceivable:

- The operator of the service platform has an interest in connecting as many machines as possible to his platform.
- The operator of the machines has an interest in an optimal utilization of his machines.
- The supplier of machines wants to differentiate himself from his competitors by connecting his machines to a service platform.

Fundamental Capabilities

Some of the fundamental capabilities from the sub scenario “Condition Monitoring Services” can be transferred directly to this sub scenario. We repeat such considerations, but nevertheless confine ourselves to the specific aspects of this sub scenario.

Perspective of the Operator of the Machines

The operator of the machines is ready to invest only if he has appropriate benefits. But when presented with compelling value propositions to improve the operational efficiency he will use the new production scheduling services offered by the value-based service provider.

The operator of the machine has the following interests:

- From a strategic business point of view he is not willing to pass on any competitiveness relevant information to anybody else, i.e. the operator of machines will define which information about his production is passed on to others.
- From a financial point of view he wants to optimize his cash flow. For example, the operator could request for a pay per use model for the production scheduling services.
- From a customer and market point of view he wants to guarantee the ability to deliver his own products and to guarantee satisfaction of his customers.
- From a technical point of view he is interested in increased productivity through better production planning and scheduling.

Perspective of the Provider of Production Scheduling Services

The provider of production scheduling services has to provide the following fundamental capabilities:

- The provider will offer new production scheduling services. He will continuously evaluate the offers and orders of the operator of the machine in order to optimize the production scheduling based on his algorithms. He will sell the optimal production schedules to the operator of the machines in the form of new value-added services.

The provider of production services has the following interests:

- He wants to focus on his core competency, namely the (mathematical) optimization. But he would like to offer this competence to the manufacturing industries, where his application competence is lacking.
- He needs a partner in the form of a provider of a service platform, who allows him to bring his services to the market. As he focuses on optimization, this partner must ensure the concrete technical connection of the machines to his optimization software and also provide the IT infrastructure needed to run his optimization software. Thus, the provider of the service platform has to provide him a market access to manufacturing industries.

Perspective of the Operator of the Service Platform

The operator of the service platform is the “driver” with respect to creating a compelling value proposition for the operator of the machines as well as the provider of production scheduling services. He wants to connect as many machines as possible to his service platform and offer as many value-added services as possible provided by service provider based on his platform.

The operator of the service platform has to provide the following fundamental capabilities:

- He has to provide the capability to (easily) connect a machine to the service platform and to (easily) provide a value-based service via the service platform.
- He has to guarantee connectivity and availability of the service platform to collect (usage) data from the machines located all over the world and to provide value-based services to operators of machines located all over the world.
- He has to provide usage data of machines to the provider of value-based services and to provide value-based services of the service provider to the operator of the machines.
- He has to guarantee security to all stakeholders involved.
- He has to offer a transparent pricing und reliable payment model.

The operator of the service platform has the following interests:

- He wants to be established in a new business role for the market.
- He wants to connect as many machines as possible.
- He wants to provide as many value-based services from service provider as possible

References

1. Aspects of the Research Roadmap in Application Scenarios, <http://www.plattform-i40.de/I40/Redaktion/EN/Downloads/Publikation/aspects-of-the-research-roadmap.html>
2. Fortschreibung der Anwendungsszenarien der Plattform Industrie 4.0, <http://www.plattform-i40.de/I40/Redaktion/DE/Downloads/Publikation/fortschreibung-anwendungsszenarien.html>
3. Proposal for a joint “scenario” of Plattform Industrie 4.0 and IIC, <http://www.plattform-i40.de/I40/Redaktion/DE/Downloads/Publikation/joint-scenario.html>
4. Wikipedia Business Model Canvas, https://en.wikipedia.org/wiki/Business_Model_Canvas
5. The Industrial Internet Reference Architecture Technical Report, <https://www.iiconsortium.org/IIRA.htm>
6. VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik: Exemplification of the Industrie 4.0 Application Scenario Value-Based Service following IIRA Structure, <http://www.plattform-i40.de/I40/Redaktion/EN/Downloads/Publikation/exemplification-i40-value-based-service.html>

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