

Dynamic Capabilities as the Key Approach to Investigate Digital Ecosystems

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Abstract. As a result of technological change and increasing digitalization, corporate and industry structures are changing. Due to a growing dynamic in the competitive environment, companies are forced to reinvent themselves. Digital and platform-based ecosystems represent a promising direction for rapid progress in competition and cooperation at the same time. From a strategic perspective, however, the question of sustainable management must be posed. The classic approach of the Resource-Based View (RBV) appears too static in the dynamic digital environment and must be supplemented by the Knowledge-Based View (KBV) or the Dynamic Capabilities View (DCV). This paper structures and analyzes the existing literature on digital ecosystems against the background of existing management theories. Within the framework of a structured literature review, we identify and analyze 23 relevant management publications. The extant literature shows an existing research gap with regard to the KBV and DCV.

Keywords: Digital Ecosystems, Resource-Based View, Knowledge-Based View, Dynamic Capabilities View, Structured Literature Review.

1 Introduction

Scientific literature [1, 2] argues that the world is experiencing a digital revolution: "Technology is underpinned by digital rather than physical means" [2]. The authors focus on "digital platform-based ecosystems at the forefront of this change" [2]. The most important aspect about this change is the characteristic of a highly dynamic environment in which companies are forced to innovate in shorter cycles to remain competitive [3–6]. One of the characteristics of digital ecosystems in general is the ability to create competitive advantages by complementing or sharing their resource base with partner companies on a digital platform [4, 7–9]. This leads to new business

opportunities [4, 10–12]. Especially in the strategic management context, research about the phenomena of being a competitor and being a cooperation partner at the same time while sharing the most important assets in an organization to gain competitive advantages is of great interest [4, 13]. Based on the idea of digital ecosystems, companies achieve their competitive advantages by using the possibility of combining different forms of resources. This paper aims to analyze and structure the current research state of digital ecosystems through the lens of a classical strategic management theory: The Resource-Based View (RBV).

The number of research publications on digital platform-based ecosystem has enormously increased in the last years [14–17]. Against the backdrop of the high relevance in terms of value creation, management literature has surprisingly little effort made to examine the linkage of digital ecosystems and the RBV [7, 18, 19]. To provide a structured and transparent overview, which is still missing, of academic results as a basis for management decision support we set out to fill out the research gap mentioned by Jacobides et al. that “only a handful of studies have explicitly tried to bridge existing perspectives [...] and ecosystems” [9].

To overcome different definitions of digital ecosystems, we provide a classification of digital ecosystems in the next section. Subsequently, we widen the scope from the RBV to the Knowledge-Based View (KBV), and the Dynamic Capabilities View (DCV). To provide a structured overview of existing contributions, we conduct a Structured Literature Review (SLR) combining both research fields: digital ecosystems and the RBV. We then analyze and structure our results to answer the following question: To what extent have the approaches of the RBV, KBV and DCV been analyzed in the scientific management literature in the context of digital ecosystems? How can practical conclusions be drawn from the theoretical knowledge? Therefore, our work represents the first holistic analysis of digital ecosystems based on the approach of the RBV (including KBV and DCV) in strategic management literature.

2 Digital Multi-Sided Platform-Based Ecosystems

Emerging from a biological metaphor, the concept of ecosystems in management literature emphasizes the need for “strategy to extend its consideration beyond rivals competing within industry boundaries” [8]. Since Moore introduced the term, a very broad understanding of ecosystems has developed [8, 20, 21]. Many research streams in ecosystem research have similar assumptions but use different terminology or use the same terminology for unrelated concepts. Jacobides et al. classify the literature on ecosystems into three streams of contributions: Business Ecosystems (BE), Innovation Ecosystems (IE), and Platform Ecosystems (PE) [9]. In this way, they complement the findings of Thomas and Autio, making a similar categorization (Technology Ecosystem instead of PE) and delimiting the ecosystem analogies by the sources of value creation and coordination [17].

In studies that focus on organizations (BE), the ecosystem is conceived as a community of interacting actors who, through their activities, influence one another and consider all relevant actors outside the boundaries of a single industry. It emphasizes

the coevolution of business skills as well as the role of ecosystem managers, who act as "hub" or "keystone companies" stabilizing the ecosystem [22]. The second flow of contributions places innovation at the centre of attention (IE). Here, the ecosystem is defined as "the collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution" [23]. The focus is on the question of how actors need to interact to create and promote innovations from which the end user benefits – with the implicit assumption that they will fail if there is insufficient coordination [7]. In the literature it is examined how agreements between the innovator and its complements affect the ability of both groups to invest in new technology and promotion [23, 24], how the exchange of knowledge influences intercompany relationships, the development of the ecosystem [25, 26], and the health and survival of the ecosystem [24, 27]. The third flow of contributions focuses on platforms and the interdependence between platform leaders and their complementors (PE). Studies consider the platform's leadership role on industry level [28], the competitiveness of PEs [29] and how technological interfaces or governance structures affect collective outcomes [28, 30, 31].

Digital multi-sided platform-based ecosystems (MSP) considered in this work belong to the third flow (PE) and, as Thomas et al. express it, "the bulk of this stream is toward the academic discipline of technology and innovation management, although there has been interest from engineering and economics researchers" [17]. Moreover, our platform concept comprises transaction between different groups of actors [1, 2]. With regard to the platform, we have additionally made the following specification: the platform is based on digital technologies and is multi-faceted. Consequently, we define digital ecosystems as: ecosystems built on a digital MSP "[that are] typically owned or governed by a [...] platform leader" that connects various sides of the world to facilitate exchange and value creation" [32] to gain competitive advantages out of their heterogeneous resource base [33, 34]. Companies such as Alibaba, Facebook and Uber serve as examples in this context [35–37].

3 Resource-Based View as the Theoretical Framework

The collective term RBV subsumes all approaches, concepts and theories in strategic management literature that justify lasting competitive advantages of companies with their heterogeneous resources. "The resource view holds that, in order to generate sustainable competitive advantage, a resource must provide economic value and must be presently scarce, difficult to imitate, non-substitutable, and not readily obtainable in factor markets" [33].

Despite its popularity, the RBV is not free of criticism. The static viewpoint leads to some fundamental problems of the resource-oriented research: The content-related evaluation of strategically relevant resources is primarily time-related meaning that dynamic aspects like changing or re-structuring a resource base are not taken into account [38]. To overcome the static aspect, literature has extended the RBV to the KBV and the DCV [38].

3.1 Knowledge-Based View (KBV)

The KBV is a development of the RBV, as knowledge is seen as the most important strategic resource [38]. The approach is based on the assumption that the individual knowledge base of enterprises and its adaption to dynamic environmental changes represent a consistent source of competitive advantage [39–41]. Referring to the criticism of the RBV's static character, the KBV is characterized by a primarily dynamically oriented view. The identification, generation, utilization, transmission and accumulation of knowledge is conceived as a dynamic process.

To illustrate the logic behind the KBV, a conceptual framework is presented integrating a static-structural and dynamic-procedural dimension of knowledge as well as three central concepts. The first dimension is used to describe the knowledge base of the organization, which is categorized into types (explicit/implicit), emergence (individual/collective) and content of knowledge (specificity level). Two categories of knowledge processes can be distinguished. The generation of knowledge describes the updating of existing knowledge. Whereas knowledge integration serves to synthesize individual knowledge into a collective knowledge structure stored in organizational routines. Uniqueness of organizational knowledge arises only from the interaction of these processes and is described by three main concepts. Absorbency describes the ability of an organization to build up knowledge potential, i.e. to identify, evaluate, absorb and apply strategically relevant knowledge from the corporate environment [42]. Path dependency means that the absorption of new knowledge is always marked by the historical development of an organization. Since the history of each organization is unique, so is the learning process [43]. Causal ambiguity arises from the existing knowledge and the integrated learning processes of an organization. These competitive advantages are opaque for competitors and represent imitation barriers [44].

3.2 Dynamic Capabilities View (DCV)

The third perspective to consider is the DCV. Like the RBV, the DCV conceives the organization as a bundle of heterogeneous resources and competences [38, 45]. The DCV can therefore be regarded as an extension of the RBV [38] and points to the shortcomings of a purely static resource-oriented consideration [46]. The DCV seeks to overcome the deficits of classical resource-oriented considerations in terms of building long-term competitive advantages in dynamic markets [45, 47]. Helfat and Raubitschek define Dynamic Capabilities (DC) as "those capabilities that enable firms to create, extend, and modify how they make a living, including through alterations in their resources [...] operating capabilities, scale and scope of work, products, customers, ecosystems, and other features of their external environments" [2]. Accordingly, DC subsume those capabilities that allow the organization to constantly innovate and adapt flexibly to ever-changing market needs [48]. In doing so, DC enable companies to adapt changes in their environment through three mechanisms which together constitute the DC framework: Sense, Seize, and Transform [49].

4 Structured Literature Research on the Current State of Research

The conducted research method is the SLR using a six-step-process [50]:

(1) Defining the Research Question. The aim is to identify further literature related to the contributions of Helfat and Raubitschek as well as Teece, to identify research gaps [1, 2]. The work of Helfat and Raubitschek is a reflection of digital MSP ecosystems based on the DCV [2]. Such a narrow definition does not raise a sufficient amount of literature. The focus of this SLR has to be more comprehensive than in the previous considerations, while at the same time it must be so narrow that only theoretically related articles with digital MSP ecosystems are recorded. Therefore, PEs, BEs and IEs are also considered. Moreover, we extended the RBV to the KBV and DCV. The research question for the SLR is then formulated: *To what extent are resource-oriented considerations (RBV, KBV, and DCV) in the existing literature on ecosystems (BE, IE, and PE) represented in the management literature?*

(2) Determining the Required Characteristics of Primary Studies. The search string was defined as: (Resource-based View OR Dynamic Capabilities OR Strategic Management OR Core Competence OR Competitive Advantage OR Knowledge-based View) AND (Ecosystem OR Value Creation OR Cooperation).

(3) Retrieving a Sample of Potentially Relevant Literature. Moore first introduced the concept of ecosystems in management literature, which is why we included research from then on to January 2019 [20]. The defined search terms must appear either in title, abstract or the Web of Science (WOS) and author keywords. The resulting literature (n=977) is restricted to the WOS categories "management" and "business", with regard to the broad use of the ecosystem concept (n=456). The literature is then restricted to contributions appearing in journals rated B or higher according to the VHB JourQual 3.0 classification (n=259) [51]. By restricting the publication to journals, a high quality and maturity of the publications can be ensured. Results of the SLR which cannot be assigned to one of the three ecosystem streams (BE, IE, and PE) as well as resource-oriented considerations not being assigned to one of the three approaches (RBV, KBV, DCV) are omitted. Results with a peripherally linking of ecosystems and resource-based orientations are excluded as well.

(4) Selecting the Pertinent Literature. The potentially relevant literature was downloaded, and the exclusion criteria applied resulting in 23 contributions.

(5) Synthesizing the Literature. We synthesized the identified contributions into a coordinate system shown in *Figure 1*. The contributions can then be assigned to nine fields based on the six selected categories BE, IE, PE, RBV, KBV, and DCV. The position of the point indicates the affiliation to this field. Articles that have been removed from the interfaces can be assigned to several approaches or do not exclusively consider one typology (e.g. the work of [2] and [1]).

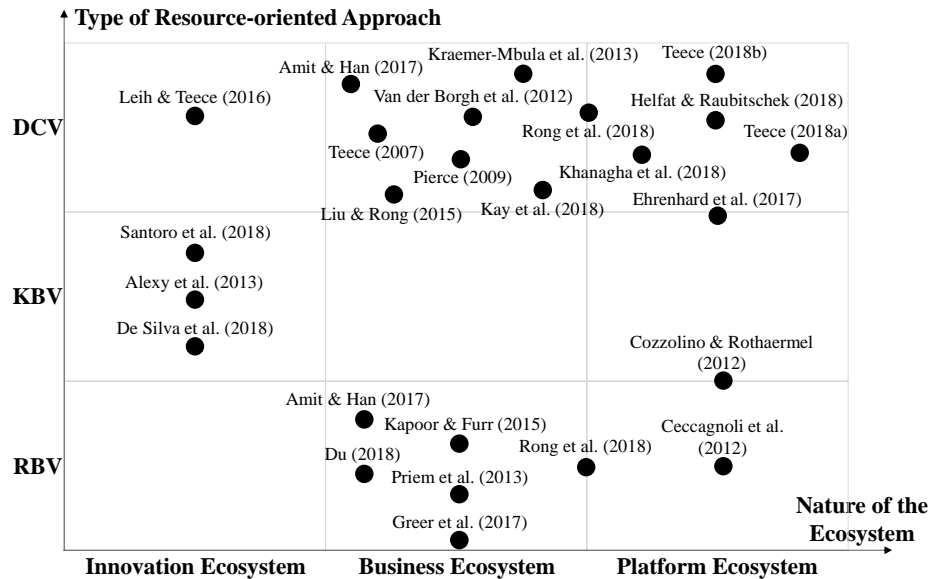


Figure 1. Synthesized literature

(6) Reporting the Results. With regard to the research question of the SLR, some resource-oriented considerations (within the meaning of the classical RBV, KBV and DCV) related to the ecosystem research (in the sense of a BE, IE, PE value creation) are already existing in management literature. It becomes apparent that the DCV is the dominant resource-based approach to ecosystem research. It is also noticeable that, although several contributions consider the linkage of the DCV with PE, research concerning the theoretical conceptions of the origin of the DCV (the classical RBV and KBV) is underdeveloped for PE. The question arises as to whether this is a research gap or whether the lack of coverage results from a lower potential in the analysis? Therefore, the present work investigates the explanatory potential of RBV and KBV for PE and more specifically for the digital MSP considered by Helfat and Raubitschek as well as Teece [1, 2]. The research question derived from the SLR for the purposes of this paper is therefore: What are the conclusions offered by the approaches of RBV for digital MSP ecosystems from the existing management research literature?

5 Explanatory Potential of the Knowledge-Based View and Dynamic Capabilities View in Regard to Digital Ecosystems

5.1 Application of the Knowledge-Based View

The classic static RBV states that individual companies should protect their valuable know-how to prevent knowledge spillovers, as these can erode or eliminate their competitive advantage. Systematically sharing valuable knowledge can be beneficial for companies and thus lead to a voluntarily acceptance of a knowledge transfer [52].

Selective Revealing (SR) can be seen as a strategic mechanism of a focal organization "to reshape the collaborative behavior of other actors in a firm's innovation ecosystem" [26]. The higher the perceived *partnering uncertainty*, the *coordination costs* and the *unwillingness to collaborate*, the more likely an organization will prefer SR to other mechanisms [26]. Simplified, SR can serve as a novel pathway to collaboration by overcoming the hurdles described above. And indirectly, SR can benefit from *pathway to reshape external knowledge*, since externals use the deliberately shared results of the platform leaders and thus intentionally or unknowingly switch their knowledge production, whereby their future outputs, and their involuntary spillover, become more valuable to the selectively-sharing enterprise [26].

The absorptivity literature is also highlighted by portraying intertemporal dynamics that had previously been disregarded [43, 49]. Absorbency is relevant in another context for platform leaders of digital MSP ecosystems. These are exposed to the pressures of competitive innovation described above in their rapidly changing markets. Thus, it is of particular interest to platform leaders to keep an eye on these markets and (potential) competitors. Monitoring their environment continuously, generates a wealth of information. But it is not enough to collect them. The platform leader needs "in-depth knowledge of a core product or service" [2] in order to interpret the information appropriately. Otherwise, the platform leader will find it difficult to estimate the potential value of including a particular product trait, product, or complement in the ecosystem or its role.

Furthermore, platform leaders may need to adapt the types of complementors in their ecosystems and the products and services offered by them when introducing innovations [2]. For this reason, platform leaders can benefit from "to have knowledge in excess of what they need for what they make" [25]. This provides platform leaders with the ability to interpret the wide variety of information that is relevant to their dependence on complements for ecosystems [2]. For example, the higher and more divergent the already existing stock of at least partially related knowledge, the faster learning succeeds [49]. Another point of KBV's construct is the establishment of routines. KBV's most important finding seems to lie in the fact that the processes require the generation of knowledge and the application of different organizational arrangements to be efficient [53]. Thus, the efficient production and storage of knowledge requires individuals to specialize in certain types of knowledge. Knowledge production also requires the integration of many different types of knowledge. One of the organization's fundamental challenge is to combine these two processes. Introducing routines that allow specialists to integrate their knowledge into a common process and thus contribute their knowledge to the team product is one possible way to do it. The introduction of routines is of particular interest to digital ecosystem platform leaders being under constant pressure from competitive innovation. Here, the innovation activities of the platform leaders include "not only new generations of core products in ecosystems [...] but also innovations that are transformational rather than upgraded versions of prior products" [2]. To drive such innovation, the platform leader needs to integrate different types of knowledge. At the same time, such integration should not lose the efficiency effects of the specializations.

Figure 2 can be explained in the following analysis. (1) The efficient production and storage of knowledge requires individuals to specialize in particular knowledge types [53]. A platform leader of digital MSP ecosystems can increase the efficiency of its knowledge production and thus also its generated outputs by using routines to advance this specialization and to maintain its efficiency effects. (2) The results of knowledge production processes can now be deliberately revealed so that actors in the environment can absorb them. An increase in outsiders using these results means more companies intending or unknowingly reorienting their knowledge production and aligning their outputs with the shared knowledge of the platform leader. This increases the related knowledge in the platform leader's environment [26]. This, in turn, has an effect on the absorption capacity, since it is a function of the already existing related knowledge [49].

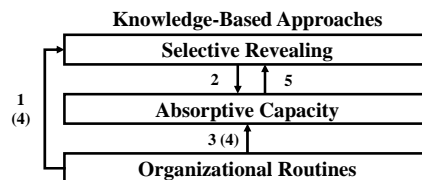


Figure 2. Interaction relationships within the knowledge-based approaches

(3) Also, a platform leader can use routines to drive the efficient integration of knowledge, increasing his generated outputs, directly affecting his knowledge base and his ability to absorb. Likewise, the integration of knowledge between different units is crucial for the absorptivity. Thus the "organization's absorptive capacity does not simply depend [26, 54, 55] on the organization's direct interface with the external environment. It also depends on transfers of knowledge across and within sub-units" [49]. (4) Constitutive relations exist between the routines of organizational capabilities as well as the ability to absorb and the ability to SR. (5) Finally, constitutive relationships between absorptivity and SR exist as a "prerequisite to gain from the contributions of others to the selective revealing effort" [26].

5.2 Application of the Dynamic Capabilities View

Previously, it was argued that the skills of platform leaders in digital MSP ecosystems should receive increased attention [2]. In particular, DC are relevant to the management of platforms and associated ecosystems, as platforms develop their own dynamics and the constituent elements must respond to changes in the enterprise environment [56]. "The dynamic capabilities framework [...] helps explain why some firms successfully create platform-powered ecosystems" [1]. Here, a different principle is presented to emphasize the respective capabilities of the DC framework: The DC are ordered in an ascending structure according to how many capabilities they address within the DC framework (Figure 3). (1) Environmental Scanning Capabilities are particularly critical in refoundation as well as finding strategic threats and opportunities [34]. Platform leaders are required to continually examine their external business environment for new or unused technology, unexploited market needs, changes in customer preferences, and

to monitor the threat of innovative market entry through new or existing platforms. (2) Innovation capabilities can be set up at the individual or organizational level, generally within teams or groups, based on routines, and in combination with material and intangible assets (resources). (3) Integrative capabilities enable reliable and repeatable communication and coordination of activities focusing on the introduction and modification of business models, capabilities, products, and resources (knowledge). The capabilities focus on strategic change and can help platform leaders to shape and transform their business model, products, governance, and ecosystem [2].

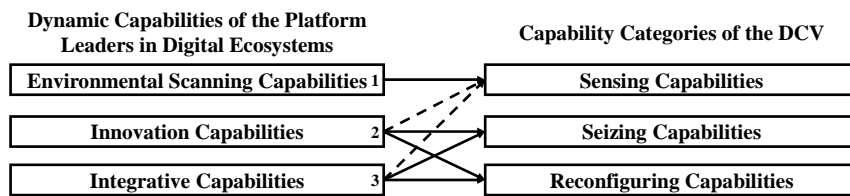


Figure 3. Interaction relationships between the dynamic capabilities and the dynamic capabilities framework (based on [2])

Before linking KBV and DC, some interaction relationships within the considered DCV are discussed. Innovation capabilities can contribute to scanning capabilities by researching new technologies and generating competitive knowledge [2]. Conversely, scanning capabilities help to early detect innovation potentials [2]. Integrative capabilities can have a positive impact on internal innovation by facilitating communication and coordination processes [2].

5.3 Declination of Knowledge-Oriented with Dynamic Capabilities Approaches

Combining the three KBV concepts with the three DCV mechanisms allows to analyze the different effects, presented in *Figure 4*.

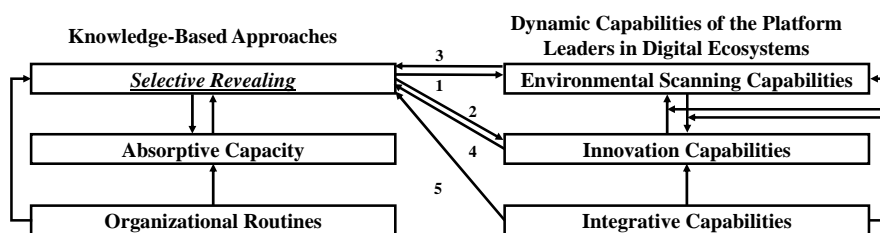


Figure 4. Relational effects between selective revealing and dynamic capabilities

(1) SR is often an invitation to collaborate. Potential partners can decide whether they want to join the collaboration or not. (2) The SR mechanism can contribute to innovation processes in two ways: directly as “a novel pathway to collaboration” or indirectly as “a pathway to reshape external knowledge” [26]. In both ways networking effects can be achieved and external knowledge can lead to innovation success. (3) The

platform leaders environmental scanning capabilities provide information about threats from competitive innovation or opportunities to innovate [2]. This information can provide the platform leader with decision support on the use of SR mechanisms. (4) By generating knowledge (e.g., product or product components) through the platform leader, the starting position for the SR is improving [26]. (5) Integrative capabilities are determinants of internal knowledge exchange and influence communication processes.

We illustrate the interactions between the absorbency and DC in *Figure 5*. (1) "The ability of a firm to recognize the value of new, external information, assimilate it, and apply to commercial ends is critical to its innovative capabilities. We label this capability a firm's absorptive capacity" [49]. (2) Conversely, the platform's innovation capabilities also contribute to the development of its absorption capacity. "Innovative activity (e.g., R&D) contributes to absorptive capacity" or "absorptive capacity itself depends on the firm's own R&D" [49].

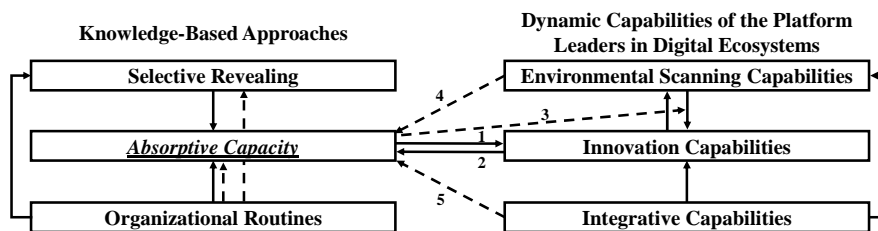


Figure 5. Interactions between absorbency and dynamic capabilities

(3) The platform leader of digital MSP ecosystems generates a wealth of information. Absorbency allows it to properly interpret the wide variety of information relevant to ecosystems [2]. (4) Environmental Scanning Capabilities also affect absorbency by making the absorption abilities of an organization dependent on those of its individual members. Thus, the kind of knowledge that individuals should possess in order to improve the absorption capacity of the organization is important. As the platform leader orchestrates an ecosystem and oversees the corporate environment, awareness of others' knowledge and abilities is strengthened [49]. (5) Absorbency refers not only to the acquisition of information, but also to the ability of the organization to exploit it. Therefore, the absorption capacity of an organization does not simply depend on the direct interface to the external environment, but also on the knowledge transfer between and within subunits [49]. Integrative Capabilities are believed to promote this communication and coordination.

DC is associated with the capacity to perform activities in a skilled and structured manner [46]. Thus, a DC enables the repeated and reliable execution of an activity oriented to strategic change, in contrast to a pure ad hoc activity, which has no practiced, structured behaviour [46, 54]. It is believed that the capacity for repeated service provision is due to a large extent to organizational routines [46]. Organizational skills are described as "high-level routine (or collection of routines)" [54]. Schilke et al. state that "a certain degree of routine is necessary for a process to qualify as a dynamic capability" [46]. The scope of these routines may vary: While some activities appear to be less routine, others are found to have important routine operations: new

product development may not be seen as a routine, as people explore new ideas, but new products are often developed in a stable framework of recurring (and therefore to some extent routinely outdated) organizational processes [46]. In summary, DCs can be assigned routines in a variety of cases [46], although the question of whether all DCs are necessarily highly routinized is still the subject of ongoing debate [46].

Figure 6 represents the interactions of organizational routines to DC. (1) As an example of environmental scanning capabilities, platform leaders can manage units to continuously monitor the external environment. Over time, such units tend to develop routines, such as which sources of information are to be evaluated, how often, and for what purpose. (2) In terms of innovation capabilities, platform leaders, like many software-based companies, often organize their developers into teams assigned to specific projects. At some stage of development, most digital MSPs have developed routines to assign software developers with different types of expertise to different teams. These routines, together with the skills and human capital of software developers and other key personnel, such as product designers, form the basis of the platform's organizational innovation capabilities. (3) Platform leaders can potentially benefit from dedicated teams that use integrative capabilities and are supported by routines in choosing partners and coordinating activities and products. The arrows in both directions signal that the DCs are routine-based, but that DCs can be used to adjust, break up and, if necessary, recreate existing routines [55].

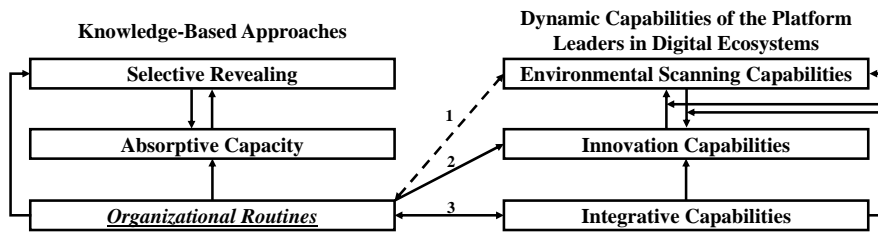


Figure 6. Interactions of organizational routines to dynamic capabilities

It becomes clear that the integrative capabilities in the organizational routines have found their knowledge-based counterpart, as both have an impact on all conceptual and relevant concepts for platform leaders of digital MSP ecosystems (Figure 7).

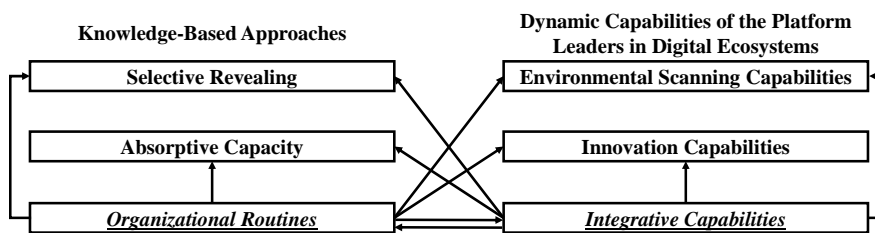


Figure 7. Interactions of organizational routines and integrative capabilities

6 Implications, Limitations and Further Research

This paper provides implications for research and practice with regard to the strategic management of digital ecosystems. Fundamentally, the paper introduces a classification of digital ecosystems and separates the underlying terms for further research. In addition, the paper classifies the existing literature on digital ecosystems in relation to the explanatory approaches of the RBV, KBV and DCV from a strategic management perspective. By combining the increasingly interrelated areas of digitization and strategic management, the contribution creates a fundamental perspective for future research work. By reviewing the current academic literature, the paper also provides an important basis for strategic decision-making regarding the engagement in digital ecosystems and their suitability for creating value for companies. In this way, existing interdependencies in digital ecosystems can be identified depending on the respective role of a company in the ecosystem and analyzed for strategic decisions.

Due to the chosen method, the contribution is subject to some limitations. In respect to the used search strings, the selected databases and the quality criteria applied to the SLR the articles do not claim to completely cover the complete body of literature. In addition, further contributions were identified that relate to PE in the light of RBV [57], KBV [58] and DCV [59]. With regard to the DC of Helfat and Raubitschekf [2] and considered here, the question remains: "how does the value of resources and capabilities differ on the role of firms in the ecosystem" [9]. Also, we offer a very abstract way of describing MSPs. Further research can link the abstract level with practical insights from case studies to assure a higher comprehensibility for readers not being familiar with this topic.

Nevertheless, we show that knowledge-oriented approaches can (or do) moderate DC. They thus provide an explanatory potential for digital MSP ecosystems and should be considered by platform leaders in the orchestration of their ecosystems. Organizational routines and integrative skills constitute a similar pattern of impact and seem to affect all the concepts within the created framework. Thus, the research question can be answered as follows: The classical-static RBV has a limited explanatory potential. The KBV and DCV offer a high potential for explanation. It seems like the integrative capabilities and the associated routines act as drivers.

Furthermore, the underrepresented view of the KBV represents a research gap. To overcome this gap further research should investigate SR mechanisms. The various possibilities of using SR as a "strategic tool in hypercompetitive industries that [...] [is used] to reshape the collaborative behavior of others" seem to be an interesting approach for strategic management [26]. Finally, less attention should be paid to the approach of the static RBV. Future work should focus on the DCV and KBV.

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