Establishing successful ecosystems for IIoT platforms and B2B business models

5 steps to implementation

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Introduction

The aim of this paper is firstly to introduce the reader to the importance of Industrial Internet of Things (IIoT) ecosystems, secondly to encourage him to address the subject and thirdly to provide him with impulses for action. A technical focus has been deliberately avoided.

The paper's basic assumption is that both the necessary technologies and the technical knowledge exist to build IIoT ecosystems. What is missing, however, is an understanding of the basic mechanisms of ecosystems and their strategic implications for business. This is the blind spot the paper addresses. It is aimed not only at users and providers of IIoT platforms but also at politicians and associations – as regulators, promoters and multipliers, they play a strategic role in the development of IIoT ecosystems.

In its argumentation and structure, the paper follows a five-step model, which is based on the questions that a company should ask itself when addressing ecosystems. The first step focuses on the fundamental question of why my company should get involved in an ecosystem in the first place. The second step is to weigh up the opportunities and risks associated with this commitment. The third step is to determine the potential positions that a company, based on core competencies, can take in an ecosystem. In the fourth step, existing ecosystems are identified and evaluated on the basis of the insights gained in the three previous stages. The fifth step then follows, if necessary, the concrete steps to becoming involved in the selected ecosystems.

The paper focuses on the pre-competitive area extending to level 3 and touching on level 4 with the presentation of selected IIoT ecosystems. Assessment, however, is the sole responsibility of the companies, as is the full scope of level 5.

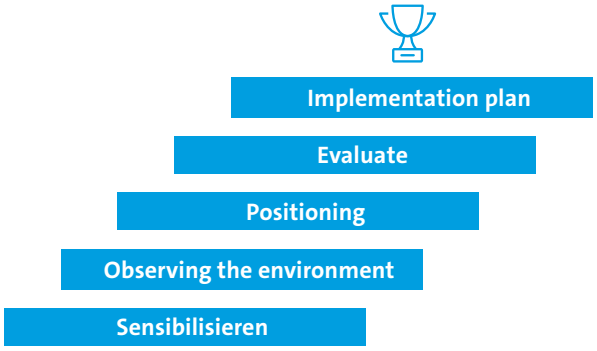


Figure 1: The 5 steps a company should take when dealing with ecosystems.

Networking is everything – platforms create order! (level 1)

Digitization and networking are not only revolutionizing the manufacturing industry. The industrial Internet of Things (IIoT) is becoming the central infrastructure of industry and paves the way for new, data-based business models. Ecosystems are of strategic importance for the success of these business models. In them, companies from different sectors and areas work together, e.g. by exchanging data, developing joint solutions in the course of co-creation or by ensuring that their services or products are not only compatible with each other but also functionally complement each other. Thanks to this cooperation – it goes far beyond the classic customer-supplier relationship in intensity and depth – the companies can realize not only synergy effects, but above all economies of scale. IIoT platforms form the technical basis of this cooperation. On an IIoT platform the data obtained by means of sensor technology from the various production assets are aggregated, analysed and visualised. This enables, for example, better coordination in the supply chain. This can be used as a basis for the development of additional services that provide their users with significant added value when using the assets – such as predictive maintenance, which can be used to avoid production disruptions and optimise uptime. This is how digital business models are created in platform ecosystems.

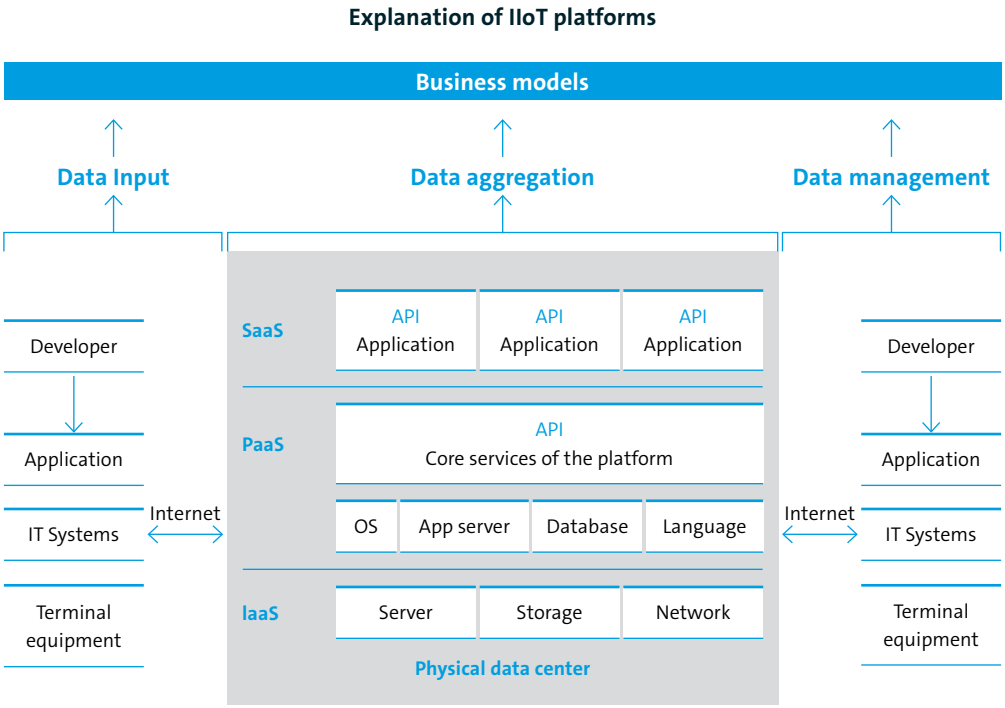


Figure 2: Technical Overview Platform

The IIoT platform is the place where the stored data is aggregated with the applications made available on the platform in order to provide added value to the platform user in the form of services. Figure 2 represents a generally valid architecture and functionality of a platform as it is frequently used by different providers on the market. In a previous publication the functionalities of IIoT platforms were discussed in detail . A platform in the sense of a platform economy, comparable to a marketplace, consists of participating companies and their business models which are mapped on a technical IIoT platform.

Transformation takes shape – properties of platforms (level 2)

The Working Group on »Digital Business Models« of the Plattform Industrie 4.0 has been working on this topic since 2018[1]. Four ideally typical value creation networks of digital business models were identified. These are the four value creation networks: the IIoT platform operator, performance in operation, the marketplace and the data trustee. Digital business models and the underlying value-added networks will be a key factor in the future, enabling providers to set themselves apart from their competitors and to open up completely new business areas. These business areas may also consist of providing data and insights to completely new participants in an anonymous form.

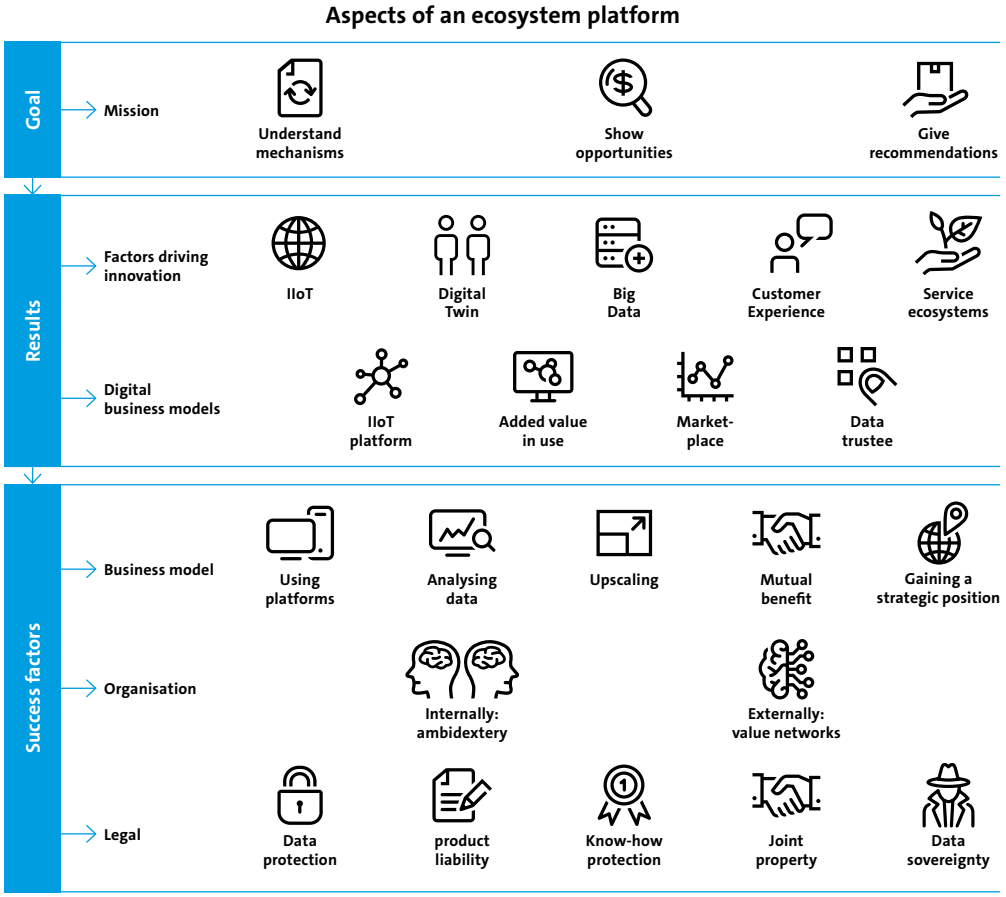


Figure 3: Digital business models for Industrie 4.0[3]

1 Platform Industry 4.0 (2019): Digital business models for Industrie 4.0. ↗ https://www.plattform-i40.de/PI40/Redaktion/DE/Downloads/Publikation/digitale-geschaeftsmodelle-fuer-industrie-40.html

Condition monitoring and pay-per-use at a manufacturer of packaging machines

The aim is to use built-in sensors to understand the condition and mechanisms in operation on site in order to ensure maximum machine availability and quality at low cost. In doing so, it is no longer the machine as such that is sold, but rather the services provided. The opportunities behind this are increased sales and better planning. For the user of the machine, the manufacturer can also advise him on how to enhance efficiency.

The innovation driver is primarily a digital twin that permanently supplies status data of the machine, places it in the context of use and compares it with target data. It uses the IIoT platform technology as infrastructure and calculates risk scenarios and forecasts from the collected data. These are communicated as a positive customer experience via a service ecosystem. This could be a local service provider, for example, who receives service instructions via IIoT and can thus resolve a problem more quickly and without travel costs. In addition, machine learning and artificial intelligence can be used to detect problems that occur automatically and to solve them efficiently through targeted service activities or active intervention in the control of the production facility.

Representatives of four major digital business models are involved in this process: the provider of the IIoT platform, usually a software company. The provider of the service in operation, which is the machine supplier itself, but also the service provider on site. The marketplace operator, who organises the specific applications and business processes among the participants, and the data trustee, who operates the computer centre, for example.

The success factors are distributed among the participants: machine manufacturers and service providers use a professional platform instead of investing in the construction of a platform themselves. The models for assessing machine performance are constantly improving through machine learning (AI) and usage is scaled across many machine manufacturers and service providers. The benefit: everyone can concentrate on their strategies and core competencies and reduce costs for non-value-added efforts.

The resulting service modularization allows companies to become both efficient and flexible, as well as to continually add or remove partners o the value-added network, for example by integrating other local service providers or redesigning their machinery.

The legal aspects result from a business architecture that is based on data protection regulations. Product liability is significantly facilitated and secured by consistent monitoring, and know-how protection is ensured by a professional process chain.

Observations

- The technologies for implementing digital business models are largely available[2,3]. Especially data integration, industrial networking, analytical tools and application development.
- A disruptive change to industrial networking, as predicted a few years ago, has been technologically implemented; the number of networked devices is already running into the billions. The entry into the commercial structures in industry is still to come.
- Most new business models in the IIoT environment are aimed at partnership as a relationship between the players. (Guarantee 4.0[4], Joint success / failure).
- Most new business models in the IIoT environment use so-called smart services such as condition monitoring to generate a business case.
- Industry offers are becoming more customer specific and benefit oriented. Thus, there is a tendency to involve the customer at an early stage through co-creation.
- The classic customer-supplier relationship is changing; customer and producer are merging to form the so-called prosumer. As a result, processes, roles and expectations are completely shuffledt.
- In terms of scaling and amortisation, IIoT projects are also subject to the familiar problem of initial investments, which only have a chance of achieving a positive ROI when they reach a later critical mass.

Networked business models have existed since the Hanseatic League or, for example, in code sharing in aviation. The merger of many providers with different requirements leads to added value for all providers and their customers. IIoT accelerates this development and creates the conditions to establish it in the industry.

2 Keep Calm and Digitize: What Approach Are German Companies Taking in the New Age? The trend study by Tata Consultancy Services (TCS) and Bitkom Research: ↗ **https://studie-digitalisierung.de**

3 Acatech : Smart Service World 2018 – Report.
↗ **https://www.acatech.de/wp-content/uploads/2018/06/SSW_2018.pdf**

4 Definition Guarantee 4.0: Figure 8

Emerge stronger from change – the right position (level 3)

Hypotheses

- Competitors cooperate: The business models of the future will be characterized by multilateral relationships that do not fit in with the currently prevailing bilateral relationships between customers and suppliers. In terms of coopetition, traditional competitors will in future increasingly find themselves as partners in IIoT ecosystems that share the economic risk and success (through pay-per-value/use/etc. payment models).

- Reliability is a must: IIoT business models require a high degree of standardisation and quality assurance of the individual services involved.

- Economic structures are also subject to disruption: structural and cultural issues play a central role in change. The conversion of a business model from product sales to service presents companies with considerable accounting challenges. The conversion of existing contracts is often a lengthy process and running both modes parallel usually causes a short-term decline in sales, since new contracts only show sales over a period of years, which according to the traditional model can be shown directly at the time of conclusion. This is often difficult to communicate to investors, especially if the business is actually healthy.

- Industrial change takes more time than technical change: For about 10 years there has been an evolutionary development towards the inclusion of performance-related success factors in business processes. Although this change towards performance-based business processes is not yet complete, new challenges and economic mechanisms (platform economy and network economy) are coming into play, and their effects must first be understood in a process of change that is currently taking place.

Over the past 5 years, IIoT ecosystems have developed from the different areas in the B2B sector and have reached a certain industrial maturity, but this is still far from the maturity and diffusion of B2C ecosystems.

Digital ecosystems are also establishing themselves in other economic sectors, such as construction and urban living spaces (e.g. Smart City) in which we find the same principles such as risk sharing, coopetition and new digital business models and added value. Supported by Building Information Management and IIoT, these partnerships are establishing themselves for the efficient and effective, sustainable control and management of real estate and properties[5].

Below are some examples of ecosystems existing today in the area of Industrie 4.0.

5 Contribution from Karl Osti and Jan Niestrath, Autodesk GmbH

We are in the middle of it – New ecosystems show success (level 4)

Sample reports on ecosystems

Five reports from existing ecosystems

Example ThingWorx from PTC

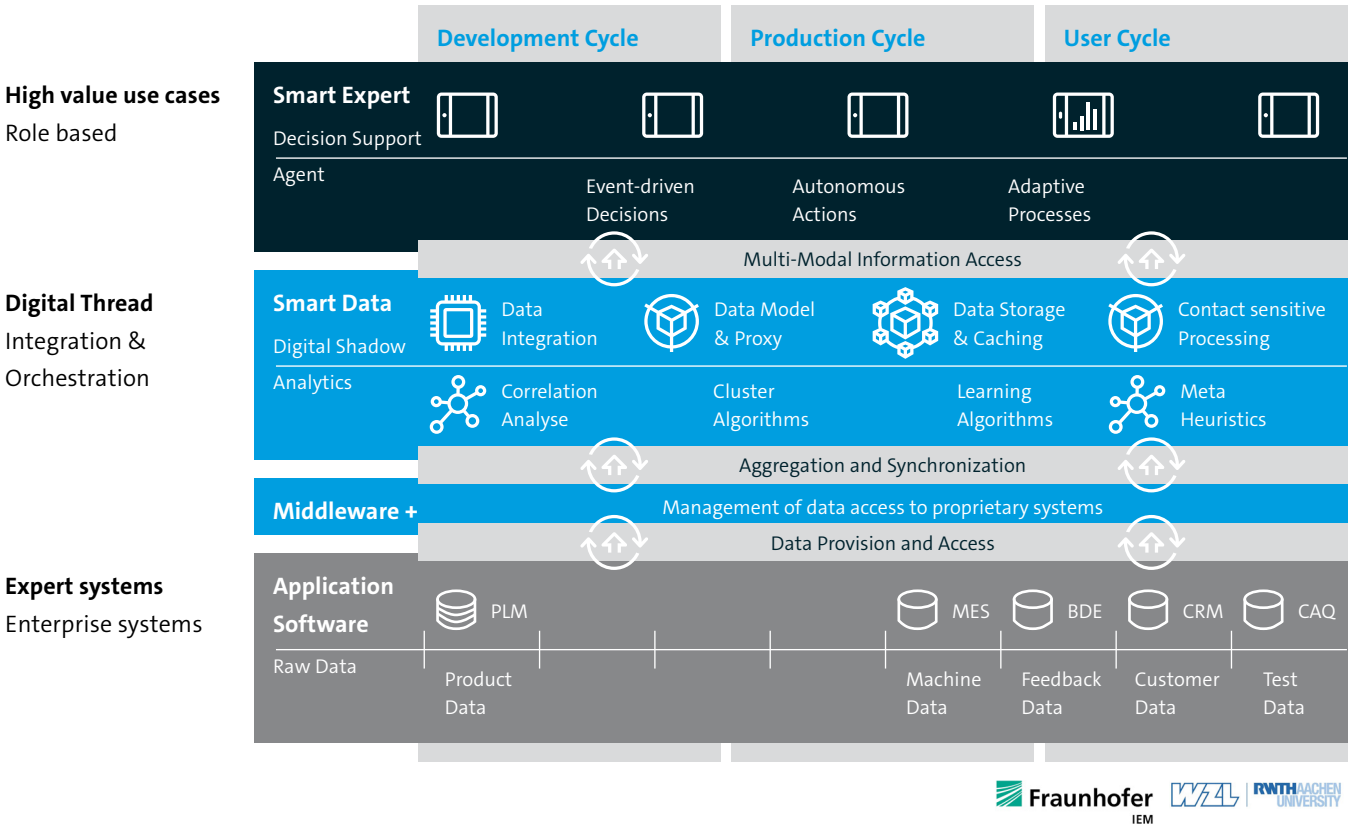


Figure 4: ThingWorx Example »Internet of Production«

In the context of the Internet of Production reference architecture of the RWTH Aachen University and the Fraunhofer-Gesellschaft, a rapidly growing ecosystem of currently several hundred industrial companies, consultants, system integrators, software vendors, resellers and operators has developed. All aspects and lifecycle phases of products and services are linked in an open architecture. The core of the concept is to network existing systems quickly and flexibly and to meet the constantly changing requirements in a robust way. This applies to products and proces-

ses as well as all the underlying data. The added value is increased turnover through improved and new business models, higher operating margins and increased efficiency of assets. In addition, the motivation for customers is the speed of industrially mature implementation of innovation and a high degree of future-proofing through the reference architecture. In addition to the ThingWorx IIoT platform, there is an open network of applications and services from many providers, most of which are also available in a marketplace.

Example Adamos

ADAMOS – From mechanical engineering for mechanical engineering

A particular example of an IIoT ecosystem is ADAMOS (ADAptive Manufacturing Open Solutions). In the form of a GmbH (limited liability company), it not only has its own legal personality – in addition to Software AG, ADAMOS partners include over a dozen renowned mechanical and plant engineering companies – but is also fully geared to the needs of the industry. The ADAMOS partners are united by the conviction that digitalization can only succeed through cross-company cooperation. Thus, Industry 4.0 requires a whole set of different skills, resources and knowledge. A single company usually does not have this set at its disposal. ADAMOS therefore offers its partners not only an IIoT platform as a common infrastructure but also the possibility of exchanging or bundling knowledge and resources in a network – e.g. in co-innovations or shared projects. With its »Digital Transformation Services«, ADAMOS also offers a standardised range of training, consulting and implementation services that make it easier for mechanical engineers to realise digital business models.

Example Nokia

Development of the Multi-Access Edge Computing Ecosystem (MEC)

Multi-access Edge Computing offers application developers and service providers a carrier-grade cloud computing platform at the »edge« of an industrial network. Deployment scenarios include the production and logistics segment, with MEC typically implemented on-premise in a production hall or 5G campus. This environment enables applications with ultra-short latencies and high bandwidths with real-time behavior, such as machine control or video surveillance. MEC is also used in public networks.

MEC represents an ecosystem with new value chains. MEC allows authorized partners to provide new applications flexibly, quickly and securely and to use them productively, e.g. in a manufacturing environment. The origin was an idea of the company NOKIA for so-called »Liquid Applications« from 2013, which bring applications and data very close to the 4G/5G user. This approach was systematically developed further by the European Telecommunications Standards Institute ETSI from 2014 onwards with the establishment of an MEC Industry Specification Group.

The growing ecosystem – currently about 100 partners – both from platform manufacturers (including NOKIA) as well as service and user providers will experience a high demand especially with the introduction of 5G in public and private campus networks. Applications include video analysis (e.g. automated final inspection in production), localization services (e.g. object detection and acquisition on a 5G campus), AR/VR applications (e.g. support for complex maintenance procedures).

Nokia has been pioneering Multi-access Edge Computing since 2013

MEC ecosystem development

2013	2014	2015	2016	2017	2018 +
Nokia launches »Liquid Applications«	**6 companies found MEC as an ETSI ISG**	One year later MEC has > 50 companies **First MEC Congress in London**	ETSI ISG MEC has 70 companies MEC renames from »Mobile« to »Multi-access«	ETSI MEC rel. 1 completed MEC key enablers defined in 5G architecture by 3GPP	ETSI MEC rel. 2 5GAA »Edge Computing for V2X« workshops

Nokia MEC product evolution

2013	2014	2015	2016	2017	2018 +
RACS plug-in unit for LTE Base Station, single application	Application hosting platform in RACS AppFactory for quick onboarding of aoolications	**Scalable server platform for all locations**	Iconic MEC deployments at **F1 Shanghai** and Hajj	MEC for Wi-Fi	Virtualized MEC MEC for edge datacenter MEC for 5G MEC evolve to SEP ORAN

Figure 5: Timeline for the development of the MEC ecosystem (Source: Nokia)[6]

6 Reference: ↗ https://www.etsi.org/technologies/multi-access-edge-computing
Brochure: ↗ https://www.etsi.org/images/files/technologies/ETSI-MEC-Public-Overview.pdf

Example Industrial Analytics

Industrial Analytics is a young innovative company in Berlin, founded by experts in the field of turbomachinery and artificial intelligence. Industrial Analytics offers a platform- and manufacturer-independent Monitoring-as-a-Service for operators of industrial plants, such as refineries, chemical plants, power plants, in order to reduce their operating and maintenance costs and to support them in digitalization. Especially processes with larger rotating machines such as turbines, compressors, pumps are in the focus of monitoring by Industrial Analytics. Through digitalization, operators gain valuable data and an overview of the condition of their machines and plants.

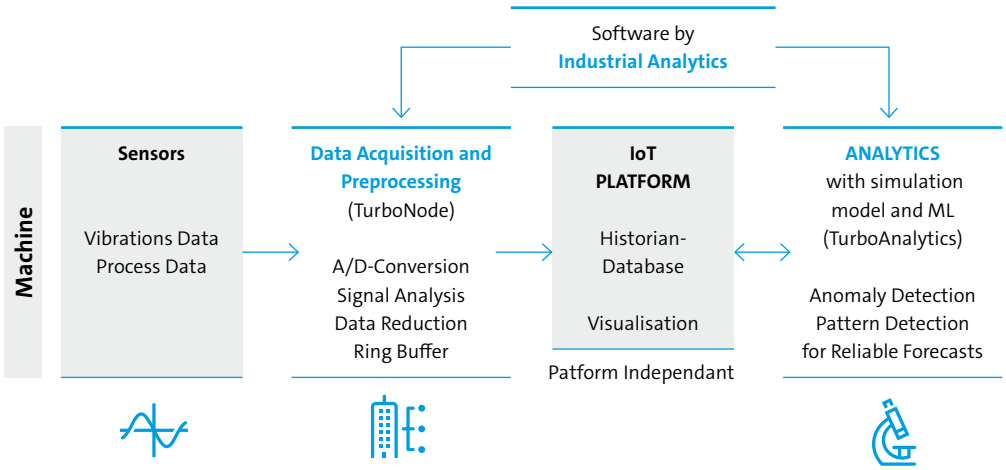


Figure 6: Platform- and manufacturer-independent Monitoring as a Service Example (Industrial Analytics)

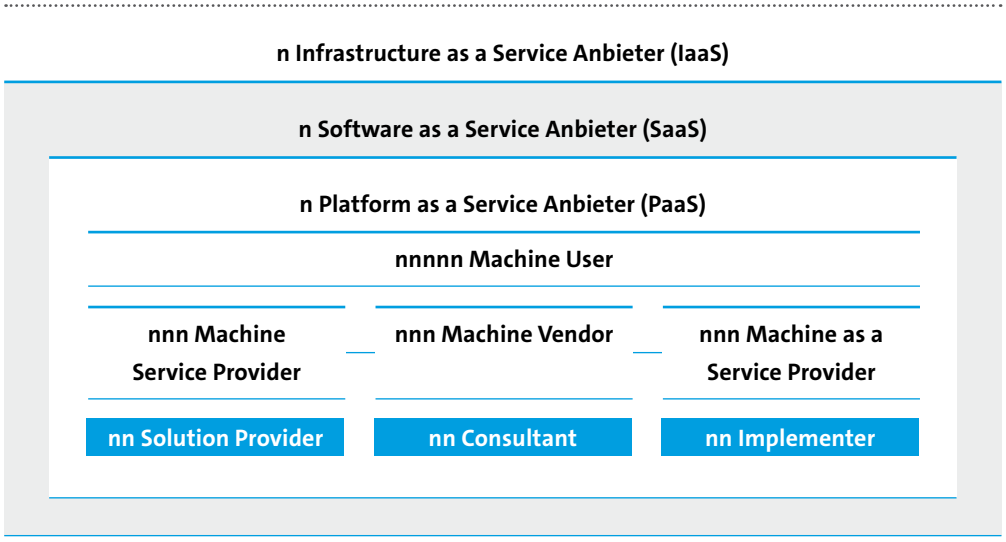
Industrial Analytics offers a licensed complete solution from sensor to analysis evaluation with recommendations for action. Individual customer requirements are considered and the algorithms are integrated into the customer's specific environment. The platform-independent integration can be either a cloud or on premise environment.

The switch to cloud solutions is still in its infancy for plant operators, as security concerns about such solutions are only slowly diminishing. For secure cloud environments, Industrial Analytics is partnering with major platform and infrastructure vendors such as SAP, OSIsoft, MindSphere and IBM Watson IoT. The platform providers often do not develop specific vertical solutions themselves, but are looking for partners to integrate these solutions into their ecosystem. With a partner such as Industrial Analytics, a portfolio of services can be expanded, thus offering plant operators a significant added value. In this context, Industrial Analytics sees itself primarily as a system integrator and technology supplier and, as a very young company, benefits from the market access of the major platform providers.

Players and roles in the Industrie 4.0 ecosystem

The Industrie 4.0 ecosystem is composed of a large number of very different members, each of whom contributes and benefits. In addition to the fact that the participants come together in the ecosystem, the ecosystem also has an impact on the structures and business models of the participants. This dynamic continues to change.

- Machine manufacturers
- Provider of operator services/operator Manufacturing as a Service
- Service provider for machines
- IaaS provider
- PaaS providers
- SaaS provider
- Solution Provider as a basis for networking/integrators
- Consultant for strategy, technology, business process
- Consultant for implementation
- Customers



*n: few / nnnnn: many

Figure 7: Players and roles in the ecosystem Industry 4.0

Differences between the platform ecosystems B2B and B2C

While in the public perception B2C platforms dominate and have also grown strongly, B2B platforms have so far been rather fragmented and there is reason to doubt that they have the same development prerequisites as B2C platforms.

Theses on the difference between B2C and B2B platforms

- Effects of scale are stronger in the B2C sector. The motives of participants in B2C and B2B are very different. In B2C the individual advantage is well defined and associated with low dependencies, whereas in B2B significant dependencies within the company prevent rapid growth.
- Different commercial models: while B2C is essentially »paid for« with data, B2B is about financial added value that can be shown.
- Different behaviour of contracting parties: private individuals vs. professional purchasing departments. Concerns include pricing, liability issues, IP security, and data use among others.
- Market entry criteria: B2C has to scale strongly from the beginning to be profitable, B2B is profitable even in small volumes due to a concrete business need, but scales much slower due to strong dependencies.
- In B2B the risk is much higher. If a company strategically relies on a platform, the need to protect itself is existential. That speaks for an established ecosystem. This fact also means that a B2B ecosystem grows much more slowly.

Vision of functioning ecosystems

An ecosystem must reach a critical size in order for the effects to be such that it can carry itself, At this point, the various digital business models can more easily reach the threshold of profitability. The question is how to develop an ecosystem that meets these criteria. This paper describes five typical ways industrial B2B ecosystems can become successful. It is intended to serve as a basis for discussion to better understand what economic effects are at work in industrial B2B platform ecosystems and what impact this has on the digital transformation of industry in Germany and Europe.

For many developments and ecosystems, several of the outlined paths can be relevant at the same time.

Possible methods to establish functioning ecosystems

1. **Voluntary cooperation to achieve a common added value (public spirit/cooperative)**
   Development of new business opportunities that go beyond the competences and/or capacities of one player. Origins, for example, from the association system. Various players are prepared to accept losses for a certain period of time when building a common IIoT ecosystem. The players do this in the expectation of a future successful ecosystem in which digital and service-based business models can be offered profitably to all market participants through network effects.

2. **Cooperation through external pressure (»common enemy/common adversary«)**
   Alliances between different competitors or the offerings of disruptive players in their market segment force players to establish a joint IIoT ecosystem with other players within the framework of cooperation.

3. **Market power of a single player/level of the ecosystem forces remaining players into an ecosystem (e.g. through standards)**
   A provider of a platform ecosystem ensures through its market power that it is essential for many other players to develop offers and services that are compatible with this platform ecosystem. This platform is highly attractive because a large number of customers and providers are on this platform (network effects).

4. **Full stack (extreme form of 3)**
   A player offers the services of an entire value-added network as a single provider on the market, thereby displacing the other market participants.

5. **One player »sponsors/incntivates« ecosystem membership by offering attractive conditions**
   The provider of an IIoT platform offers the use and basic services of its platform at very favourable conditions. He does this with the aim of ensuring that many players use this platform. This creates an ecosystem with many market participants. Digital business models that are offered in this ecosystem scale better and ensure profitable operation from the point of view of the platform provider.

The right thing at the right time – action impulses (level 5)

Recommendations for action

IIoT platforms affect everyone. The information technology (ICT) companies, the users of digitisation technologies from the manufacturing industry and the political sector – in strategy development, in the choice of partners, in setting suitable framework conditions.

Based on the five steps of strategy findings, the authors have summarized impulses for action that should help the different groups to contribute to the success of digitization around the topic of platforms from their perspective.

ITC industry

The ITC industry is regarded as a driver of digitization and at the same time is subject to serious changes, as its business models are among the first to be affected and react most quickly to change. They therefore have the greatest opportunities and also the greatest risks. Platforms offer ITC companies marketing opportunities but also high integration costs.

- Step 1 – Sensitization:
  - Active market observation: What new structures, architectures and business models are emerging around me?
  - Questioning business relationships: How is the situation of my customers changing? Which interests and implementation paths are changing?
- Step 2 – Observing the environment:
  - Outside-in observation: What risks, new players and competitors are emerging? What are my competitors doing?
  - Inside-out observation: What opportunities and new markets are opening up due to digitalization and emerging platforms? As an addition, or new business.

- Step 3 – Positioning:
  - Make-or-buy decision: What is my core competence? What do I buy in addition? Where do I join a trend or a platform?
  - Protection: What measures should I take to ensure that my offer continues to provide my customers with differentiating added value, even under changed conditions? Which platforms will become relevant for my customers? Am I present there?
  - Offensive: Can I myself become the center of a platform? What measures should I take so that others recognize and take up the added value behind it? What guarantees must I be able to provide?
- Stufe 4 – Evaluate:
  - Design the complete product: What does a value-added offering look like from my customer's perspective? What ingredients does it consist of? What does a pricing model look like?
  - Ensure implementation: In which network should I integrate myself? Which platforms and partners do I need to achieve the best added value for my customers?
  - Define business models: How do the opportunities and interests of potential alliance partners fit together in a platform?

Producing industrial companies

The group of users is faced with the challenge of identifying for themselves where they should – far beyond their traditional fields - build up digital core competences and where they can and should better rely on partners.

Platforms offer users great market potential, but also the risk of high costs or the loss of their own customer interface.

Plattformen bieten Nutzern große Marktpotentiale, aber auch das Risiko von hohen Kosten oder dem Verlust der eigenen Kundenschnittstelle.

- Step 1 – Sensitization:
  - Active observation of trends and potentials: Why should I join an ecosystem? What changes are happening from the perspective of my customers and competitors?

- Step 2 – Observing the environment:
  - Outside-In Observation: Mapping changes to your own business. What are the opportunities and risks, what new boundary conditions, competitors and needs are emerging?
  - Inside-out observation: how do my goals and abilities fit with these changes? How do I prepare for participation in emerging ecosystems? Which questions do I first have to clarify myself?
  - Compare: What are the possibilities of participation?
- Step 3 – Positioning:
  - Distinguish: How do I find an ecosystem »suitable« for me? What are the interests and possibilities in the ecosystem, does it fit me strategically?
  - Weighing up: How do I benefit from an ecosystem? Does it serve to secure or expand my business? What must I be able to rely on and what is replaceable?
  - Question my market position: Do I set up an ecosystem myself?
- Step 4 – Evaluate:
  - Draw a strategic map: Which ecosystems exist and how do they differ? Where do I invest and where do I differentiate myself?
  - Reconcile interests: What are my first concrete steps as an ecosystem member? How do I learn to use the contributions of others for my own benefit?
  - Ecosystem effect: How do I differentiate myself in the ecosystem to achieve a win-win effect with other members?

Political decision makers

Politics has a key role to play in establishing IIoT ecosystems. It has a creative mandate and should give the opportunities offered by digital platforms the space to develop. To this end, framework conditions must be created that are conducive to the creation and development of ecosystems, and companies must be supported in their involvement in ecosystems through targeted measures. Four points are critical as relates to the project group:

- Reduction of legal uncertainties in ecosystem cooperation, e.g. through the possibility provided for in the 10th amendment to the ARC for the Bundeskartellamt to conduct a preliminary review of the cooperation.

- Reduction of technical uncertainties and prevention of log-in effects to facilitate cooperation in the ecosystem, e.g. through political support of standardization efforts and the development of reference architecture in GAIA X.

- Initiation of publicly funded information and consulting programs to sensitize companies – especially small and medium-sized ones – to the importance of ecosystems and to provide them with the know-how to deal with ecosystems and to become active in them if necessary.

- Targeted tax incentives to make it easier for companies to make the investments required to enter an ecosystem, e.g. in infrastructures, platforms and applications (»Digital-AfA«).

Annex

Guarantee 4.0

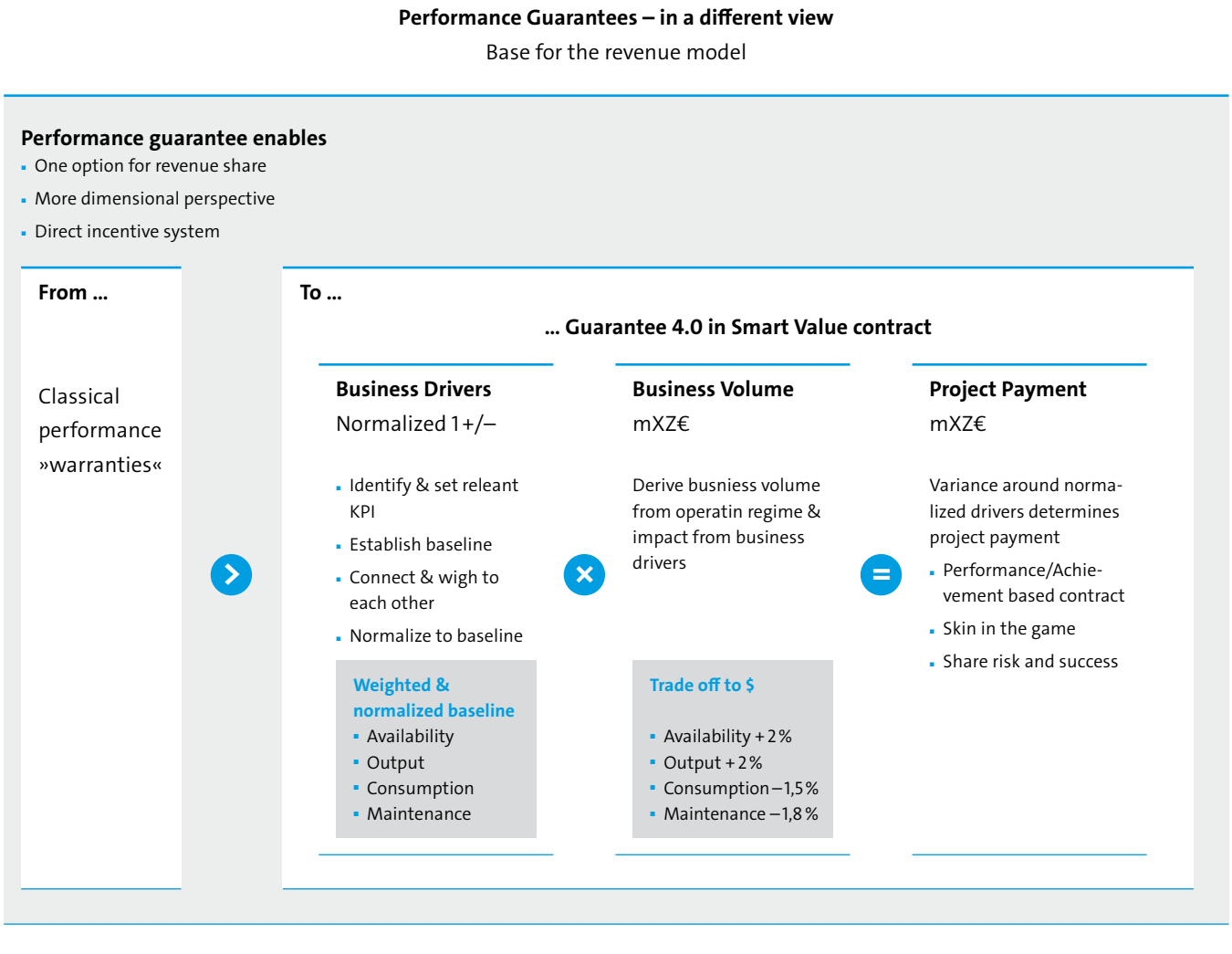


Figure 8: Guarantee 4.0

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Bitkom represents more than 2,700 companies of the digital economy, including 1,900 direct members. Through IT- and communication services alone, our members generate a domestic annual turnover of 190 billion Euros, including 50 billion Euros in exports. The members of Bitkom employ more than 2 million people in Germany. Among these members are 1,000 small and medium-sized businesses, over 500 startups and almost all global players. They offer a wide range of software technologies, IT-services, and telecommunications or internet services, produce hardware and consumer electronics, operate in the digital media sector or are in other ways affiliated with the digital economy. 80 percent of the members' headquarters are located in Germany with an additional 8 percent both in the EU and the USA, as well as 4 percent in other regions of the world. Bitkom promotes the digital transformation of the German economy, as well as of German society at large, enabling citizens to benefit from digitalisation. A strong European digital policy and a fully integrated digital single market are at the heart of Bitkom's concerns, as well as establishing Germany as a key driver of digital change in Europe and globally.

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