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Categorizing Challenges And Potentials Of Digital Industrial Platforms

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Abstract

In complex supply chains, digital platforms play an emerging role as an infrastructure for network-based collaboration of industrial companies to stay competitive. Participating in a platform business offers a range of new potentials, while also introducing new challenges. Awareness of these is crucial for both users and providers to make informed decisions. Thus, this paper provides an overview about typical challenges and potentials from the perspective of potential or actual digital industrial platform users to support decision making processes. Against that backdrop, a descriptive study is conducted in the field of industrial service platforms motivated from two sides. Expert workshops are held to examine the practical opportunities and hurdles. The findings are then compared to those identified in literature. Then, the results are organized into a category system that highlights the key challenges and potentials for users as well as providers of digital industrial platforms.

Keywords

Digital Platform; Industrial Service; B2B; Literature Review; Expert Workshop; Category System

1. Introduction

The increased use of information and communication technologies as well as advancing digitalization is affecting industrial companies and its value chains. Thus, significantly more data is gathered, making it an economic resource critical for success [1]. However, enhanced networking of the partners simplifies the exchange between them and thus facilitating interaction. Digital platforms play an important role as the predominant marketplace for exchanging data. [2] At the same time, the industrial service sector gains importance, leading to a transformation of the industry into a service society, forcing companies to secure their competitiveness by offering additional services to their existing products [3]. This so-called servitization [4] enables companies to develop unique selling propositions by offering services individually tailored to various customers' demands. The expansion of the value-added spectrum further enables new sales and profit potentials. [5] Furthermore, the interplay of services with platform economies opens the scope for completely new disruptive business models [6]. Low entry barriers initially stimulated the platform market in the business-to-consumer (B2C) area and platforms such as Amazon or Netflix changed the competitive market dramatically. This trend is also increasingly observable in the business-to-business (B2B) area, but challenges slow down business transformation. [7] Research on the fundamental requirements for digital platforms has progressed significantly in recent years [8–10]. Nevertheless, it is still unclear for many companies, particularly small and medium-sized enterprises (SMEs), whether it is beneficial for them to enter the platform business, which is of great interest due to its current relevance for optimizing processes in

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industrial service industry. While actual research focuses on specific aspects and components of digital platforms [11–13], there is a lack of a comprehensive view in the targeted domain. To address this gap, this paper aims to answer the following research question: ***What are companies' challenges and potentials using digital platforms for industrial services?*** The paper addresses both users considering participating in platform businesses, as well as platform providers seeking to design and operate successful platforms. For this, we conducted a two-stage mixed inductive and deductive approach. We first analyzed practice-led knowledge obtained from expert workshops and compared this to theoretical insights gained through a systematic literature review. By combining the results from these two sources, we develop a category system that we utilize to present the implementations of identified challenges and potentials. Finally, the paper concludes with a summary of the results, an assessment of limitations and a subsequent outlook for future research.

2. Related Background

In order to understand the research, we explain basics about the related topics digital platforms and industrial services. It is worth noting that while platforms can also have a physical presence, we narrow our focus to digital platforms for the purposes of this investigation. Additionally, we consider industrial services as the use case for these digital platforms, taking into account the background and expertise of the practitioners involved.

2.1 Digital Platforms

Digital platforms are two-sided or even multi-sided markets that facilitate transactions between different costumer groups or consumers [14,15]. The most important assets of digital platforms are information and interactions, which boosts the interplay by far-reaching developments in Information and Communication Technology that made computing power cheaper and allowed the homogenization of huge amounts of data. Those digital platforms scale well due to the fact that no physical structure has to be owned, which make network effects as their key characteristic easier to exploit. [16,17] The activity of many users on a platform encourages new users to join the platform, which results in scale effects [18]. Those digital platforms consist of two main elements: the actual core with its technological infrastructure, dominated by the platform owner, and the periphery with complementary apps of third parties. Combined, these serve as a base for externals to build their products or services on. [19,6] The owners of the platform control the intellectual property and the dynamic interactions between various roles of participants, also called governance. Providers operate as intermediary to the user, whereas producers offer something on the platform and consumers take up those offerings. [20] After all, platforms can create value in two different ways or a combination of them. On transaction platforms individuals are brought together to interact with each other. Besides, innovation platforms offer a technological infrastructure for innovators to develop new services or products. [21]

2.2 Industrial Services

Due to the heterogeneity of industrial services, no common accepted definition has been found yet. DONABEDIAN [22] provides an integrative definition that divides services into three phases: potential orientation, process orientation and result orientation [23]. Other approaches focus on specific attributes, but there is no consensus about which these are exactly [24]. In this context, services are often characterized by their intangibility, heterogeneity, inseparability and perishability [25]. Other authors mention attributes like lack of transfer of ownership, non-storage capability and simultaneity of production and consumption. In general, services can be defined by two characteristics: the immateriality of services and the external integrity in the service creation process. [26] Addressing customer needs, the industrial sector often combines service-based offerings with tangible goods. Thus, TUKKER distinct between eight different types of product-service systems, each with a different degree of material goods and services [27]. In summary, industrial services have a wide range of manifestations, from basic transactional services, e.g. maintenance or repair, to more complex relational offerings, e.g. plant operating or full service contracts [28,29].

3. Research approach

To gain a comprehensive and rigorous understanding of challenges and opportunities of digital industrial platforms, the authors utilize a two-stage mixed inductive and deductive approach is conducted. First, we analyzed practice-led knowledge from expert workshops, highlighting the topic by both users and providers. In order to further expand our understanding, we conducted a systematic literature review to gather additional theoretical insights. The results from these two stages were then combined and organized into a category system to provide a structured, easily understandable overview.

3.1 Focus Group Workshops

To get a broad range of different views of the examined topic and to start with understanding the meanings behind this as well as efficiently use the group dynamics arising from that method [30,31], focus group interviews according to MISOCH have been conducted [32]. The underlying design is presented in Table 1.

Table 1: Research design for the focus group interviews

Date	Length	Number of groups	Number of participants	Composition of groups
07.05.2021	10 + 35 + 10 min	3	14	Mostly practitioners
25.06.2021	10 + 30 + 20 min	2	10	Mostly researchers

We conducted a total of five focus group interviews with 24 participants (4-6 per group) on two different occasions. These interviews took place in the context of a workshop during a conference on maintenance and service, as well as a webinar featuring different research projects in the field of digital platforms. The groups were divided in a manner that ensured the best possible mix of different backgrounds. For the first iteration, a surplus of practitioners was noted, for the second one more researchers were involved. The given stimulus was a 10 minutes' presentation with basic information about industrial services and digital platforms. Within the 30 respectively 35 minutes the groups had to answer four different questions, whereof two referred to the current processes and the other two explicitly to the challenges and potentials of platforms ("Where are you seeing the greatest potentials of platforms?" and "Which problems arise using platforms?"). We conducted the workshop with an online collaboration whiteboard, where the participants formulate their ideas under moderation. For a better structure, we used relevant modules of a reference process for industrial services according to [33], which contained an exemplary process. After, the participants presented and summarized their results within 10 respectively 20 minutes to the other groups. To complement and cross-validate the findings from the expert workshop, the authors conducted a systematic literature review.

3.2 Systematic Literature Review (SLR)

To also build upon existing knowledge from academic research and enhance that knowledge through the given input from the practical side, an exhaustive systematic literature review has been conducted [34,35]. This is based on the methodological guidelines proposed of WEBSTER & WATSON [36] and VOM BROCKE ET AL. [37]. To ensure a broad base of literature, the authors used a selection of well-known databases (Scopus, Web of Science, IEEE Xplore). Within those, we applied the searchstring '(challenge OR barrier OR hurdle) AND (opportunity OR chance OR potential) AND platform AND industrial AND service'. The use of three operators regarding challenges and potentials helped us including publications in which synonyms of these appear. The terms 'platform', 'industrial' and 'service' derive directly from the research question. As a result, he literature search provided a total of 595 publications identified in October 2022. In the first iteration we excluded 157 duplicates and non-available papers. Afterwards, the authors examined the papers in context of content, only including papers dealing with digital industrial platforms with reference to engineering. Papers dealing with physical platforms, such as those used in automotive, were excluded.

Similarly, papers from other domains such as healthcare where the term platform is widely used in context of service robots or in the IT sector where programming units are often referred to as services, were not taken into account. Applying this, the remaining 438 publications were reviewed based on their titles, abstracts and keywords. If that was not enough to define the specific topic and thus determine relevance, we scanned the papers, resulting in 31 relevant publications. Following, the authors conducted a forward- and backward-search using Google Scholar, identifying additional relevant papers, resulting in 4 further publications. To ensure the reliability of the results, two of the authors independently carried out the process of identifying relevant publications. If there was any uncertainty about the relevance of a publication, a discussion followed until we reached a consensus. As a result, the authors identified a total of 35 publications (see Figure 1).

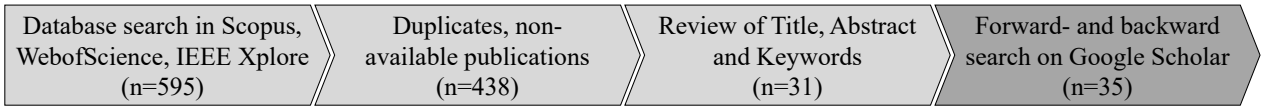

Figure 1: Process of the structured literature review

3.3 Categorization

In order to structure the findings and derive a category system out of this, the authors conducted a qualitative content analysis in the form of an inductive categorization according to MAYRING & FENZL [38]. Complementary to this, the structural framework proposed by GIOIA ET AL., a three-level classification consisting of so-called 1st-order terms and 2nd-order themes as well as the aggregate dimensions (which correspond to the term "categories" used in this paper) to make the process more understandable and resilient [39]. To ensure the comprehensiveness and relevance of our category system, we paid close attention to the completeness and selectivity of the categories, only including relevant issues [40]. In total, we collected 189 1st-order terms out of the focus group workshops (86) and SLR (103), including 83 challenges and 106 potentials. First, the authors derived seven categories (standardization, technology, co-creation, resources, governance, communication and security) from the 1st-order terms. Following, we found 26 variant 2nd-order attributes for the 1st-order terms and assigned these to the categories. The categorization process was carried out in multiple iterations by three different researchers, ensuring reliability [41]. Considering completeness and selectivity, this results in a structured and easily understandable overview of the challenges and potential benefits of digital industrial platforms.

4. Challenges and Potentials

To structure and summarize the results with its categorization, we propose the following Table 2. The 2nd-order attributes from the categorization are referred to as 'Attributes' and assigned to the respective 'Category'. The terms 'Challenge/ Potential' and 'Workshop/ Literature' show how often the respective 1st-order terms are mentioned. If there were identical statements within the literature, we removed these – if two different points are addressed, we integrated both.

Table 2: Categorized Challenges and Potentials of digital industrial platforms

Category	Attribute	Challenge/ Potential	Workshop/ Literature	References
Standardization	Interfaces	13 / 1	2 / 12	[44,43,50,42,48,52,47,49,45, 51,13,46]
	Specification clarification	3 / 8	10 / 1	[46]
	Data structure	2 / 4	5 / 1	[42]
	Maturity level	2 / 1	1 / 2	[53,45]
	Customizability	2 / 1	3 / 0	-

Technology	Data management	4 / 9	9 / 4	[44,47,45,46]
	Additional services	2 / 9	2 / 9	[54,57,53,47,56,12,45,51,55]
	Dependency	5 / 0	3 / 2	[52,58]
	Scalability	2 / 3	1 / 4	[59,42,53,47]
Co-Creation	Mergers	0 / 16	0 / 16	[54,42,60,65,64,62,11,12,63, 61,13]
	Network effect	1 / 8	4 / 5	[58,11,46,66]
	Partner management	4 / 3	1 / 6	[12,51,55,61,13]
Resources	Know-how	11 / 0	6 / 5	[58,11,51,13,67]
	Process modifications	1 / 6	3 / 4	[68,12,61,13]
	Portfolio	0 / 6	2 / 4	[69,11,13]
	Financial	1 / 1	0 / 2	[54,13]
Governance	Transparency	5 / 3	7 / 1	[52]
	Roles	4 / 3	5 / 2	[70,13]
	Trust	2 / 3	3 / 2	[42,13]
	Sovereignty	2 / 1	3 / 0	-
Communication	Customer relations	1 / 9	3 / 7	[70,47,11,51,61,13]
	Networking	0 / 6	5 / 1	[71]
	Unified language	2 / 2	3 / 1	[60]
Security	Data security	8 / 0	2 / 6	[52,47,45,46]
	Counterfeit protection	2 / 3	3 / 2	[47]
	Attacks from outside	4 / 0	0 / 4	[42,47,73,72]

Subsequently, the authors explain and discuss the attributes, including the challenges and potentials per category. This is done based on the 2nd-order attributes, referenced from both the focus group workshop as well as the SLR, to deduce further implications for practitioners and researchers. Since the authors mention all references within the table, the following statements only include an excerpt of the most relevant thus representative literature. If all challenges and potentials derive from the workshops (‘Customizability’ and ‘Sovereignty’), there is no further reference to literature.

4.1 Standardization

Standards can help simplify many processes by providing predefined building blocks, but they can also restrict *customizability*, making it harder to react to unexpected situations or deviations from the standard. Finding the right balance is not trivial and many stakeholders may be included, which is why standardization may often not reach the needed *maturity level* [53]. For example, in the industrial sector, it can be challenging to find a common language for *specification clarification* at the beginning of an order [46]. Especially, introducing standards within companies might lead to problems with physical and digital *interfaces* due to heterogeneous system landscapes and *data structures* [44,42,51].

4.2 Technology

Digital platforms have the potential for *scalability* due to their digital structure, but this requires a corresponding architecture [53,47]. A major issue is the technical *dependency* that users may have on a platform. For example, the need to build platform-specific interfaces can make it difficult or even prevent

users to change systems. [58] Additionally, platforms often allow the incorporation of external parties for *additional services*. If these parties can be easily integrated into the platform, it can provide added value for all users. [54,57] However, to fully realize this value, functioning *data management* is essential above all. Since many companies do not even have most of their data in a digital way, this is both a challenge and a potential. By using platforms, they may be forced to digitize further, potentially leading to improvements in internal processes. [44,46]

4.3 Co-Creation

Co-Creation between platform users is a central aspect of digital platforms. Accordingly, digital platforms provide *mergers* by entering cooperation with other participants, expand the customer base, exchange knowledge, services and values, and reduce initiation costs [11–13]. It can also facilitate *partner management* by providing a common place to find suitable partners and to communicate and exchange data [51,55]. These increases with the number of users, a phenomena known as the *network effect*, which is the core benefit of platforms [46]. However, it can fail to materialize if not enough active users on the platform.

4.4 Resources

Platforms can disrupt the internal structures of companies, presenting both potentials and challenges. For many companies, platforms are new and unfamiliar due to a lack of *know-how* and commitment among employees [58]. This can require significant efforts and *financial* investments at the beginning due to training, knowledge generation and internal changes, leading to uncertainties according the benefits of the platform [54]. At the same time, breaking up traditional structures can offer new opportunities, such as *process modifications* or the ability to expand the *portfolio* due to platform-based optimizations [68,11,13].

4.5 Governance

Trust, *sovereignty* and *transparency* are crucial considerations for companies when connecting to a platform. Potential users must trust the platform, especially with regard to data sovereignty. In addition to the platform owner, companies must also trust other third-party providers. At the same time, companies can benefit being transparent in some situations, such as allowing them to present their processes openly and disclose their capabilities to potential customers. [42,52,13] To ensure necessary hierarchies and associated rights and obligations, clear *roles* must be defined to prevent unauthorized transactions or data manipulation [70].

4.6 Communication

One of the main advantages of digital platforms is their ability to facilitate the exchange and *networking* of a broad range of users. Companies can present themselves to a large number of other users and easily connect with target groups. [71] Doing so, platforms can help with *customer relations*, allowing to establish new or maintain existing contacts and increase customer loyalty. This can be achieved through optimal in-service feedback and constant exchange. [70,47,13] However, to bring the diverse target groups and their ways of thinking together and support their common understanding, a *unified language* is necessary [60].

4.7 Security

Data and the related know-how are valuable resource for companies. Therefore, *data security* of platforms is of particular importance, especially in the B2B sector [52,47,45]. Companies fear the loss their data sovereignty, which can increase their vulnerability to *attacks from outside* [42,73]. *Counterfeit protection* is also important, as companies may worry about losing their data integrity. However, a platform as an intermediary for data exchange can use appropriate technologies to meet these requirements and enable a secure and regulated exchange. [47]

5. Conclusion, Limitations and Outlook

By examining the topic from both practical and literature-based perspectives, this study provides a broad overview of emerging challenges and potentials for companies using digital platforms for industrial services. The findings serve as a foundation for further research and help practitioners make informed decisions and assess their own situation. We reveal that there are categories in which challenges arise above all, such as security, and there are also categories that offer more potentials, such as co-creation. Overall, the number of identified challenges (83) and potentials (106) are nearly balanced, indicating a degree of skepticism but also recognition of the significant potential of digital platforms. To fully realize this potential, however, there are still several steps to be taken, including standardization for a better communication and the use of appropriate technologies to reduce interface problems. Education and training for users and providers of platforms on the use of digital technologies are also important factors.

This paper also has underlying limitations. The evaluation shows that there was bias in the workshops, with certain topics receiving more attention than others through discussions during the implementation. Additionally, participating in the workshops was voluntary, which attracted people with a general positive and open attitude towards digital platforms. Furthermore, a large part of the literature deals with the operator side, which created a certain gap between the mentions from the focus group workshops and the literature, but at the same time broadened the scope of consideration. During the selection of literature during the SLR, we noticed that both terms ‘service’ and ‘platforms’ were broadly used and not clearly characterized, posing a challenge in the context of our research topic as well as in terms of clearly differentiating different research streams.

As previously noted, the user side of platforms has not been extensively studied in the research field. However, this study has specifically identified significant challenges faced by companies in participating in the platform business, while they generally have a positive attitude. Further research should aim to address this gap and provide support to companies during the implementation process. This could be achieved through practical access to identify the most important factors for companies and developing a structured process model with clear recommendations for both users and providers to address the challenges and take advantage of the opportunities presented by the platform business.

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