Aligning Value Creation in Ecosystems through Roadmapping

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Abstract: There is a growing consensus in research and practice that value-creating networks and ecosystems are supplementing the traditional distinction between the internal firm and market perspectives. To achieve joint value in ecosystems, it is crucial to align the various interests of independently acting ecosystem actors and create a common vision. In this paper, we argue that the ecosystem-wide use of product roadmaps may help with this. To get a better understanding of how roadmapping is conducted in the dynamic ecosystem environment, we systematize the main characteristics of product roadmaps and perform a conceptual comparison with the known challenges of ecosystem management. Comparing the two concepts of ecosystems and product roadmaps, we highlight the fit between the characteristics and objectives of the roadmaps and the challenges of ecosystem management. Hence, we propose to experiment with the ecosystem-wide use of product roadmaps as well as the empirical study of the challenges emerging in the process and the associated redesign of the roadmaps.

Keywords: Ecosystems, Value Networks, Ecosystem Management, Ecosystem Orchestration, Value Alignment, Product Roadmaps, Roadmapping, Ecosystem Roadmaps.

1 Uncertainties Navigating Ecosystems and Dynamic Networks

Digitalization rapidly changes the market conditions for business organizations, reshaping the product design and competition rules. The integration of information technologies, for instance, makes products more intelligent and networked [PH14], [SHL20]. Digitalization even fosters the decoupling of information, functionality, and technologies from the physical products, blurring the traditional organizational boundaries and fostering systemic innovation [LN15], [SHL20]. However, many digitalization initiatives did not realize their potential by relying on their own capabilities despite the changes in product design described earlier. Whether data or digital infrastructure, it becomes evident that companies can only realize the superior value of digital services in ecosystems by balancing their internal resources with the external resources [Sk19], [JSP21].

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doi:10.18420/inf2022_35

Ecosystems represent dynamic cooperation forms to organize value creation, particularly effective in sourcing external resources and capabilities to achieve efficient value creation [TA18], [DAA18]. Ecosystems also build a structure to organize a set of multilateral firms to contribute to a shared value proposition [Ad17]. Accordingly, ecosystem actors are independent firms who may collaborate to jointly realize a specific value manifestation and compete to realize other products or services. The presence of coopetition underlies the prevalent dynamics and fuels a higher degree of uncertainty during the value creation in ecosystems. To illustrate this source of uncertainty, it is worth taking a closer look at platform-based ecosystems, an ecosystem type where ecosystem actors usually agree to utilize a digital platform. Platform-based ecosystems can suffer from information and power asymmetries since the platform provider has control over the fundamental ecosystem building block [He20]. If a platform provider, as a key technology supplier, decides to change its strategy or architecture (e.g., depreciation of Flash by Apple for iOS), this may significantly impact the product development of all ecosystem actors [Ea15]. The prevailing power asymmetry increases uncertainty in the value co-creation in ecosystems, as the value creation partners lack knowledge about the decisions of other ecosystem actors [HHD21]. Hence, ecosystem actors may strive to achieve different strategic goals, preventing beneficial cooperation in an ecosystem. Consequently, planning ahead without knowing what other ecosystem actors you depend on will do in the future is challenging and may even lead to an ecosystem demise, indicated by less value-creating activities.

One of the central sustainability approaches in networked business models is understanding that no sustainable value can be created for customers without creating value for a broader range of stakeholders [JTS20]. In the ecosystem context, we understand this economic sustainability approach as the necessity to manage a fair distribution of success among the value co-creating ecosystem actors. Against this background, ecosystems must establish fair governance and promote the shared value proposition of the ecosystem [TA18], [SP21]. Although hints can be found about the design importance of the ecosystem participation architecture [SP21], ecosystem management is still an infant discipline. Accordingly, there are gaps concerning prescriptive knowledge on how a functioning participation architecture can be designed concretely, while other known scientific disciplines of managing distributed value-creating networks, such as SCM, neglect critical ecosystem determinants [Go21]. Hence, in this paper, we argue that adapting the so-called roadmapping approach with the resulting roadmaps for ecosystem-wide use could work out as a potential solution to support success-critical ecosystem challenges, which may lead to ecosystem demise at some point. Product roadmaps are strategic communication tools that provide an overview of the future direction of product planning and include all important perspectives [Lo17], [Su11]. Product roadmaps align stakeholders' different perspectives and needs, aiming to gain their support through transparent coordination [Tr21]. Consequently, using product roadmaps to align the various ecosystem actors may be promising and motivates the following research question: *Which ecosystem challenges can be addressed through roadmapping*? Therefore, we intend to achieve a conceptual embedding of the roadmapping technique in the context of ecosystem management, reflecting its potential against the known challenges in different ecosystem types. This enables a comparison of ecosystem challenges and roadmap potentials to shed light on how product roadmaps can support the management of dynamic networks such as ecosystems.

2 Ecosystem Value Creation

2.1 Background and definitions

As stated before, firms increasingly create value by cooperating with other firms in networks. Such networks can become dynamic, so Moore [Mo93] reinterpreted biological ecosystems to analyze the interdependence of firms during their interactions. Networks and ecosystems are cooperative forms of organization, with networks determined by dyadic relationships, and ecosystems determined by multilateral relationships [PS21]. Despite the similarities with the traditional research on networks of supply chains (i.e., exploring how organizations can manage their dependencies on the external environment), ecosystem research is considered to be in the definition stage [SG20], [Go21]. Prior research distinguishes at least six recognized ecosystem types [Gu20]. All the ecosystem types can be considered as structures of loosely coupled actors that cooperate and compete simultaneously, resulting in the actors' interdependency [Ad17], [JCG18]. Business ecosystems consist of multiple coopeting organizations to create a superior business value satisfying customer needs [Mo93], [Gu20]. Innovation ecosystems primarily refer to the co-creation of innovation output [Va15], [JCG18]. Service ecosystems organize co-created services [Sk19], [Gu20]. These ecosystem types are, in many cases, underpinned by a shared digital infrastructure (e.g., specific software or standards) to support exchange between ecosystem actors [Gu20]. If platform characteristics determine the commonly agreed digital infrastructure, it is more accurate to refer to platform-based ecosystems. Platform-based ecosystems are based on a central platform architecture serving as a technical foundation to realize value. So-called innovation platforms, for instance, consist of technological building blocks that platform providers and loosely coupled platform users share to create complementary products and services based on the platform [CGY19]. The platform-based output is understood as non-generic (i.e., unique or supermodular) complements since it interacts with the platform core and extends the platform functionality, constituting systemic innovation [PAJ17], [Go21].

2.2 Complexity of ecosystem structure and management

All of these ecosystem types share the complexity for decision-makers to navigate the firm, achieving optimal strategic positioning in an ecosystem [WN13], [CF21]. The complexity is partially caused by the distributed nature of ecosystemic value creation (understood as the *ecosystem structure*), as value-creating activities and the resulting non-generic complements are not directly controlled by a single firm [JCG18]. The structure of ecosystem actors is complex, as **independent yet interdependent complementary firms** (complementors) co-create systemic innovation, which is usually not the case in value networks. Ecosystem actors act independently with no bilateral contractual basis, leading to additional competition for similar innovations. In addition, other ecosystem actors may be involved in the value creation process, such as suppliers, strategic partners, and end customers (e.g., contributing their data) across different domains [JCG18], [He20], [SG20]. The diversity of ecosystem actors can be high since ecosystems manifest organizational openness so that access to the ecosystem is open to potential enterprises outside the ecosystem. Under such conditions, ecosystems can scale more dynamically than traditional value networks and are therefore difficult to capture in long-term planning [Ga14], [He20], [PS21]. Hence, openness induces ecosystem dynamics, sacrificing the stability of closed innovation [WFC14], [CF21], adding new sources of uncertainty during the value creation activities. Ecosystem actors can, for instance, independently work on similar innovations in secret. Alternatively, ecosystem actors may sacrifice certain technologies or standards for the benefit of others. Therefore, ecosystem actors cannot be sure about the individual interests of other ecosystem actors, despite possible technological dependencies. Thus, decision-makers also associate ecosystems with the **risks of information asymmetries** for their firms. Besides, organizational openness may lead to an **oversupply of certain services** or decrease the quality if **"free-riders" join the ecosystem**. Empirical research has confirmed that uncontrolled ecosystem crowding with similar offerings fosters negative network effects, negatively impacting innovation incentives [Bo12]. Consequently, it is a challenge to **fully assess the value flows in ecosystems** to optimally incorporate one's own value contribution into the ecosystem. Accordingly, prior ecosystem research acknowledges the **necessity of careful ecosystem management** as a key to ecosystem success. In addition to the previously described trade-off related to ecosystem openness, orchestration becomes a critical capability for firms to successfully navigate in dynamic and complex environments such as ecosystems [BO18], [Go21].

Similar to the differentiation of different ecosystem types, current literature is also dominated by at least three terms, which conceptually overlap and indicate a conceptual ambiguity. These are ecosystem, orchestration, governance, and management. Ecosystem governance is a multidimensional discipline. Generally speaking, ecosystem governance sets which ecosystem actor (1) does what, (2) what does he control, and (3) how does he benefit [TA18], [DAA18], [TKB10]. Extant research has already discovered multiple variables of ecosystem governance [RS21]. To name a few recognized fields of action, the establishment of controlled access points, incentives for creating qualitative and unique complements, and distribution rights constitute the orchestration discipline. One of the critical action fields is the alignment of ecosystem actors for joint value creation without formal contract-based control. Therefore, orchestration is also defined as a construct aiming to define ecosystem roles, establish an appropriate participation architecture for filling these roles, and coordinate value-creating activities between the roles to achieve the ecosystem vision [DAA18], [Au21], [DP06]. Therefore, orchestration is about creating favorable conditions for valuable companies to actively contribute their resources, which they only do if they achieve their individual goals to some degree [BO18]. A foundation of the ecosystem management concept covered by the literature categorizes it at a higher level. The latest research anticipates multiple views on ecosystem management. Managing the **interdependence tensions** or the complementor is assigned to the process view. Management of the ecosystem structure, rules, and orchestration are considered as the configurational view. Rearrangements of the ecosystem scope is an exemplary focus of the competitive view [Go21]. Tiwana also distinguishes between orchestration and governance in his book on platform-based ecosystems. From his point of view, governance actions that shape the architecture of the ecosystem (e.g., the underlying platform) enable and affect the orchestration of the ecosystem evolution, including the coordination of the ecosystem actors [Ti14]. It is noteworthy to add that governance can be either formal (i.e., in competitive ecosystems such as the iOS ecosystem) or informal (i.e., in collaborative ecosystems such as Wikipedia) [BO18]. However, the previously described openness in domains where value creation manifests in ecosystems, the **diversity of co-creating ecosystem actors** also reduces the chances of effective one-size-fits-all governance and significantly complicates the orchestration of stakeholders. Empirical examples such as the demise of the Symbian ecosystem, on the other hand, illustrate that excessive rigidity in governance does not meet the needs of ecosystem actors since a participation architecture must correspond to the ecosystem dynamics [WW14].

It has also been demonstrated that some companies could organize other firms around them, positioning themselves as hubs in ecosystem value-adding activities. Usually, such firms develop sufficient partner management capabilities or make a critical contribution to the ecosystem's core value proposition [IL04], [BO18], [JCG18]. On the one hand, this means that their value contribution can lie, among other things, in the provision of a digital platform that improves transactions between ecosystem actors or provides important technological building blocks for innovation. On the other hand, by controlling the digital infrastructure, hub companies can set standards and influence the evolution of platform-based complements and, in the best case, gain competitive advantages for the entire platform-based ecosystem. This strategy is also known as platform leadership [GC13]. However, platform leadership can also be considered as evidence of **power asymmetries** in ecosystems. Ecosystem actors may technically depend on the ecosystem infrastructure, and its significant changes may, as illustrated by the deprecation of Flash by Apple, it can jeopardize other actors' business models. Other platform providers exploit their position to replicate complements of other ecosystem actors [KBZ21]. Overall, the resulting power asymmetry is a constant risk in the delivery of ecosystem value. Accordingly, it is also assumed that especially incumbents from industrial domains are reserved about collaboration in ecosystems [CK21].

Digital platforms can coordinate activities, although the platform organization does not have to be a single firm [Ga14]. Accordingly, a hub organization is expected to exercise a certain degree of ecosystem governance over the ecosystem determinants, for instance, controlling the design of the underlying platform. In reality, governance does not have to reside with one company and can also be shared and open to other ecosystem actors [OK20]. Platform organizations are usually capable of setting the rules (1) of the technological platform architecture, such as the modular core, standardized interfaces, and the complementary extensions and (2) social processes to guide the independent ecosystem actors [WFC14]. Platform governance consists of numerous instruments such as the **definition of decision rights, different controls of platform-based input, provision of boundary resources, strategic partnerships of the platform provider, preference of specific complements over others**, and much more [SWK16], [Go21], [RS21]. With this versatile set of measures, platform providers and ecosystem leaders can stimulate network effects, helping ecosystem actors achieve their goals while pursuing a shared ecosystem-wide vision without directly controlling them. It is assumed that other ecosystem actors will follow this direction and align around the ecosystem leaders [Mo96]. However, extant research did not offer support in the form of frameworks or tools, although each of the governance measures in itself represents a complex trade-off decision given the heterogeneous ecosystem structure. As a result of governing the ecosystem architecture or rule sets, orchestration may aim for different goals. It may satisfy the individual goals of innovative ecosystem actors, **correcting the power imbalances** among formally equal ecosystem actors, **fostering matchmaking** and innovative collaborations between actors, or **promoting specific complements** to attract certain customer groups. Accordingly, *trade-offs in governance and orchestration decisions* constitute one more ecosystem challenge category.

In addition to the uncertainties arising from ecosystem management decisions, the variety of *ecosystem dynamics* add to the ecosystem challenges and some examples of these are given below. Ecosystem actors may evolve into **multiple roles**, which can negatively affect innovation incentives if a certain ecosystem outcome becomes too much affected by competition [HW22], [Bo12]. Ecosystems may also be affected by so-called **bottlenecks**, which are components that prevent the overall positive development of the ecosystem. These may be critical technologies needed for a jointly created innovation or tendencies toward monopolistic behavior among orchestrating companies [HE17]. Furthermore, ecosystem actors may form **sub-ecosystems**, decoupling from the rest of the ecosystem, occurring as an unintended effect of orchestration measures. While sub-ecosystems can undoubtedly also generate unforeseen value (i.e., PhoneGap apps for mobile devices), there is also the potential for sub-ecosystems to jeopardize the ecosystem goals (i.e., performance deficits of PhoneGap apps). These ecosystem specifics can be addressed by ecosystem orchestration [JCG18] and thus require appropriate analysis techniques. Lastly, *competitive strategies* can contribute to ecosystem challenges. Known strategies such as **envelopment** or **platform injection** can also disrupt an ecosystem balance by exposing the ecosystem to competitive threats [SKD18], [KR20]. Therefore, applying such strategies should be based on systemic ecosystem analyses.

3 Roadmapping for Ecosystem Navigation

The previous section should outline why firms experience uncertainty, complexity, and high dynamics when navigating or orchestrating ecosystems. The following section addresses the question of how roadmaps support coping with these inherent ecosystem challenges.

Roadmapping is a versatile technique that has been predominantly used in the context of individual companies as well as in the context of domains and markets for requirements engineering, strategic management, long-range planning, and other disciplines [Ka01], [AK03] [PFP04], [Su11], [Vi21]. Roadmapping is also a process of creating and revising roadmaps [LKK05], [Su11]. In their original form, roadmaps are graphic representations of the dynamic linkages between the three high-level strategy views on markets, products and technologies over time, enabling their exploration and communication to stakeholders [AK03], [Su11]. Diverse roadmap types can be combined as multiple layers and represent pathways from the actual state to a certain vision [PFP01], [PFP04], [AK03]. Roadmapping usually intends to create different forms of roadmaps, such as technology, product, innovation, project, or functions roadmaps [MI17]. In the last years, roadmaps were used to support transparent, business-driven, and cooperative decision-making during software development [VLR02], [LKK05]. One can observe that roadmaps have been used in different software development processes. However, recent research has found that feature-based roadmaps have their limitations in dynamic market environments. This is because roadmaps tend to shift the focus to features (e.g., prioritizing them for financial reasons), neglecting business goals or visions. Feature-based roadmaps are fixed-time-based charts that provide a forecast for specific products, features, or services (including concrete launch or deployment dates) [MTL19a]. Consequently, the focus often shifts to functions that do not contribute to the customer or business goals. Therefore, feature-based roadmaps are not suitable in dynamic market environments with the associated uncertainties but only in market environments that are predictable, stable, and reliable [MTL19a]. Hence, so-called dynamic roadmaps could be used. They describe how a company could achieve its vision and strategy to fulfill customer needs, connecting vision and needs with pathways to execute [MTL19b], [Tr21]. Roadmaps visualize possible routes to achieve a firms' vision and can be used as an artifact to raise awareness of internal and external stakeholders about the decisions made during the development [Lo17]. It should be noted that such roadmaps are appropriate to create alignment between the various actors in the ecosystem. In addition, roadmaps should be treated as revisable artifacts to cope with the changing conditions in dynamic environments. Depending on the purpose of the roadmap, there is a discussion on how to make the use of roadmaps more flexible, and there is already research on maturity models so that companies can evaluate whether they use roadmaps systematically and iteratively [MTL19b].

Nevertheless, the current scientific discourse on the use of roadmaps reveals that, although they are quite versatile, many companies still use them for long-range planning, which is rather static, and encounter difficulties in applying roadmaps according to the requirements of an uncertain and dynamic environment [MTL18], [MTL19b]. The dynamic roadmaps are precisely the ones that could potentially take on the ecosystem dynamics. However, few research studies have been conducted on the design of dynamic roadmaps, and they still relate to the individual organization level. Most roadmapping papers in the context of software describe the use of roadmaps for coordination within individual organizations. However, roadmaps in dynamic networks such as ecosystems have hardly been researched. The missing application of roadmaps between the markets and single organization levels inspired us to highlight the fit between the characteristics and objectives of roadmaps and the challenges of ecosystem management, proposing the roadmapping approach for its ecosystem-wide use.

4 A Proposal for Using Roadmaps to Support Ecosystem Navigation

Ecosystem management is complex, cannot always be planned or remain directly controllable, and can eventually lead to undesired effects, whereby the absence of ecosystem management also increases the risk of ecosystem demise. This can be caused, for instance, by ruinous competition, which negatively impacts incentives for innovation, or by an increase in complementary products of insufficient quality [Bo12], [WFC14]. Both effects endanger the economic sustainability of an ecosystem. Thus, dynamic roadmaps deployed ecosystem-wide, offer the potential to promote alignment among multilateral ecosystem actors, achieving greater reliability in development and increasing ecosystem stability. Fig. 1. illustrates a proposal for using multi-layered ecosystem roadmaps to enable ecosystem actors to (1) start reflecting on the ecosystem-related vision, (2) then assessing the current state, and (3) the planning on how to achieve the vision.

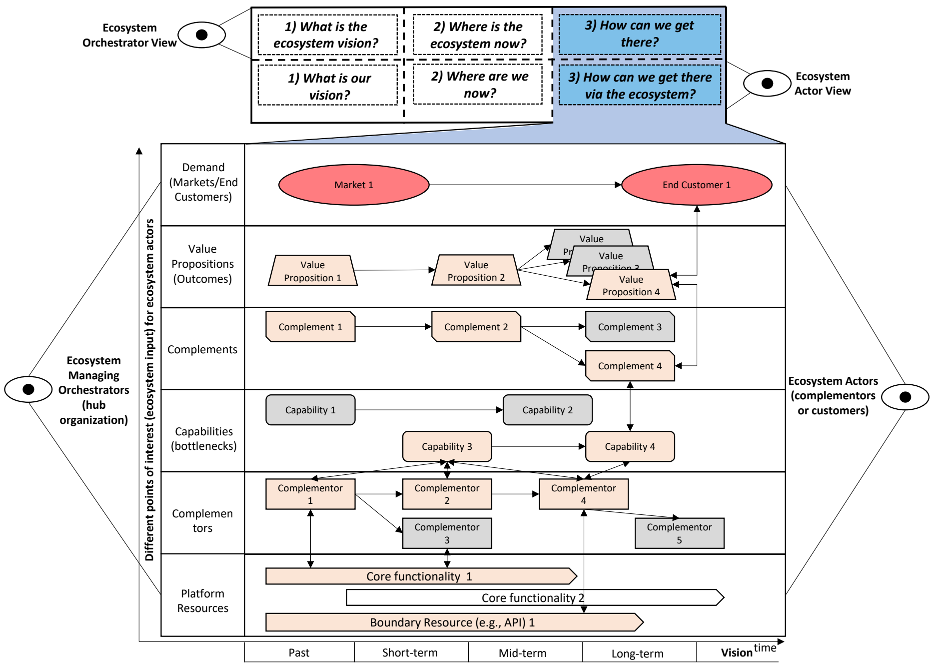

Fig. 1: Approach for ecosystem-wide use of roadmaps

As explained in the section before, different types of roadmaps can constitute a living artifact, which illustrates the causal relationships between different determinants that constitute ecosystems. That said, diverse ecosystem actors can see the critical pathways to position themselves to discover niches and recognize their own power position in the ecosystem. On the other hand, ecosystem orchestrators can use roadmaps to identify critical ecosystem actors, which could help to discover more ecosystem bottlenecks. Besides, ecosystem orchestrators can use roadmaps to improve value co-creation as the visualized added-value flows support matchmaking activities. Additionally, ecosystem orchestrators can use roadmaps to improve ecosystem communication, which is critical to defending significant governance decisions. If roadmaps are obligatory in ecosystems, power asymmetry cannot be prevented, but at least information asymmetry can be prevented. Imagine every ecosystem actor is required to document in the roadmap his decisions to abandon certain technologies, complements, or projects in the ecosystem. This would help increase transparency and trust about the competitive behavior of ecosystem actors among other ecosystem actors who rely on this abandoned technology. This would reduce the power asymmetry risks of both technological dependencies on platform providers (e.g., iOS and Flash deprecation) and complementary value-added partners (e.g., a unique complement). The beneficial use of roadmaps in ecosystems is based on the assumption that ecosystems cannot be designed but can be planned to a limited extent from the orchestrator's perspective. Planning can also help other ecosystem actors navigate (e.g., positioning) ecosystems. We suggest reading the roadmap from bottom to top in the ecosystem context. It starts with the illustration of platform boundary resources required by complementary ecosystem actors, which may contribute valuable capabilities to the ecosystem and create complements with a certain value proposition to fulfill the needs of end customers, representing the demanding side of the ecosystem [He20]. The time axis also allows for a specific mapping of ecosystem dynamics, which is often lacking in existing ecosystem management techniques [Ma21]. As a central artifact, ecosystem roadmaps can help visualize the ecosystem determinants relevant for joint value creation, and foster the discovery of critical bottlenecks or gaps. While ecosystem orchestrators could safeguard the bottlenecks, complementors could occupy the gaps in the offering. However, in contrast to earlier research, all ecosystem actors should view and collaboratively shape the roadmap across companies. In particular, using the roadmap as a living document for communicating strategic changes by individual ecosystem actors could prevent information and power asymmetries and increase transparency and trust. Based on roadmaps, the risks of potential and already participating ecosystem actors can be reduced through roadmaps, and companies' willingness to participate in the ecosystem can be promoted. Tab. 1 sums up the potential of roadmaps for ecosystem management.

After all, if roadmaps help to avoid certain risks for ecosystem actors, for example, increasing trust between organizations or even domains, research on ecosystem-wide use of roadmaps has the potential to foster the sustainability of ecosystems [Ga21], ensuring that complementors and customers benefit from mutual economic stability.

	Ecosystem Challenges	Roadmap Potentials
Ecosystem structure	• Structure of interdependent actors • Formal independency • Oversupply • Diversity of actors • Power asymmetries • Information asymmetries	• Fostering the ecosystem transparency • Ecosystem actor alignment • Identification of product risks • Transparency on actors and capabilities • Visibility of dependencies • Increasing inter-organizational trust
Ecosystem manageme nt trade-offs	• Definition of decision rights • Input control • Provision of boundary resources • Preference for specific complements • Matchmaking	• Transparency on responsibilities • Outcome-based ecosystem control • Boundary resources management • Supporting discussion of preference decisions • Fostering actor assessment
Ecosystem dynamics	• Role instability • Bottlenecks • Sub ecosystems	• Ecosystem actor alignment • Communication of threats • Communication of threats
Ecosystem strategies	• Envelopment • Platform injection	• Transparency • Countering unwanted evolutions

Tab. 1: Potentials of roadmapping for ecosystem management

5 Future Steps

Some ecosystems also lack hub organizations, as the power differentials between organizations are small [TA18]. [DAA18], [HMP22]. Without hub organizations, ecosystems are considered to have an even higher degree of uncertainty for potential actors. Especially in such domains, the alignment of ecosystem actors with individual goals and agendas is problematic. We are confident that structuring ecosystem activities can also help the ecosystem firms better navigate without being in an orchestrating position. Ecosystem management is considered a critical capability for ecosystem navigation, and it needs to be acquired, especially by companies that were used to linear value chains and currently adapt to ecosystems. Roadmaps can, for instance, help sensitize industrial incumbents in contact with ecosystems. However, ecosystem roadmaps must be tailored for inter-organizational use and specific ecosystem determinants such as complements, ecosystem rules, or critical resources. Although tools for ecosystem management seem to exist already, most of these tools are not adapted to ecosystems

[Ma21]. In line with Matzner et al., we see the need for further research to test existing tools such as roadmaps for their suitability in an ecosystem-wide approach. Therefore, requirement elicitation studies with representatives from companies that create value in ecosystems is a promising future research direction. Empirical studies on the use of roadmaps in ecosystems could also be instantiated for the industrial domain, as prior research indicates several examples of ecosystem failure there. Considering industrial firms' rigorous requirements to participate in ecosystems [PFM21], empirical validation of the roadmap suitability in general and its adoption for ecosystem navigation in the industrial domain would be valid for future research, as there is currently no application example for dynamic roadmaps in ecosystems. In addition, an analysis of software ecosystems with release roadmaps for developers (e.g., Apple iOS) could be helpful in determining the status quo in ecosystem communication and use it as a basis for future design-oriented research on ecosystem roadmaps.

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