Towards a Maturity Model for Digital Business Ecosystems

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Abstract. The digital transformation impacts longstanding business models and forces enterprises to compete, not only between enterprises but also between supply chains and networks. The concept of digital business ecosystems (DBE) allows enterprises to concentrate on network co-creation and co-evolution of bundled services and products across enterprise boundaries. This exploratory case study investigates the status of existing DBEs and their maturity. Therefore, we interviewed 28 experts in the field of DBEs and derived a maturity model from the interview results. This maturity model helps practitioners to identify gaps for improvements in the collaboration within DBEs and help researchers to assess and compare the current state of existing DBEs.

Keywords: Digital business ecosystems, Maturity models, Enterprise architecture management, Expert interviews

1 Introduction

The digital transformation impacts established business models and creates opportunities for new ones [1], enabling companies to increase their profits and sales figures [2]. The increase of competition, not only between companies but also between supply chains and networks, forces an alignment of Business and IT, with stakeholders across companies' borders [6]. Enterprise Architecture Management (EAM) is designed to support and improve Business-IT alignments [4] [5]. It is responsible for transforming a company's "as-is" IT landscape into a "to-be" IT landscape following an enterprise's business strategy. With the introduction of new technologies such as the Internet of Things, companies are seeking new bundled or hybrid business models that combine services and products from different providers [7].

The concept of digital business ecosystems (DBE) impacts traditional industry boundaries for organizations to compete and collaborate through digital technology [3,8]. It allows enterprises to shift their concentration to network co-creation and co-evolution of bundled services and products. Every involved enterprise is self-organized in terms of its business processes and EAM [3,9]. The success of companies, such as
Alibaba, Amazon, Uber and Airbnb, outlines the potential of DBEs [10,11,12]. Currently, there is still uncertainty on how DBEs start, grow, develop, become extinct, and renew themselves [13]. Furthermore, it was attested that a lack of maturity in terms of practices to organize a DBE exists.

Research [14,15,16] discusses important aspects such as the meaning of trust or regulatory issues within DBEs. The work of [17] describes key challenges in terms of stakeholders’ role-related issues. They highlight the general need for a coordinating and governing function to achieve mature management of DBEs. Also, [9] concludes there will be an emerging role of an Ecosystem Architect. This role may arise from the formerly known role of Enterprise Architect. It can add significant value in the early stages of ecosystems by governing strategy development and analyzing the key strategic implications and risks. However, many researchers [3,13,22,27] identified research gaps within DBEs. In general, there is a lack of case studies [3,27] reflecting the practitioner’s perspective out from existing DBEs among different industries. Besides, [27] identified that existing literature does not clearly distinguish between DBE maturity levels. This identification reveals a lack of two components. (1) The definition of maturity levels and (2) the maturity assessment of existing DBEs within the industry. Furthermore, the authors expressed the need for theorization and the development of models as a current research gap within the field of DBEs [27]. Also, the authors [9,36] describe the fact that during the evolution of DBEs, it reaches different maturity levels. Still, the authors left open how these levels are defined, and DBEs are assessed. These gaps reveal that the definition and assessment of the maturity of existing DBEs are not sufficiently covered by scientific literature.

We conducted an exploratory case study across multiple industries to address these gaps. Based on the results, we derive a maturity model for DBEs from the case study results. This maturity model aims at providing transparency to achieve an understanding of the mature management of DBEs. It allows practitioners to position their as-is DBE and guides further improvements. Therefore, we defined the following two research questions:

- RQ1: What is the nature of existing DBEs?
- RQ2: How can different maturity levels of DBEs be defined and evaluated?

In doing so, we interviewed 28 senior experts working with DBEs in the field of EAM. The interview took approximately 50 minutes to complete, and the participants had to answer qualitative questions.

The remainder of this paper is structured as described in the following. Section 2 discusses related work. In section 3, the applied research methodology is presented. Section 4 illustrates the case study results, and section 5 evaluates the maturity model. Finally, section 6 concludes the paper and provides an outlook on future work.

2 Related Work

Research in the field of DBEs can be classified into four categories: (1) literature reviews, which analyze types of DBEs, (2) methods and frameworks for modeling and
exploring DBEs, (3) strategic analysis of diverse DBEs, and (4) the maturity of DBEs from a practitioner's perspective.

Concerning (1) literature reviews [8,14,27], conduct systematic literature reviews in the field of DBE. They analyze different types of DBEs, the matter of knowledge sharing within DBEs, and propose future research directions.

Other authors focus on the definition of (2) methods and frameworks. In [31], a framework for exploring DBEs is introduced. This framework serves as a structure for exploring the value network and enterprises as part of a DBE. The work of [32] describes a DBE architecture modeling framework. The authors applied this framework in two use cases, which give insight into the business-IT alignment problem of network organizations. Moreover, [23] proposes a methodology for modeling interdependencies between partners in DBEs. [20] develops an interdependence modeling methodology—this methodology aims at providing a systematic approach to capture interdependencies in DBEs. The work of [30] investigates usage control architecture options to enable data sovereignty within DBEs. The paper of [21] investigates a DBE framework that enables a business manager to define new user requirements and functionalities for cloud integration.

Besides, the authors addressed the topic of (3) strategic analysis of diverse DBEs. [35] applies a SWOT (Strength Weakness Opportunities Threats) analysis of DBEs. The purpose of their work is to design SWOT analyses that allow business managers to oversee new insights concerning digital ecosystem services from a variety of different business contexts. [29] employs the theoretical concept of institutional theory to explore the implications of public and private sector collaboration in DBEs. The work of [17] describes key challenges within DBEs and how to cope with them. [36] develop a process model of how a DBE may be developed and leveraged for enterprise agility by the example of Alibaba.com.

Only a few researchers partly highlighted (4) the maturity of DBEs from a practitioner's perspective. The first steps were done by [31] when DBEs were at a quite early stage. Their work describes a framework for exploring DBEs, which they developed from Zachman's enterprise architecture. This framework serves as a basic structure for exploring the value network within DBEs. The work of [3] focuses on the political will in DBEs and the socioeconomic benefits of DBEs. They suggest a framework that also partially considers the maturity of DBEs. However, their focal research focuses on state organizations rather than on enterprises. Furthermore, it provides only a vague description of the meaning of maturity. [9] are describing the emerging role of an ecosystem architect. They also highlight changing maturities of DBEs over their lifecycle but leave open how maturity levels are defined and how these can be assessed.

These findings reveal that it is unclear how the maturity of DBEs can be defined and assessed by researchers and practitioners. To the best of our knowledge, there is no exploratory interview investigating the definition and assessment of the maturity levels of DBEs.
3 Applied Research Methodology

The research at hand is based on the design science methodology [34], which consists of three cycles: (1) the relevance cycle, (2) the design cycle, and (3) the rigor cycle. For (1), we conducted an expert interview that is designed in a semi-structured form based on [24]. The goal of the interview is to analyze the practitioner's perspective on the maturity of existing DBEs. For (2), we used the method of [28] to derive a maturity model from the qualitative expert interview results. (3) To evaluate the designed artifact, we applied the maturity model to an existing DBE provided by the experts. Section 3.1 provides a detailed description of the expert interview, and section 3.2 describes the participants and section 3.3 the analysis of the interview results.

3.1 Expert Interviews

The expert interviews were carried out between May and July 2020. We derived several interview questions from the research questions according to [25]. These interview questions were structured thematically, such that the sequence of questions introduced the participants to the topic and made it comprehensible to them [26]. This design facilitated a more natural understanding of the interview [26] and led to a semi-structured study. In the following, we outline the interview questions (SQ) and their mapping to corresponding research questions (RQ).

- (SQ1) Can you describe the DBE in your environment? (RQ1)
- (SQ2) Can you outline the expected benefits of this DBE? (RQ1)
- (SQ3) Can you outline the challenges in the management of DBEs? (RQ2)
- (SQ4) How would you define different levels of maturity which you passed along in the establishment of the DBE? (RQ2)

We interviewed via Skype or phone to be able to ask further inquiries in case of any ambiguities.

3.2 Participants

We selected the participants according to their membership in the EAM related forums within the social networks LinkedIn [18] and Xing [19]. The following selection criteria were defined to identify eligible interview participants: (1) employment in the field of EAM within a DBE and (2) at least five years of professional experience in the field of EAM. In total, we contacted 94 experts, whereby 28 experts were willing to participate in the interview. The interviewers participated voluntarily and were distributed worldwide across 12 countries in 17 different industries. Five participants came from small-sized enterprises (<50 employees), two participants from mid-sized enterprises (<250 employees), and 21 participants from large-sized enterprises (>=250 employees). The average level of EAM experience was about 11.9 years.

3.3 Analysis of the Interview Results

We evaluated the interviews according to the method described by [28]. This approach was required to analyze the qualitative formulated questions. We used the results of the analysis to design a maturity model according to the methods and principles by [34,43]. These methods give guidance in ascertaining and measuring dedicated aspects of technical and social systems maturity.
4 Case Study Results

This section discusses the main results of the interviews. It is structured according to the survey questions SQ1-SQ4. With this, we reference the participant’s statements with the shortcut (P).

4.1 (SQ1) The Nature of Existing DBEs

We asked the participants to describe the existing DBE, where they currently work. Our analysis led to three main categories of DBEs. (1) Governments are initiating DBEs among federal authorities, municipalities, and private enterprises. (2) Holdings are organizing DBEs with the enterprises within their holding structure. (3) Independent enterprises are jointly establishing DBEs. In the following, we describe one example for each category and outline its current status.

(1) DBEs in governmental environments: For example, P4 described a DBE initiated by the Swiss government. It allows Swiss residents to register a change of the place of residence with an online service. This online service includes features such as a target address validation, a request for a new vehicle registration plate, required tax adjustments, and automatic post redirection. This DBE comprises different public authorities, such as communities, cities, federal provinces (cantons), national institutions, and private enterprises. In total, the participants (P4, P12, P16, P21, P23, P27) described examples of DBEs in governmental environments.

(2) DBEs within a holding structure: For example, P6 described a DBE ecosystem that was embedded into a holding structure of the company. In the past, this company was operating in a telecommunication business, including the provisioning of internet services and mobile networks. The holding initiated a DBE to act as a cloud provider for their different legal entities in order to develop their business further. The holding offers different services such as IaaS (Infrastructure as a Service), Voice over IP (Internet Protocol), Voice over WLAN (Wireless Local Area Network), or functionalities for streaming television that can be used, enhanced and adapted from their legal entities. An example is an affiliates company in a country that is willing to launch a new TV service (streaming television) based on a new TV platform. It can reuse provided standard functionalities such as cloud resources, network resources, and existing content (movies, series), whereby third-party providers provide the content. The content of the TV platform is integrated with many additional services. In total, the participants (P3, P5, P6, P19, P20, P22, P28) described DBEs within a holding structure.

(3) DBEs among independent enterprises: For example, P13 described a DBE that comprises competing and non-competing enterprises out of the financial industry. This DBE is referenced under the naming Open Banking. The notion of Open Banking is to enable different service providers to access accounts and customer information of a bank in order to provide value-adding attainments. For example, FinTech companies offer solutions where the customer can access via a single entry point multiple accounts and stock portfolios from different banks. Another use case is that banks can

1 www.eumzug.swiss/ (accessed on 16.10.2020)
recognize their customers with the help of online video identification services. The cus-
tomer can authenticate via face recognition services offered by third-party providers to
carry out financial transactions. Within this DBE enterprise can offer their services, but
also consume services of others without any central instance. In total, the participants
(P1, P2, P3, P7, P8, P9, P10, P11, P13, P14, P15, P17, P18, P24, P25, P26) described
examples of DBEs among independent enterprises.

4.2 (SQ2) The Expected Benefits

Our study also focused on the advantages and expected benefits of enterprises that par-
ticipate in DBEs. We figured out that the participants see the advantages and expected
benefits in many different directions. Thus, we classify between (1) business-related
benefits and (2) technological benefits, as described in the following. (1) Business-re-
lated benefits: Market access (P10, P12, P13, P14, P15, P24, P26) is seen as a primary
reason to participate in DBEs by many enterprises. Often enterprises are struggling in
entering new markets such as markets of foreign countries or online markets. Therefore,
it is possible to speed-up market entry with the help of partner-enterprises within a
DBE. Furthermore, companies try to attain more visibility in the market (P12, P14,
P18) to attract the attention of prospects. These endeavors should strengthen customer
loyalty (P9, P12) since DBEs allow the customer to select out of a wide range of prod-
ucts and services with the help of a single-entry point. Besides, DBEs are facilitating
enterprises to offer an end-to-end customer journey (P11, P12, P19, P26) in cases where
different products from different vendors supplement each other. This facilitation is
also fostering the extension of business models (P8, P14, P18, P19) of enterprises, for
example, with the brokering of complementing services. In addition, it allows enter-
prises to focus on their core competencies (P3, P10, P11, P17, P25) while satisfying the
customer needs holistically with the help of the DBE.

(2) Technological benefits: Primary, the reuse of existing functionalities and capabili-
ties (P7, P8, P13, P17, P25, P26, P27), was mentioned as a technological benefit. Fur-
thermore, the participants outlined a seamless integration of solutions (P4, P5, P15,
P16, P24, P27) as an advantage of the forced service-orientation of DBEs. Besides, it
urges enterprises to use standardized solutions and to standardize their own-built solu-
tions (P5, P6, P15, P20, P24). Moreover, DBEs enabled improved quality (P12, P16,
P20, P21, P24) of exchanged information objects. Participation within DBEs helps an
enterprise to leverage synergies and reduce its efforts (P4, P5, P12, P15, P19, P20, P21,
P22, P23, P28). Finally, it allows enterprises to conduct quicker changes (P2, P3, P6,
P27) such as infrastructure extension with the help of cloud technologies (Infrastructure
as a Service).

4.3 (SQ3) Challenges

We asked the participants about the perceived challenges in the management of DBEs.
With this, we distinguish between (1) challenges on the strategic level, (2) challenges
on the technical level, and (3) challenges on the skill level.

(1) Challenges on the strategic level: The participants highlighted, most often differing
interests (P5, P8, P9, P11, P12, P16, P22, P25, P26), which makes it challenging to
create a win-win situation for all participating enterprises every time. Moreover, our
results revealed the protection of an enterprise's intellectual property (P7, P11, P14,
P15, P16, P21, P25) as a challenge. Since in DBEs, not only cooperating but also competing enterprises are participating, the preservation of intellectual properties such as insights on customer information, business strategies, and expert knowledge is perceived as problematic. Apart from this, the strategy alignment (P7, P10, P11, P17, P22, P24, P25) among different enterprises concerning commonly offered services, products, and the corresponding budget planning, the definition of KPIs (Key Performance Indicators) and incentives to achieve a common goal were stated as a challenge. The participants mentioned that segregated responsibilities (P3, P4, P6, P17, P22, P25) are hindering in improving individual overlapping business processes. The topic of decision making (P4, P12, P22) is seen as challenging since it is not clear on which level, and with which partner the decision needs to be aligned. Furthermore, the potential vendor-lock-in effect (P7, P10) of DBEs was highlighted. Once enterprises integrate their services and products into a shared portfolio, they fear to lose their capability to act independently on the market. This challenge may end up in a loss of control (P12, P13) of their assets, their visibility on the market, and their steady customers. The scope alignment concerning customer demand (P6) becomes challenging. Enterprises usually focus on their customer group and try to satisfy their demand. Thereby, the alignment of project scope to fulfill manifold customer demands of a DBE is perceived as a challenge. The limitation of entrepreneurial freedom within DBEs (P12) is seen as a challenge since for every extension of shared products and services alignment and joint agreement needs to be achieved. The risk of making the wrong investments (P13, P25) by the selection of partner enterprises and the usage of third-party services was also highlighted. The emerging DBEs lead to more competition (P11, P13) on the market since competing enterprises can more and more easily participate in existing DBEs.

(2) Challenges on the technical level: A missing holistic view of the entire DBE (P2, P3, P7, P10, P18) was mentioned. This missing view is related to the complexity of commonly capturing the shared platforms, security, compliance, infrastructure components, and people’s interaction within a model. Through growing DBEs, also the number of linked dependencies of systems and processes (P8, P10, P12) is growing. These dependencies bear the problem if a central system or service crashes, many business transactions, and enterprises are affected. On the implementation level, the participants highlighted different timelines (P6, P11, P13, P14) among enterprises as a challenge. Also, missing aligned and used standards (P1, P3, P5, P20, P21, P27) of interfaces and information objects such as the structure and details of business partner information are outlined as a challenge. Some participants highlighted a missing centralized IT (P12, P13) of DBEs as a challenge. Every IT governance activity needs to be steered decentralized, which causes additional efforts for the enterprises. Information security (P2, P18, P19, P22, P25, P26, P27) is also seen as a challenge. Since the interaction of enterprises requires a considerable number of interfaces and shared platforms, the challenge of missing overarching information security was highlighted. Also, for some DBEs missing collaboration tools (P11), such as document management tools, is a struggle. The legacy system compatibility (P11, P18, P20, P23, P24, P28) was outlined as a challenge for enterprises within a DBE.

(3) Challenges on the skill level: Also, the participants outlined a lack of common understanding (P5, P6, P12, P14, P17, P19, P21) as challenging. This lack emerges
from different used terminologies, focuses, and scope among the participating enterprises. Furthermore, missing know-how (P1, P15, P26) is seen as a challenge. Since the requirements on knowledge concerning used technologies and available business capabilities within the DBE are growing, this needs to be considered in terms of knowledge transfers. Finally, closely related is the complexity (P6, P8, P9, P19) resulting from growing DBEs, which is also perceived as a challenge.

4.4 (SQ4) The Maturity of DBEs

We highlight the maturity of DBEs from a practitioner's perspective in this study. Therefore, we asked the participants how they would distinguish between different levels of maturity that they experienced in their work with DBEs. The participants described different characteristics that enable us to assess the maturity of a DBE. Simple expandability (P2, P3, P5, P7, P8, P11, P14, P16, P19, P21, P23, P25) was seen as vital since it allows DBEs to involve new enterprises. Joint governance (P5, P11, P12, P16, P19, P20, P21, P22, P24, P25, P26, P27) gives guidance and can make decisions concerning the common DBE strategy. Extended security and data privacy (P2, P23, P24, P25, P27, P28) are required to detect vulnerabilities in the distributed landscape of a DBE. A central data privacy function assuring compliance with GDPR (General Data Protection Regulation) [42] standards in case of distributing personal related information among participating enterprises is perceived as valuable. Moreover, a DBE knowledge base (P2, P11, P16, P19, P21, P22) that is maintained and used by the participating enterprises to learn with the evolving DBE continuously is seen as necessary. Also, the ability to reuse existing services (P2, P12, P13, P15, P16, P23, P24, P25), platforms, and software solutions were highlighted as a characteristic of maturity. The degree of standardization (P2, P5, P11, P13, P15, P20, P21, P25, P26, P27) of deployed software solutions, business processes, and interface technologies is seen as an aspect of the maturity of DBEs. Finally, to have transparency (P8, P11) on dependencies that comprise a particular overarching business process was highlighted as crucial.

4.5 The Maturity Dimensions of DBEs

Based on the mentioned challenges in section 4.3 and the named maturity characteristics in section 4.4, we derived seven maturity dimensions.

Transparency: Every involved enterprise has transparency on the dependencies of their business processes, business models, and the strategy of partner-enterprises. The business and technical architecture is reflected in one single view (e.g., enterprise architecture model).

Governance: A central overarching governance functionality steers the DBE. It organizes improvement initiatives, aligns the enterprise business strategies to each other, and gives consultancy in setting up the right incentives and KPI's to foster DBE success.

Expandability: The DBE can add new partner-enterprises to the DBE, and the DBE can dock to other existing DBEs. Furthermore, the DBE needs to be able to integrate legacy systems.

Cybersecurity: A central security and data privacy function cares about security assessment, vulnerability detection, and legal requirements such as GDPR.
Knowledge base: A DBE in-house knowledge base that enables the participating enterprises to learn DBE processes, capabilities, and dependencies continually with the evolving DBE.

Reusability: A DBE establishes the opportunity to reuse existing services, platforms, and solutions for different business purposes, use cases, and partner-enterprises.

Standardization: The DBE aligns on interoperability standards for technological aspects, such as the information exchange via interfaces and business aspects such as alignment on a single customer complaint management process.

4.6 The Maturity Levels of DBEs

We derived five maturity levels from the literature [44-50] and adapted it to each of the presented maturity dimensions in section 4.5. In doing so, we also considered approaches that are highlighted as helpful by [P1, P9, P10, P17] to attain mature management of DBEs, such as Six Sigma and CMMI [33]. Our interview results let us conclude that a DBE is moving sequentially through the proposed levels from the lowest level L1 to the highest level L5.

Transparency: (L1) The initial level describes a DBE where enterprises have only haphazard transparency. (L2) Enterprises get transparency only on certain parts of a DBE, which are required for the next tactical implementation steps. (L3) The transparency within the DBE is coordinated. (L4) Oversight on the operational parts of the DBE is established. (L5) Transparency on the different strategic parts of the DBE is given.

Governance: (L1) The governance functionality is on an inconsistent level. (L2) Governance functionality is mainly managing people. (L3) The governance functionality is managing competencies within the DBE. (L4) Governance functionality is managing DBE capabilities. (L5) Governance functionality is managing DBE changes.

Expandability: (L1) The conduction of DBE extensions is reactive and unpredictable. (L2) DBE extensions are managed on a project level. (L3) Extensions are conducted proactively, rather than reactively. (L4) Extensions are measured and controlled. (L5) Extensions are stable and flexible.

Cybersecurity: (L1) Despite existing issues, no security and data privacy controls exist. (L2) Some security and data privacy controls are in development with limited documentation. (L3) More security and data privacy controls are documented and developed to avoid issues. (L4) Security and data privacy controls are monitored and measured. (L5) Security and data privacy controls are comprehensively implemented and automated.

Knowledge base: (L1) The DBE knowledge base is undefined. (L2) The DBE knowledge base is established but maintained only in a basic form. (L3) The knowledge base achieves a level of expertise and is used for decision-making. (L4) The knowledge base is used for quantitative decision-making. (L5) The knowledge base is used as a sharing platform and allows for reliable decision-making.

Reusability: (L1) Reuse is only possible in exceptional cases. (L2) The reuse is encouraged. (L3) The reuse is incentivized and rewarded. (L4) The reuse is indoctrinated. (L5) The reuse is perceived as the way the DBE is doing business.
**Standardization:** (L1) The standardization is at an early stage since the enterprises use their proprietary built solutions. (L2) Standardization is building common foundations. (L3) Standardization is beginning to blueprint solutions jointly. (L4) A standardization comprises implementing jointly designed blueprints. (L5) Standardization is rolling out predefined templates.

We propose that different employees of an enterprise should conduct the maturity assessment. First, each enterprise determines the average value and discusses potential contrast in the assessment of their employees. Second, the participating enterprises compare their assessment and discuss potential gaps or mismatches in their maturity perception.

5 Discussion

Within this section, we apply the maturity model and outline the limitations of our study.

5.1 Application of the Maturity Model

We applied the maturity model to the described DBE in section 4.1 (DBEs within a holding structure). The holding company initiated the DBE, where it acts as a cloud provider and is owning the intellectual property of products and services. The affiliate company reuses and adapts these products and services such as streaming television to regional conditions. The third-party provider is offering content (movies, series). For reasons of brevity, we kept out other companies that play a minor role in this DBE. We have asked P6 to assess their DBE with the given maturity model.

As a result, we have discerned strong governance activities by the holding company, which manages general DBE changes, such as extending the service portfolio (e.g., Voice over IP). The affiliate and third-party focus on their governance activities only on specific competencies concerning the TV platform's content. These competencies include the alignment of broadcasting dates of certain movies. Therefore, we categorize the holding's governance activities in level 5, the affiliate and third-party company in level 3. The transparency on the operational parts of the DBE was mainly given between the holding and their affiliates. Both companies oversee the operational parts, such as the current cloud platform's hardware resource utilization. The third-party company only has haphazard transparency, which will be offered on-demand in workshop discussions. Hence we categorize the holding and affiliate company in level 4, the third-party company in level 1. In terms of standardization, the holding is organizing blueprints of future solutions such as a movie recommender system, with the affiliate's assistance. The affiliate company's IT landscape and product portfolio build on common foundations steered by the holding. Moreover, we observed the TV platform's content is offered as services by the third-party company with standardized templates that enable smooth integration into existing IT landscapes. Thus, we categorize the holding in level 3, the affiliate in level 2, and the third-party company in level 5. The holding rewards the reuse of content, applications, and technologies within the DBE. On these grounds, the reuse of TV content, applications, and cloud resources is the way how the affiliate company does business. The third-party indoctrinated reuse in their business
model since it offers their movies and TV series also to other enterprises. Therefore, we categorize the holding in level 3, the affiliate in level 5, and the third-party company in level 4. The holding company’s knowledge base achieved a level of expertise and is used for decision-making, such as selecting a specific customer-relationship-management solution for the DBE. The affiliate company’s knowledge base is undefined. Gained knowledge is mainly shared and documented via email or PowerPoint slides. The third-party company established its own knowledge base but maintained it only in a basic form. In conclusion, we categorize the holding in level 3, the affiliate in level 1, and the third-party company in level 2. The holding company implemented security and data privacy controls to fulfill audit requirements. The affiliate company already had security issues; however, no security and data privacy controls exist. At the time of the interview, the affiliate was planning to rework its security measures. The third-party company is currently developing some security and data privacy controls with limited documentation. These insights let us categorize the holding in level 3, the affiliate in level 1, and the third-party company in level 2. Finally, we investigated the expandability of the DBE. The holding measured and controlled its expansions concerning the offering of its IaaS to new markets and further legal entities. The affiliate also measured and controlled its expansions to win new customers by providing more individualized content. The third-party company described its expansion activities as proactively but not yet measured and controlled. Hence we categorize the holding and affiliate in level 4, the third-party company in level 3. The following Figure 1 illustrates the application of the maturity model.

Fig. 1. Maturity model

This application allows practitioners to reveal gaps in the DBE and distinctions of maturity within the participating enterprise by considering the perspective of each participating enterprise and the perspective of multiple employees of each enterprise. This approach might help practitioners to identify room for improvements in the collabora-
tion and helps enterprises to assess and compare their current state with partner-enterprises within DBEs. Moreover, it gives guidance for further improvements and enables researchers to assess existing DBEs.

5.2 Limitations

Threats might limit this study to validity, namely the (i) biased selection of eligible participants, (ii) off-topic discussions, (iii) biased statements of the interviewer, (iv) bias of the moderator, (v) language barriers, (vi) wrong interpretation, and (vii) preliminary evaluation and application of the maturity model. To overcome (i), we applied the selection criteria as described in section 3.2. To cope with (ii, iii, iv, v), we defined interview guidelines and provided the questionnaire upfront in English. Furthermore, (vi), we evaluated the survey according to a method for qualitative text analysis introduced by [28]. Moreover, the correct application of [28] was reviewed by at least two authors of this publication. To tackle (vii), we will further evaluate the maturity model in a multiple case study by outlining different stakeholder's perspectives. Due to the limited page number, we will cover this in a journal publication. As a result, the risk of (i, ii, iii, iv, v, vi) and (vii) is at an acceptable level.

6 Conclusion

Prior work started investigating aspects of DBEs, such as the meaning of trust, regulatory issues, and stakeholder role-related [14,15,16,17] issues. However, these studies did not define and assess the maturity of existing DBEs, which are crucial for achieving more mature management of DBEs.

In this exploratory case study, we investigated the maturity status of existing DBEs. In doing so, we derived seven different DBE maturity dimensions and five levels from the expert interview results. Moreover, we found that the industry lacks mature management of DBEs. The industry misses central governance functions that give them guidance on how to manage the DBE. Our study exposed that the practitioners expect DBEs to play a crucial role in their companies' future business success. Besides, we revealed that DBEs emerge among partner-enterprises, at which the initiating enterprises attempt to create a lock-in situation for further participating enterprises and customers. This attempt is made by offering proprietary platforms to others and give allowance to provide their services on that platform.

These findings illustrate clear insights into the mentioned research gaps from [3,9,13,27,36], which were missing the practitioner's perspective on DBEs and its maturity. In addition, our maturity model enables practitioners to identify room for improvements in the DBE collaboration and helps enterprises to assess and compare their current state with partner-enterprises. This study gives transparency to DBEs, which leads to a mutual understanding of the required improvements. Furthermore, it gives guidance on how to achieve more mature management of DBEs. Our future work will consider a comprehensive evaluation of the maturity model by case studies of different industries. Besides, we will further investigate the perspectives of different stakeholders in the process of maturity assessments of DBEs.
References

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