2nd Conference on Production Systems and Logistics

Digital Industrial B2B Platform Patterns From A Business Perspective

Fabian Hartner[1], Ulrich Löwen[2], Jörg Franke[1]

[1]*Institute for Factory Automation and Production Systems, University of Erlangen-Nürnberg, Germany*
[2]*Siemens AG Technology, Erlangen, Germany*

Abstract

Platform companies such as Amazon and Google have changed the business-to-consumer (B2C) sector at a rapid pace. In the context of the digitization of products, production systems, and processes, the importance of digital business-to-business (B2B) platforms is also increasing. In the manufacturing industry, value chains change to complex platform-based value networks between business entities. This publication presents the results from the analysis of more than 160 platforms in the manufacturing industry from a business perspective. Using a value network-oriented methodology, defining business roles as well as revenue streams and business relationships, recurring value-creating interactions were observed. In total, eight clearly distinguishable platform patterns have been identified. In this article, these patterns are described in detail with their value and revenue streams as well as their benefits for the individual roles. These patterns aim to achieve a well-founded understanding of platforms in the manufacturing industry and form the fundamentals for further analysis for successful digital industrial B2B platforms.

Keywords

Digital Platforms; Value Networks; Platform Patterns; Business Models; Manufacturing Industry;

1. Introduction

In the ongoing digitalisation, in addition to new technical developments, new digital business models are emerging. Since very successful platform companies have been developed in the business-to-consumer (B2C) market (e.g. Apple, Uber), platform-based business models have attracted a high level of attention from individuals, companies, politics and researchers. Following the successes in B2C, digital platforms and associated business models are also becoming increasingly relevant in the business-to-business (B2B) environment and especially in the manufacturing industry, where more and more platform-based offerings are coming onto the market. According to Kenney et al. [1], digital platforms represent powerful principles for economic effects and designs in the manufacturing industry in the coming decades. Pauli et al. shows in [2] that industrial platforms are different from other platforms already intensively considered in previous studies (e.g. mobile platforms, video games consoles). Therefore, previous results from other domains cannot be directly transferred without further reflection. In the manufacturing industry, an increasing number and a wide variety of platforms can be observed that offer users a diverse range of value propositions. In order to understand and explain the underlying dynamics of the very heterogeneous platforms, digital platforms can be classified into different types [3]. This publication shows the results of the analysis of practical examples using a methodology concentrating on value and revenue streams from a business perspective (see chapter 3) and describes identified pattern of digital B2B platforms in the manufacturing industry (see chapter 4).

2. Theoretical Background and related work

This publication focuses on platforms in the manufacturing industry. According to the United Nations ISIC classification system [4], manufacturing refers to an industry in which a physical or chemical transformation of materials, substances or components into new products takes place typically in plants or factories with the use of powered machinery and material handling equipment. Furthermore, this research focuses on platforms facilitating B2B transactions. According to Kleinaltenkamp and Saab [5], the B2B market refers to a business transaction between two or more companies where the customer typically further processes the purchased product or uses the product for its own service or production process. Transactions typically are characterised by the involvement of several people and departments on supplier and customer side and by the often complexity of the services. According to Falck and Koenen [6], the differences between B2B and B2C are particularly apparent with regard to the size of transactions, customer relationships, focus on profits and efficiency, as well as contract terms and lead to different mechanisms for B2B platforms compared to B2C.

The term platform cannot be defined uniformly. In order to define the term platform, a distinction should be made between two different perspectives on platforms. On the one hand, Gawer [7] describes a technical understanding in which platforms are technological architectures that support companies with modules in the development and innovation of modular products or technologies. On the other hand, an economic perspective defines a platform according to Parker et al. [8] as "a business based on enabling value-creating interactions between external producers and consumers". This perspective on business interactions between external partners is also adopted in this publication by focussing on value-creating relationships between business partners based on digital technologies.

Regarding different platform types, some general classifications have already been developed. Engelhardt et al. [9] divide platforms very generic into transaction-centred platforms, which act as intermediaries to bring offer and demand together, and data-centred platforms, which connect data based on hardware and software. Täuscher and Laudien [10] focus on marketplaces as business models and identified six different marketplace platform types across industries. Evans and Gawer [3] distinguish between four platform types: transaction platforms that facilitate transactions between different users, innovation platforms as a foundation on which companies develop complementary offerings, integrated platforms as a combination of transaction and innovation platforms and investment platforms that consist of several companies acting as investors. Due to the complexity of industrial platforms, a more detailed level of abstraction is necessary.

However, these three studies follow very general distinctions and pay insufficient attention to B2B and industry-specific platform offerings. An initial analysis with detailed focus on industrial platforms has so far been carried out by Wortmann et al. [11], in which the following five platform types were defined: Two- and multi-sided markets as intermediaries for matching between actors, service platforms as intermediaries offering targeted collaboration, IoT platforms offering technical solutions in pipeline models, IoT-based intermediaries use IoT platforms for intermediary functions and Smart IoT platforms as an extension of IoT platforms with further services. At the current state of the art, there is no detailed research that defined their classification based on value propositions, value creation relationships and income mechanisms in industrial B2B. For this reason, this publication addresses the research question, which B2B platform patterns can be distinguished in the manufacturing industry based on the value creation relationships.

3. Methodology and research procedure

To ensure a systematically consistent approach from a business perspective, this research applied a value creation perspective to examples of digital platforms in the manufacturing industry. A value network perspective with the analysis of physical and service value streams was chosen to analyse the business transactions including benefits, value propositions, and revenue flow between partners through offerings from a platform provider. The methodology was published by the working group "Digital Business Models

in Industry 4.0" of Plattform Industrie 4.0 in [12] and initially applied to five examples. Until yet, the methodology has been proven and established in several publications for the analysis of practical examples on a uniform business level, as in [13] and [14]. The representation of the value creation networks follows a methodology in which nodes (as icons) represent certain business roles of a company and lines (as arrows) represent corresponding value creation relationships. The value creation relationships are divided into physical value creation and value creation through services, and the concrete proposition is supplemented by a brief caption. The representation of the revenue streams is done with dashed and labelled arrows and shows who pays for which service or product.

For a comprehensive research basis, the methodology was applied to platform examples from the manufacturing industry. In this work, platforms are considered that have at least one actor in their value networks that acts according to the definition of ISIC and has an industrial character (e.g. through machine use, work in factories). The following research procedure was used to select platform examples as a data basis for further research and analysis. First, publications focusing on platforms in the manufacturing industry were searched for concrete business examples (e.g. [13], [15]). This was expanded by means of an internet search via Google and Google Scholar with the terms "digital B2B platform", “platform businesses manufacturing industry” and related terms. An example was included in the research base if it was described with the term "platform" by the provider or the author, considers primarily B2B transactions, was available on the market (no research projects) and was related to the manufacturing industry. Based on these criteria, 160 examples were identified in a first research, which have no claim to completeness. In a second step, business roles as well as their business relationships and their value propositions were defined and visualized with the value network methodology. Furthermore, the revenue streams between the business roles were analysed and documented. The information in this step was primarily taken from published company descriptions and partly expanded by contacting and interviewing the platform operators.

After a clear understanding of the platform examples and their value networks, the individual examples were analysed in a third step for recurring value relationships and service offerings based on their value networks and revenue streams. Generalised, eight clearly separable platform patterns from a business perspective could be identified, which are described in detail in the following chapter 4. A draft of the first three patterns has already been presented in [16].

4. Industrial B2B platform patterns

In the following chapter, the eight identified digital B2B platform patterns are presented and described with their respective value streams and revenue streams. In addition, a description is given of what the platform provider specifically offers and how each role benefits from it. Each pattern is based on specific practical examples. The patterns represent abstracted value creation networks and revenue streams, each of which can be modified in company-specific variants. The value streams focus on the platform operator and the roles receiving value propositions directly from the platform operator.

4.1 Innovation platform pattern

The innovation platform operator (shown in Figure 1) has the business purpose of enabling connectivity between machine users for enabling complementary services and solutions. To enable and support the analysis of usage information, service provider can use services of the innovation platform to develop applications (apps). These apps can be executed on the platform and have access to provided information by the machine user (depending on access rights). Practical examples are Siemens MindSphere, Bosch IoT Suite or GE Predix. The innovation platform pattern does not focus on mediating apps of 3rd parties via an app store.

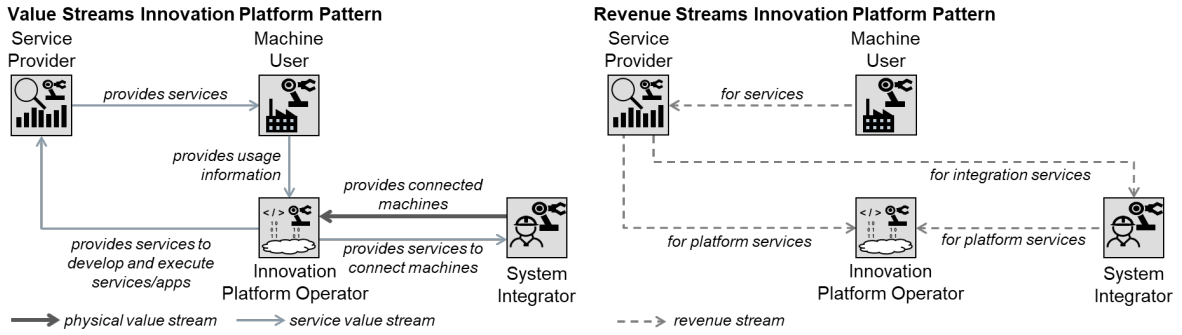

Figure 1: Value and revenue streams of the innovation platform pattern

The innovation platform operator provides a technical infrastructure that enables users to obtain usage information from machines and receive process-optimising services. The innovation platform operator enables other roles to offer and monetise new services. The business partners benefit through following aspects:

- The service provider benefits by being able to offer new or previously not economically possible services to the machine operator through the available usage information of the machines and services offered by the innovation platform operator.
- The machine user benefits by optimising internal processes by receiving services (e.g. machine downtime prediction, quality monitoring).
- The system integrator enables machines to transmit usage information and adapt the innovation platform for the specific requirements of the machine user by using services of the innovation platform operator.

The business roles involved in the value network receive revenue for the following value propositions:

- The innovation platform operator receives revenue from the service provider who pay according to the platform usage (e.g. number of connected machines) and from the system integrator for the platform services.
- The service provider receives revenues according to contractual agreements for provided services.
- The system integrator receives revenue for its integration services to connect machines.

4.2 Brokerage platform pattern

The purpose of the brokerage platform operator (shown in Figure 2) is to mediate the needs of two actors who would not have come together, or not in this form, without an independent broker. The brokerage platform operator takes on the requirements of a requester as well as the capabilities and offers of various providers. The platform operator provides the necessary coordination, mediation and selection process (request, offer and order) between the requester and a provider. Solutions, prices and available quantities are typically not fixed at the initial stage. Depending on the specific business model, the brokerage platform operator partly assumes a contractual commitment to the actors or just mediates the needs. Practical examples are V-Industry, Protiq and Spanflug.

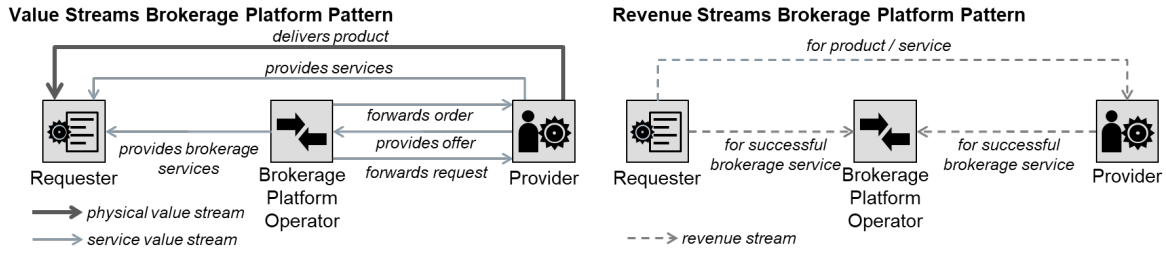

Figure 2: Value and revenue streams of the brokerage platform pattern

The brokerage platform provider offers the partners an independent mediation between two different actors, each with a different business interest, and simplifies the time-consuming coordination process from offer to order. Typically, the brokerage platform provider enables the easy establishment of contact and efficient transaction. The business partners benefit from the platform operator as follows:

- The requester gains the advantage of reducing the process of searching for suitable provider as well as the business coordination. The requester receives security for the transaction, as typically the platform operator provides a guarantee.
- The provider profits by an additional sales channel via the brokerage platform, where the customer acquisition is supported or partly already carried out by the brokerage of the platform operator.

The business roles involved in the value network receive revenue for the following value propositions:

- The brokerage platform operator receives a commission fee for each successfully brokered service or product, typically depending on the value of the transaction.
- The provider receives revenue from the sale of products and services.

4.3 E-Shop platform pattern

The purpose of the e-shop platform operator (shown in Figure 3) is to enable quick and easy buying and selling of products or services across different actors. The difference to the brokerage platform pattern is that an e-shop offers concrete services and products that are already announced with a fixed price and known availability. A direct purchase can be made via the e-shop platform without negotiations. The payment flows via the platform operator. Practical examples are Amazon for Business, Mercateo and Wucato.

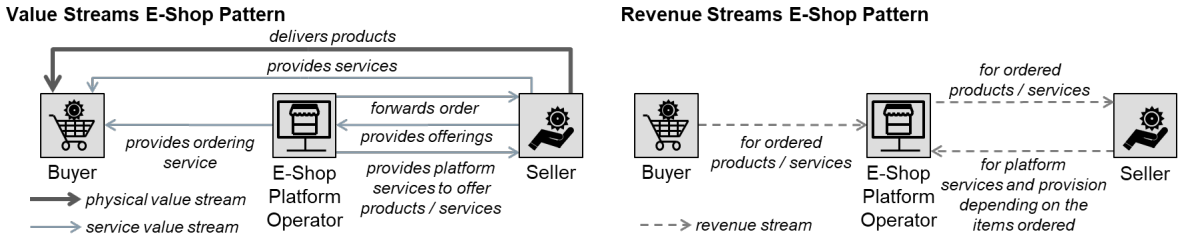

Figure 3: Value and revenue streams of the e-shop platform pattern

The e-shop platform operator offers a digital shop through which the purchase of products and services from many sellers and buyers can be handled centrally via the platform. The business partners benefit from the platform operator's offerings as follows:

- The seller can present and sell products and services to many customers with low effort via a new sales channel. In addition, processing tasks such as invoicing are taken over by the platform operator. However, the seller becomes transparent and comparable to competitors.
- The buyer benefits from the e-shop by being able to find various and comparable products centrally in one place and to order them uniformly. The buyer can purchase from different sellers in a short time and has only one central contact partner with the e-shop platform operator.

The business roles involved in the value network receive revenue for the following value propositions:

- The e-shop platform operator receives commission fees for the products and services sold via the e-shop. In some cases, the seller has to pay an additional one-time fee for the platform access.
- The seller receives revenue from the sale of products and services via the e-shop.

4.4 Supply Chain Management (SCM) platform pattern

The purpose of the SCM platform operator (shown in Figure 4) is to create a comprehensive exchange of information along the supply chain by bundling information and communication channels. For this purpose,

an SCM platform offers companies the possibility to combine relevant information and process flows across companies and thus make information relevant for the delivery accessible in their supply chain (e.g. customers, suppliers). Practical examples are AirSupply, Siemens AX4 and Flexport.

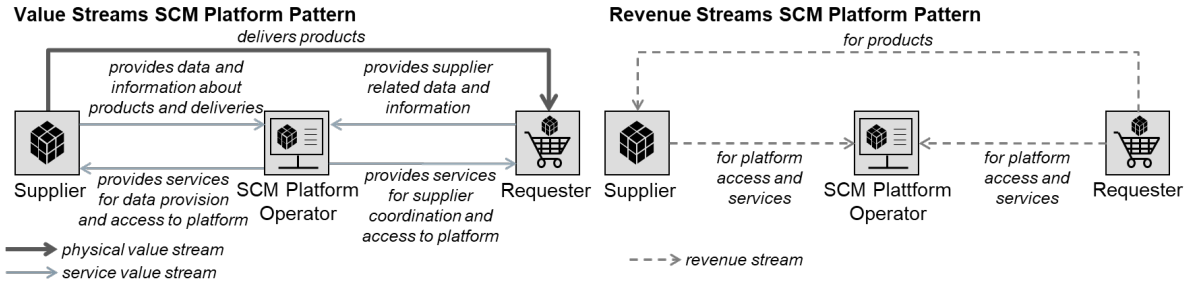

Figure 4: Value and revenue streams of the SCM platform pattern

An SCM platform provider offers an infrastructure so that information from different sources can be managed centrally and provided to partners. The SCM platform ensures access from different companies to uniform information (single point of truth). Additionally, the SCM platform provides software applications that optimise and automate process steps (e.g. sending invoices). The business partners benefit as follows:

- The requester and the supplier benefit from the SCM platform by receiving information on orders and deliveries uniformly via a single database. Furthermore, an optimisation of cross-company and internal processes as well as improved coordination with various supplier and requesters can be achieved, partly also through further services (e.g. delivery evaluations).

The business roles involved in the value network receive revenue for the following value propositions:

- The SCM platform operator receives revenue for the provision of the platform and additional services.
- The supplier receives revenues for the delivered products.

4.5 Content platform pattern

The purpose of the content platform operator (shown in Figure 5) is the uniform provision of information (e.g. image, text or price information) from different content providers via a single database. The content platform provides easy access to a uniform database with functions for analysis, searching or sorting. The information can be accessed simultaneously, but in contrast to the collaboration platform, they cannot be edited jointly by several users. In contrast to the SCM platform pattern, the content platform provides information not only for partners within a supply chain with the aim for optimizing supplier processes. Practical examples like Traceparts, Europages or E-Plan Data Portal provides data partly publicly accessible.

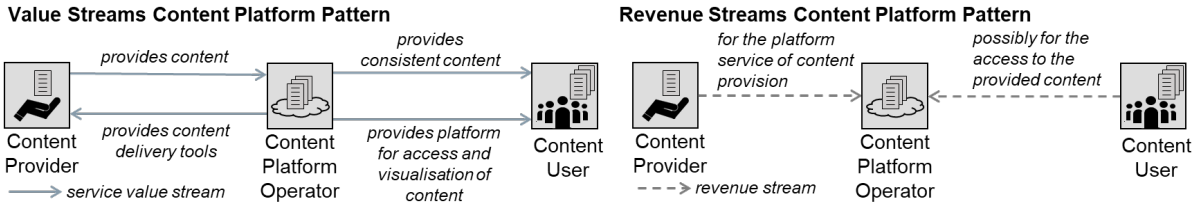

Figure 5: Value and revenue streams of the content platform pattern

The platform operator enables the partners with an easily accessible infrastructure for the uniform storage and provision of information. Thus, the operator provides the basis for a broad and comparable provision of information. The business partners benefit from the platform operator as follows:

- The content provider benefits by sharing information centrally to a broad user group in a uniform way (e.g. 3D-files). However, the standardization of the content by the content platform also makes the provider more comparable.

- The content user benefits by being able to access and use information from many providers on the content platform and reduces internal processes for searching and comparing information.

The business roles involved in the value network receive revenue for the following value propositions:

- The platform operator receives a fee from the content provider for access to the platform and partly for special placements of the content. In some cases, the platform operator also receives revenue from the content user for general access fees, access to premium content or further services.

4.6 Integrated platform pattern

The integrated platform pattern (see Figure 6) has the business purpose of providing a technical infrastructure as a basis for complementary solution offerings and mediating apps of 3rd parties via an app store. The complementary solutions are offered in relation or are executed on the integrated platform and the solution user can deploy further functions with low integration effort. Examples are Siemens Mendix or Amazon AWS.

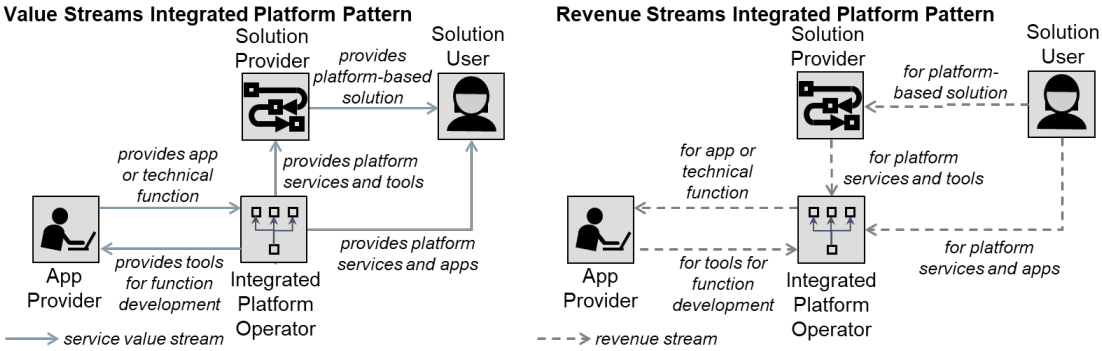

Figure 6: Value and revenue streams of the integrated platform pattern

The integrated platform operator offers an infrastructure on which other roles can offer further complementary solutions or expanding applications. Besides operation, the platform operator provides for example maintenance, security, and supporting services. The business partners benefit as follows:

- The solution provider is enabled to offer services or develop comprehensive products using features of the integrated platform or using provided apps by the app provider.
- The solution user benefits from the solution provided by the solution provider. The solution user can either use the solution without further adaptations, or can extend the solution via the integrated platform operator (e.g. via apps).
- The app developer benefits from the available development tools and can thus provide functions in addition to the integrated platform and sell apps via the integrated platform as a new sales channel.

The business roles involved in the value network receive revenue for the following value propositions:

- The integrated platform operator receives revenue from the solution provider respectively from the solution user for providing the platform (e.g. licence fee, monthly user fee). In addition, the platform operator receives income from the app provider for the provision of development tools, as well as commissions for applications successfully sold via the platform.
- The solution provider receives payment from the solution user for the platform-based solution.
- The app provider receives a usage-based fee for apps used by the solution provider or solution user.

4.7 Data exchange platform pattern

The data exchange platform owner (shown in figure 7) has the business purpose of providing a software solution for connectivity and data transmission between internal or external IT systems. The provided

software solution is then integrated by a system integrator for specific uses. The data exchange platform operator typically uses the platform to exchange data internally, but maybe also with external partners. Examples for the data exchange platform pattern are KAMPF the@dvanced, Cybus and Ondeso.

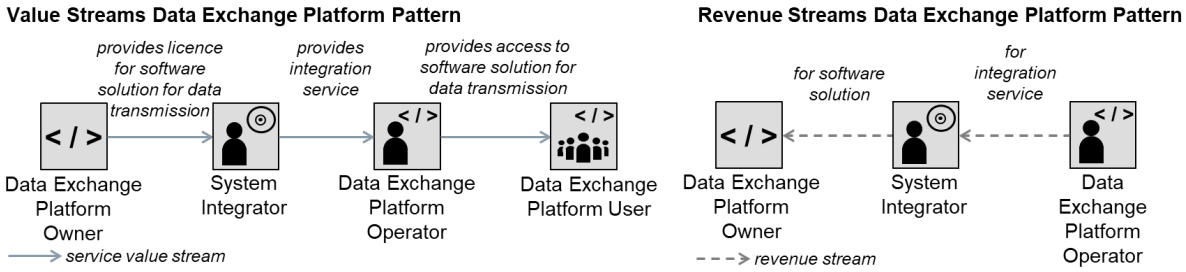

Figure 7: Value and revenue streams of the data exchange platform pattern

At this point, two roles need to be distinguished:

- The data exchange platform owner owns the intellectual property of the platform solution. However, the platform owner does not have any business relation with the end user or operate the solution, but provides a software solution that enables users to exchange data between different IT systems. Additionally, the platform owner provides updates and maintenance.
- The data exchange platform operator uses the software solution typically integrated and adapted for its specific IT environment by a system integrator to its users (typically within the own company).

The business partners benefit from the platform operator's offerings as follows:

- The data exchange platform user is technically enabled to exchange data between different IT systems.
- The system integrator takes on the role of an enabler by integrating and adapting the software to the data exchange platform operator.

The business roles involved in the value network receive revenue for the following value propositions:

- The data exchange platform owner receives revenue, typically in form of a licence model, for the provision and maybe for the usage of the software and, if applicable, for updates.
- The system integrator receives revenue for the integration service.

4.8 Collaboration platform pattern

The collaboration platform owner (shown in Figure 8) has the business purpose of providing a software solution for interdisciplinary and partly cross-company usage. For this purpose, the platform owner offers a software which can be integrated by the software integrator for specific usage, so that users can work simultaneously together (e.g. in a development project). The collaboration platform operator typically provides the integrated collaboration environment to internal and external company stakeholders. Practical examples are Siemens Teamcenter, COMOS and Contact Elements.

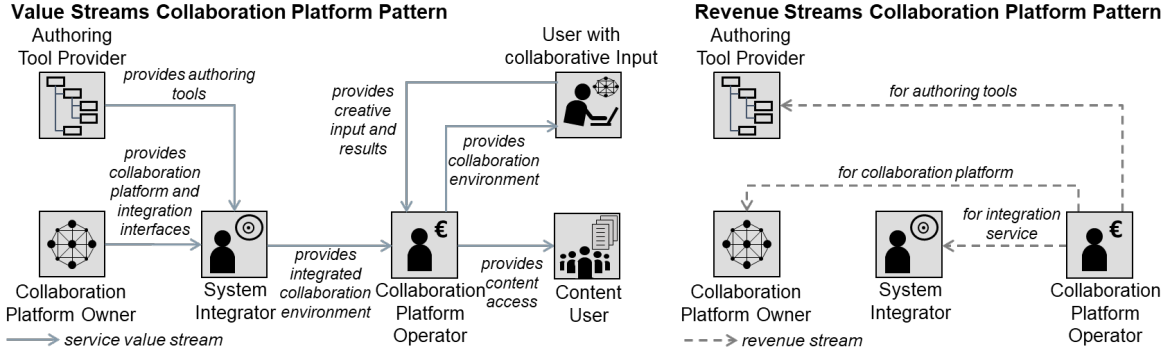

Figure 8: Value and revenue streams of the collaboration platform pattern

At this point, two roles need to be distinguished:

- The collaboration platform owner provides a software solution that enables users to work jointly on the same database. Typically, the collaboration platform owner provides updates and maintenance.
- The collaboration platform operator provides a specifically integrated collaboration environment, primarily to internal company stakeholders, but also to external company stakeholders, for collaborative working.

The business partners benefit from the platform operator's offerings as follows:

- The user with collaborative input benefits by being able to improve collaboration processes with internal and cross-company departments.
- The content user benefits by being able to easily access information from a unified database.
- The authoring tool provider acts as an enabler by providing additional software tools (e.g. CAD-Tools) necessary for collaboration.
- The system integrator enables the provision of an integrated collaboration environment of the collaboration platform operator.

The business roles involved in the value network receive revenue for the following value propositions:

- The collaboration platform owner receives revenue for the provision and maybe also for the usage of the collaboration software.
- The authoring tool provider receives revenue for providing the authoring tool.
- The system integrator receives revenues for the integration services.

5. Conclusion and Further Research

Based on a very heterogeneous range of different platform offerings in the manufacturing industry, it was possible to structure 160 identified platform offerings using a methodology concentrating on value and revenue streams from a business perspective. The research conducted shows that platform operators offer different value propositions to their partners, for example matching of actors, provision of new sales channel or enablement for further databased services. Thus, it can be concluded that platforms in the manufacturing industry also need to be differentiated from a business perspective. Despite the company-specific characteristics, eight patterns could be elaborated by abstracting the value creation relationships and revenue streams, which can be clearly distinguished from each other from a business perspective. Distinct means that a business decision is necessary to decide on a pattern. The focus on value propositions provides a decisive representation of what a platform operator offers partners in the value network. These business-relevant aspects are chosen as central criteria for the analysis and classification. Thus, a precise description and explanation of different platform patterns in the manufacturing industry could be achieved.

Further research is necessary to subdivide these general patterns into sub-patterns with more examples and to describe specific modes of transactions. These patterns form a well-grounded basis for future research in order to carry out differentiated analyses regarding dynamic effects, network effects and further success factors. Furthermore, further research can also examine what requirements companies should meet in order to implement the different platform patterns and how individual patterns can be combined. The aim is that in the future, industrial B2B platforms will become differentiated and transparent based on their concrete characteristics, and that specific success potentials can be identified in addition to B2C platforms.

References

[1] Kenney, M., Rouvinen, P., Seppälä, T., Zysman, J., 2019. Platforms and industrial change. Industry and Innovation 26 (8), 871–879.

[2] Pauli, T., Fielt, E., Matzner, M., 2021. Digital Industrial Platforms. Bus Inf Sys Eng 63 (2), 181–190.

[3] Evans, P.C., Gawer, A., 2016. The Rise of the Platform Enterprise. The Center of Global Enterprise. New York.

[4] Department of Economic and Social Affairs of the United Nations, 2008. International Standard industrial classification of all economic activities (ISIC), Rev. 4 ed. United Nations, New York.

[5] Kleinaltenkamp, M., Saab, S., 2009. Einführung in das Business-to-Business-Marketing, in: Kleinaltenkamp, M., Saab, S. (Eds.), Technischer Vertrieb. Springer Berlin Heidelberg, Berlin, Heidelberg, 1–14.

[6] Falck, O., Koenen, J., 2020. Industrielle-Digitalwirtschaft-B2B-Plattformen. https://bdi.eu/publikation/news/Industrielle-Digitalwirtschaft-B2B-Plattformen. Accessed 28 March 2021.

[7] Gawer, A., 2014. Bridging differing perspectives on technological platforms. Research Policy 43 (7), 1239–1249.

[8] Parker, G., van Alstyne, M., Choudary, S.P., 2016. Platform Revolution. Norton & Company, New York.

[9] Engelhardt, S. von, Wangler, L., Wischmann, S., 2017. Eigenschaften und Erfolgsfaktoren digitaler Plattformen. https://www.digitale-technologien.de/DT/Redaktion/DE/Downloads/Publikation/autonomik-studie-digitale-plattformen.pdf?__blob=publicationFile&v=6. Accessed 28 March 2021.

[10] Täuscher, K., Laudien, S.M., 2018. Understanding platform business models: A mixed methods study of marketplaces. European Management Journal 36 (3), 319–329.

[11] Wortmann, F., Ellermann, K., Kühn, A., Dumitrescu, R., 2019. Typisierung und Strukturierung digitaler Plattformen im Kontext Business-to-Business, in: Vorausschau und Technologieplanung. 15. Symposium für Vorausschau und Technologieplanung, Berlin. 21. und 22. November 2019, 191–214.

[12] Plattform Industrie 4.0., 2019. Digitale Geschäftsmodelle für die Industrie 4.0. https://www.plattform-i40.de/PI40/Redaktion/DE/Downloads/Publikation/digitale-geschaeftsmodelle-fuer-industrie-40.html. Accessed 28 March 2021.

[13] Chen, J., Cheng, Y., Chen, Z., Dorst, W., Gierging, L., Leonardy, H., Löwen, U., Zhao, H., 2020. Examples for Business Scenarios in Manufacturing Industry. https://www.gpqi.org/files/upload/china/studies/201015_GIZ_UseCases_BusinessScenarios.pdf. Accessed 28 March 2021.

[14] Plattform Industrie 4.0, Robot Revolution & Industrial IoT Initiative, 2021. Digital Platforms in Manufacturing Industries. https://www.plattform-i40.de/PI40/Redaktion/DE/Downloads/Publikation/digital-platforms-in-manufacturing-2021.html. Accessed 28 Mai 2021.

[15] Bundesverband der Deutschen Industrie e.V. (BDI), 2020. Deutsche digitale B2B-Plattformen, https://bdi.eu/publikation/news/deutsche-digitale-b2b-plattformen/. Accessed 28 March 2021.

[16] Löwen, U., Hartner, F., 2020. Business model patterns for digital B2B platforms, in: 21. Leitkongress der Mess- und Automatisierungstechnik, Automation 2020, VDI Wissensforum, Baden-Baden, 741–754.

Biography

Fabian Hartner, M.Sc. (*1994) is a research associate and doctoral candidate at the Institute for Factory Automation and Production Systems (FAPS) at the Friedrich-Alexander University of Erlangen-Nürnberg (FAU) since 2019. He studied previously industrial engineering and management at FAU.

Prof. Dr. Ulrich Löwen (*1961) is working for Siemens as a subject matter expert on digitization in the manufacturing industry. He has many years of professional experience and is involved in various associations, consortia, and international collaborations. His work focuses on scenarios and use cases to illustrate the business value of new digital technologies.

Prof. Dr. Jörg Franke (*1964) is Head of Chair of the Institute for Factory Automation and Production Systems at the FAU. There he focuses research on innovative manufacturing processes for mechatronic products. He is involved in leading functions in scientific organisations such as IEEE, CIRP, WGP, and 3D-MID. Before his professorship, he led different management positions in industry e.g. at McKinsey & Co., Robert Bosch GmbH, ZF Lenksysteme GmbH, and Schaeffler AG.