The Importance of Platforms to Achieve Digital Maturity

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Abstract. An important "building block" for an organization's digital maturity seems to be the implementation of platforms. In general, platforms as software or hardware infrastructures through which users and organizations can create applications, services, and communities, can trigger so-called network effects. These effects act as a catalyst for the organization's digital maturity, by positively impacting key factors such as IT infrastructure, collaboration or innovation within the firm. The importance of implementing platforms for organizations pursuing the goal of raising their digital maturity is thus widely accepted. However, there is a lack of knowledge concerning the type of platforms that is beneficial for an organization's desired digital transformation. Based on the qualitative content analysis of 24 Digital maturity models (DMMs) that are frameworks prescribing key elements and a model path for an organization's digital maturity, we establish a first comprehensive overview of ten different platform types relevant for digital maturity. The most prominent types are: IT-Infrastructure, collaboration, and value chain platforms. Using an established framework, we were able to classify the differing platform concepts into "platforms with selectively open interfaces" and "platforms with N-sided market infrastructures". Based on these insights, we derive a first working definition of the term platform in the context of digital maturity. We thus contribute to the advancement of both research fields and their overlap. Furthermore, we offer managers guidance in the interpretation and application of DMMs – in due consideration of different platform types.

Keywords: Digital Maturity · Platforms · Digital Transformation · Maturity Models

1 Introduction

Most scholars and practitioners believe that being 'digital' is a key priority for businesses to stay competitive in the era of digital transformation [1]. As an effort to conceptualize this abstract idea, the construct of *digital maturity* has emerged. It designates "what a company has already achieved with regard to transformation efforts" [2]. To satisfy the omnipresent need of assessing and ultimately raising the digital maturity of an organization, so-called digital maturity models (DMMs) have been designed. These frameworks define key elements for the digital maturity of organizations and prescribe a concrete path along different maturity stages [3].

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For today's organizations, the implementation of platforms is widely considered as important building block in achieving digital maturity [4]. In general, platforms as software or hardware infrastructures through which users and organizations can create applications, services, and communities [5], can trigger so-called network effects [e.g., 6]. These effects act as a stimulant for the organization's digital maturity, by positively impacting key elements such as *IT infrastructure*, *collaboration* or *innovation* within the firm [7]. Even though the outstanding relevance of implementing platforms for organizations pursuing the goal of raising their digital maturity is largely recognized within the academic community, there is a lack of knowledge concerning the type of platforms that is beneficial for an organization's desired digital transformation.

This is a significant problem as the platform literature proposes a great variety of distinct platform types for differing areas of application within and across organizations and ecosystems: e.g., *internal platforms* in contrast to *industry platforms*. *Internal platforms* are infrastructures that are confined to the boundaries and the use of one single firm, whereas *social media platforms* dispose of open interfaces with a potentially unlimited pool of external complementors including firms and individuals [8].

Given this knowledge gap, there is a great uncertainty, especially among managers, seeking to keep pace with the ongoing digital transformation, regarding the definition of the term platform and the relevance of its respective types for this endeavor. DMMs, as popular practical tools, prescribing a variety of key elements for an organization's digital maturity, including platforms, can provide valuable insights on the nature and context of differing platform types relevant for this transformation process. We thus derive the following research questions for this study:

1. *In the context of present DMMs, what are the different platform types addressed as relevant for an organization's digital maturity?*
2. *In the context of digital maturity, what definition of the platform concept can be derived?*

In this study, we seek to paint a comprehensive picture of the differing platform types, that are deemed significant for an organization's digital maturity – based on the contents of present DMMs. In doing so, we further underline the fact that the concept of platforms and digital maturity are indeed closely interrelated. To provide a foundation for future research at this point of intersection of the two research fields, we derive a first working definition of platforms in the context of digital maturity. While investigating on this matter, we thus contribute to the advancement of the research field of digital maturity and platforms accordingly.

From a practical perspective, we inform managers on the meaning of platforms in the context of their organization's digital maturity and provide them with an overview of the relevant platform types. By implementing a suitable platform concept, practitioners can add an important building block to increase their organization's level of digital maturity.

To reach our aims, we will first outline current definitions of digital maturity, DMMs, the term platform and its overarching classifications in a general context, to then show how these concepts are interrelated. Then, by executing a systematic literature review, we shall identify all relevant DMMs for a business context of the past 10 years covering the term of platform according to a general definition. After having amassed the literature

pool, we will follow Mayring's [9] qualitative content analysis approach for inductive category creation to identify the differing platform concepts and their frequency of distribution within the models. Subsequently, we will discuss the findings. Then, outline theoretical and practical contributions of this paper. Following, we present a working definition of platforms in the context of digital maturity and present and research agenda, consisting of potential research questions while proposing suitable research approaches for further investigation. Finally, we provide respective limitations.

2 Research Background

2.1 Digital Maturity Models

Today, we look back on eleven years of digital maturity research [10]. In this context, we refer to the following established definitions in the IS community:

Digital Maturity describes "the status of a company's digital transformation" – designating "what a company has already achieved with regard to transformation efforts" [2]. Here, efforts encompass both implemented changes from an operational perspective and acquired capabilities with regards to the management of the organization's transformation endeavor. In line with current beliefs of the academic community, [11] see a positive relationship between digital maturity and business performance as highly likely. It is suggested that the assessment of an organization's maturity is one of the key factors in the process of achieving a higher level of firm performance [12].

Digital Maturity Model denotes normative reference models which are utilized in organizations to assess the status quo of its digital maturity and provide concrete measures to increase its level [13]. Through a catalogue of benchmark indicators, various stages of maturity are framed in terms of evolutionary levels [14]. Current models display in average four to six evolutionary stages on the path to digital maturity [13]. DMMs are mainly designed for the following fields of application. The largest stake of the models serves a general business context [15, 16]. Manufacturing [17, 18] constitutes the target sector of another substantial portion of present DMMs. Remaining models address a broach spectrum of business fields such as IT [19], telecommunications [20] and Education [21, 22].

In general, every digital organization starts with a carefully formulated company-wide *digital strategy* [23–25]. Intermediary stages towards digital maturity are characterized by more radical changes in the firm's IT infrastructure, processes, culture, and hierarchy. In this context, *platformization*, the implementation of platforms, is considered a key factor for an organization's digital maturity.

Typically, the DMMs' final stages are marked by a new orientation of the organization focusing on the customer. This novel approach is enabled by the data-driven enterprise. To maintain the organization's digital maturity, a continuous anticipation and adaptation to the increasingly dynamic business environment is necessary. Given the simple nature of maturity models and their particular practical relevance and value, a plethora of DMMs has emerged over the last decade [26].

2.2 Platforms

The notion of *platform* was established by the tech industry in the early 2000s to label digital intermediaries connecting information, goods, and persons [27]. A platform can be described as software or hardware infrastructure through which users, organizations, and institutions can create applications, services, and communities [5]. Such a network provides common standards, interfaces, and instruments to leverage core technologies, which enable data and knowledge sharing, collaboration, and foster innovation within or across firms [7]. Platforms are catalysts for these key factors for achieving digital maturity [28]. The phenomenon of platforms can be observed at different levels and in several organizational settings: within one firm, across supply-chains, or across entire ecosystems.

Despite the relevance of platforms for the management discipline, the research agenda has been limited and divided. Gawer [8] proposes a theoretically sound integrative framework for platforms that combines the two dominant, yet distinct theoretical perspectives. Instead of conceptualizing platforms either as markets – following the economic perspective – or as infrastructures – according to the engineering perspective, Gawer [8] unifies these differing approaches, portraying platforms through the organizational lens. Gawer's [8] unified framework suits the context of digital maturity as organizational phenomenon perfectly. It underlines the essential characteristics of different platform types while taking into consideration the particular setting of an organization. The following figure outlines Gawer's [8] classification of platforms (Fig. 1).

	Internal platform	Supply-chain platform	Industry platform
Level of analysis	• Firm	• Supply-chain	• Industry ecosystems
Platform's constitutive agents	• One firm • Its constituent sub-units	• Assembler • Suppliers	• Platform leader • Complementors
Technological architecture	• Modular design • Core and periphery		
Interfaces	• Closed interfaces Interfaces specifications are shared within the firm, but not disclosed externally	• Interfaces selectively open Interface specifications are shared exclusively across the supply-chain	• Open interfaces Interface specifications are shared with complementors
Accessible innovative capabilities	• Firm capabilities	• Supply-chain's capabilities	• Potentially unlimited pool of external capabilities
Coordination mechanisms	• Authority through managerial hierarchy	• Contractual relations between supply-chain member organizations	• Ecosystem governance ◦ In the special case of multi-sided markets: exclusively through pricing
Examples	• Black and Decker (machine tools) • Sony Walkman (consumer electronics)	• Renault–Nissan (automotive manufacturing) • Boeing (aerospace manufacturing)	• Facebook (social networking) • Google (Internet search and advertising) • Apple iPhone and Apps (Mobile)

Fig. 1. Classification of platforms according to Gawer [8]

Following the above unified framework, three overarching types of platforms can be identified. Internal platforms refer to a set of subsystems and *closed interfaces* that are accessible only within one firm. Here, innovative capabilities, collaboration and knowledge sharing are confined to the firm's boundaries. Examples for such platforms include the *Sony Walkman* and *Black and Decker machine tools*. Platforms with *selectively open interfaces* are an advancement of internal platforms. Their added value is shared across the entire supply chain of a certain organization. Therefore, they are also called supply chain platforms [8]. These types of platforms are particularly popular in the automotive industry. Industrial platforms display *N-sided market infrastructures* that connect buyers

and suppliers [29]. They are much more complex as they represent entire ecosystems consisting of multiple organizations. Accordingly, innovative capabilities, collaboration and knowledge sharing are potentially unlimited [30]. Nowadays, entire business models are based on the service of providing digital platforms. In line with previous years, in 2020, seven of the top ten companies are taken by providers of such platforms [31].

2.3 Platforms and Digital Maturity

Platformization describes the process of a stepwise transformation, where "the IT silo structure is transformed to a platform-oriented infrastructure" [32]. Experts claim that platforms are necessary to enhance the quick connect capability of internal and external interactions and thus to harness market opportunities in today's dynamic business environment. The added value of a platform is determined by the amount and intensity of interactions on that a platform [33]. Through platformization, business networks can be transformed into digital ecosystems. Digital ecosystems are environments that allow time- and location-independent, "flexible and demand-driven collaboration" [30]. Due to these network effects, platforms are considered a key factor for an organization's digital transformation journey [e.g., 6]. In this context driving factors for digital maturity, such as *IT infrastructure*, *collaboration* or *innovation*, are boosted by the implementation of platforms [7].

3 Research Design

Our research goal is to identify the differing platform concepts that are addressed in current DMMs and thus deemed relevant for an organization's digital transformation journey. Furthermore, we seek to identify the respective business contexts in which the differing platform concepts are covered. Ultimately, we aim at gaining a better understanding of the platform phenomenon and its types in the context of DMMs and to derive avenues for future scientific investigations.

An explorative research design seems to be the appropriate approach for this given subject matter. The method of choice is a systematic literature review. In this endeavor, we draw on the insights of previous works [1] and further optimize the search strategy by adding new search terms and extending the relevant timeframe to encompass the past eleven years of DMM literature (2011–2021). This timeframe is especially relevant, as to our best knowledge, the first DMM was developed in 2011 [34]. Subsequently, we shall identify the models encompassing any notion of platforms to then outline the respective business foci of the DMMs. As a next step, we will conduct an inductive qualitative content analysis according to Mayring [9] to analyze the respective platform concepts and how they relate to the differing business contexts. In the following, we are going to lay out the details of our modus operandi.

3.1 Literature Search Methodology

Based on the guidelines of Vom Brocke et al. [35], we focused on a eleven-year period (2011 to 2021), searching in ten leading IS journals (Senior Basket of 8 plus BISE and

MISQE), four major IS conferences (AMCIS, ECIS, ICIS, PACIS) and two complementary databases (Business Source Premier and Google Scholar). In the selection of databases and outlets, we draw on the experience of [36], who have previously engaged in the analysis of existing DMMs. The keywords of this systematic literature review were designed according to the PICO criteria (Population, Intervention, Comparison and Outcomes). Kitchenham and Charters [37] deem these parameters as particularly suitable for a literature review in the discipline of IS. Furthermore, we identified synonyms and alternative spellings for the search phrases by consulting both experts and literature. Search strings for Business Source Premier are e.g.: ((“maturity model” OR “stages of growth model” OR “stage model” OR “change model” OR “transformation model” OR “grid”)) AND ((“Transformation” OR “Digit*”)). In addition to the existing catchphrases identified by Thordsen et al. [1], we added “index”, “matrix”, “evaluat*”, “framework”, “quotient”, “industry 4.0”, “readiness”, and “assess*”. A detailed overview of the literature search process can be found in Fig. 2.

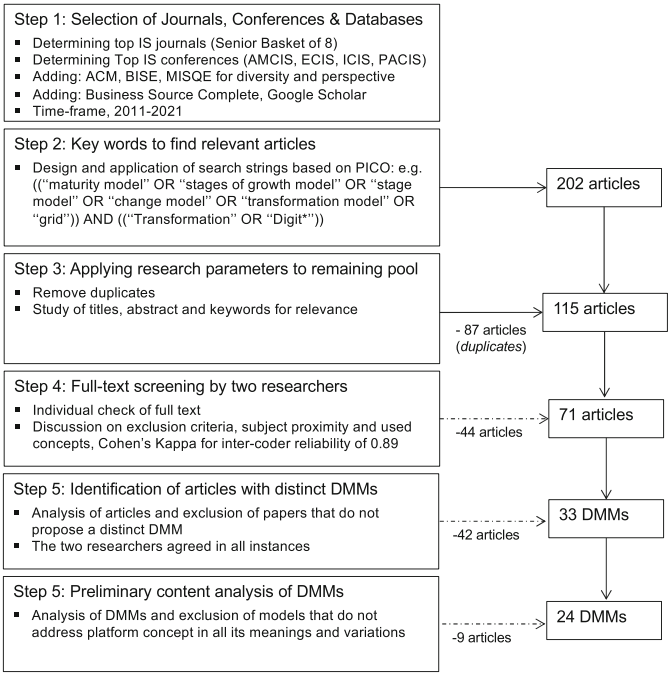

Fig. 2. Literature search process

The search was first performed focusing on titles, abstracts, and keywords. It resulted in a total of 202 papers, of which 87 were duplicates. After a full-text screening of the remaining 115 papers, we further excluded 44 works that did not address a business context. This step was at first completed by each author individually. Then, we discussed our screening and agreed on the papers to be included. Cohen’s Kappa indicating the inter-coder reliability was at 0.89 [38]. Finally, our pool of literature comprised 71

articles. These included two publications from leading IS journals, 27 conference articles, and 42 papers of other journals or publications of consultancies. We included consultancy reports and practitioners' works as a majority of DMMs come from these backgrounds and we seek to paint a comprehensive picture of this research field. Within the 71 papers, we could identify 33 DMMs. A preliminary screening of all 33 publications reveals that the concept of platform is addressed in a total of 24 studies –forming our final literature pool. This step was performed based on the presence of all varieties and meanings of the platform concept as it has been described earlier in the text. As a last step, we identified the industry focus of the DMMs for further investigation on the relationship between the addressed platform type and potential area of application. Here the inter-coder reliability was at 0.85. The following table provides an overview of the analyzed models with their respective business focus (Table 1).

As indicated, 24 models address the platform idea as it is described by [5]. Taking a closer look at the respective publication dates of the DMMs, it can be noted that the platform concept remains relevant along the past eleven years. In line with the findings of previous studies, the large majority of DMMs identified in our literature pool addresses a general business context (13) and thus has no industry focus. Seven DMMs concentrate solely on the manufacturing sector, whereas logistics, education, auditing, and IT are the target sectors of one DMM of the literature pool respectively.

3.2 Qualitative Content Analysis

For our DMM analysis we applied Mayring's [9] qualitative content analysis approach for inductive category creation. It is an established qualitative research approach successfully utilized in various IS studies for the analysis of systematic literature reviews [e.g., 56]. Mayring's [9] qualitative content analysis procedure allows an unbiased, transparent and methodologically controlled content analysis of qualitative data and thus ensures qualitative rigor. The first step of this content analysis consists in a frequency analysis. Within this procedure, we identify different passages within the studies' terminology and compare their frequency of occurrence with each other. In this context, the use of comprehensive category systems, including all relevant elements of the relevant concept is of special importance. Following this approach, we highlighted all text passages referring to the concept of "platform" in its simplest form – as it is defined by Casilli and Posada [5]: software or hardware infrastructure through which users, organizations, and institutions can create applications, services, and communities. Once we have identified all instances referring to this concept, we investigated on the respective contexts and the number of DMMs that the platform construct was mentioned in. In the analysis, we thus unitized and coded every identified idea of platforms to abstract codes with similar context and meaning. In total, we formed ten categories. For this procedure, we used the QCAmap-Software (qcamap.org). After approximately 50% of the content analysis, we revised and refined the category system [9, 57]. Two researchers performed the initial coding process independently. The intercoder-reliability was at 90%. Remaining cases were clarified during a discussion with a third researcher [57]. In a next step, our goal was to increase the level of abstraction of the previously identified classifications to further reduce the number of sets. Consulting the foregoing platform classifications according to [8], through deductive reasoning, we were able to further cluster the platforms into:

platform with selectively open interfaces (also Supply Chain Platform) and *platform with N-sided market infrastructure (also Industry Platform)*. Figure 3 depicts the results of our first analysis.

Table 1. Literature pool

ID	Study	Business focus	Year
1	[39]	General	2011
2	[34]	General	2011
3	[40]	General	2012
4	[16]	General	2015
5	[41]	Logistics	2015
6	[42]	Manufacturing	2015
7	[43]	Manufacturing	2016
8	[44]	General	2016
9	[45]	General	2016
10	[6]	General	2016
11	[17]	Manufacturing	2018
12	[46]	Education	2019
13	[47]	General	2019
14	[48]	General	2019
15	[49]	General	2019
16	[28]	Manufacturing	2020
17	[10]	General	2020
18	[26]	General	2020
19	[50]	General	2020
20	[51]	Auditing	2020
21	[52]	Manufacturing	2020
22	[53]	IT	2020
23	[54]	Manufacturing	2020
24	[55]	Manufacturing	2021

4 Findings

The differing concepts of platforms that we were able to detect in present DMMs are displayed in Fig. 3. Moreover, Fig. 3 shows the broader classification of these platforms according to by Gawer [8]. Nine of the 24 DMM studies name platforms in the context of *IT or digital infrastructure* (see number in parentheses). The same frequency of naming applies to *collaboration*, followed by *value/supply chain* with seven, and *knowledge*

with six instances. *Social media* appears in five models, whereas *e-commerce* is named four times, *innovation* and *manufacturing* three and finally *CRM* and *business model* two times. The frequency analysis also shows that the overarching classification *platform with selectively open interfaces (also Supply Chain Platform) is* addressed more than three times as frequently and by a significantly larger number of DMMs than the classification *platform with N-sided market infrastructure (also Industry Platform).*

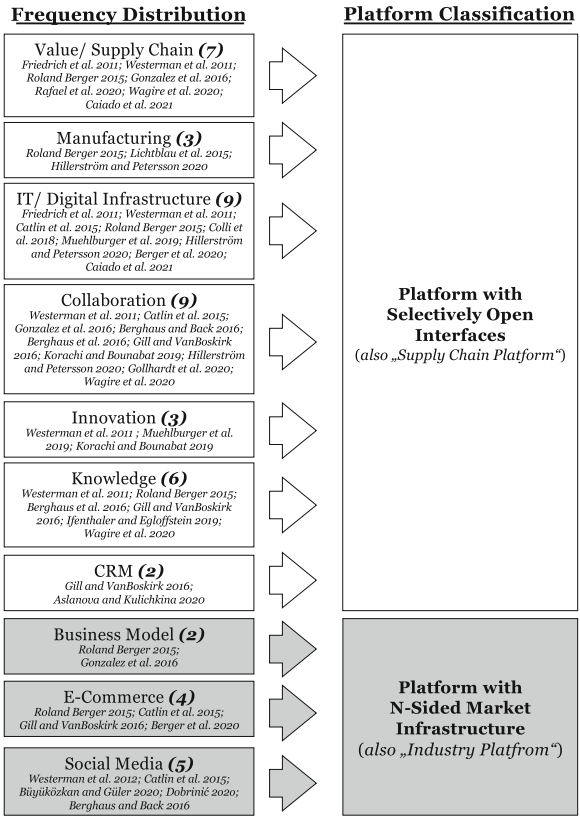

Fig. 3. Overview of the platform types in present DMMs

5 Conclusion and Working Definition

In the last decade of DMM research, the dominating perspective on platforms is a that of a modular software and hardware infrastructure across the firm and its suppliers. Internal platforms, however, are not addressed by current DMMs and thus do not seem beneficial for an organization's digital journey. The positive network effects of platforms with selectively open interfaces on collaboration, knowledge sharing, and innovation are appreciated by the present studies. These platforms are confined to the firm and its

suppliers. In this setting, especially the benefit of platforms designed for the value chain management and manufacturing are widely considered. These platforms limit the access to internal data from the outside and thus protect sensible information. However, the sharing and innovation potential is thus also confined. Present DMMs also acknowledge the advantages of platforms with N-sided market infrastructures that form entire data ecosystems. Particularly in the context of business models, based on the exchange of data, e-commerce and social media platforms, a potentially unlimited ecosystem of users and firms is crucial to generate value.

Based on these insights, we can draw several conclusions. In the context of digital maturity and viewed through an organizational lens, the term platform can be defined as:

1. *Modular software or hardware infrastructure composed of a core and a periphery with multiple interfaces extending across supply chains and/ or industry ecosystems.*
2. *The constitutive agents of a platform are either a firm and its suppliers or a platform leader and its complementors - creating value by enabling and making use of economies of scope in supply or/and in demand.*
3. *As the platform's access to innovating agents increases, the diverse capabilities and network effects beneficial for the organization's digital transformation increase.*

Based on the findings of the present study, we are confident to propose a valid first working definition of the platform concept in relation to a firm's digital maturity. Furthermore, we provide a first comprehensive overview of the differing types of platforms relevant to an organization's digital transformation. We thus contribute to the advancement and refinement of the still widely uncharted intersection of the research fields of digital maturity and platforms accordingly. From a practical perspective, we offer managers with guidance in the interpretation and application of DMMs – in due consideration of the platform phenomenon. By implementing a suitable platform type from the provided overview, practitioners can add an important building block to increase their organization's level of digital maturity. This study has provided us with valuable insights regarding platforms, underlining their relevance for an organization's digital maturity. Nevertheless, this specific research field is still at its very beginning – further scientific inquiry is necessary. Here, e.g., the correlation between the organization's industry focus and the relevant platform type could be investigated upon. Furthermore, it could be of added value to analyze at which level of digital maturity, the present DMMs suggest implementing platforms.

We acknowledge the limitations of this paper. Of course, the keywords and catchphrases of the literature search, as well as the databases and outlets, can be further extended to complement the existing pool of DMMs. Nevertheless, we are confident to further stimulate the academic discussion and to encourage future investigations on the subject matter.

References

1. Thordsen, T., Murawski, M., Bick, M.: How to measure digitalization? A critical evaluation of digital maturity models. In: Hattingh, M., Matthee, M., Smuts, H., Pappas, I., Dwivedi, Y.K.,

Mäntymäki, M. (eds.) I3E 2020. LNCS, vol. 12066, pp. 358–369. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-44999-5_30
2. Chanias, S., Hess, T.: How digital are we? Maturity models for the assessment of a company's status in the digital transformation. Manag. Rep./Institut für Wirtschaftsinformatik und Neue Medien **2**, 1–14 (2016)
3. Pavel, E.V., Kudryashova, T.V., Bykova, P.A.: Research on the digital maturity of mechanical engineering companies in Russia. In: International Scientific and Practical Conference "Russia 2020-a New Reality: Economy and Society (ISPCR 2020), pp. 408–411. Atlantis Press (2021)
4. Pauli, T., Fielt, E., Matzner, M.: Digital industrial platforms. Bus. Inf. Syst. Eng. **63**(2), 181–190 (2021). https://doi.org/10.1007/s12599-020-00681-w
5. Casilli, A., Posada, J.: The platformization of labor and society. Society and the internet: how networks of information and communication are changing our lives, pp. 293–306 (2019)
6. Gill, M., VanBoskirk, S.: The digital maturity model 4.0. Benchmarks: digital transformation playbook (2016)
7. Teece, D.J.: Dynamic capabilities and (digital) platform lifecycles. In: Entrepreneurship, Innovation, and Platforms. Emerald Publishing Limited (2017)
8. Gawer, A.: Bridging differing perspectives on technological platforms: toward an integrative framework. Res. Policy **43**, 1239–1249 (2014)
9. Mayring, P.: Qualitative content analysis: theoretical foundation, basic procedures and software solution (2014)
10. Aslanova, I.V., Kulichkina, A.I.: Digital maturity: definition and model. In: 2nd International Scientific and Practical Conference "Modern Management Trends and the Digital Economy: from Regional Development to Global Economic Growth" (MTDE 2020), pp. 443–449. Atlantis Press (2021)
11. Eremina, Y., Lace, N., Bistrova, J.: Digital maturity and corporate performance: the case of the Baltic states. J. Open Innov. Technol. Market Complex. **5**, 54 (2019)
12. Bititci, U.S., Garengo, P., Ates, A., Nudurupati, S.S.: Value of maturity models in performance measurement. Int. J. Prod. Res. **53**, 3062–3085 (2015)
13. Williams, C., Schallmo, D., Lang, K., Boardman, L.: Digital maturity models for small and medium-sized enterprises: a systematic literature review. In: ISPIM Conference Proceedings, pp. 1–15. The International Society for Professional Innovation Management (ISPIM) (2019)
14. Becker, J., Niehaves, B., Poeppelbuss, J., Simons, A.: Maturity models in IS research (2010)
15. Westerman, G., Bonnet, D., McAfee, A.: Leading Digital: Turning Technology into Business Transformation. Harvard Business Press (2014)
16. Catlin, T., Scanlan, J., Willmott, P.: Raising your digital quotient. https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/raising-your-digital-quotient
17. Colli, M., Madsen, O., Berger, U., Møller, C., Wæhrens, B.V., Bockholt, M.: Contextualizing the outcome of a maturity assessment for Industry 4.0. Ifac-papersonline **51**, 1347–1352 (2018)
18. Gajsek, B., Marolt, J., Rupnik, B., Lerher, T., Sternad, M.: Using maturity model and discrete-event simulation for Industry 4.0 implementation. Int. J. Simul. Model. **18**, 488–499 (2019)
19. Isaev, E.A., Korovkina, N.L., Tabakova, M.S.: Evaluation of the readiness of a company's IT department for digital business transformation. Бизнес-информатика (2018)
20. Ochoa-Urrego, R.-L., Peña, J.-I.: Digital maturity models: a systematic literature review. In: ISPIM Conference Proceedings, pp. 1–15. The International Society for Professional Innovation Management (ISPIM) (2020)
21. Jugo, G., Balaban, I., Pezelj, M., Begicevic Redjep, N.: Development of a model to assess the digitally mature schools in Croatia. In: Tatnall, A., Webb, M. (eds.) WCCE 2017. IAICT, vol. 515, pp. 169–178. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-74310-3_19
22. Đurek, V., Kadoic, N., Ređep, N.B.: Assessing the digital maturity level of higher education institutions. In: 41st International Convention, pp. 671–676 (2018)

23. Matt, C., Hess, T., Benlian, A.: Digital transformation strategies. Bus. Inf. Syst. Eng. **57**, 339–343 (2015)
24. Ochoa, O.L.: Modelos de madurez digital:¿ En qué consisten y qué podemos aprender de ellos?/Digital maturity models: what are they and what can we learn from them? Boletín de estudios económicos **71**, 573 (2016)
25. Chanias, S., Hess, T.: Understanding digital transformation strategy formation: insights from Europe's automotive industry. In: PACIS, p. 296 (2016)
26. Büyüközkan, G., Güler, M.: Analysis of companies' digital maturity by hesitant fuzzy linguistic MCDM methods. J. Intell. Fuzzy Syst. **38**, 1119–1132 (2020)
27. Evans, D.S., Hagiu, A., Schmalensee, R.: Invisible Engines: How Software Platforms Drive Innovation and Transform Industries. The MIT Press (2008)
28. Rafael, L.D., Jaione, G.E., Cristina, L., Ibon, S.L.: An Industry 4.0 maturity model for machine tool companies. Technol. Forecasting Soc. Change **159**, 120203 (2020)
29. Iansiti, M., Levien, R.: The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation, and Sustainability. Harvard Business Press (2004)
30. Aulkemeier, F., Iacob, M.-E., van Hillegersberg, J.: Platform-based collaboration in digital ecosystems. Electron. Mark. **29**(4), 597–608 (2019). https://doi.org/10.1007/s12525-019-00341-2
31. Forbes: The 100 largest companies in the world by market capitalization in 2020 (in billion U.S. dollars). https://www-statista-com.revproxy.escpeurope.eu/statistics/263264/top-companies-in-the-world-by-market-capitalization/
32. Bygstad, B., Hanseth, O.: Transforming digital infrastructures through platformization (2018)
33. Alt, R., Zimmermann, H.D.: Electronic markets on platform competition. Electron Markets **29**, 143–149 (2019). https://doi.org/10.1007/s12525-019-00353-y
34. Westerman, G., Calméjane, C., Bonnet, D., Ferraris, P., McAfee, A.: Digital transformation: a roadmap for billion-dollar organizations. MIT Center for Digital Business and Capgemini Consulting, vol. 1, pp. 1–68 (2011)
35. vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R., Cleven, A.: Reconstructing the giant: on the importance of rigour in documenting the literature search process. In: ECIS, vol. 9, pp. 2206–2217 (2009)
36. Thordsen, T., Bick, M.: Towards a holistic digital maturity model. In: ICIS 2020 (2020)
37. Kitchenham, B., Charters, S.: Guidelines for performing systematic literature reviews in software engineering (2007)
38. Kane, M., Crooks, T., Cohen, A.: Validating measures of performance. Educ. Meas. Issues Pract. **18**, 5–17 (1999)
39. Friedrich, R., Le Merle, M., Grone, F., Koster, A.: Measuring Industry Digitization: Leaders and Laggards in the Digital Economy. Booz & Co., London (2011)
40. Westerman, G., Tannou, M., Bonnet, D., Ferraris, P., McAfee, A.: The digital advantage: how digital leaders outperform their peers in every industry. MITSloan Management and Capgemini Consulting, MA, vol. 2, pp. 2–23 (2012)
41. Berger, R.: The digital transformation of industry. The study commissioned by the Federation of German Industries (BDI), Munich (2015)
42. Lichtblau, K., et al.: Industrie 4.0 Readiness. IMPULS-Stiftung for mechanical engineering, plant engineering, and information technology (2015)
43. Gonzalez, A.A., et al.: Digitale Transformation-Wie Informations-und Kommunikationstechnologie etablierte Branchen grundlegend verändern. Abschlussbericht des vom Bundesministerium für Wirtschaft und Technologie geförderten Verbundvorhabens. IKT-Wandel (2016)
44. Berghaus, S., Back, A.: Stages in digital business transformation: results of an empirical maturity study. In: MCIS 2016, Cyprus, p. 22 (2016)

45. Berghaus, S., Back, A., Kaltenrieder, B.: Digital maturity & transformation report 2016. Crosswalk AG (2016)
46. Ifenthaler, D., Egloffstein, M.: Development and implementation of a maturity model of digital transformation. TechTrends **64**, 302–309 (2020)
47. Muehlburger, M., Rueckel, D., Koch, S.: A framework of factors enabling digital transformation (2019)
48. Nguyen, D.K., Broekhuizen, T., Dong, J.Q., Verhoef, P.C.: Digital readiness: construct development and empirical validation (2019)
49. Korachi, Z., Bounabat, B.: Towards a maturity model for digital strategy assessment. In: Ezziyyani, M. (ed.) AI2SD 2019. AISC, vol. 1105, pp. 456–470. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-36674-2_47
50. Berger, S., Bitzer, M., Häckel, B., Voit, C. (eds.): Approaching Digital Transformation-Development of a Multi-dimensional Maturity Model (2020)
51. Dobrinić, D.: Digital maturity of auditing companies in the Republic of Croatia (2020)
52. Hillerström, M., Petersson, I.: Measuring Digital Maturity in the CNC Manufacturing Industry: A Maturity Evaluation Model (2020)
53. Gollhardt, T., Halsbenning, S., Hermann, A., Karsakova, A., Becker, J.: Development of a digital transformation maturity model for IT companies. In: 2020 IEEE 22nd Conference on Business Informatics (CBI), pp. 94–103. IEEE (2020)
54. Wagire, A.A., Joshi, R., Rathore, A.P.S., Jain, R.: Development of maturity model for assessing the implementation of Industry 4.0: learning from theory and practice. Prod. Plan. Control 1–20 (2020)
55. Caiado, R.G.G., Scavarda, L.F., Gavião, L.O., Ivson, P., de Mattos Nascimento, D.L., Garza-Reyes, J.A.: A fuzzy rule-based industry 4.0 maturity model for operations and supply chain management. Int. J. Prod. Econ. **231**, 107883 (2021)
56. Osterrieder, P., Budde, L., Friedli, T.: The smart factory as a key construct of industry 4.0: a systematic literature review. Int. J. Prod. Econ. **221**, 107476 (2020)
57. Krippendorff, K.: Content Analysis: An Introduction to its Methodology. Sage Publications (2018)