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[Collaborative digital platform ecosystems: A governance perspective - A literature review combined with insights from the Norwegian aquaculture industry]

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Collaborative digital platform ecosystems: A governance perspective

A literature review combined with insights from the Norwegian aquaculture industry

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Abstract

Digital platform ecosystems are increasingly shaping how business is conducted in all industries. However, building them is far from straightforward. Specifically, building a digital platform ecosystem refers to the actors' act of developing such a platform, its boundary resources, and the other resources necessary to promote its intended use. It also requires actors to agree on the goals of the ecosystem and the roles they will assume. Here, governance is a key topic because it helps address coordination problems and collaborative and competitive challenges. Poor governance choices have been acknowledged as causing platform failures. Therefore, there is increasing interest in this topic, although many questions remain. For instance, it is still unknown how the different governance choices can be best combined or affect one another. Moreover, the current understanding of which choices are more effective at various stages of a platform's development or in specific contexts, as in decentralized platform ecosystems, is scant.

Therefore, I have decided to investigate decentralized platform ecosystems under development, and, specifically, collaborative platform ecosystems, where companies join forces to address a problem that they cannot solve in isolation. The overarching research question that this thesis examines is: *How does governance contribute to building a collaborative digital platform ecosystem?*

This introductory chapter first provides an overview and general understanding of the nature of digital platforms and digital platform ecosystems. There follows a description of what to consider when building a digital platform ecosystem. I also cover existing knowledge on digital platform ecosystem governance, focusing on its various concepts and connections to the building phase.

Overall, the present thesis addresses governance in the context of (collaborative) digital platform ecosystems and its role in building them. The first article of the thesis is a literature review that provides a structured overview and synthesis of digital platform ecosystem governance from a systematic and multidisciplinary perspective. Articles 2 and 3 are empirical and based on a longitudinal, qualitative case study of a collaborative digital platform ecosystem in the Norwegian aquaculture industry.

This research contributes to the academic conversation on digital platform ecosystem governance by showing that, in building collaborative digital platform ecosystems, governance can enable coordination among actors and ease their competitive and cooperative challenges. Moreover, this research suggests that collaborative digital platform ecosystems can be at least partially planned and that their governance is more collective and emergent compared to centralized platform ecosystems. Furthermore, each individual article provides specific theoretical and practical implications.

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Time flies. As I sit down to write these acknowledgments, it's hard to believe that almost five years have passed since I first applied to the PhD program, eager yet uncertain about the academic journey that lay ahead. Now, as I write these lines, I am filled with gratitude for the experiences, challenges, and growth that have characterized this remarkable chapter of my life.

The adventure of this doctoral thesis has not only been a scholarly pursuit but also a transformative journey marked by significant life changes. The decision to pursue a PhD led me to traverse borders, leaving behind familiar landscapes and professional roles that had shaped my career until that time and enriching myself with new and diverse perspectives.

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Carolina Costabile,

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Introductory chapter

1. Introduction

Digital platform ecosystems are reshaping industries, economies, and societies. Platforms, such as malls that connect consumers and merchants, have existed for many years; however, pervasive technological development has made it possible to reduce the need to own physical infrastructure and assets to scale up in a cheaper way, to foster nearly frictionless participation, and to exchange large amounts of data (Van Alstyne et al., 2016).

Following Gawer (2014), Gulati et al. (2012), Hein et al. (2020), and Jacobides et al. (2018), I understand digital platform ecosystems as evolving meta-organizations that coordinate interdependent yet autonomous actors through means other than a hierarchy. Digital platform ecosystems comprise both technical and social elements (e.g., architecture, actors, and activities), thus presenting a socio-technical nature (de Reuver et al., 2018; Iden et al., 2022). Platform ecosystems are usually characterized by the presence of a single focal actor called the platform owner, who establishes the governance of the ecosystem (Cennamo & Santaló, 2019; Thomas & Ritala, 2022). However, in this thesis, the primary focus is on *collaborative platform ecosystems* in which independent companies join forces in building and governing the ecosystem to solve a common challenge. Little study has been devoted to decentralized types of digital platform ecosystems, creating not only a theoretical gap but also a practical one given that more and more collaborative ecosystems are becoming established in various industries.

Despite increasing interest from both academics and practitioners, our knowledge of how companies embark upon the journey of establishing a thriving digital platform ecosystem is limited. Building a digital platform ecosystem refers to the actors' act of developing the digital platform, its boundary resources, and the other resources necessary to promote its intended use (Iden et al., 2021:2). This initial phase is delicate and presents a variety of challenges and coordination problems that, if not properly addressed, make it difficult to establish the envisioned platform ecosystem in the very first place (Foss et al., 2023; Gelhaar & Otto, 2020). It is usually difficult to build an ecosystem, and this is even more the case when different companies collectively want to establish one. Research has found that one-third of digital platform ecosystems fail due to poor governance decisions (Floetgen, Novotny, et al., 2022, as cited in Floetgen, 2023; Reeves et al., 2019, as cited in Floetgen, 2023). Thus, the importance of governance in building digital platform ecosystems cannot be underestimated.

Therefore, in this thesis, I explore the role of governance in the delicate building phase of collaborative digital platform ecosystems by asking this overarching research question: *How does governance contribute to building a collaborative digital platform ecosystem?*

To answer the research question, I include three articles in this thesis – a review paper and two empirical articles. In the review paper, I provide an overview and synthesis across different fields of research on digital platform ecosystem governance. In doing so, I provide a robust foundation for the topic and address the current fragmented state of related research. In the two empirical papers, I explore specific aspects of governance that are directed toward building collaborative ecosystems to fulfill their purpose. These empirical papers are based on insights from a longitudinal, qualitative case study of a collaborative digital platform ecosystem in the Norwegian aquaculture industry. My research contributes to the academic conversation on digital platform ecosystem governance. Specifically, I focus on the building stage, on which there is little extant research. Moreover, my research shows that, in building collaborative digital platform ecosystems, governance can enable actors' coordination and ease their

competitive and cooperative challenges. Furthermore, the present research suggests that collaborative digital platform ecosystems can be at least partially planned and that their governance is more collective and bottom up compared to centralized platform ecosystems.

The three papers included in this thesis are tightly linked through their common aim of providing insights into governance choices. The common focus is a consequence of the findings and conclusions drawn in the literature review, such as the need for more research on collaborative platform ecosystems, on how a platform's degree of decentralization affects other governance choices, and on the best fit between governance choices and platform ecosystems' evolutionary stages. Figure 1 illustrates selected directions for future research presented in Article 1 that are addressed by Articles 2 and 3 and my overall research.

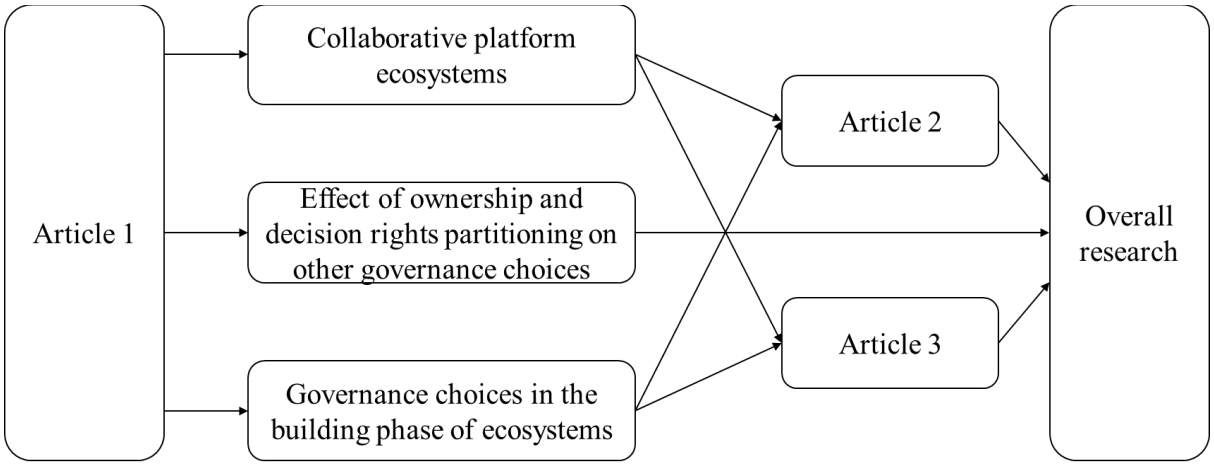

Figure 1. Connections among the thesis articles.

The remainder of this introductory chapter is structured as follows. In Section 2, I introduce relevant concepts and literature on digital platform ecosystems and governance. In Section 3, I present my methodological choices, such as the research paradigm, methods, and an introduction to the selected case. I also touch upon data collection and analysis to add information in relation to what has already been presented in the papers, and I discuss the trustworthiness of the research findings. In Section 4, the three articles are briefly presented. In Section 5, I discuss the theoretical and practical contributions of this research. Section 6 presents the research limitations and directions for future research. Section 7 concludes the thesis.

2. Literature

In this section, I explore in greater depth the concepts of digital platforms and digital platform ecosystems. I then introduce literature related to the building phase of digital platform ecosystems and governance.

2.1. Digital platforms

Digital platforms are among the most important digital innovations. They are spreading quickly and are having a major impact on the way businesses organize and carry out activities (e.g., marketing, strategy, and delivery) in a wide array of industries (Asadullah et al., 2018). For instance, digital platforms have revolutionized industries such as software development (e.g., Google Android), finance (e.g., PayPal), transportation (e.g., Uber), and hospitality (e.g., Airbnb). Some companies have witnessed a rapid domination of their industries. This occurred

in the case of Apple, which, from 2007 to 2015, achieved a market share representing 92% of global profits with the iPhone and its operating system, which were conceived as a two-sided market connecting app developers and users (Van Alstyne et al., 2016). Given the significant growth in size and scale that they facilitate, digital platforms are considered an attractive business model that can be realized through the combination of digital technologies, such as cloud computing, in-memory databases, and analytical solutions (Asadullah et al., 2018; Hein et al., 2019a, as cited in Hein et al., 2020; Iden et al., 2022).

Digital platforms' dependence on technologies has made them of increasing interest to the information systems (IS) research community (Asadullah et al., 2018), although they have also been studied in various other research fields. Due to this broad interest, there continues to be ambiguity in the way digital platforms are defined and conceptualized (Asadullah et al., 2018; de Reuver et al., 2018). Some researchers have adopted a technical perspective to examine the technical elements of digital platforms (Hein et al., 2020; Tiwana et al., 2010). From this perspective, digital platforms consist of a technical core upon which complementary products and services can be developed (Ghazawneh & Henfridsson, 2013; Spagnoletti et al., 2015; Tiwana et al., 2010). In this sense, the cocreation of value and innovation (e.g., the creation of applications for an operating system platform) are the purpose of platforms (Schreieck et al., 2016). Most studies conducted from this perspective have focused on software development industries, such as Apple iOS, and the dynamics between the core and the capabilities provided to app developers (Asadullah et al., 2018). Other researchers have followed a nontechnical, market-oriented perspective rooted within economics (Eisenmann et al., 2011; Tan et al., 2015, as cited in Asadullah et al., 2018). According to this view, platforms resemble two- or multi-sided markets that connect two or more groups of actors via business-to-business (B2B), business-to-consumer (B2C), or even consumer-to-consumer (C2C) transactions (Asadullah et al., 2018; Bazarhanova et al., 2020; Otto & Jarke, 2019; Schreieck et al., 2016). From this perspective, the primary foci are to match supply and demand, exchange information, foster network effects, and understand how the platform's value on one side depends on the size of the other side (Gawer, 2014; Hein et al., 2020; Schreieck et al., 2016).

Some researchers have acknowledged the benefits of integrating these perspectives because they are not inherently distinct (Asadullah et al., 2018; Gawer, 2014; Hein et al., 2020; Schreieck et al., 2016). Schreieck et al. (2016) suggest that all platforms need underlying technologies and present a market's features. For instance, an app store is a marketplace that matches app developers and app users, and at the same time, it enables innovation via the operating systems of mobile devices. With such an integrative approach, both the technical core and the ecosystem of participants that is built around it can be accounted for (Asadullah et al., 2018). In this thesis, I adhere to this integrated view to examine digital platforms and their ecosystems.

2.2. Digital platform ecosystems

Digital platform ecosystems are typical instantiations of ecosystems (Riasanow et al., 2021). The ecosystem perspective originated within biology and was first introduced in the research field of strategic management thanks to the seminal work of James Moore, "Predators and Prey" (1993). Moore (1993) suggested using this perspective because companies do not operate in isolation but rather affect and are affected by other companies. Thus, the success of a company depends on several distributed entities, such as suppliers, partners, customers, and competitors,

and their interrelationships (Iansiti & Levien, 2004). From the field of strategic management, the ecosystem perspective has since reached other fields of research, such as IS.

Ecosystems are understood differently in different research streams (see Adner, 2017), leading to the lack of a unique, agreed-upon definition. In this thesis, I employ an organizational lens and rely on Gawer (2014), Gulati et al. (2012), and Jacobides et al. (2018) to understand digital platform ecosystems as open, evolving meta-organizations that coordinate actors through means other than a hierarchy. The large variety of digital platform ecosystems makes it complicated to define what they include, but it is possible to say that such an ecosystem comprises actors, activities, and architecture (Adner, 2017; Iden et al., 2021; Iden et al., 2022). The *actors* are usually of four types. The platform owner controls the platform and who can participate in the ecosystem, such as Google with its Android. A complementor creates offerings (e.g., apps on the Android platform), and a consumer uses these offerings (Van Alstyne et al., 2016). A supplier provides the interfaces for the platform (e.g., Samsung provides mobile phones for the Android platform). *Activities* are related to the creation of value in the ecosystem and are undertaken by actors in interactions. Examples of activities are the development and exchange of information, products and services, and payment. *Architecture* refers to the digital platform and other technological solutions that facilitate interactions and, thus, activities between the actors (e.g., the internet, infrastructure, interfaces, and smartphones).

The existence of both technological and social elements makes digital platform ecosystems socio-technical in nature (de Reuver et al., 2018). Another feature of digital platform ecosystems is their dynamicity. As suggested by Gawer (2014), actors may change over time (e.g., a consumer can become a complementor), and new groups of actors (or sides) can be added. Offerings and technological aspects as interfaces may also change over time. Therefore, understanding how to integrate and govern an ecosystem of shifting actors, architecture, and activities is key (de Reuver et al., 2018; Gawer, 2014; Hein et al., 2020). Existing literature has mainly approached governance from the point of view of the single platform owner and of mature platform ecosystems (e.g., Ghazawneh & Henfridsson, 2013).

In the next two subsections, I outline the extant literature on the initial phase of digital platform ecosystems and on digital platform ecosystem governance, on which I rely for my investigation of building collaborative platform ecosystems from a governance perspective.

2.3. Building digital platform ecosystems

Digital platform ecosystems evolve differently (Evans, 2009, as cited in Staykova & Damsgaard, 2017) and have varying lifecycles, according to researchers. For instance, Moore (1993) outlines four development stages: birth, expansion, leadership, and self-renewal (or death). In the first stage, defining what customers want (i.e., the value proposition) is crucial, cooperation is beneficial, and a platform owner usually emerges. The expansion stage sees ecosystems controlling customer relationships and core centers of value and innovation and engaging in direct battles with other ecosystems. In the leadership stage, a dominant ecosystem emerges as the sole provider of a specific product or service. The final stage faces threats from new ecosystems and innovations. Other researchers suggest a two-stage lifecycle (Caillaud & Jullien, 2003). The first stage sees companies competing to establish ecosystems in their respective target markets, addressing initial coordination issues, and attracting a critical mass of consumers and complementors (Caillaud & Jullien, 2003; Rochet & Tirole, 2003). In the

second stage, relative equilibrium is achieved, and the focus is on orchestrating complementors, as consumers have converged on one or a few platform ecosystems (Halckenhaeusser et al., 2020).

In this thesis, I focus on the initial stage – *building a digital platform ecosystem*. This stage can be considered a process in which companies innovate, strive to scale the resulting novelty, and make it recognizable (Seidel & Greve, 2017, as cited in Daymond et al., 2022). This stage starts with envisioning the ecosystem, and it is characterized by high uncertainty encompassing the creation of rules and agreements and coordination around a value proposition (Foss et al., 2023). This stage ends when the ecosystem reaches full maturity,[1] at which point activities are modularized and no longer necessitate coordination (Baldwin & Clark, 2000; Foss et al., 2023). This stage holds intrinsic significance and influences subsequent evolution, affecting the success or failure of generative platform activities, shaping network externalities, and modifying governance choices (Dattée et al., 2018; de Reuver et al., 2018; Wareham et al., 2014).

Companies building digital platform ecosystems must navigate competitive and cooperative challenges through a trial-and-error approach (Altman & Tripsas, 2015, as cited in Schreieck et al., 2021; Gelhaar & Otto, 2020; Ofe & Sangberg, 2019; Thomas & Autio, 2015). Given the socio-technical nature of digital platform ecosystems, both social and technical aspects must be considered. Social aspects comprise defining the value proposition, agreeing on roles, and balancing value cocreation and capture (Bharadwaj et al., 2013; Foss et al., 2023; Hodapp et al., 2019). Technical aspects pertain to the architecture (i.e., the platform and the interfaces, such as standards; Gelhaar & Otto, 2020; Jacobides et al., 2018).

Companies should first define the *value proposition* that is the ecosystem's goal and the benefits for participants (Adner, 2017; Foss et al., 2023). This requires considering which interactions to enable, including which actors to involve (e.g., buyers and sellers, or developers and users) and which products and/or services to make available on the platform (Van Alstyne et al., 2016). The value proposition serves as a *proof of concept*, demonstrating the ecosystem's viability and the satisfaction of initial customers' needs (Moore, 1996). It is a joint effort, improvable through partner collaboration and customer feedback, which takes time due to varying actor interests and beliefs (Annanperä et al., 2016; Gelhaar & Otto, 2020; Moore, 1996; Van Dyck et al., 2021). The attractiveness of the value proposition, a common understanding of it, and commitment to it hinge on having an unambiguous platform owner with the ability to communicate, engage other actors, and demonstrate the benefits of participation (Annanperä et al., 2016; Foss et al., 2023; Gelhaar & Otto, 2020).

However, at this stage, *actors' roles and leadership positions* are unclear (Dattée et al., 2018; Hodapp et al., 2019). Hence, actors must agree on their roles, that is, their performed functions within the ecosystem (Oliveira & Lóscio 2018). Typically, a company initiating an ecosystem assumes the platform owner role, contingent on its ability to adapt the ecosystem to changing conditions and on other actors' willingness to follow (Adner, 2017; Foss et al., 2023; Iansiti & Levien, 2004; Jansen et al., 2013b, as cited in Gelhaar & Otto, 2020). Agreeing on roles is complex due to limited awareness among actors of each other's capabilities and how to collaborate effectively for success (Dattée et al., 2018; Hannah & Eisenhardt, 2018). The discussion about actors and roles introduces the chicken-and-egg problem, that is, the challenge

[1] Full maturity doesn't mean that uncertainty is completely removed (Foss et al., 2023).

of attracting both supply and demand sides when there is no counterpart (Caillaud & Julien, 2003; Hein et al., 2020; Ofe & Sandberg, 2019; Evans & Schmalensee, 2010, as cited in Weiss et al., 2023). For instance, a consumer sees no benefit from participating on a platform without sellers who produce offerings to buy, and vice versa.

For a compelling value proposition, it is also important to balance the tension between *value cocreation and capture* (Bharadwaj et al., 2013; de Reuver et al., 2018; West, 2003). An attractive ecosystem for actors to join is one that can create value and make it quantifiable (Hodapp et al., 2019). Although prioritizing value cocreation is essential at this stage, companies should not overlook fair value capture, as sustained profits and further actor recruitment depend on it (Ceccagnoli et al., 2012; Cennamo & Santaló, 2019; Jacobides et al., 2018; Schreieck et al., 2021).

Regarding technological aspects, companies must agree on the *architecture* of the developing ecosystem, which is considered the conceptual blueprint describing the division of an ecosystem into a stable core, complementary modules, and connecting rules (Tiwana et al., 2010). Among the aspects to be considered are how the different parts are decomposed to minimize their interdependence and to support changes and variation. Another important choice is modularity, which often characterizes the core, reduces the need for the coordination of complementary modules, and fosters generativity (e.g., the generation of complements from autonomous actors; Cennamo & Santaló 2019; Jacobides et al., 2018; Tilson et al., 2010; Yoo et al., 2010). Agreeing on an architecture can be challenging when actors from different industries have historical dominance, and integrating legacy technology adds complexity (Hodapp et al., 2019). Therefore, defining rules and compelling interfaces (known as *boundary resources*) for interoperability among components and coordination among actors and their activities is crucial (Baldwin & Clark, 2000, 2006; Gawer, 2014; Ghazawneh & Henfridsson, 2013; Ofe & Sandberg, 2019; Tiwana et al., 2010). Among these boundary resources, standards and data have been highlighted, with proper data management being key for platform adoption (Gawer, 2014; Gelhaar & Otto, 2020; Jacobides et al., 2018; Lis & Otto, 2020; Schreieck et al., 2016). Regarding data, companies must determine their role (e.g., data providers or data users), understand the data that is available, and decide how it will be accessed, used, and shared (Lis & Otto, 2020; Vesselkov et al., 2019). For example, individual-level data are usually key for transaction platforms' ecosystems, whereas higher-level and aggregated data may be more relevant for innovation platforms (Bhargava et al., 2020). At the building stage, architecture is not yet mature, and actors may be unsure about its stability and generativity (Mei et al., 2021).

To conclude this section, it is worth mentioning that an ongoing debate surrounds the emergent or planned nature of digital platform ecosystems (Adner 2017; de Reuver et al., 2018; Otto & Jarke, 2019). On the one hand, they are seen as outcomes of a structured design process, generally organized around the platform owner (Iansiti & Levien, 2004; Immonen et al., 2014; Jacobides et al., 2018; Tian et al., 2008). On the other hand, they are viewed as emergent settings, arising around a value proposition that can be planned and designed only to a limited extent, and which may also thrive without a platform owner, although one tends to emerge in most instances (Adner, 2017; Otto & Jarke, 2019).

2.4. Digital platform ecosystem governance

Unlike pipeline companies, platform companies focus less on designing, developing, and distributing products and more on governing actors, activities, and infrastructure to enhance

ecosystem outcomes (Boudreau, 2010; Cennamo & Santalo, 2013; Evans & Schmalensee, 2016, as cited in Halckenhaeusser et al., 2020). In platform ecosystems without principal-agent relationships, governance involves actors' coordination and orchestration rather than coercion (Constantinides et al., 2018; Foss et al., 2023; Tiwana, 2015). In building an ecosystem, governance plays a key role in solving coordination, cooperation, and competition problems and in attracting a critical mass (as described in Subsection 2.3) – problems that, if not solved, make it impossible for an envisioned platform ecosystem to be established in the very first place (Caillaud & Jullien, 2003; Foss et al., 2023; Halckenhaeusser et al., 2020; Rochet & Tirole, 2003). Initial governance arrangements can have enduring impacts on capturing value for a platform owner or influencing subsequent governance choices (Foss et al., 2023; Uzunca et al., 2022).

Despite actors' autonomy and independence, governance is often investigated from the perspective of the platform owner, who must strike a balance between retaining and relinquishing control to ensure complementors' ability to innovate and maintain the platform's integrity (Gawer, 2014; Tiwana et al., 2010). Extant research has discussed various governance concepts, including ownership, decision rights partitioning, control, openness, pricing, boundary resources, and value cocreation and capture (Eisenmann et al., 2009; Perscheid et al., 2020; Schreieck et al., 2016; Tiwana et al., 2010).

Ownership concerns whether the platform ecosystem is owned by a single firm, multiple firms, or a peer-to-peer network (Perscheid et al., 2020; Schulze et al., 2021; Tiwana et al., 2010). *Decision rights partitioning* entails how decisions regarding user interfaces, complements' features and functionality are shared between a platform owner and complementors. While platform owners may wield more decision-making authority, balancing diverse interests is crucial to attracting and retaining complementors (Schulze et al., 2021; Tiwana et al., 2010). These two choices affect the degree of decentralization of a platform ecosystem, ranging from centralized to decentralized to autonomous (e.g., blockchain-based platform ecosystems; Perscheid et al., 2020; Riasanow et al., 2018; Schulze et al., 2021; Werner et al., 2020). These governance choices are closely related to the definition and agreement of roles within a platform ecosystem (Schreieck et al., 2016).

Control involves encouraging and aligning actors' behavior with the platform ecosystem's goals (Tiwana et al., 2010). It can be enforced through formal or informal means, including, respectively, explicit prescriptions over inputs, outputs, processes, and tasks, or shared norms and values (Askay, 2017; Constantinides et al., 2018; Croitor et al., 2021; Ens et al., 2023; Tiwana et al., 2010). Moreover, control can originate from the platform owner's intentions or can be more distributed, coming from other participants (Ens et al., 2023; Tiwana et al., 2010).

Openness pertains to easing restrictions on the platform's development, commercialization, and use (Boudreau, 2010; Eisenmann et al., 2009). It exists on a continuum, with a higher level potentially encouraging platform adoption, fostering complement variety, increasing customer satisfaction, and supporting network effects and value cocreation (Boudreau, 2010; Eisenmann et al., 2009; Gawer, 2014). For incumbents building digital platform ecosystems, it may be strategic to start with a low level of openness (by opening selected resources) and gradually increase it over time (Schreieck & Wiesche, 2017; Van Dyck et al., 2021).

Pricing is a critical choice to kickstart a platform ecosystem (Eisenmann et al., 2006, 2011). To attract a critical mass, platform owners often employ subsidization, especially in consumer

platform ecosystems (Caillaud & Jullien, 2003; Parker & van Alstyne, 2005; Rochet & Tirole, 2003). This means that one side (usually demand) can participate in the ecosystem for free, facilitating the attractiveness of actors on the other side. For example, in the AppStore, consumers can usually download and use apps for free, while app developers pay a fee to participate. Sometimes, platform owners may even pay users to encourage them to join, as shown by PayPal's initial offer of money to sign up and open an account (Staykova & Damsgaard, 2015). Typically, platform owners initially focus on the most price-sensitive side to grow their ecosystems (e.g., Eisenmann et al., 2006; Gawer & Cusumano, 2008). However, for startups, it may be better to start with the side that can be best approached with existing resources, as demonstrated by Facebook, which started with the participation of friends and classmates close to its founders. Overall, when building a platform ecosystem, determining the starting side is a crucial consideration (Wang & Nandhakumar, 2017).

Boundary resources are software tools and regulations that can both control and stimulate actors' interactions and activities (Constantidines et al., 2018; Ghazawneh & Henfridsson, 2013). Technical boundary resources (e.g., application programming interfaces (APIs), software development kits, data, and standards) improve complements' technical feasibility, permit access to the platform, and facilitate communication across actors' technologies, whereas social boundary resources (e.g., guidelines and agreements) transfer knowledge for better understanding and interactions across actors (Gawer, 2014; Dal Bianco et al., 2014; Foerderer et al., 2019; Luo et al., 2019; Schreieck et al., 2016). While platform owners often set these boundary resources on their own, involving other actors in their design may be crucial for incumbents building a platform ecosystem and when other actors perceive only a limited set of these resources' functionalities (Jacobides et al., 2018; Mohagheghzadeh & Svahn, 2016; Weiss et al., 2023). In the absence of a platform owner, setting design and engagement rules becomes even more challenging (Miller & Toh, 2020). When looking specifically at standards, companies may compete to gain competitive advantages and avoid later lock-ins, which open standards may mitigate (Borgogno & Colangelo, 2018, as cited in Gelhaar & Otto, 2020; Farrell & Klemperer, 2007, as cited in Gelhaar & Otto, 2020; Hodapp et al., 2019). Concerning data, a platform owner should take care of the interests of both sides to build a healthy platform ecosystem (Bonina & Eaton, 2020) by ensuring, for data providers, data safety, transparent management, and appropriate usage, and, for data users, attractive and high-quality data to meet their purposes.

Digital platform ecosystem governance aims at *value cocreation and capture* for a targeted audience (de Vasconcelos Gomes et al., 2021). Value cocreation encompasses, among other things, transactions, innovations, and customer satisfaction, involving collaboration between the platform owner and complementors and among complementors (Foerderer et al., 2018; Gawer, 2014; Gawer & Cusumano, 2014; Goldbach & Benlian, 2015; Gol et al., 2019; Huber et al., 2017; Schreieck & Wiesche, 2017; Zhang et al., 2020; Zhang et al., 2022). Value capture, the portion of the co-created value that actors can appropriate, should be considered in the building phase of an ecosystem to safeguard future profits (Schreieck et al., 2021). However, value capture often relies on revenue-sharing mechanisms and a platform owner's entry into complementary markets (Oh et al., 2015; Zhu & Liu, 2018), which may not be, respectively, well defined, or viable for a developing platform ecosystem.

Other concepts recurring in the extant literature are trust, transparency, and fairness. *Trust* is considered a key coordination mechanism for ecosystem success (Hurni & Huber, 2014),

stemming from sources such as the platform, technology trends, actor relationships, repeated interactions fostering familiarity, and the use of formal or informal control (Goldbach et al., 2014; Perscheid et al., 2020; Rickmann et al., 2014; Schreieck et al., 2016; Zhang et al., 2020). *Transparency* can come from documentation that aids in understanding a platform's functioning and developmental activities, as well as from information about governance choices within the ecosystem (Benlian et al., 2015; Hein et al., 2016). *Fairness* pertains to how actors perceive that they are treated by the platform owner in terms of pricing, costs, and revenue distribution compared to other actors of the same type (Iden et al., 2021; Parker et al., 2016; Schreieck et al., 2016). Despite numerous studies and reviews on digital platform ecosystem governance (e.g., Halckenhaeusser et al., 2020; Perscheid et al., 2020; Schreieck et al., 2016), many questions remain unanswered. The relationships between various governance concepts are often unclear, and we still know little about the effectiveness and subsequent influence of governance choices in different contexts, such as single or shared ownership and the different characteristics of platform owners (Floetgen et al., 2023). Existing research has predominantly focused on mature, centralized platform ecosystems, neglecting decentralized and developing ones (de Reuver et al., 2018; Hein et al., 2020). Additionally, while research has begun to explore data governance in platform ecosystems (e.g., Lee et al., 2017; Lis & Otto, 2020), it remains separate from the broader ecosystem governance research stream (an exception is the work of Bagheri, 2023).

Table 1 provides a recap of extant research on the building stage of digital platform ecosystems and governance, highlighting what we know and what we do not yet understand (well).

Table 1. Summary of literature.

Theme	**What we know**	**What we do not yet understand (well)**
Building digital platform ecosystems	A process starting from envisioning an ecosystem and ending when coordination is no longer needed (Foss et al., 2023) Characterized by high uncertainty, competitive, and cooperative challenges (Foss et al., 2023; Gelhaar & Otto, 2020; Moore, 1993)	Scant research on this phase (Schermuly et al., 2019; Van Dyck et al., 2021) Debate about the emergent or planned nature of digital platform ecosystems (Adner, 2017; de Reuver et al., 2018; Otto & Jarke, 2019)
Digital platform ecosystem governance	A balancing act aimed at stimulating innovation while preserving platform's integrity (Gawer, 2014; Tiwana et al., 2010) Comprising several concepts (e.g., ownership, decision rights partitioning, control, boundary resources; Ghazawaneh & Henfridsson, 2013; Tiwana et al., 2010)	Unclear relationships among various governance concepts and effectiveness and subsequent influence of governance choices in different contexts (Floetgen et al., 2023) Overlooked in decentralized and/or developing digital platform ecosystems (de Reuver et al., 2018; Hein et al., 2020) Neglected connection with data governance (Bagheri, 2023)

The present research aims to provide additional insights into the delicate and under-investigated building stage, with special attention paid to collaborative digital platform ecosystems. Moreover, I want to contribute to our current understanding of digital platform ecosystem governance in terms of what it entails, the connections among the various concepts, its role in building collaborative digital platform ecosystems, and its connection with data governance.

3. Methodological choices

In this section, I describe the methodological choices for this research. In each of the articles included in this thesis, there is a section about the method. Here, I want to provide some extra information, especially related to the two empirical articles, about the research paradigm, research methods, case setting, and data collection, treatment, and analysis.

3.1. Research paradigm

A research paradigm refers to the researchers' philosophical assumptions about the world that affect their choice of tools, instruments, participants, and method (Ponterotto, 2005). Research paradigms include researchers' beliefs regarding ontology and epistemology, both of which influence the research process (Saunders et al., 2012). Ontology is concerned with the nature of reality, whereas epistemology refers to the nature of knowledge and how it is constructed (Al-Ababneh, 2020; Saunders et al., 2012). Saunders et al. (2012) describe two aspects of ontology: objectivism and subjectivism. From the perspective of the former, things exist as a meaningful reality external to and independent of the actors who are focused on their existence; from the latter perspective, it is actors' perceptions and consequent actions that create reality. Epistemology refers to what is considered acceptable knowledge in a field of study (Saunders et al., 2012). For researchers who embrace a positivistic stance, collected data on resources (or objects) are considered facts and objective truths upon which to develop knowledge; for others who adopt an interpretative or social constructive stance, knowledge comes from the feelings, attitudes, and perspectives of the involved people.

In conducting my research, I have adopted an interpretive epistemology, although I have not adopted a specific ontological stance. In hindsight, I believe I have been pragmatic, and I have adjusted my choice based on the specific research question(s) that I have raised in each article included in the thesis (Kelemen & Rumens, 2008; Saunders et al., 2012). Indeed, different research questions can be answered more appropriately with one specific philosophical stance rather than another (Saunders et al., 2012), and in Articles 2 and 3, we have raised, respectively, a *how* and a *what* question.

More specifically, in Article 2, "Building Digital Platform Ecosystems Through Standardization: An Institutional Work Approach," we investigated the development of standards for a digital platform ecosystem without a focal actor, where actors' existing technological solutions and business practices differed. Here, in line with actors' different interests and understanding of standards, as well as our focus on examining a collaborative process, we adopted a subjective ontology that holds that social phenomena are created through the perceptions and actions of the involved social actors. In line with this, our epistemological stance is that of social constructionism or interpretivism, in which reality is constructed in the mind of the individuals, and the interaction between researchers and the object of investigation is key (Ponterotto, 2005). Therefore, viewed from such a stance, researchers and participants jointly create findings from their dialogues and interpretations.

In Article 3, "Identifying Governance Mechanisms for Data Sharing in Collaborative Platform Ecosystems," we investigated the data governance mechanisms in the process of enabling data sharing in collaborative platform ecosystems. Here, our philosophical position is realism, since we looked for explanations of a phenomenon, that is, data sharing and the actors' maturation with regard to it. (Dobson, 2001, as cited in Bygstad, 2010; Easton, 2010, as cited in Bygstad, 2010; Smith, 2010, as cited in Bygstad & Munkvold, 2011). Critical realism combines a realist ontology with an interpretive epistemology (Sayer, 2000), meaning that even if a real world independent of the mind exists, we socially and fallibly construct our knowledge of it (Bygstad, 2010; Saunders et al., 2012). There are two steps to experiencing the world: the first is the thing itself and the sensations it brings; the second is the mental processing after the sensation has met our senses (Saunders et al., 2012). Therefore, some theories can approximate reality better than others, and the goal of critical realism is not to uncover general laws but rather to understand and explain the underlying structure and mechanisms, which is done through retroduction, that is, taking an observation and making hypotheses regarding mechanisms that may explain it (Bygstad, 2010).

3.2. Research methods

In this thesis, two different methods are employed. The first article is a systematic literature review based on the guidelines of Okoli and Schabram (2010), Webster and Watson (2002), and Fink (2013). I chose this method because I wanted to obtain a deep knowledge of digital platform ecosystem governance, with the objective of synthesizing and consolidating existing knowledge across fields and uncovering areas in need of further investigation. Such a method can provide a solid foundation for all academic communities interested in a specific topic (Okoli & Schabram, 2010).

Articles 2 and 3 are based on a longitudinal, qualitative case study of a collaborative digital platform ecosystem in the Norwegian aquaculture industry. A case study refers to the study of a case in its real-life, contemporary context over time through detailed, in-depth data collection from multiple sources (Creswell, 2012). Case studies allow the investigation of a phenomenon from the point of view of the participants and within their context (Kaplan & Maxwell, 2005); thus, they align well with my interpretivist epistemology stance. Case studies are well suited to investigating *how* and *why* questions and complex social phenomena about which we still know little (Benbasat et al., 1987; Yin, 2014), such as how to build a collaborative digital platform ecosystem from a governance perspective. In the empirical articles, I followed the selected collaborative digital platform ecosystem over time by means of interviews, archival data, and participation in various arrangements, which allowed me to cover a time span from the very beginning of the ecosystem in 2016 to the first half of 2022.

3.3. Case setting

The selected collaborative digital platform ecosystem was established with the aim of fighting the industry's most severe challenge, that is, the parasitic salmon louse. The ecosystem was envisioned at a conference in Bergen held in 2016, where farming companies had the chance to talk about the sea lice problem. On this occasion, the need for the aquaculture players to collaborate and communicate better was highlighted. Communicating about a sea lice outbreak was fundamental since once this parasite is in a cage, it can easily spread to neighboring areas. The idea was to collect data from production cages through technologies such as sensors and cameras to make sea lice forecasts and act before an outbreak.

In 2016, the innovation cluster that facilitates the work of the ecosystem had been recently established, and it was said that its task was to improve communication among and to coordinate the different players. It all started with a pilot project with four farming companies. After a six-month phase of technological vendors' testing, the companies settled on their choice of a central platform on the basis of technological characteristics (such as data security and visualization) that could best serve a data-centric ecosystem. Through piloting, companies wanted to find out whether, using historical data, it was possible to predict sea lice growth and reduce costs in treating fish affected by sea lice. In 2017 and 2018, first with the development of APIs and then with the development of a new graphic user interface, it was possible to download and transfer daily data automatically from farming companies' production management systems to the central platform. In 2018, three other small farming companies joined the initiative. Since 2019, the main goal of the ecosystem has evolved from forecasting sea lice to becoming the data hub for industry activities. To this end, the ecosystem started standardization work to render data more comparable and thus increase the quality of the datasets. The first dataset was launched in 2021. The selected ecosystem moved from being a one-sided ecosystem enabling interactions among the group of farming companies (as data contributors and data users) to being an ecosystem consisting of multiple sides with additional data users, such as innovators, researchers, and authorities.

With the aim of providing a picture of the investigated case and inspired by the literature on platform ecosystems and the work of Bonina and Eaton (2020), the core architecture of the selected case (in its latest form) contains modules of datasets that can be accessed by different data users. These data users, who can also be called complementors, can use modules of datasets in developing innovative products and services (periphery), which can be further used, for instance, by farming companies (who contribute data) toward more sustainable production and better fish health. Compared to traditional and more commercial platform ecosystems, such as Google's Android, the modules in the core used for innovation comprise data and not functionalities (Bonina & Eaton, 2020).

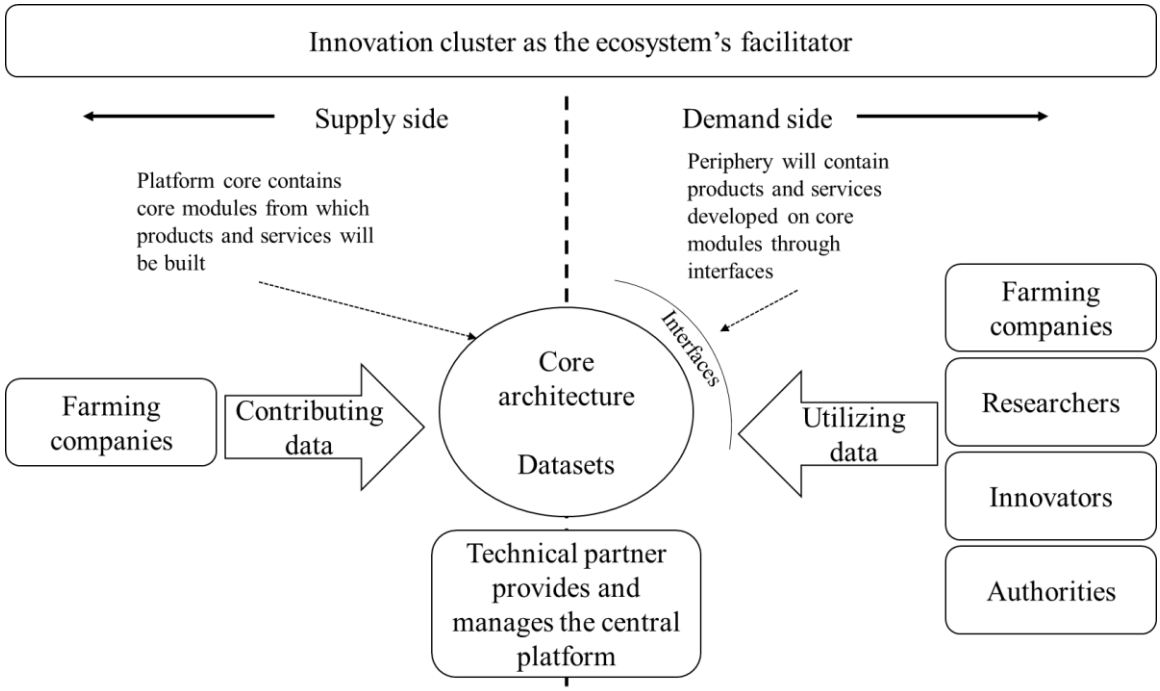

Figure 2. Overview of the selected digital platform ecosystem. Inspired by Bonina and Eaton (2020).

Here, I would also like to briefly mention the reasons why I selected this case for my research. The companies that built this platform ecosystem are competitors and were not previously collaborating, something that makes the study of building an ecosystem from a governance perspective more interesting. It is a business to business/government (B2B/G) platform ecosystem, which complements extant research on B2C digital platform ecosystems. Furthermore, there is a paucity of studies on more decentralized types of ecosystems, even though they are increasingly emerging. For instance, only in Norway are collaborative digital platform ecosystems built in several industries, such as agriculture, health, and oil and gas. Overall, I recognized that investigating such a collaborative platform ecosystem was valuable for its potential to generate new insights (Benbasat et al., 1987) into building digital platform ecosystems from a governance perspective, from both theoretical and practical standpoints.

3.4. Data collection

3.4.1. Primary data

The collection of primary data started after making contact with the innovation cluster that acts as a facilitator of the companies governing the ecosystem. The cluster's managing director was positive about a collaboration and suggested the first informant to me. The first interview was held at the innovation cluster's premises. From there, more informants were interviewed through snowball sampling (Naderifar et al., 2017). Informants were open in sharing further contacts that could be relevant for my research. These initial contacts were also key in accessing some of the archival data and in giving me the opportunity to participate in a course on digitalization in aquaculture and the case.

Overall, my research is based on 25 interviews with 19 informants. Interviews lasted between 30 and 90 minutes, and most of them were held on Teams because of the Covid-19 pandemic. Most of the interviews were video-recorded with the informants' consent and transcribed immediately afterward to ensure accuracy and to promptly note down thoughts and ideas arising from the conversations. Informants were approached by an email in which I clarified the aim of my research and how the interview would be performed. I chose a semi-structured format for the interviews, using interview templates as a basis to start and move the conversation along, but remaining open to asking new questions or following new themes that seemed worthy of investigation or about which informants wanted to talk. In conducting interviews, I followed Seidman's (2013) guidelines in asking real questions (as opposed to sharing assumptions), in following up, and in asking for tangible examples. Moreover, I deemed it important to ensure that informants experienced a safe and respectful session, without being tricked, manipulated, forced to say things, or judged (Seidman, 2013). I also asked open questions without leading informants' answers in any specific direction while trying to foster open conversations and engaging in active listening (Seidman, 2013; Walsham, 1995).

With the first round of interviews, my goal was to obtain an understanding of the ecosystem history in terms of how the idea for the ecosystem was conceived and by whom. There were also interesting topics related to the technology used and the way that the ecosystem was moved forward. Through these interviews, it became clear that there were two specific topics that I could investigate further, which are reflected in the two empirical papers included in this thesis. These topics are standardization and data sharing, which are crucial in the governance of digital platform ecosystems in their building stage.

Although I did not collect any sensitive information through the interviews, the informants still shared perspectives and opinions on the topic at hand, and they might not have wanted to share these with others in the ecosystem. Therefore, it was important to guarantee anonymity and confidentiality when conducting interviews and working with the data (Fujii, 2012). Regarding anonymity, among other things, I tried my best not to mention the informants' names or their companies during recorded conversations; however, this is not something that a researcher can control fully, for instance, because the informant may mention the name of their company. In such cases, anonymity can be addressed when transcribing and using keys for hiding identities (e.g., pseudonyms, letters, or numbers; Oliver, 2010; Richardson & Godfrey, 2003; Wiles et al., 2008). Regarding confidentiality, among other things, I conducted interviews in settings where others could not hear the conversations, such as meeting rooms booked for the interview, and by using headphones. Moreover, I transcribed interviews with headphones on or where people could not listen to the recordings (Arifin, 2018). I also sent an information letter about what it meant to be interviewed for my research project to informants in emails, and sometimes I also held talks about some specific aspects on Teams before starting the interview. The letter was produced according to the guidelines of the Norwegian Agency for Shared Services in Education and Research (in Norwegian, Kunnskapssektorens tjenesteleverandør [SIKT], previously called the Centre for Research Data, or Norsk senter for forskningsdata [NSD], at the time I registered my PhD research project).

3.4.2. Archival data

In this research, I also used archival data in the form of documents shared by informants (e.g., related to standardization or data governance), articles in online newspapers, university theses, and information available on the ecosystem's web page. Through archival data, I gained valuable (new) information about the case and its context, which helped in triangulating primary data.

3.4.3. Arrangements

I had the opportunity to participate in a one-year international program for professionals new to the seafood industry that ran from 2020–2021. This course was a good opportunity to gain contextual information about the industry in which the selected ecosystem operates, as well as complementary information about the case itself, which was also useful for triangulation. Specifically, the course focused on sustainable growth and innovation in the seafood value chain. The program consisted of four modules of around three days each, and access to a leading digital e-learning platform about aquaculture. Due to the Covid-19 pandemic, the course was partly held in a digital format, and the last module was postponed to 2022 to be able to hold it physically for a better experience and increased knowledge.

I also attended several webinars and seminars organized by the innovation cluster online or on their premises, depending on the Covid-19 measures that were in place at the time of each arrangement. These webinars/seminars also provided more contextual information and were used for triangulation with primary data.

3.5. Data treatment

In qualitative research, gaining voluntary, informed consent to collect data from participants is fundamental (The Norwegian National Research Ethics Committee [NESH], 2016). As for interviews, I ensured informed consent by informing potential respondents of what my research

was about, how the interview would be conducted, the voluntarily nature of it, as well as their rights (e.g., the right to withdraw from the research at any point). When starting interviews, I asked informants whether I could video-record our conversation using the dedicated functionality on Teams. As written in the information letter, I explained that recordings served to ensure accuracy in the interview transcription phase and that they would be disposed of at the end of my research project. In the transcription of the interviews, I anonymized the name of the informants and the name of the company where they were working with some codes. By doing so, I ensured that the participants were de-identified in the transcripts. This de-identification was also ensured in the articles, where, when reporting quotes, I only used the type of company (e.g., farming company, research institute) and the professional role of the informant (e.g., chief innovation officer, professor).

While attending the professional course, seminars, and webinars, I took notes about what was relevant to my research and sometimes also received slides and documents from the organizers. In the professional course, everyone introduced themselves, so everyone knew that I was a researcher conducting research on the selected case.

I reported the research project to SIKT. The report included information on the type of data I was going to collect, the aim and duration of the research project, and who would have access to the data. In the report, there was also general information about the informant sample and how the data would be collected, documented, and treated. I followed SIKT's guidelines for data treatment and storage, and information about these topics was provided in the letter to the informants. All data were securely stored until the end of my project and were inaccessible to others. I was also cautious not to report quotes that informants explicitly asked me not to write anywhere.

3.6. Data analysis

I followed a different data analysis approach in each article included in this thesis.

In Article 1, "Digital Platform Ecosystem Governance of Private Companies: Building Blocks and a Research Agenda Based on a Multidisciplinary, Systematic Literature Review," I conducted a multidisciplinary, systematic literature review following the guidelines of Okoli and Schabram (2010), Fink (2013), and Webster and Watson (2002). After selecting the papers to include in the review following explicit inclusion/exclusion criteria, I extracted several pieces of information from each paper, such as the title, author(s), year, research method, and topic. I included all this information in an Excel file, with a row for each paper. The Excel spreadsheet helped to keep all the information in one place, as well as to filter the data as needed. A key point was being able to filter and group articles on a specific concept of digital platform ecosystem governance. As recommended by Webster and Watson (2002), reviews should be concept-centric because concepts determine the organizing framework of a review, and they can enhance our understanding of a topic, whereas author-centric reviews only present a summary of the relevant articles. This concept-centric approach was the basis for further aggregation of the concepts into the components to be studied in my review and for the development of the conceptual model.

In Article 2, "Building Digital Platform Ecosystems Through Standardization: An Institutional Work Approach," we analyzed primary and secondary data in six steps. In analyzing these data, we first familiarized ourselves with the data by reading the transcripts, notes, and documents

several times. Second, we created a chronology of each standardization workflow by writing narratives, which served as a data organization device for further analysis (Langley, 1999). Third, we independently coded the data by identifying key aspects, such as actors involved in the standardization process, how standardization was organized, and the challenges encountered. Then, we created a visual timeline of the overall standardization process and compared the different workflows to derive practices to use to establish common standards. Fifth, we used abduction (Dubois & Gadde, 2002) and moved back and forth between the case analysis and the chosen theoretical lens (i.e., institutional work theory; Lawrence & Suddaby, 2006) to frame the practices used in the standardization process. Finally, being three authors, we had to compare and reconcile our interpretations.

In Article 3, "Identifying Governance Mechanisms for Data Sharing in Collaborative Platform Ecosystems," inspired by Bygstad et al. (2016), we analyzed our data by following four steps. First, we developed a timeline for the ecosystem's evolution. By coding the data, we recognized that there was a gradual improvement in the way data were handled and, consequently, maturation in data sharing. Second, we established a chronological narrative for the case (Langley, 1999). Third, we used retroduction (Bygstad et al., 2016) to explain the causes of the evolution of data sharing. More specifically, we tried to understand which governance mechanisms could explain continual data sharing, and we discarded others that could not explain it. We also identified research related to data sharing through a limited literature review. Fourth, based on the previous steps, we inductively developed a process model for the maturation of data sharing.

NESH (2016) recommends being open and self-critical during qualitative data analysis. To address openness, the data analysis process is openly described in each article. To address self-criticism, I have relied on my co-authors and feedback from my supervisors.

3.7. Trustworthiness of findings

In this subsection, I emphasize the trustworthiness of the empirical articles. In doing so, I will refer to the criteria proposed by Lincoln and Guba (1985) for qualitative research. These criteria are credibility, transferability, dependability, and confirmability.

Credibility refers to the congruence between the findings and reality, which is affected by the methodological choices underlying the findings (Lincoln & Guba, 1985). To achieve credibility, I collected and analyzed data from several data sources rigorously. As specified earlier in this section (Subsection 3.4), archival data and participation in various types of arrangements were used to collect new and contextual data and to triangulate them with those derived from interviews. I also ensured that ethical considerations and fair treatment of respondents were in place. Working with co-authors through discussions and feedback was also key to increasing credibility.

Transferability pertains to the possibility of applying findings to other contexts (Lincoln & Guba, 1985). The present research is based on a single case study, for which I present a rich description in the case setting and findings sections of the articles. I also provide information about data collection and include supporting quotes. The findings build on existing literature; therefore, I think that they can be transferred to other contexts (Yin, 2014), with certain boundary conditions. For instance, I believe that our findings can be useful for researchers

investigating other collaborative digital platform ecosystems and can provide inspiration for practitioners involved in such inter-organizational settings.

Dependability is close to the quantitative criterion of reliability, which refers to the replicability of the findings in new, similar studies. However, with qualitative methods, it is practically impossible to achieve this replication because qualitative research is context dependent, and contexts are subject to change (Lincoln & Guba, 1985). Thus, dependability in qualitative research is more connected to the findings being consistent with the underlying data and the research process being sufficiently documented for readers to be able to follow and critique it. By collaborating with my co-authors, I believe that such consistency has been achieved. Moreover, in each empirical article, there is a detailed description of how the data were collected and analyzed, which is relevant for readers to follow the research process.

Confirmability looks at the features and quality of the data, that is, whether the data are confirmable (Lincoln & Guba, 1985). Confirmability was ensured via triangulation. Primary data collected through interviews were checked against secondary data and vice versa. Moreover, by transcribing interviews complete with pauses, whispers, and taking notes on tone, I was able to obtain a more thorough understanding of what informants were saying with words.

I would also like to briefly address trustworthiness in relation to Article 1. A systematic literature review is considered a replicable and scientific process that can ensure reliable and valid outcomes by following a predefined, structured approach and rigorous methodology (Fisch & Block, 2018; Sauer & Seuring, 2023; Seuring et al., 2020; Okoli & Schabram, 2010; Tranfield et al., 2003, as cited in Shree et al., 2021). To do so, I have been transparent, explicit, and detailed in describing the structured approach I employed, which makes the review reproducible and helps to address subjectiveness (Okoli & Schabram, 2010; Rousseau et al., 2008). I have clearly stated the choice of the topic and the research questions, the selected keywords, and the inclusion and exclusion criteria to determine which articles and conference papers to consider for the review process. I have also explained how I analyzed the data. Moreover, I have not only compiled a summary of extant research, but I have also synthesized it, offered a critique of knowledge gaps, and suggested several avenues for future research. Besides reproducibility, another mark of a rigorous review is comprehensiveness with respect to relevant literature (Okoli & Schabram, 2010). To address this aspect, I have searched journal articles across several fields, included conference papers, and been careful in screening articles by keeping the ones that only touched upon the review's topic.

4. A brief presentation of the three articles

In the following subsections, I briefly present the three articles included in this thesis.

4.1. Article 1: "Digital Platform Ecosystem Governance of Private Companies: Building Blocks and a Research Agenda Based on a Multidisciplinary, Systematic Literature Review" (Costabile)

In the first article, I conducted a multidisciplinary, systematic literature review on the topic of digital platform ecosystem governance. Despite the great interest in the topic, different streams of research have moved forward in isolation, focusing on different aspects, and resulting in partial understanding and variegated terminology (de Reuver et al., 2018; Halckenhaeusser et al., 2020; Rietveld & Schilling, 2021; Vesselkov et al., 2019). Thus, I recognized that there was an opportunity and a need to consolidate and synthetize research across fields. I selected and

analyzed 103 articles, 60 from top journals (ranked ABS[2] 3 or higher) in the fields of IS, strategy, organization studies, innovation, and economics, and 43 from four top IS conferences. The research questions that guided this study were as follows: *What are the building blocks of digital platform ecosystem governance? What do we need more research on?*

This article contributes to existing research in several ways. It organizes extant knowledge into a conceptual model of digital platform ecosystem governance consisting of five building blocks. The developed conceptual model also suggests how the different governance building blocks are related to one another, thus adding to extant knowledge (e.g., Halckenhaeusser et al., 2020; Perscheid et al., 2020; Schreieck et al., 2016) and rendering one of the blocks (i.e., governance scope) more explicit. Moreover, it visually shows what is known and what deserves more investigation. Therefore, the model represents a useful tool for both experienced and inexperienced academics who want to conduct research on digital platform ecosystem governance. In the same direction, the literature review provides a detailed research agenda with several questions that can guide future research. I wrote this review article considering academics as the main audience. However, the conceptual model can also help practitioners govern their ecosystems in a more structured manner.

This article is in press in the special issue Systematic Review and Meta-analysis in Information Management Research of the journal *Data and Information Management*.

Link to the article:

https://www.sciencedirect.com/science/article/pii/S254392512300027X?via%3Dihub

4.2. Article 2: "Building Digital Platform Ecosystems Through Standardization: An Institutional Work Approach" (Costabile, Iden, & Bygstad)

In the second article, we investigated the development of standards for technologies and work practices in a collaborative digital platform ecosystem in the Norwegian aquaculture industry. Defining standards is an important part of digital platform ecosystem governance because it allows for interoperability and collaboration. However, in the absence of a single platform owner, defining standards may become more challenging (Miller & Toh, 2020), and we wanted to contribute new knowledge about standardization in this context.

Our study was based on the question: *How can standards be developed for a digital platform ecosystem when there is no focal actor and where the actors' existing technological solutions and work practices differ?* Drawing on institutional work theory (Lawrence & Suddaby, 2006), we uncovered four practices involved in standardization: constructing identities, constructing normative networks, educating, and mimicry and advocacy. We found that standardization is a dynamic process in which a broad set of actors combine their experience, competences, and skills. Moreover, we showed that inclusiveness may promote standardization versus the more common regulated approach that research on consortia has considered successful (see, e.g., Weiss & Cargill, 1992, as cited in Markus et al., 2006). Our study also suggests that the development and diffusion of standards are highly intertwined and that they can be jointly dealt with. Moreover, we also showed the benefits of applying a socio-technical perspective to

[2] The Academic Journal Quality Guide or the ABS list is the ranking of business journals released by the Chartered Association of Business Schools (CABS).

standardization. We contribute further by offering a preliminary framework for standardization in digital platform ecosystems. In addition, we provide three lessons learned for practitioners.

This article is published in the special issue Standardization for Platform Ecosystems of the journal *Electronic Markets*.

Link to the article: https://link.springer.com/article/10.1007/s12525-022-00552-0

4.3. Article 3: "Identifying Governance Mechanisms for Data Sharing in Collaborative Platform Ecosystems" (Costabile & Øvrelid)

In this article, we investigated data sharing in the context of a collaborative digital platform ecosystem in the Norwegian aquaculture industry. Data sharing across organizational boundaries is challenging because it comes with risks and fears of how data may be used by other actors and for what purposes (Klievink et al., 2018; Lis & Otto, 2020; Zeiringer, 2021). Therefore, governance is crucial. Given the emergence of this topic (de Prieëlle et al., 2020; Gelhaar et al., 2021; Lee et al., 2017; Lis & Otto, 2020; Nokkala et al., 2019), we wanted to gain further insight and to examine the practical problem of data sharing. Therefore, we raised the following research question: *What are the data governance mechanisms in the process of enabling data sharing in collaborative platform ecosystems?* Based on our case, we identified three governance mechanisms that enabled and sustained data sharing.

This article contributes to the literature on (data) platform governance in several ways. In addition to identifying three governance mechanisms for data sharing, we provided insights into how data ownership, quality, access, and usage can be effectively implemented in ecosystems. Moreover, we developed a model of gradual maturation for data sharing. We briefly touch upon the connection between data and ecosystem governance, which has usually been overlooked (Bagheri, 2023). We also complemented extant research by showing that a bottom-up approach is more suitable for collaborative and B2B/G platform ecosystems in alignment with collaborative governance (Ansell & Gash, 2008; Ostrom, 1990). The study also offers two lessons learned for practitioners.

This article was accepted and presented at the European Conference on Information Systems (ECIS) 2023 and published in the conference proceedings.

Link to the article: https://aisel.aisnet.org/ecis2023_rp/283/

5. Discussion

In this section, I return to my overarching research question: *How does governance contribute to building a collaborative digital platform ecosystem?*

To reply to this question, in this introductory chapter, based on extant literature, I have provided a description of the coordination problems, collaborative and competitive challenges to consider when building a digital platform ecosystem (Subsection 2.3), and an overview of the nature of digital platform ecosystem governance (Subsection 2.4). Moreover, in answering the overarching question, I have included three articles in this thesis: a literature review of the multiple components of governance and two empirical papers based on a longitudinal, qualitative case study of a collaborative platform ecosystem. In this section, I discuss my overall findings and reply to the thesis question.

The short answer is that governance contributes by enabling coordination among actors and by easing their competitive and cooperative challenges. To provide a more elaborated answer, in what follows, I describe how various governance choices jointly aid in overcoming challenges in the delicate building phase and how they can be best approached for collaborative digital platform ecosystems (see also Subsection 5.1).

Building a collaborative digital platform ecosystem is a joint endeavor from day one. Companies envisioning a collaborative platform ecosystem need to agree on and commit to a value proposition. First, as the case shows, companies must see the need for collaboration, which happened during a conference (Costabile & Øvrelid, 2023). Moreover, despite the urgency and severity of the problem being known, it was important to shape a common understanding of what the ecosystem could achieve. Therefore, experimenting in the pilot phase was key. Moreover, it was important to meet one another frequently to get to know each other and decide on the direction of the ecosystem all together in a steering committee. As for the roles, the four initial farming companies assumed the same function as data providers and users and as leaders of the ecosystem, under the guidance of the innovation cluster that served as facilitator. One of the smaller farming companies that joined the ecosystem later did not have the time and resources to participate in the steering committee, something that increases the need for transparency about the ecosystem's governance choices and current and future directions (Costabile, 2023a). This point highlights how size can affect roles within collaborative platform ecosystems. Overall, using the synthesis from Article 1 (Costabile, 2023b), agreeing on a value proposition and roles was possible by focusing on shared ownership and distributed decision rights (governance structure) and on physical arrangements (offline governance scope).

Regarding the acquisition of a critical mass, extant literature has shown that ecosystems mainly subsidize one side (or group of actors) and obtain money through fees and subscriptions from another (e.g., Caillaud & Jullien, 2003; Rochet & Tirole, 2003). The mechanism of payment may also be combined with openness (Boudreau, 2012). The selected case presents certain interesting traits, some due to its own peculiarities. At the start, it was a one-sided digital platform ecosystem, enabling the interactions between one group of actors, that is farming companies as both data contributors and data users. The selected case did not make use of subsidization. Joining the platform ecosystem was based on a non-monetary incentive (i.e., solving a common problem). Moreover, the companies who joined financed the ecosystem by sharing expenses, which seems to be common among collaborative ecosystems compared to traditional ones that are usually financed through transactions, subscriptions, and licenses (Osmundsen et al., 2023). Later, the selected case received additional funding from an external actor, thus broadening the value proposition and causing the ecosystem to move toward a multi-sided digital platform ecosystem. In this direction, an open standardization approach with shared ownership and meetings was key (Costabile et al., 2022). Overall, whereas previous studies have often approached growing a critical mass in terms of online governance scope and payment mechanisms (e.g., offering new APIs, reducing transaction fees and fake customer bots; Choudary et al., 2016, as cited in Wang & Nandhakumar, 2017; Eisenmann et al., 2006; Ghazawneh & Henfridsson, 2013), in the context of collaborative digital platform ecosystems, it may be more important to focus on communicating the goal to be achieved (outcome) and on different types of arrangements (offline governance scope).

Boundary resources as standards and APIs are key when building a collaborative platform ecosystem because they increase actors' and systems' interoperability and harmonization (Costabile et al., 2022). My research brings to the table a few interesting points: standardization not only refers to technologies but also to practices. The existence of various data formats across farming companies (or even the facilities of the same company) does not allow for data comparisons. The same applies to different terminologies regarding production phases or fish health conditions, or to different data collection methods (e.g., in terms of the depth of the measurements inside the cage). Thus, standards as boundary resources are needed not only to connect and enable communication between a platform owner and complementors but also among the actors leading a collaborative platform ecosystem. My research confirms that standardization initiatives and agreeing on standards are crucial during an ecosystem's building stage and that, through standards, alignment, and understanding across actors can be achieved, as well as social order (Brunsson et al., 2012; Gelhaar & Otto, 2020; Jacobides et al., 2018). Past research has shown that standardization can be characterized by competition with the aim of gaining advantages and avoiding later lock-ins (Borgogno & Colangelo, 2018, as cited in Gelhaar & Otto, 2020; Farrell & Klemperer, 2007, as cited in Gelhaar & Otto, 2020; Jacobides et al., 2018). For collaborative digital platform ecosystems, it is important to foster an open and inclusive design of these boundary resources based on a broad involvement of the industry and on consensus among the actors' various perspectives (Costabile et al., 2022). Open standards can lessen actors' perceptions of being trapped or locked in (Hodapp et al., 2019).

My research and the selected case can also illuminate how to handle data in ecosystems under development (see Costabile & Øvrelid, 2023). For example, for data providers, it is important to have a safe technological platform where data can be uploaded and stored and APIs to transfer data as well as to control who is accessing them. Furthermore, it is important that they can all decide on sharing data together. Moreover, it is important that contracts are in place to ensure that data are used only for certain purposes. This aligns with previous research that posits that it is crucial to transparently present how and by whom data are used (Gelhaar & Otto, 2020). From the perspective of data users, it is important to obtain access to standardized, high-quality data in the best possible way, which could be via APIs. Overall, to ensure data sharing, it is important to cultivate both data providers and data users and to balance their interests (Bonina & Eaton, 2020). Furthermore, it is essential to combine mechanisms that act on both online and offline scopes (e.g., APIs, contracts, and gatherings) and to decide on a governance structure (decision rights and architecture). The focus on data also provides insights into openness, another critical governance choice for the building phase (Cusumano & Gawer, 2002; West, 2003). The case shows that access to data can increase over time, confirming past works that suggest starting with a kind of closed platform and rendering it more open over time as necessary for the ecosystem to increase its value potential through various actors (Gelhaar & Otto, 2020). Moreover, for collaborative platform ecosystems that are not based on previous alliances, an adequate handling of data, focusing on governance structure (e.g., distributed decision rights, architecture) and boundary resources may increase trust (Costabile & Øvrelid, 2023).

For ecosystems in the building stage, extant research has highlighted the importance of focusing on value cocreation without forgetting value capture (Schreieck et al., 2021). The selected case confirms this point. In terms of value cocreation, despite the main goals not having been reached yet, the selected ecosystem suggests the importance of small wins (e.g., increased skills and learning) that feed back into the cocreation of value (Ansell & Gash, 2008; Costabile, 2023a).

In terms of value capture, even if the case has not yet implemented any monetization strategies (payment mechanism) to obtain revenues from the usage of datasets in a fair way, this is a point that is under consideration (Costabile, 2023a). The change in the value proposition and moving from a one-sided to a multi-sided ecosystem may have impacted value capture since shaping interactions among one group of actors makes it difficult to define a revenue side (Staykova & Damsgaard, 2015). The case also revealed, adding to extant research, that value cocreation in collaborative platform ecosystems may go beyond economic considerations. Moreover, in collaborative platform ecosystems, defining the nature of value can be complex, given the company and ecosystem levels. Furthermore, society may benefit more from a collaborative platform ecosystem (Osmundsen et al., 2023).

5.1. Theoretical implications

In each article, the theoretical implications and contributions are presented. Here, I want to discuss the overarching contributions of my research to the literature on digital platform ecosystems and their governance, especially regarding the building stage.

First, as part of this introductory chapter, I have reviewed and presented the challenges to consider when building a digital platform ecosystem and the role of governance in addressing these challenges. The empirical articles included in this thesis provide insights into the building stage of collaborative platform ecosystems by focusing on standards for integrating technologies and facilitating actors' interactions and activities (Article 2), as well as on governing data to increase trust in actors, the platform, and data quality for a successful data-centric collaborative platform ecosystem (Article 3). Thus, I contribute to the literature by focusing on the ecosystem's building phase, which has often been overlooked (Schermuly et al., 2019; Van Dyck et al., 2021). This is somewhat surprising, considering that the initial stage is a delicate nexus for the success or failure of platform ecosystems (de Reuver et al., 2017, as cited in Hodapp et al., 2019). Moreover, establishing an ecosystem is different from reinforcing an incumbent one because emerging platforms present neither a stable value proposition nor a user base and will often have little bargaining power (Ofe & Sandberg, 2019). By focusing on the building phase, I also contribute to the debate about whether ecosystems can be planned or just emerge (Adner, 2017; Jacobides et al., 2018). Specifically, my research (Articles 2 and 3) shows that collaborative ecosystems are built because of the willingness and efforts of actors around a common challenge. Despite having an emergent feature, meaning that not everything can be planned in a structured way but can be more bottom up, actors must join forces and shape the direction of the collaborative ecosystem from day one with purpose, experimentation, testing, learning by doing, and some planning. Therefore, my research confirms that ecosystems can be at least partially planned (Jacobides et al., 2018).

Second, as a part of this introductory chapter, and especially with Article 1, I provide a comprehensive picture of digital platform ecosystem governance. The conceptual model developed in the first article of this thesis synthesizes and consolidates research on governance across fields, suggests connections among the facets of governance, and makes the component of governance scope more explicit, thus extending extant research (e.g., Halckenhaeusser et al., 2020; Perscheid et al., 2020; Schreieck et al., 2016).

Third, I provide a new perspective on digital platform ecosystems by focusing on a collaborative digital platform ecosystem with a B2B/G orientation, complementing the more common perspective on centralized platform ecosystems with a B2C orientation. Despite the

fact that the challenges encountered in the building phase may not completely differ between the two types of platform ecosystems, their governance approaches differ. Some researchers have stated that centralized platform ecosystem governance is more directive and authoritative because the connections among actors are typically industry- or technology- anchored, meaning that they revolve around a focal firm and/or its technology, and thus are more transactional in nature (Daymond et al., 2022). These platforms are usually developed with the minimal engagement of external parties (David et al., 2020), even if this may not always be the case for the design of boundary resources (e.g., Weiss et al., 2023). My research shows that governance in collaborative platform ecosystems is more collective and emergent, thus aligning with the collaborative governance studies in the field of public administration research (see Ansell & Gash, 2008; Ostrom, 1990). For actors in collaborative platform ecosystems, it is important to learn, build, and shape the ecosystem together. Hence, they are more interested in arrangements whereby actors can meet, discuss, and get to know each other to facilitate dialogue, nurture trust, and develop shared practices and meanings. Physical meetings and closer interactions also represent a way to increase the platform ecosystem's visibility, in contrast to the social media used in traditional platform ecosystems (Osmundsen et al., 2023). Thus, an offline governance scope becomes relevant in these settings. Overall, my research confirms that different governance structures (ownership and decision rights) can affect other governance choices, which has been established in marketplace research (Yoo et al., 2007) but has been less prominent in platform research (Floetgen et al., 2023). I also posit that collaborative digital platform ecosystems present extra complexities due to an increased number of levels of analysis; that is, not only is there a need to look at the relationship between owners and other actors but also at the relationships among the different owners within the leading consortium (Costabile, 2023a). This entails a challenging focus on accounting for conflicting interests and goals, as well as the need to achieve consensus and shared governance choices (e.g., de Reuver et al., 2018, as cited in David et al., 2020; Markus & Bui, 2012, as cited in David et al., 2020).

Fourth, my research also touches upon the relationship between digital platform ecosystem governance and data governance, which has been neglected, except for the work of Bagheri (2023). This is unfortunate because data are central to digital platform ecosystems (Bhargava et al., 2020) and can be used to govern them (Schreieck et al., 2016). On the one hand, governing data makes it possible to share data and thereby enable innovation (which is a governance outcome). Moreover, governing data creates trust (which is fundamental to ecosystem success; Hurni & Huber, 2014). On the other hand, as the case shows, governance outcomes in the form of innovation may influence data governance, for instance, in terms of increasing the number of actors who can access and use available data. In addition, a higher level of governance includes a lower level of governance. In this regard, it has been suggested that IT governance often addresses information/data governance, and information governance includes data governance (de Abreu Faria et al., 2013). Furthermore, the lower level of governance should align with the goals and concepts established at the higher level (Lee et al., 2017). Along the same lines, digital platform ecosystem governance includes data governance, and the latter should align with the former. In Article 3, we posited that through data governance, it is possible to govern platform ecosystems centered on data (Costabile & Øvrelid, 2023) since governance mechanisms for data sharing align with areas of interest to the governance of an entire platform ecosystem, such as roles, control, and trust (Lee et al., 2017).

5.2. Practical implications

The present research also offers insights and implications for practice. Based on this introductory chapter, practitioners may derive insights to facilitate knowing what to focus on (interactions), the challenges they may face when building a digital platform ecosystem, and how governance can help them to address those challenges. These insights are relevant considering that companies find it challenging to transition into a platform ecosystem, deal with competing concerns, and drive the developing ecosystem to their advantage (Altman & Tripsas, 2015, as cited in Schreieck et al., 2021; Thomas & Autio, 2015). As noted in Article 1, practitioners can deepen their understanding of what digital platform ecosystem governance entails and how its different components can be related and affect one another. Based on my research findings, practitioners may also adjust their governance approach to the type of digital platform ecosystem they want to build. They may be more authoritative and set the rules in a stricter way if they are willing to establish a centralized platform ecosystem. In the case of collaborative digital platform ecosystems, they must assume a more collaborative governance approach, engaging actors within and outside the leading consortium and granting importance to physical arrangements. They may also be aware that for this type of ecosystem, governance choices may be more emergent and bottom up, and thus may require more time. Practitioners may glean valuable insights from the thesis's empirical articles (Articles 2 and 3) regarding how to employ collaborative governance, embrace different views, competences, and an inclusive approach to standardizing technologies and practices and for governing data.

6. Limitations and future research

As with all studies, my research has inherent limitations, which I discuss in this section.

The literature review (Article 1) is based on subjective choices, for instance, related to the query used and the chosen inclusion and exclusion criteria. However, it is based on high-quality research published in journals ranked ABS 3 or higher and is based on well-acknowledged guidelines (Fink, 2013; Okoli & Schabram, 2010; Webster & Watson, 2002), which make me confident in the results and insights provided.

The empirical articles are based on a single qualitative case study. The selected case operates in a specific industry and has its own specificities, for instance, in terms of how it developed from a one-sided platform ecosystem to a multi-sided one. Other collaborative platform ecosystems may follow a different evolutionary path. Moreover, the investigated topics as standardization and data sharing are complex phenomena, and interviews and data on these topics have been interpreted in a subjective way. Other researchers may have seen and interpreted things differently. Moreover, as interviewing is a construction between informants and interviewer, the data may have also been gathered differently because researchers may have asked different questions, and informants may have replied in another way. However, in the papers, I relied on the relevant literature and methodology to conduct my research. I have clarified how data were collected and analyzed, which should properly illustrate the chains of evidence (Yin, 2014).

There is a belief that what has been learned from a single case based in a certain context cannot be transferred to another context. Therefore, as already done in the empirical articles, and given the complexity and emergence of the investigated topics (standardization and data sharing), I here call for future research in additional contexts to confirm or strengthen our findings. To do

so, future research may take a longitudinal approach to a collaborative digital platform ecosystem in another industry and/or country. In any case, I believe that what we found in our papers can be a source of inspiration for other industries, which perhaps may apply some variations to better fit their context.

7. Conclusion

This research contributes to the interesting and increasingly studied topic of digital platform ecosystem governance, with a focus on how collaborative platform ecosystems can be built from a governance perspective. In this introductory chapter, I have provided an overview of digital platforms and ecosystems, the challenges in the building phase of digital platform ecosystems, and the nature of digital platform ecosystem governance. Through the articles included in this thesis, I have provided a robust and multifaceted understanding of digital platform ecosystem governance by developing a conceptual model based on a systematic, multidisciplinary review across fields (Article 1). Furthermore, I have provided insights into the processes of defining standards and sharing data in the context of a developing collaborative digital platform ecosystem (Articles 2 and 3). Compared to centralized digital platform ecosystems, which can be built with a more authoritative and transactional governance and the minimal engagement of external actors (David et al., 2020; Daymond et al., 2022), my research shows that building a collaborative digital platform ecosystem is a joint effort that can be (at least) partially planned (Jacobides et al., 2018) and is characterized by inclusiveness and a more bottom-up approach, in line with collaborative governance (see Ansell & Gash, 2008; Ostrom, 1990).

8. References

Adner, R. (2017). Ecosystem as structure: An actionable construct for strategy. *Journal of Management*, *43*(1), 39–58.

Al-Ababneh, M. M. (2020). Linking ontology, epistemology and research methodology. *Science & Philosophy*, *8*(1), 75–91. https://ssrn.com/abstract=3708935

Annanperä, E., Liukkunen, K., & Markkula, J. (2016). Managing emerging business ecosystems—A knowledge management viewpoint. In M. Hirano, M. Myers, & K. Kijima (Eds.), *Twenty-second Americas conference on information systems* (*AMCIS)* (pp. 1–10). https://aisel.aisnet.org/amcis2016/EndUser/Presentations/12

Ansell, C., & Gash, A. (2008). Collaborative governance in theory and practice. *Journal of Public Administration Research and Theory*, *18*(4), 543–571. https://doi.org/10.1093/jopart/mum032

Arifin, S. R. M. (2018). Ethical considerations in qualitative study. *International Journal of Care Scholars*, *1*(2), 30–33. https://doi.org/10.31436/ijcs.v1i2.82

Asadullah, A., Faik, I., & Kankanhalli, A. (2018). Digital platforms: A review and future directions. In M. Hirano, M. Myers, & K. Kijima (Eds.), *Twenty-second Pacific Asia conference on information systems* (*PACIS*) (p. 248). https://aisel.aisnet.org/pacis2018/248/

Askay, D. (2017). A conceptual framework for investigating organizational control and resistance in crowd-based platforms. In T. Bui (Ed.), *Proceedings of the 50th Hawaii international conference on system sciences* (*HICSS*) (pp. 1727–1736). https://scholarspace.manoa.hawaii.edu/handle/10125/41364

Bagheri, S. (2023). Towards a governance framework for data platform ecosystems in the construction industry. In *Proceedings of the 25th international conference on enterprise information systems (ICEIS)*, vol. 2 (pp. 566–574). 10.5220/0011853100003467

Baldwin, C., & Clark, K. (2000). *Design rules: The power of modularity*. MIT Press.

Baldwin, C. Y., & Clark, K. B. (2006). The architecture of participation: Does code architecture mitigate free riding in the open source development model? *Management Science*, *52*(7), 1116–1127. https://doi.org/10.1287/mnsc.1060.0546

Bazarhanova, A., Yli-Huumo, J., & Smolander, K. (2020). From platform dominance to weakened ownership: How external regulation changed Finnish e-identification. *Electronic Markets*, *30*, 525–538.

Benbasat, I., Goldstein, D. K., & Mead, M. (1987). The case research strategy in studies of information systems. *MIS Quarterly*, *11*(3), 369–386. https://www.jstor.org/stable/248684

Benlian, A., Hilkert, D., & Hess, T. (2015). How open is this platform? The meaning and measurement of platform openness from the complementors' perspective. *Journal of Information Technology*, *30*, 209–228.

Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. V. (2013). Digital business strategy: Toward a next generation of insights. *MIS Quarterly*, *37*(2), 471–482. https://www.jstor.org/stable/43825919

Bhargava, H. K., Rubel, O., Altman, E. J., Arora, R., Boehnke, J., Daniels, Derdenger, T., Kirschner, B., LaFramboise, D., Loupos, P., Parker, G., & Pattabhiramaiah, A. (2020). Platform data strategy. *Marketing Letters*, *31*, 323–334. https://doi.org/10.1007/s11002-020-09539-3

Bonina, C., & Eaton, B. (2020). Cultivating open government data platform ecosystems through governance: Lessons from Buenos Aires, Mexico City and Montevideo. *Government Information Quarterly*, *37*(3), 101479. https://doi.org/10.1016/j.giq.2020.101479

Boudreau, K. (2010). Open platform strategies and innovation: Granting access vs. devolving control. *Management Science*, *56*(10), 1849–1872. https://doi.org/10.1287/mnsc.1100.1215

Boudreau, K. J. (2012). Let a thousand flowers bloom? An early look at large numbers of software app developers and patterns of innovation. *Organization Science*, *23*(5), 1409–1427. https://doi.org/10.1287/orsc.1110.0678

Brunsson, N., Rasche, A., & Seidl, D. (2012). The dynamics of standardization: Three perspectives on standards in organization studies. *Organization Studies*, *33*(5–6), 613–632. https://doi.org/10.1177/0170840612450120

Bygstad, B. (2010). Generative mechanisms for innovation in information infrastructures. *Information and Organization*, *20*(3–4), 156–168. https://doi.org/10.1016/j.infoandorg.2010.07.001

Bygstad, B., & Munkvold, B. E. (2011). In search of mechanisms. Conducting a critical realist data analysis. In *Proceedings of thirty-second international conference on information systems* (*ICIS*) (pp. 1–15). https://aisel.aisnet.org/icis2011/proceedings/researchmethods/7

Bygstad, B., Munkvold, B. E., & Volkoff, O. (2016). Identifying generative mechanisms through affordances: A framework for critical realist data analysis. *Journal of Information Technology*, *31*, 83–96. https://link.springer.com/article/10.1057/jit.2015.13

Caillaud, B., & Jullien, B. (2003). Chicken & egg: Competition among intermediation service providers. *RAND Journal of Economics*, 309–328. https://www.jstor.org/stable/1593720

Ceccagnoli, M., Forman, C., Huang, P., & Wu, D. J. (2012). Cocreation of value in a platform ecosystem! The case of enterprise software. *MIS Quarterly*, 36(1), 263–290. https://www.jstor.org/stable/41410417

Cennamo, C., & Santaló, J. (2019). Generativity tension and value creation in platform ecosystems. *Organization Science*, *30*(3), 617–641. https://doi.org/10.1287/orsc.2018.1270

Constantinides, P., Henfridsson, O., & Parker, G. G. (2018). Introduction—Platforms and infrastructures in the digital age. *Information Systems Research*, *29*(2), 381–400. https://doi.org/10.1287/isre.2018.0794

Costabile, C. (2023a). Navigating value cocreation and value capture in the developing phases of collaborative platform ecosystems: A single-case study (No. 10838). In *The 15th Mediterranean conference on information systems* (*MCIS*) and *The 6th Middle East & North Africa conference on digital information systems* (*MENACIS*) (pp. 1–16). EasyChair.

Costabile, C. (2023b, in press). Digital platform ecosystem governance of private companies: Building blocks and a research agenda based on a multidisciplinary, systematic literature review. *Data and Information Management*, Article 100053.

Costabile, C., Iden, J., & Bygstad, B. (2022). Building digital platform ecosystems through standardization: An institutional work approach. *Electronic Markets*, *32*(4), 1877–1889. https://link.springer.com/article/10.1007/s12525-022-00552-0

Costabile, C., & Øvrelid, E. (2023). Identifying governance mechanisms for data sharing in collaborative platform ecosystems. In *Thirty-first European conference on information systems* (*ECIS*) (pp. 1–16). https://aisel.aisnet.org/ecis2023_rp/283

Creswell, J. W. (2012). *Qualitative inquiry and research design. Choosing among five approaches* (3rd ed.). SAGE Publications.

Croitor, E., Werner, D., & Benlian, A. (2021). The effects of control mechanisms on complementors' behavioral intentions: An empirical study of reward-based crowdfunding platforms. In T. Bui (Ed.), *Proceedings of the 54th Hawaii international conference on system sciences* (*HICSS*) (pp. 6173–6182). University of Hawaii. http://hdl.handle.net/10125/71365

Cusumano, M.A., & Gawer, A. (2002) The elements of platform leadership. *MIT Sloan Management Review*, *43*(3), p. 51.

Dal Bianco, V., Myllärniemi, V., Komssi, M., & Raatikainen, M. (2014, April). The role of platform boundary resources in software ecosystems: A case study. In *2014 IEEE/IFIP conference on software architecture* (pp. 11–20). IEEE. https://ieeexplore.ieee.org/abstract/document/6827094

Dattée, B., Alexy, O., & Autio, E. (2018). Maneuvering in poor visibility: How firms play the ecosystem game when uncertainty is high. *Academy of Management Journal*, *61*(2), 466–498.

David, R., Aubert, B. A., Bernard, J. G., & Luczak-Roesch, M. (2020). Critical mass in inter-organizational platforms. In *AMCIS 2020 proceedings*. https://aisel.aisnet.org/amcis2020/adv_info_systems_research/adv_info_systems_research/21

Daymond, J., Knight, E., Rumyantseva, M., & Maguire, S. (2022). Managing ecosystem emergence and evolution: Strategies for ecosystem architects. *Strategic Management Journal*, *44*(4), 1–27. https://doi.org/10.1002/smj.3449

de Abreu Faria, F., Maçada, A. C. G., & Kumar, K. (2013). Information governance in the banking industry. In *46th Hawaii international conference on system sciences* (*HICSS*) (pp. 4436–4445). IEEE.

de Prieëlle, F., De Reuver, M., & Rezaei, J. (2020). The role of ecosystem data governance in adoption of data platforms by Internet-of-Things data providers: Case of Dutch horticulture industry. *IEEE Transactions on Engineering Management*, *69*(4), 940–950. https://doi.org/10.1109/TEM.2020.2966024

de Reuver, M., Sørensen, C., & Basole, R. C. (2018). The digital platform: A research agenda. *Journal of Information Technology*, *33*(2), 124–135.

de Vasconcelos Gomes, L. A., Flechas, X. A., Facin, A. L. F., & Borini, F. M. (2021). Ecosystem management: Past achievements and future promises. *Technological Forecasting and Social Change*, *171*, 120950, 1–15. https://doi.org/10.1016/j.techfore.2021.120950

Dubois, A., & Gadde, L. E. (2002). Systematic combining: An abductive approach to case research. *Journal of Business Research*, *55*(7), 553–560. https://doi.org/10.1016/S0148-2963(00)00195-8

Eisenmann, T., & Van Alstyne, M. W. (2006). Strategies for two-sided markets. *Harvard Business Review*, *84*(10), 92.

Eisenmann, T. R., Parker, G., & van Alstyne M. W. (2009). Opening platforms: How, when and why?. In A. Gawer (Ed.), *Platforms, markets and innovation*. Edward Elgar Publishing.

Eisenmann, T., Parker, G., & Van Alstyne, M. (2011). Platform envelopment. *Strategic Management Journal*, *32*(12), 1270–1285.

Ens, N., Hukal, P., & Blegind Jensen, T. (2023). Dynamics of control on digital platforms. *Information Systems Journal*, *33*, 890–911. https://doi.org/10.1111/isj.12429

Fink, A. (2013). *Conducting research literature reviews: From the internet to paper* (4th ed.). Sage Publications.

Fisch, C., & Block, J. (2018). Six tips for your (systematic) literature review in business and management research. *Management Review Quarterly*, *68*, 103–106. https://doi.org/10.1007/s11301-018-0142-x

Floetgen, R. J., Winder, P., Fielt, E., Weking, J., Hein, A., Schreieck, M., Böhm, M., & Krcmar, H. (2023). Ownership structures and governance strategies for digital platform ecosystems: An empirical study. In M. Aanestad, S. Klein, M. Tarafdar (Eds.), *Thirty-first European conference on information systems* (*ECIS*) (pp. 1–18). Association for Information Systems (AIS). https://aisel.aisnet.org/ecis2023_rp/246

Foerderer, J., Kude, T., Mithas, S., & Heinzl, A. (2018). Does platform owner's entry crowd out innovation? Evidence from Google Photos. *Information Systems Research*, *29*(2), 444–460. https://doi.org/10.1287/isre.2018.0787

Foerderer, J., Kude, T., Schuetz, S. W., & Heinzl, A. (2019). Knowledge boundaries in enterprise software platform development: Antecedents and consequences for platform governance. *Information Systems Journal*, *29*(1), 119–144. https://doi.org/10.1111/isj.12186

Foss, N. J., Schmidt, J., & Teece, D. J. (2023). Ecosystem leadership as a dynamic capability. *Long Range Planning*, *56*(1), Article 102270.

Fujii, L. A. (2012). Research ethics 101: Dilemmas and responsibilities. *PS: Political Science and Politics*, *45*(4), 717–723. https://doi.org/10.1017/S1049096512000819

Gawer, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. *Research Policy*, *43*(7), 1239–1249. https://doi.org/10.1016/j.respol.2014.03.006

Gawer, A., & Cusumano, M. A. (2008). How companies become platform leaders. *MIT Sloan Management Review*, *49*(2), 28–35.

Gawer, A., & Cusumano, M. A. (2014). Industry platforms and ecosystem innovation. *Journal of Product Innovation Management*, *31*(3), 417–433. https://doi.org/10.1111/jpim.12105

Ghazawneh, A., & Henfridsson, O. (2013). Balancing platform control and external contribution in third-party development: The boundary resources model. *Information Systems Journal*, *23*(2), 173–192.

Gelhaar, J., & Otto, B. (2020). Challenges in the emergence of data ecosystems. In D. Vogel, K. Ning Shen, & P. Shan Ling (Eds.), *Twenty-third Pacific Asia conference on information systems* (*PACIS*) (pp. 1–14). Association for Information Systems (AIS). https://aisel.aisnet.org/pacis2020/175/

Gelhaar, J., Gürpinar, T., Henke, M., & Otto, B. (2021). Towards a taxonomy of incentive mechanisms for data sharing in data ecosystems. In *Twenty-fifth Pacific Asia conference on information systems* (*PACIS*) (pp. 1–14).

Gol, E. S., Stein, M. K., & Avital, M. (2019). Crowdwork platform governance toward organizational value creation. *The Journal of Strategic Information Systems*, *28*(2), 175-195. https://doi.org/10.1016/j.jsis.2019.01.001

Goldbach, T., & Benlian, A. (2015). Understanding informal control modes on software platforms—The mediating role of third-party developers' intrinsic motivation. In T. A. Carte, A. Heinzl, & C. Urquhart (Eds.), *Thirty-sixth international conference on information systems* (*ICIS*) (pp. 1–19). Association for Information Systems (AIS). https://aisel.aisnet.org/icis2015/proceedings/ManagingIS/2

Goldbach, T., Kemper, V., & Benlian, A. (2014). Mobile application quality and platform stickiness under formal vs. self-control—Evidence from an experimental study. In M. D. Myers & D. W. Straub (Eds.), *Thirty-fifth international conference on information systems* (*ICIS*) (pp. 1–18). Association for Information Systems (AIS). https://aisel.aisnet.org/icis2014/proceedings/ProjectManagement/7

Gulati, R., Puranam, P., & Tushman, M. (2012). Meta-organization design: Rethinking design in interorganizational and community contexts. *Strategic Management Journal*, *33*(6), 571–586.

Halckenhaeusser, A., Foerderer, J., & Heinzl, A. (2020, June). Platform governance mechanisms: An integrated literature review and research directions. In *Proceedings of the twenty-eighth European conference on information systems (ECIS)* (pp. 1–17).

Hannah, D. P., & Eisenhardt, K. M. (2018). How firms navigate cooperation and competition in nascent ecosystems. *Strategic Management Journal*, *39*(12), 3163–3192.

Hein, A., Schreieck, M., Riasanow, T., Setzke, D. S., Wiesche, M., Böhm, M., & Krcmar, H. (2020). Digital platform ecosystems. *Electronic markets*, *30*, 87–98.

Hein, A., Schreieck, M., Wiesche, M., & Krcmar, H. (2016, March). Multiple-case analysis on governance mechanisms of multi-sided platforms. In *Multikonferenz Wirtschaftsinformatik* (pp. 9–11). Universitätsverlag Ilmenau.

Hodapp, D., Hawlitschek, F., & Kramer, D. (2019, December). Value co-creation in nascent platform ecosystems: A Delphi study in the context of the Internet of Things. In *Fortieth international conference on information systems* (*ICIS*) (pp. 1–17).

Huber, T. L., Kude, T., & Dibbern, J. (2017). Governance practices in platform ecosystems: Navigating tensions between cocreated value and governance costs. *Information Systems Research*, *28*(3), 563–584. https://doi.org/10.1287/isre.2017.0701

Hurni, T., & Huber, T. (2014). The interplay of power and trust in platform ecosystems of the enterprise application software industry. In M. Avital, J. M. Leimeister, & U. Schultze (Eds.), *Proceedings of the Twenty-second European conference on information systems* (*ECIS*) (pp. 1–15). Association for Information Systems (AIS). https://aisel.aisnet.org/ecis2014/proceedings/track15/19/

Iansiti, M., & Levien, R. (2004). *The keystone advantage*: *What the new dynamics of business ecosystems mean for strategy, innovation, and sustainability*. Harvard Business School Press.

Iden, J., Danilova, K. B., & Osmundsen, K. S. (2022). Digitaliseringsledelse [Digitalization management]. Fagbokforlaget.

Iden, J., Bygstad, B., Osmundsen, K. S., Costabile, C., & Øvrelid, E. (2021). Digital platform ecosystem governance: Preliminary findings and research agenda. In *Norsk IKT-konferanse for forskning og utdanning* (No. 2). https://ojs.bibsys.no/index.php/NIK/article/view/944

Immonen, A., Palviainen, M., & Ovaska, E. (2014). Requirements of an open data based business ecosystem. *IEEE Access*, *2*, 88–103. https://doi.org/10.1109/ACCESS.2014.2302872

Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. *Strategic Management Journal*, *39*(8), 2255–2276.

Kaplan, B., & Maxwell, J. A. (2005). Qualitative research methods for evaluating computer information systems. In *Evaluating the organizational impact of healthcare information systems* (pp. 30–55). Springer New York.

Kelemen, M., & Rumens, N. (2008). *An introduction to critical management research*. Sage.

Klievink, B., Van Der Voort, H., & Veeneman, W. (2018). Creating value through data collaboratives. *Information Polity*, *23*(4), 379–397. 10.3233/IP-180070

Langley, A. (1999). Strategies for theorizing from process data. *Academy of Management Review*, *24*(4), 691–710. https://doi.org/10.5465/amr.1999.2553248

Lawrence, T. B., & Suddaby, R. (2006). Institutions and institutional work. In S. R. Clegg, C. Hardy, T. B. Lawrence, & W. R. Nord (Eds.), *The Sage handbook of organization studies* (pp. 215–254). SAGE Publications.

Lee, S. U., Zhu, L., & Jeffery, R. (2017). Data governance for platform ecosystems: Critical factors and the state of practice. In R. A. Alias, P. S. Ling, S. Bahri, P. Finnegan, & C. Sia (Eds.), *Pacific Asia conference on information systems* (*PACIS*).

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. SAGE Publications.

Lis, D., & Otto, B. (2020). Data governance in data ecosystems–Insights from organizations. In B. Anderson, J. Thatcher, & R. Meservy (Eds.), *Proceedings of Americas conference on information systems* (*AMCIS*) (pp. 1–10). https://aisel.aisnet.org/amcis2020/strategic_uses_it/strategic_uses_it/12/

Luo, D., Fang, Y., Song, P., & Wang, C. A. (2019). The impact of digital platform rapid release strategy on app update behavior: An empirical study of Firefox. In H. Krcmar, J. Fedorowicz, W. Fong Boh, J. M. Leimeister, & S. Wattal (Eds.), *40th international conference on information systems*

(*ICIS*) (p. 1807). Association for Information Systems (AIS). https://aisel.aisnet.org/icis2019/is_heart_of_innovation_ecosystems/innovation_ecosystems/7

Markus, M. L., Steinfield, C. W., & Wigand, R. T. (2006). Industry-wide information systems standardization as collective action: The case of the US residential mortgage industry. *MIS Quarterly*, *30*, 439–465. https://www.jstor.org/stable/25148768

Mei, J., Zheng, G., & Zhu, L. (2021). Governance mechanisms implementation in the evolution of digital platforms: A case study of the Internet of Things platform. *R&D Management*, *52*(3), 498–516. https://doi.org/10.1111/radm.12494

Miller, C. D., & Toh, P. K. (2020). Complementary components and returns from coordination within ecosystems via standard setting. *Strategic Management Journal*, *43*(3), 627–662. https://doi.org/10.1002/smj.3143

Mohagheghzadeh, A., & Svahn, F. (2016). Transforming organizational resource into platform boundary resources. In *ECIS proceedings, Vol. 9, Research papers*. http://aisel.aisnet.org/ecis2016_rp/9

Moore, J. F. (1993). Predators and prey: A new ecology of competition. *Harvard Business Review*, *71*(3), 75–86.

Moore, J. F. (1996). *The death of competition: Leadership and strategy in the age of business ecosystems*. Harper Paperbacks.

Naderifar, M., Goli, H., & Ghaljaie, F. (2017). Snowball sampling: A purposeful method of sampling in qualitative research. *Strides in Development of Medical Education*, *14*(3).

NESH, 2016. Guidelines for research ethics in the social sciences, law and the humanities. https://www.forskningsetikk.no/ressurser/publikasjoner/guidelines-social-sciences-humanities-law-and-theology/

Nokkala, T., Salmela, H., & Toivonen, J. (2019). Data governance in digital platforms. In *Proceedings of twenty-fifth Americas conference on information systems* (*AMCIS*).

Ofe, H., & Sandberg, J. (2019). Digital platform establishment: Navigating competing concerns in emerging ecosystems. In *Proceedings of the 52nd Hawaii international conference on system sciences* (HICSS). https://scholarspace.manoa.hawaii.edu/server/api/core/bitstreams/580ac662-8160-440c-96ae-d1f715cf3103/content

Oh, J., Koh, B., & Raghunathan, S. (2015). Value appropriation between the platform provider and app developers in mobile platform mediated networks. *Journal of Information Technology*, *30*, 245–259. https://doi.org/10.1057/jit.2015.21

Okoli, C., & Schabram, K. (2010). A guide to conducting a systematic literature review of information systems research. *Social Science Research Network*, *10*(26), 1–49. https://doi.org/10.2139/ssrn.1954824

Oliveira, M. I. S., & Lóscio, B. F. (2018). "What is a data ecosystem?" In A. Zuiderwijk & C. C. Hinnant (Eds.), *Proceedings of the 19th annual international conference on digital government research*. ACM.

Oliver, P. (2010). *The student's guide to research ethics*. McGraw-Hill Education (UK).

Osmundsen, K. S., Costabile, C., Bygstad, B., Iden, J., & Eikebrokk, T. R. (2023). *Diversity in digital platform ecosystems: Purposes, governance, and outcomes* (No. 10836). In *The 15th Mediterranean conference on information systems* (*MCIS*) and *The 6th Middle East & North Africa conference on digital Information systems* (*MENACIS*) (pp. 1–14). EasyChair.

Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge University Press.

Otto, B., & Jarke, M. (2019). Designing a multi-sided data platform: Findings from the international data spaces case. *Electronic Markets*, *29*(4), 561–580. https://doi.org/10.1007/s12525-019-00362-x

Parker, G., & van Alstyne, M. W. (2005). Two-sided network effects: A theory of information product design. *Management Science*, *51*(10), 1494–1504.

Parker, G. G., Van Alstyne, M. W., & Choudary, S. P. (2016). *Platform revolution*. Norton and Co.

Perscheid, G., Ostern, N. K., & Moormann, J. (2020). Determining platform governance: Framework for classifying governance types. In J. F. George, S. Paul, R. De, E. Karahanna, S. Sarker, & G. Oestreicher-Singer (Eds.), *Forty-first international conference on information systems* (*ICIS*) (pp. 1–16). Association for Information Systems (AIS). https://aisel.aisnet.org/icis2020/governance_is/governance_is/8

Ponterotto, J. G. (2005). Qualitative research in counseling psychology: A primer on research paradigms and philosophy of science. *Journal of Counseling Psychology*, *52*(2), 126–136. https://psycnet.apa.org/doi/10.1037/0022-0167.52.2.126

Riasanow, T., Burckhardt, F., Soto Setzke, D., Böhm, M., & Krcmar, H. (2018). The generic blockchain ecosystem and its strategic implications. In *Twenty-fourth Americas conference on information systems* (*AMCIS*) (pp. 1–10). Association for Information Systems (AIS). https://aisel.aisnet.org/amcis2018/StrategicIT/Presentations/13

Riasanow, T., Jäntgen, L., Hermes, S., Böhm, M., & Krcmar, H. (2021). Core, intertwined, and ecosystem-specific clusters in platform ecosystems: Analyzing similarities in the digital transformation of the automotive, blockchain, financial, insurance and IIoT industry. *Electronic Markets*, *31*(1), 89–104. https://doi.org/10.1007/s12525-020-00407-6

Rietveld, J., & Schilling, M. A. (2021). Platform competition: A systematic and interdisciplinary review of the literature. *Journal of Management*, *47*(6), 1528–1563. https://doi.org/10.1177/0149206320969791

Richardson, J. C., & Godfrey, B. S. (2003). Towards ethical practice in the use of archived transcripted interviews. *International Journal of Social Research Methodology*, *6*(4), 347–355. https://doi.org/10.1080/13645570210142874

Rickmann, T., Wenzel, S., & Fischbach, K. (2014). Software ecosystem orchestration: The perspective of complementors. In Twentieth Americas conference on information systems (pp. 1–14). Association for Information Systems (AIS). https://aisel.aisnet.org/amcis2014/e-Business/GeneralPresentations/7

Rochet, J. C., & Tirole, J. (2003). Platform competition in two-sided markets. *Journal of the European Economic Association*, *1*(4), 990–1029. https://doi.org/10.1162/154247603322493212

Rousseau, D. M., Manning, J., & Denyer, D. (2008). 11. Evidence in management and organizational science: Assembling the field's full weight of scientific knowledge through syntheses. *The Academy of Management Annals*, *2*(1), 475–515. https://doi.org/10.1080/19416520802211651

Sauer, P. C., & Seuring, S. (2023). How to conduct systematic literature reviews in management research: A guide in 6 steps and 14 decisions. *Review of Managerial Science*, 1–35.

Saunders, M., Lewis, P., & Thornhill, A. (2012). *Research methods for business students*. Pearson Education.

Sayer, A. (2000). *Realism and social science*. London: Sage Publications.

Schermuly, L., Schreieck, M., Wiesche, M., & Krcmar, H. (2019). Developing an industrial IoT platform–Trade-off between horizontal and vertical approaches. In *14th international conference on Wirtschaftsinformatik* (pp. 32–46). https://aisel.aisnet.org/wi2019/track01/papers/3/

Schreieck, M., & Wiesche, M. (2017). How established companies leverage IT platforms for value co-creation–Insights from banking. In I. Ramos, V. Tuunainen, & H. Krcmar (Eds.), *Proceedings of the 25th European conference on information systems* (*ECIS*) (pp. 1726–1741). Association for Information Systems (AIS). https://aisel.aisnet.org/ecis2017_rp/111

Schreieck, M., Wiesche, M., & Krcmar, H. (2016). Design and governance of platform ecosystems–Key concepts and issues for future research. In *Twenty-fourth European conference on information systems (ECIS)* (pp. 1–20).

Schreieck, M., Wiesche, M., & Krcmar, H. (2021). Capabilities for value co-creation and value capture in emergent platform ecosystems: A longitudinal case study of SAP's cloud platform. *Journal of Information Technology*, *36*(4), 365–390. https://doi.org/10.1177/02683962211023780

Schulze, L., Trenz, M., & Nickerson, R. C. (2021). Fingers in the pie: Characterizing decision rights partitioning on digital labor platforms. In J. S. Valacich, A. Barua, R. Wright, A. Kankanhalli, X. Li, & S. Miranda (Eds.), *Forty-second international conference on information systems* (*ICIS*) (pp. 1–17). Association for Information Systems (AIS). https://aisel.aisnet.org/icis2021/is_future_work/is_future_work/1

Seidman, I. (2013). *Interviewing as qualitative research: A guide for researchers in education and the social sciences*. Teachers College Press.

Seuring, S., Yawar, S. A., Land, A., Khalid, R. U., & Sauer, P. C. (2020). The application of theory in literature reviews–Illustrated with examples from supply chain management. *International Journal of Operations & Production Management*, *41*(1), 1–20. https://doi.org/10.1108/IJOPM-04-2020-0247

Shree, D., Singh, R. K., Paul, J., Hao, A., & Xu, S. (2021). Digital platforms for business-to-business markets: A systematic review and future research agenda. *Journal of Business Research*, *137*, 354–365. https://doi.org/10.1016/j.jbusres.2021.08.031

Spagnoletti, P., Resca, A., & Lee, G. (2015). A design theory for digital platforms supporting online communities: A multiple case study. *Journal of Information Technology*, *30*, 364–380.

Staykova, K. S., & Damsgaard, J. (2015). A typology of multi-sided platforms: The core and the periphery. In *Twenty-third European conference on information systems* (*ECIS*) (pp. 1–16). http://aisel.aisnet.org/ecis2015_cr/174

Staykova, K. S., & Damsgaard, J. (2017). Towards an integrated view of multi-sided platforms evolution. In *Thirty-eighth international conference on information systems* (*ICIS*) (pp. 1–22).

Thomas, L. D., & Autio, E. (2015). The processes of ecosystem emergence. In *Academy of Management Proceedings*. https://www.researchgate.net/profile/Llewellyn-Thomas/publication/356997073_Processes_of_ecosystem_emergence/links/61b74afda6251b553ab6456c/Processes-of-ecosystem-emergence.pdf

Thomas, L. D., & Ritala, P. (2022). Ecosystem legitimacy emergence: A collective action view. *Journal of Management*, *48*(3), 515–541. https://doi.org/10.1177/0149206320986617

Tian, C. H., Ray, B. K., Lee, J., Cao, R., & Ding, W. (2008). BEAM: A framework for business ecosystem analysis and modeling. *IBM Systems Journal*, *47*(1), 101–114. https://doi.org/10.1147/sj.471.0101

Tilson, D., Lyytinen, K., & Sørensen, C. (2010). Research commentary—Digital infrastructures: The missing IS research agenda. *Information Systems Research*, *21*(4), 748–759. https://doi.org/10.1287/isre.1100.0318

Tiwana, A. (2015). Evolutionary competition in platform ecosystems. *Information Systems Research*, *26*(2), 266–281. https://doi.org/10.1287/isre.2015.0573

Tiwana, A., Konsynski, B., & Bush, A. A. (2010). Research commentary—Platform evolution: Coevolution of platform architecture, governance, and environmental dynamics. *Information Systems Research*, *21*(4), 675–687.

Uzunca, B., Sharapov, D., & Tee, R. (2022). Governance rigidity, industry evolution, and value capture in platform ecosystems. *Research Policy*, *51*(7), 1–15, 104560. https://doi.org/10.1016/j.respol.2022.104560

Van Alstyne, M. W., Parker, G. G., & Choudary, S. P. (2016). Pipelines, platforms, and the new rules of strategy. *Harvard Business Review*, *94*(4), 54–62.

Van Dyck, M., Lüttgens, D., Piller, F. T., Diener, K., & Pollok, P. (2021). Positioning strategies in emerging industrial ecosystems for Industry 4.0: A longitudinal study of platform emergence in the agricultural industry. In *Proceedings of the 54th Hawaii international conference on system sciences* (*HICSS*) (pp. 6153–6162).

Vesselkov, A., Hämmäinen, H., & Töyli, J. (2019). Design and governance of mHealth data sharing. *Communications of the Association for Information Systems*, *45*(1), 18. https://aisel.aisnet.org/cais/vol45/iss1/18/

Walsham, G. (1995). Interpretive case studies in IS research: Nature and method. *European Journal of Information Systems*, *4*(2), 74-81. https://doi.org/10.1057/ejis.1995.9

Wang, G., & Nandhakumar, J. (2017). Strategic swaying: How startups grow digital platforms. In Y. J. Kim, R. Agarwal, & J. K. Lee (Eds.), *Thirty-eighth international conference on information systems* (*ICIS*) (pp. 1–17). Association for Information Systems (AIS). https://aisel.aisnet.org/icis2017/Strategy/Presentations/17

Wareham, J., Fox, P. B., & Cano Giner, J. L. (2014). Technology ecosystem governance. *Organization Science*, *25*(4), 1195–1215. https://doi.org/10.1287/orsc.2014.0895

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly*, *26*, xiii–xxiii. https://www.jstor.org/stable/4132319

Weiss, N., Schreieck, M., Wiesche, M., & Krcmar, H. (2023). Lead complementor involvement in the design of platform boundary resources: A case study of BMW''s onboard apps. *Information Systems Journal*, *33*, 1279–1311. https://doi.org/10.1111/isj.12449

Werner, J., Frost, S., & Zarnekow, R. (2020). Towards a taxonomy for governance mechanisms of blockchain-based platforms. In F. Rowe, R. El Amrani, M. Limayem, S. Newell, N. Pouloudi, E. van Heck, & A. El Quammah (Eds.), *ECIS proceedings* (Vol. 26). https://aisel.aisnet.org/ecis2020_rp/26

West, J. (2003). How open is open enough? *Research Policy*, *32*(7), 1259–1285.

Wiles, R., Crow, G., Heath, S., & Charles, V. (2008). The management of confidentiality and anonymity in social research. *International Journal of Social Research Methodology*, *11*(5), 417–428. https://doi.org/10.1080/13645570701622231

Yin, R. K. (2014). *Case study research: Design and methods* (3rd ed.). SAGE Publications.

Yoo, B., Choudhary, V., & Mukhopadhyay, T. (2007). Electronic B2B marketplaces with different ownership structures. *Management Science*, *53*(6), 952–961. https://doi.org/10.1287/mnsc.1060.0685

Yoo, Y., Henfridsson, O., & Lyytinen, K. (2010). Research commentary—The new organizing logic of digital innovation: An agenda for information systems research. *Information Systems Research*, *21*(4), 724–735. https://doi.org/10.1287/isre.1100.0322

Zeiringer, J. (2021). Tackling knowledge risks in data-centric collaborations: A literature review. In D. Vogel, K. N. Shen, P. S. Ling, M. N. Ravishankar, & J. X. Zhang (Eds.), *Pacific Asia conference on information systems* (*PACIS*) (pp. 1–14). https://aisel.aisnet.org/pacis2021/37

Zhang, Y., Li, J., & Tong, T. W. (2022). Platform governance matters: How platform gatekeeping affects knowledge sharing among complementors. *Strategic Management Journal*, *43*(3), 599-626. https://doi.org/10.1002/smj.3191

Zhang, Y., Pinkse, J., & McMeekin, A. (2020). The governance practices of sharing platforms: Unpacking the interplay between social bonds and economic transactions. *Technological Forecasting and Social Change*, *158*, 120133, 1–13. https://doi.org/10.1016/j.techfore.2020.120133

Zhu, F., & Liu, Q. (2018). Competing with complementors: An empirical look at Amazon.com. *Strategic Management Journal*, *39*(10), 2618–2642. https://doi.org/10.1002/smj.2932

Thesis articles

Article 1

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Digital platform ecosystem governance of private companies: Building blocks and a research agenda based on a multidisciplinary, systematic literature review

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ABSTRACT

Digital platform ecosystem governance refers to a platform owner's decisions and mechanisms that seek to influence complementors and users to build and sustain an ecosystem. The relevance of digital platform ecosystem governance is broadly acknowledged by researchers. However, the extant body of research is fragmented, and varied terminologies are employed, leading to challenges in identifying and recognizing results across different fields. This article provides a multidisciplinary and systematic literature review with the aim of consolidating knowledge on this important topic. Based on an analysis of 103 journal articles and conference papers, this review synthesizes the literature into a conceptual model with five building blocks of platform ecosystem governance. The model aims to create a robust foundation for researchers approaching the topic for the first time and conducting subsequent research. The conceptual model also offers practical guidance for governing ecosystems in a structured manner. Finally, this article provides a research agenda with five areas for future investigation.

1. Introduction

"Digital platform ecosystem governance" is understood as a platform owner's decisions and mechanisms that seek to influence complementors and users to build and sustain an ecosystem. The term refers to orchestration rather than coercion because digital platform ecosystems are more structured than a market but less structured than a supply chain (Foss et al., 2023; Jacobides et al., 2018; Parker & Van Alstyne, 2018, as cited in Halckenhaeusser et al., 2020). Adopting a sociotechnical view, digital platform ecosystems can be defined as evolving meta-organizations consisting of a platform and all the actors interacting on that platform, which are coordinated through means other than a hierarchy (Gawer, 2014; Gulati et al., 2012; Jacobides et al., 2018). Without the possibility of enforcing direct control of a multitude of autonomous actors, platform governance aims to address the delicate balance between retaining and relinquishing control to ensure that actors will join, use, and enhance the platform's purpose while maintaining its integrity (Gawer, 2014; Tiwana et al., 2010). Governance influences the evolution of a digital platform ecosystem, which can make a huge difference in a business landscape characterized by increased competition across digital platform ecosystems (Tiwana et al., 2010). Indeed, around one out of three platform ecosystems has failed due to poor governance choices (Floetgen et al., 2022; Pidun et al., 2020; Reeves et al., 2019).

Given the importance of this topic at the theoretical and practical levels, research interest is increasing. However, despite this interest, the extant body of knowledge remains fragmented (de Vasconcelos Gomes et al., 2021; Mukhopadhyay & Bouwman, 2019; Vesselkov et al., 2019). The topic has been examined in isolation across different streams of research, resulting in relevant but partial understandings, which can also be attributed to the variegated terminologies used (de Reuver et al., 2018; de Vasconcelos Gomes et al., 2021; Halckenhaeusser et al., 2020; Rietveld & Schilling, 2021). Moreover, research has focused on different aspects, such as pricing in the field of economics and control and the division of decision rights in the field of information systems (Vesselkov et al., 2019). Therefore, there seems to be a need for a review of the literature on digital platform ecosystem governance to synthesize and consolidate extant research across fields and to identify future research avenues. To this end, the present article provides a multidisciplinary, systematic literature review in the fields of information systems (IS), strategy, organization studies, innovation, and economics. This literature review was guided by two research questions: (1) "What are the building blocks of digital platform ecosystem governance?" and (2) "What do we need more research on?"

This review makes two contributions to the literature. First, this review develops a conceptual model of digital platform ecosystem governance by grouping governance concepts into five building blocks

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(governance structure, governance mechanisms, governance scope, contingency factors, and outcomes) and by suggesting how these blocks are interrelated—a topic that has not yet been addressed by extant research (Perscheid et al., 2020; Schreieck et al., 2016). This review also makes the concept of "governance scope" more explicit. The proposed conceptual model aims to present a broad overview of governance, which is relevant for researchers who are approaching the topic for the first time; provide a foundation for further research, such as empirical investigations into the relationships among the building blocks; and assist practitioners in understanding what they need to consider when governing their digital platform ecosystems in a more structured manner. Second, the paper suggests avenues for future research to guide and move our knowledge forward.

The remainder of the paper is structured as follows. First, Section 2 provides a detailed description of the method used in conducting this review. Section 3 describes how the findings are structured according to the conceptual model and the development of the proposed model. Section 4 delineates the findings from the analysis of the extant research. Section 5 discusses the findings and offers a research agenda with questions for future investigation. Finally, Section 6 presents the conclusions and limitations.

2. Method

This review is a stand-alone literature review, as opposed to reviews that aim at setting the theoretical background for a specific research question and researchers' own endeavors (Okoli & Schabram, 2010). Therefore, this article provides a rigorous review of extant research results (Okoli & Schabram, 2010). Based on Fink's (2013) work, this review is *systematic* in following a methodological approach, *explicit* in explaining the procedures used, *comprehensive* by including all relevant materials, and *reproducible* by others who adopt the same approach. This review aims at synthesizing existing literature, identifying gaps in current research, and providing a conceptual framework as a foundation and point of departure to move our knowledge forward. In the following subsections, the definition of the research questions, the search and screening process, the inclusion/exclusion criteria, and the data extraction are presented in depth.

2.1. Research questions

As recommended by Okoli and Schabram (2010), a review must define clear and concise research questions. Thus, two questions were defined for the current review and subsequently served as a guide: (1) What are the building blocks of digital platform ecosystem governance? And (2) What do we need more research on? With the first question, the review aims to identify what digital platform ecosystem governance entails by grouping and connecting the concepts identified in the extant research. With regard to the second question, this review aims to identify areas for future research. Both questions are in line with the general purpose described in the introduction of the Method section. As for the audience (Okoli & Schabram, 2010), this review is mainly beneficial to researchers—both experienced and inexperienced—in the topic at hand. The review can also be helpful for practitioners who want to govern their ecosystems in a structured manner.

2.2. The search and screening process

The search process was organized according to the guidelines by Webster and Watson (2002) and Okoli and Schabram (2010). To obtain a multidisciplinary overview of platform governance, this review searched for articles published in the fields of IS, strategic management, innovation, organization studies, and economics. The goal was to identify articles of validated quality. As major contributions are likely to be published in leading journals (Webster & Watson, 2002), this review searched only within journals in the Association of Business Schools' Academic Journal Quality Guide (updated in 2021)[1] ranked ABS 3 or higher. The database Scopus was used to perform this search.

This review used the following keywords: platform OR ecosystem OR "two-sided market" OR "two sided market" OR "multi-sided market" OR "multi sided market" AND governance OR governing OR orchestrat* OR control. These keywords were chosen to account for a breadth of fields and differing terminologies for digital platform ecosystems and governance. In fact, in the field of economics, the term "two-sided or multi-sided market" is often used when referring to platform ecosystems; whereas in the management and IS fields, "platform ecosystems" is more common. Moreover, "governance" is also described by using different terms as orchestration or control.

The search was performed on the articles' keywords because it was expected that relevant articles would use these words in their keyword sections. In Scopus, two ABS journals (e.g., the Journal of the Association for Information Science and Technology (JASIST), within the IS field, and the American Economic Review: Insights, within economics) were not available. To include them, a search was performed on these journals' websites. As for the former, the same query used in Scopus was used to search within the keyword section. Regarding the latter, as the search within keywords was not possible, the search was performed by going through all the articles, which was also possible due to a manageable number of issues.

Next, the search was extended to four of the most prestigious international IS conferences, as recommended by Webster and Watson (2002). This choice was also based on the fact that the conferences' review process can be considered similar to that of journals. In addition, conferences present shorter reviews and publication times, which allows for a more comprehensive overview of the research status. To search for conference papers, the same query used in Scopus was used in the e-library of the Association for Information Systems (AIS) within the abstract field because this database does not allow searching within keywords. The selected conferences were the International Conference on Information Systems (ICIS), the European Conference on Information Systems (ECIS), the Hawaii International Conference on System Sciences (HICSS), and the Americas Conference on Information Systems (AMCIS). In total, this paper searched 135 journals, along with the published proceedings for four international conferences.

This paper set the temporal limitations to contributions from January 2010 to mid-July 2023 because digital platform ecosystem governance is a relatively new topic that only became of interest to researchers during this period (Mukhopadhyay & Bouwman, 2019). The search resulted in 311 journal articles and 372 conference papers, which were screened first by title, then by abstract, and finally by the articles themselves. This screening process resulted in 37 journal articles and 40 conference papers.

Then, a backward and forward search was performed (Webster & Watson, 2002). In particular, a backward search was performed by reviewing the citations for the identified articles through the main search. This process resulted in an additional 18 papers, 16 journal articles, and 2 conference papers. The forward search aimed to identify articles citing the articles identified in the previous two steps (main search and backward search). This step was done on Scopus, which allowed for the tracking of the citations with the function "view cited by." For articles not available in Scopus, the forward search was performed on Google Scholar by screening among "cited by" articles. In this step, 8 additional papers (7 journal articles and 1 conference paper) were identified. For these steps, again, only articles ranked ABS 3 or higher in the selected fields of research during the chosen timeframe were considered. Ultimately, 103 papers (60 journal articles and 43 conference papers) were included in this review. The overall search and screening process is summarized in Fig. 1.

[1] In the ABS list, the field of information systems (IS) is referred to as "Information Management."

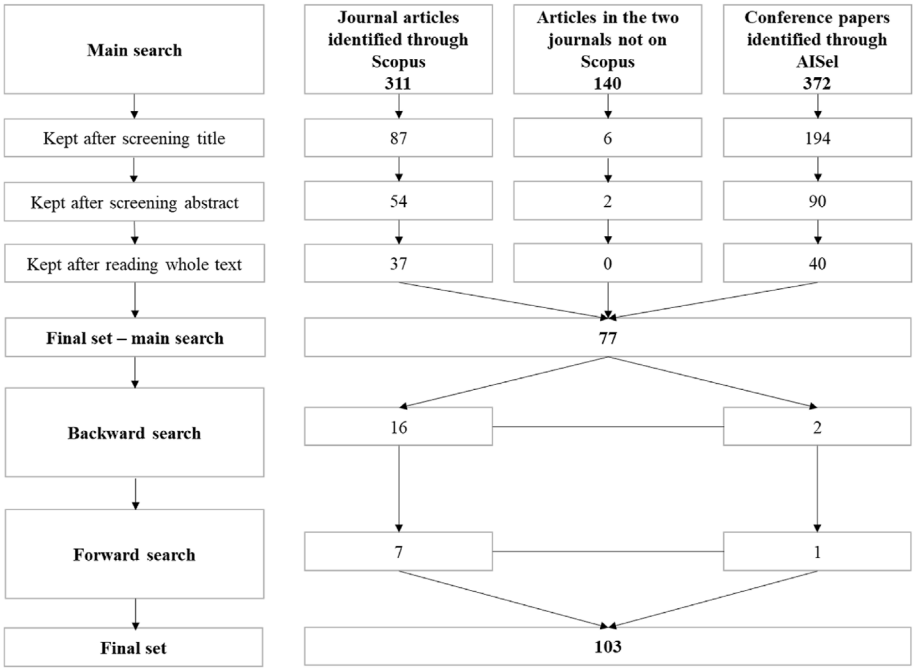

Fig. 1. Search and screening process.

2.3. Inclusion and exclusion criteria

As stated, this review targeted journal articles and conference papers of validated quality in the timeframe from January 2010 to mid-July 2023. Only articles written in English were included. For conference papers, only completed research papers were included. The search included articles on the following topics: digital platform (ecosystem) governance, governance mechanisms, components, dimensions, contingency factors, and outcomes. Articles that touched on these topics were also included. However, only those that addressed the digital platform ecosystems of private companies were considered. Private and public organizations differ in several factors, such as the legal and political environments in which they operate, the strength of their competitive pressures, and their internal structures and processes (Rainey et al., 1976). For example, public companies are less autonomous in their decisions, purposes, and operations; are usually interested in collective purposes; and must meet the fairness and integrity expected by citizens. In comparison, private companies usually have individual goals and aim at efficiency. It is also reasonable that the actors involved would be different, such as complementors and/or users in private companies' platforms and hospitals, government agencies, or other institutions in public platforms. In line with this focus, articles on the following topics were excluded: public sector governance, governance/management of natural resources (e.g., forests, coasts, and wetlands), policymaking, welfare, and education. Aside from the topic, these articles focused on the country level, far from the ecosystem and governance at the heart of this review. Moreover, articles about the governance of specific elements within the ecosystems (e.g., IT or data governance) and those that did not match the inclusion criteria were excluded.

2.4. Data extraction

From each article, the following information was extracted: the full reference, name of the journal or conference, and year; research method(s); theoretical frameworks and reference theories used; main topic; context and case if available (e.g., software-based platform, blockchain platform, crowdwork, and Apple and Amazon); level of analysis; research questions; contingency factors and summary of the study; and gaps for future research. The data extraction was performed on an Excel spreadsheet, where each extracted information was written in a different column.

3. Platform ecosystem governance and model

To synthesize and consolidate the extant research, the findings of this review are structured according to a conceptual model (Miles & Huberman, 1994). Conceptual models explain, in a graphical or narrative way, the main aspects to be studied (e.g., factors, variables, and constructs) and their presumed relationships, as identified from theories, experiences, and the general objectives of a study (Miles & Huberman, 1994).

The creation of the conceptual model in the current study was based on an analysis of the selected set of articles. Extracting information from the different articles was key to identifying the main components of digital platform ecosystem governance to be investigated and their relations. As specified in the previous section (Section 2.4), this extraction was performed by filling in an Excel spreadsheet with multiple columns for different information. This approach facilitated filtering of the collected data and grouping papers in a concept-centric fashion and along their level of analysis (i.e., focusing on the same aspects of governance, such as control or openness; Webster & Watson, 2002). Then, concepts were further aggregated into the components to be studied in this review (e.g., governance mechanisms). The aggregation was based on the researcher's understanding of the literature and the aims of this review. This process was inspired by previous studies on governance in different contexts (e.g., IT governance or corporate governance; Tiwana et al., 2013; Weill and Ross, 2004) and the context-mechanism-outcome scheme (Pawson et al., 1997). The resulting conceptual model is shown in Fig. 2.

The conceptual model has five components. **Governance structure** refers to who owns and chooses the digital platform ecosystem's use, development, and architecture. **Governance mechanisms** refer to the means used to implement the chosen governance structure. **Governance scope** refers to the expansiveness of the governance mechanisms, such as on what relationship (e.g., on all complementors or some of them) and where (e.g., on or off platform) they act. These three components are the core building blocks of digital platform ecosystem governance and are organized in a funnel wherein the components are narrowed down. **Contingency factors** refer to the elements that affect the core blocks or

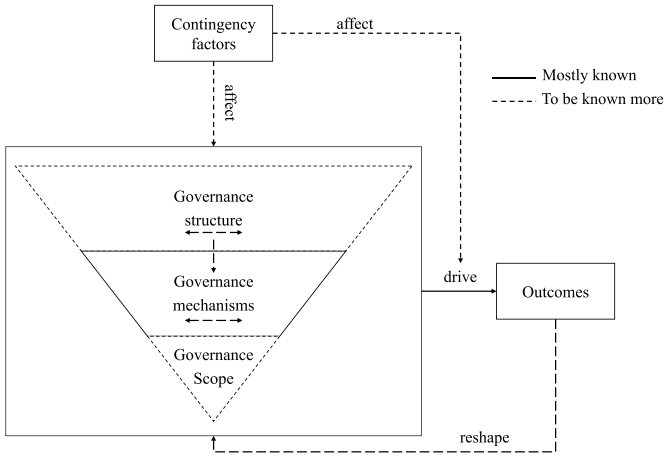

Fig. 2. Conceptual model for platform ecosystem governance.

moderate the outcomes of digital platform ecosystem governance. These factors include the characteristics of the actors involved, as well as the characteristics of the platform and of the market in which the digital platform ecosystem operates. **Outcomes** refer to the results achieved by digital platform ecosystem governance that mainly relate to value dynamics, that is, value co-creation and value capture.

4. Findings

In the following subsections, this paper presents and discusses the current state of the literature using a detailed version of the conceptual model above (Fig. 2). This detail version is shown in Fig. 3.

4.1. Governance structure

Governance structure includes ownership, decision rights, and architecture. **Ownership** refers to who owns a platform, whether it is a single actor (proprietary ownership), a multitude of actors (shared ownership), or a peer-to-peer network (decentralized ownership; Perscheid et al., 2020; Schultze et al., 2021; Tiwana et al., 2010). Ownership is also connected to the definitions of roles comprising the distribution of power and the number of sides within a platform ecosystem (Schreieck et al., 2016). Common roles in a platform ecosystem are the platform owner (an organization that offers the technical platform and sets standards and assets on which other organizations can build), complementors (other organizations that use the platform's technology to create complementary products and/or services; refers mainly to the supply side), and the users of those products and services (demand side; de Lima Fontão et al., 2019; Heimburg & Wiesche, 2022). Some researchers have pointed out that these roles are unstable and that actors can also occupy dual roles, such as platform owners and complementors or complementors and users (Burda et al., 2022; Heimburg & Wiesche, 2022). Foss et al. (2023) suggested that a company becomes a platform owner not only when building an ecosystem in the first place, but also by virtue of successfully sustaining the ecosystem.

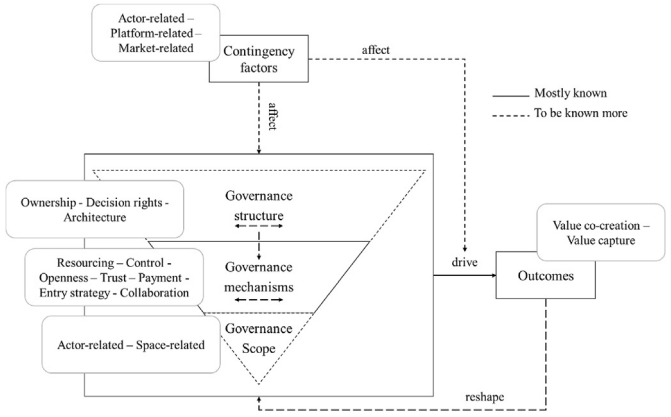

Fig. 3. A detailed conceptual model of platform ecosystem governance.

Decision rights indicate who has the authority and responsibility to make specific decisions, such as those related to the features, functionality, design, and implementation procedures of complementary products (Tiwana et al., 2010). Decision rights can be divided between platform owners and complementors, and they balance complementors' autonomy and coordination within the ecosystem (Tiwana et al., 2010). Decision rights can affect complementors' participation within a platform, because they may increase or decrease costs and risks incurred when complying with specifications (Dellermann & Reck, 2017). Platform owners who have decision-making authority can exercise this right to their benefit, but diverse interests must be balanced if the platform owners want to attract and retain complementors (Schulze et al., 2021; Tiwana et al., 2010). Focusing on ownership and decision rights, researchers have distinguished between centralized, decentralized, and autonomous digital platform ecosystems (Perscheid et al., 2020; Riasanow et al., 2018; Schulze et al., 2021; Werner et al., 2020). In centralized arrangements, decision rights are mainly in the hands of the platform owner, especially with regard to whether a decision is to be implemented and how its performance is measured. In decentralized platform ecosystems, decision rights are handled by the community (i.e., the users of the platform). In autonomous platform ecosystems, such as blockchain-based ecosystems, decision rights are encoded in smart contracts. Schulze et al. (2021) identified different archetypes of digital labor platforms that go beyond the centralized and decentralized dichotomy by showing that decision rights can be distributed differently during the stages of a service transaction.

Architecture refers to the ecosystem's blueprint, which describes the parts within the ecosystem and how they are related (Tiwana et al., 2010). The architecture comprises the central platform, the interfaces that mediate between the platform and its complements, and the complements. In platform ecosystems, authority also comes from the architecture, specifically from the control of the architecture at the center of the ecosystem (Kretschmer et al., 2022). Several researchers have stated that the interrelation between the division of decision rights and platform architecture affects complementors' engagement and a platform's success (Jacobides et al., 2018; Saadatmand et al., 2019; Tiwana et al., 2010). For example, Tiwana et al. (2010) suggested that a modular architecture (i.e., an architecture wherein the core and extension modules are loosely coupled so that complementors can act more independently) reinforces the benefits of decentralizing decision rights by reducing the costs incurred by complementors, thus accelerating the platform's evolution. According to Saadatmand et al. (2019), complementors' engagement is low when decision rights over architecture are allocated to a single actor, whereas engagement is high when decision rights are distributed among ecosystem complementors that have the same opportunities for value capture. Some researchers have suggested that architecture and its changes should also be dynamically related to governance mechanisms (Jovanovic et al., 2022b; Mei et al., 2022), which will be described in the following subsection (4.2).

4.2. Governance mechanisms

The literature has identified several governance mechanisms that are often based on boundary resources. Thus, before each mechanism is described, boundary resources should first be clarified. Boundary resources are technical and social tools that enable interactions between the platform owner and complementors (Ghazawneh & Henfridsson, 2013). Whereas technical boundary resources make the development of complementary products or services more feasible and improve platform access, social boundary resources transfer knowledge to ensure better

understanding and interaction among actors (Ghazawneh & Henfridsson, 2013; Luo et al., 2019; Miric et al., 2023). Examples of technical boundary resources include application programming interfaces (APIs) and software development kits (SDKs); examples of social boundary resources include guidelines and knowledge that support complementors (Foerderer et al., 2019; Ghazawneh & Henfridsson, 2013; Luo et al., 2019). These resources can be standardized for all complementors (e.g., general agreements) or individualized to account for specific needs (e.g., a personal contact complementors can refer to; Engert et al., 2022).

As previously mentioned, several governance mechanisms exist, such as resourcing, control, openness, trust, payment, entry strategy, and collaboration. In what follows, each governance mechanism will be presented in detail.

Resourcing aims to stimulate complementors toward creating increasingly diverse products or services (Ghazawneh & Henfridsson, 2013; Halckenhaeusser et al., 2020). Providing boundary resources is not a one-way mechanism from the platform owner to the complementors. Rather, boundary resources can be developed through interactions and fine-tuning between these actors (Eaton et al., 2015; Foerderer et al., 2019; Mohagheghzadeh & Svahn, 2016a). For example, if complementors perceive that certain boundary resources have limited functionalities, they may decide not to use them (Mohagheghzadeh & Svahn, 2016b), develop new boundary resources (i.e., self-resourcing; Ghazawneh & Henfridsson, 2013), or require additional boundary resources be provided to achieve their goals (Glaser et al., 2020; Rickmann et al., 2014). In the process of building a platform ecosystem, involving lead complementors (e.g., those whose boundary resource requirements are representatives of a broader group because they face such requirements earlier than others owing to their technical expertise and use of boundary resources) in designing boundary resources can result in boundary resources that are both attractive for complementors and aligned with the interests of incumbent platform owners (Weiss et al., 2023).

The mechanism of **control** refers to maintaining control over a platform ecosystem and attempting to align complementors with the platform's purpose (Ouchi (1980) in Goldbach & Benlian, 2015b). Given that principal–agent relationships do not hold in ecosystems, control acts more to coordinate actors than to mitigate agency risks, that is, when the agent acts for their benefit and against the principal (Constantinides et al., 2018; Tiwana, 2015). Different types of control exist. Control can be *informal* when fostering culture, common values, shared beliefs, and norms to influence complementors' behavior (so-called *clan control and self-control*), or *formal* when complementors' outputs, processes, tasks, and inputs must comply with specific criteria (Askay, 2017; Constantinides et al., 2018; Croitor et al., 2021; Lin et al., 2023; Schreieck et al., 2016; Tiwana, 2015; Tiwana et al., 2010). Input control has recently received increasing attention, and researchers are investigating how it is perceived by complementors (e.g., its fairness) and how it affects platforms (Croitor & Adam, 2020; Croitor & Werner, 2021; Song et al., 2018; Thies et al., 2018), sometimes also in combination with other types of control (e.g., self-control; Croitor et al., 2021). Due to the growth of gig platforms, the emergence of algorithmic control (Hirsch et al., 2023; Wiener et al., 2021), an automatic control that does not require human presence and is based on the use of algorithms and related digital technologies (e.g., smartphone apps; Hirsch et al., 2023), has also been noted. Its different forms, transparency, and resistance and tension from the workers' perspectives are among the main aspects of algorithmic control investigated by researchers (Chen et al., 2023; Göttel, 2021; Hirsch et al., 2023; Jiang, 2023; Möhlmann et al., 2021; Weber et al., 2022).

Control is a dynamic mechanism due to actors' interactions and the ways in which technological features are understood and used; thus, it changes over time between formal and informal control and can originate from the intentions of platform owners or other participants (Ens et al., 2023; Tiwana et al., 2010). For example, some researchers have pointed out that (quality) control can be more distributed and not only confined in the hands of the platform owner, and that centralized and distributed control types can complement each other (Tang et al., 2021).

Another mechanism is **openness**, which refers to who is allowed to join and use the platform and its resources (Ingram Bogusz & Kashyap, 2022). An open platform can stimulate experimentation and decrease innovation costs, whereas a closed platform allows for maintaining control and quality over complementors' contributions (Gawer & Cusumano, 2014; O'Mahony & Karp, 2022). Openness is often the result of other governance mechanisms. For instance, it can come from reduced input control (e.g., reducing the screening process for campaign submission to a crowdfunding platform) or from resourcing APIs that grant access to a platform's core module (Eaton et al., 2015; Ghazawneh & Henfridsson, 2013; Wessel et al., 2017). Determining an adequate level of openness and adjusting it over time is a challenging and strategic decision that must account for complementors' perceptions of openness and for its potential impacts on value co-creation and its intensity (Benlian et al., 2015; Gawer & Cusumano, 2014; Hilkert et al., 2011; Schreieck et al., 2016; Schreieck & Wiesche, 2017; Van Dyck et al., 2021; Wessel et al., 2017).

Trust is the governance mechanism that aims to create and maintain relationships and a favorable environment (Goldbach & Benlian, 2015a; Guo et al., 2021). Trust enhances actors' willingness to participate in an ecosystem and is a prerequisite for the ecosystem's success (Hurni & Huber, 2014; Riasanow et al., 2018; Zhang et al., 2020). Trust can be placed in the platform or in other actors. On the one hand, *trust in the platform* may come from different sources, such as technologies and institutions. For example, trust can be encoded in smart contracts on blockchain-based platforms, or it can come from terms and conditions that form the basis for dispute resolution (Guo et al., 2021; Perscheid et al., 2020). On the other hand, *trust in actors* can be shaped through online and offline interactions, conflict resolution mechanisms, and verification, ratings, and review systems, all of which can help reduce information asymmetry and exchange uncertainty, as well as increase transparency (Guo et al., 2021; Jovanovic et al., 2022a; Zhang et al., 2020). If actors trust each other, they are more likely to spread the platform's norms, values, and common goals, thus encouraging others to act according to them and be more committed (Goldbach & Benlian, 2015a; Guo et al., 2021). Trust can also be an outcome of other governance mechanisms, such as payments (see below) and informal and formal controls (Goldbach et al., 2014; Zhang et al., 2020).

The mechanism of **payment** refers to money flows and distributions, such as pricing, revenue sharing, and payment for the provision of services (Gol et al., 2019a; Schreieck et al., 2016). This governance mechanism is mainly used to aid network effects and overcome the chicken-and-egg problem in the early stages (building) of an ecosystem (e.g., Sterk et al., 2022). In the case of two-sided platforms, one of the two sides is often subsidized to attract a critical mass of actors on the other side. Payment can also be useful in later stages, when owners aim to sustain their ecosystem or capture value. In this case, payments can refer to service fees that platform owners can introduce to capture value when they do not have the capabilities to enter a complementary market (Zhu & Liu, 2018).

The governance mechanism of the **entry strategy** refers to the decision of platform owners to enter complementors' markets by releasing their own complements that overlap with complementors' products and services (Foerderer et al., 2018; Wen & Zhu, 2019). Entering complementors' markets is a way to control and stimulate them, as well as to appropriate value (Foerderer et al., 2018; Zhu & Liu, 2018). However, the impact of this governance mechanism seems ambiguous. Entry can increase consumer demand and, therefore, bring new ideas and opportunities for innovation, especially for larger and more diversified complementors (Foerderer et al., 2018). However, it may also stunt complementors' innovation due to increased competition, especially for those with popular products, and it can benefit consumers because of reduced shipping costs (Zhu & Liu, 2018). Other times, entry makes complementors defensive and prompts them to divert offline customers away from the platform, thus reducing demand and hurting the entire

platform (He et al., 2020). Researchers have also examined the effects of potential entry on complementors, showing that innovation may shift to less popular areas or may be reduced; meanwhile, prices may be increased (Wen & Zhu, 2019).

Aiming at reconciling these divergent results, a recent study (Shi et al., 2023, in press) showed that it is the early or late timing of a platform owner's entry that makes a difference: early timing indicates the owner's commitment to grow the market's prosperity and its focus on value co-creation, whereas later timing suggests platform owners' intention of capturing value.

Finally, **collaboration** is the mechanism used by platform owners to team up with complementors (Halckenhaeusser et al., 2020; Schreieck et al., 2016; Schreieck & Wietsche, 2017). Collaboration can take different forms. For instance, Rietveld et al. (2019) investigated the use of selective promotion (e.g., featuring specific apps on the home screen of the app store or creating special marketing campaigns) to manage the ecosystem's value. Selective promotion increases the success of individual complementary products, but it can also increase competition, which, in turn, affects other complementors' incentives and bargaining power. Cenamor and Frishammar (2021) invited platform owners and complementors to unite forces in the development and commercialization of complementary products to aim at higher performance in terms of unit sales. Rewards are another form of collaboration (Halckenhaeusser et al., 2020). For instance, through partnership ranks, complementors can be awarded greater resources and higher responsibilities (Wareham et al., 2014). Awards can also guide complementors' attention toward a market niche, even if they may multihome (e.g., join and operate their complements on other platforms; Foerderer et al., 2021).

Some researchers have suggested that platform owners can and should use both collaborative and competitive approaches (e.g., entry strategy) to foster complementors' engagement in the short and long run (Engert et al., 2023).

4.3. Governance scope

Governance scope refers to the expansiveness of governance mechanisms, that is, to what relationships (actors involved, e.g., all complementors or some of them) and where (on or off platforms) they act. In the first case, the scope is actor-related; in the second case, the scope is space-related.

For the **actor-related scope**, governance mechanisms can affect the relationship between the owner and all (or some) complementors and the relationships among the complementors (or users). Most studies have focused on the *relationship between the platform owner and complementors* (Foerderer et al., 2018; Ghazawaneh & Henfridsson, 2011; Goldbach et al., 2018; Heimburg & Wiesche, 2022; Mohagheghzadeh & Svahn, 2016a, 2016b). The complementors investigated were mostly external companies, with the only exception being the work of Glaser (2020), which examined internal complementors (i.e., teams that belong to the platform provider and that develop platform add-ons). The platform owner usually takes an ecosystem-wide approach, which means that it uses the same standardized rules (e.g., rights and duties), values (e.g., promoted in codes of conduct), and technologies (e.g., boundary resources) to govern the ecosystem. Research agrees that this approach saves costs, but its impact on value co-creation and capture seems ambiguous. For instance, some researchers found that a standardized approach leads to less novel but more commercially successful products (e.g., higher sales; Miric et al., 2023). Others found that it may hamper value co-creation opportunities, suggesting that a platform owner focuses on its *relationship with a set of complementors* and on their local needs through additional, individualized resourcing or partnership programs in which the partner level can be self-selected, or through the use of more flexible rules (Engert et al., 2022; Glaser, 2020; Huber et al., 2017; Hurni et al., 2021; Kindermann et al., 2022; Wareham et al., 2014). Platform owners must recognize that complementors are autonomous and active actors who will try to ensure that their specific needs are not lost, which is essential for value co-creation (Hurni et al., 2022).

Thus far, researchers have paid very little attention to how governance mechanisms can affect the *relationships among complementors (or users)*, with a couple of exceptions. For example, Zhang et al. (2022) investigated how openness can affect knowledge-sharing activities among complementors to balance value co-creation and capture. Burtch et al. (2019) focused on interactions among users through peer recognition (e.g., in the form of "likes" and awards) that can encourage more, but less novel, content generation.

Space-related scope refers to whether the focus of governance mechanisms is *online* (on the platform) and/or *offline* (outside the platform). Zhang et al. (2020) showed that online and offline practices interact and encourage varied interpersonal relationships in the context of sharing platforms. Wang and Nandhakumar (2017) suggested growing and governing a platform and its sides by focusing on online and offline spaces, such as, respectively, chat rooms, information standardization, or more APIs, and through user meetings, peripheral gifts (e.g., t-shirts) or trusteeship management. Although most articles focus on online space, focusing on off-platform activities can foster relationships, create a sense of community, and incentivize platform participation (Suvivuo et al., 2023; Wang & Nandhakumar, 2017). Sometimes, however, these off-platform events may discourage platform users from connecting on the platform (Zhang et al., 2020).

Thus far, this review has provided a description of the three core building blocks of digital platform ecosystem governance. In the following two subsections, the focus will be on contingency factors and outcomes.

4.4. Contingency factors

Contingency factors refer to elements that affect the core building blocks or mediate the outcomes of digital platform ecosystem governance. There are three types of contingency factors: actor-, platform-, and market-related.

Actor-related contingency factors refer to the *individual characteristics of platform owners and/or complementors*. For platform owners, whether they are established companies or start-ups makes a difference, for instance, when it comes to the extent of openness or in relation to their bargaining power in building or sustaining platforms (Floetgen et al., 2023; Schreieck & Wiesche, 2017; Sterk et al., 2022; Wang & Nandhakumar, 2017). A platform owner's bargaining power, previous decisions, and capabilities (which can also be learned) can affect how governance is enacted and changed from emergent to mature stages (e.g., whether the governance scope will address the entire ecosystem or local needs), or the possibilities of co-creating and capturing value through the platform (Foss et al., 2023; Helfat & Raubitschek, 2018; Huber et al., 2017; Kindermann et al., 2022; Schreieck et al., 2021; Uzunca et al., 2022).

For complementors, some researchers have shown that their size (in terms of app portfolios), diversification (in terms of targeted categories), popularity, and capabilities affect their perceptions of and responses to entry strategies (Foerderer et al., 2018; Wen & Zhu, 2019; Zhu & Liu, 2018). Other researchers have mentioned that complementors' complex or routinized knowledge, locations, perceptions, and assessments, or their products' reputation affect their activities and the effectiveness of governance mechanisms (Croitor et al., 2021; Croitor & Werner, 2021; Goldbach et al., 2018; Gutt et al., 2019; Koo & Eesley, 2021; Wiener et al., 2021; Zhang et al., 2022).

Platform-related contingency factors refer to a *platform's characteristics*, such as its evolutionary stage and type. Van Dyck et al. (2021) reported that emergent ecosystems need to strategically balance resource openness. Schreieck et al. (2021) suggested that creating value is more important than capturing value when building ecosystems, yet value capture cannot be neglected in the early stages or it will be more difficult afterward. For the platform type, crowdfunding platforms may need to quickly increase the critical mass of funders due to the short time horizon

of their campaigns (i.e., days or weeks) compared with other types of platforms based on games or apps that are available for a longer time (i.e., months or years; Thies et al., 2018). Another example is blockchain-based platforms, which are usually more open than other types of platforms that require users and complementors to authenticate (Pereira et al., 2019). Another platform-related contingency is platform strategy, which, if generalist (specialist), increases (decreases) the range of possibilities for reducing conflicts between platform owners and complementors, thus increasing (decreasing) outcomes (Islam et al., 2023).

Market-related contingency factors are *characteristics of the market* in which the platform ecosystem operates. A competitive market can reduce complementors' investments in a platform (Wang, 2021). In the case of crowded markets, platform owners can reduce openness to lower competitiveness and foster complementors' cooperation (Zhang et al., 2022). Markets with high demand growth increase opportunities for collaboration toward value co-creation, whereas markets with low demand growth (more mature markets) have poor opportunities for value co-creation and make actors compete to capture value (Uzunca et al., 2022). Another aspect may be the higher regulated environment that prompts platform owners to (re)shape platform functionalities and decide on the level of openness (Ingram Bogusz & Kashyap, 2022). Another study concluded that legitimacy (i.e., what is considered desirable, proper, or appropriate within a context) can affect a platform's openness and sustainability and even has a heavier weight along a platform's evolution (Brandwijk & de Reuver, 2023).

4.5. Outcomes

Outcomes are the results expected or achieved by the chosen governance structure, mechanisms, and scope and are mediated by contingency factors. Outcomes essentially refer to a platform ecosystem's value dynamics—that is, value co-creation and value capture.

Value co-creation is generally understood as *innovations* (development activities) or *transactions* between the sides of a platform ecosystem (Foerderer et al., 2018; Foss et al., 2023; Gawer, 2014; Gawer & Cusumano, 2014; Gol et al., 2019b; Goldbach & Benlian, 2015b; Huber et al., 2017; Inoue, 2021; Zhang et al., 2020). In digital platform ecosystems, value is co-created because it is shaped through interactions by platform owners and complementors or among complementors (Cenamor & Frishammar, 2021; de Vasconcelos Gomes et al., 2021; Halckenhaeusser et al., 2020; Schreieck & Wiesche, 2017; Selander et al., 2013; Zhang et al., 2022).

Value co-creation is often described and measured in different ways, such as through product performance, increased quality of app notifications, user satisfaction, or the tangible and intangible benefits resulting from combining partners' resources with the soon-to-be realized value that can come from acquiring important clients or serving important clients' needs (Cenamor & Frishammar, 2021; Cennamo & Santaló, 2019; Claussen et al., 2013; Huber et al., 2017). Therefore, value is dependent on context and can be affected by the governance structure, governance mechanisms, and/or governance scope. For instance, for the structure, the configuration of the decision rights and architecture can affect complementors' engagement, and the centralization of decision rights can affect their uncertainties and hazard costs, thus influencing their willingness to invest in the development of complementary products (Dellermann & Reck, 2017; Niedermayer, 2013; Saadatmand et al., 2019). For mechanisms, higher value co-creation can be achieved through collaboration between owners and complementors, whereas formal control (e.g., rigid regulations) can stunt it (Cenamor & Frishammar, 2021; Eaton et al., 2015; Schreieck et al., 2016). For governance scope, Zhang et al. (2022) suggested that fostering knowledge sharing among complementors can generate value, whereas Huber et al. (2017) suggested that addressing local needs can lead to higher value.

Co-creating value is not a straightforward process. One of the reasons is its interaction with **value capture**, that is, the appropriation of part of the co-created value—a topic that has received less attention (Foss et al., 2023; Schreieck et al., 2021). The dynamics of value co-creation and value capture must be well balanced because if a platform owner captures a large portion of the co-created value or distributes it in a way that seems unfair to complementors, the recruitment of potential complementors can be difficult (Jacobides et al., 2018; Sterk et al., 2022). Another reason is related to mediation by contingency factors. For instance, the outcomes of platform ecosystem governance may be uncertain because of changes in the way complementors, each with varying degrees of product popularities, adjust their value co-creation and capture strategies in response to governance mechanisms (Wen & Zhu, 2019).

5. Discussion and research agenda

As the findings and the conceptual model demonstrate, platform ecosystem governance is complex and multifaceted; thus, it cannot be adequately understood when looking narrowly at some of its building blocks. Platform ecosystem governance occurs within a context and is thus influenced by contingency factors related to the actors, platforms, and markets in which they operate. The core building blocks of platform ecosystem governance (governance structure, governance mechanisms, and governance scope) or their elements can also serve as contingency factors for one another. For instance, within a governance structure, the definition of ownership affects the division of decision rights (Hein et al., 2020). When a platform ecosystem has a single owner, this actor will allocate to themselves the full (or at least the largest) share of decision rights; in other cases, decision rights can be divided among actors, as in the hybrid and collective modes of governance in the work of O'Mahony and Karp (2022).

Ownership also affects an ecosystem's evolution by affecting outcomes (directly or indirectly via governance mechanisms) and changing how governance mechanisms are implemented (Gol et al., 2019a; Hein et al., 2016; Tiwana, 2013; Tiwana et al., 2010). For example, ownership—and the bargaining power that comes from it—has been described as a commitment device that can influence complementors' willingness to invest in complementary product development (Niedermayer, 2013) and hence, their participation in value co-creation. How ownership affects the implementation of governance mechanisms can be understood using the following examples: Facebook, which has a centralized platform ecosystem, is the only organization that establishes and changes the platform's governance mechanisms, whereas Uber, which is midway between a centralized and a decentralized platform ecosystem, has full control over prices but gives users quality control through a driver rating system (Hein et al., 2016).

Governance mechanisms can be implemented to orchestrate an ecosystem widely or more locally and to coordinate complementors or their interactions, both online and offline, thus affecting the governance scope. Sometimes, governance scope may also affect governance mechanisms, such as when physical relationships among actors lead to higher levels of trust among them.

The core building blocks of governance structure, governance mechanisms, and governance scope, together with contingency factors, affect the generation of outcomes in terms of value co-creation and value capture. In turn, these outcomes can reshape governance mechanisms and governance scope, which can be investigated further (Huber et al., 2017; Wessel et al., 2015). In addition, deepening our understanding of the relationships among and within the building blocks is key to advancing our theoretical and practical knowledge. Thus, avenues for future research are presented in the following subsections.

5.1. Research agenda

Based on what researchers have investigated thus far, along with the changes in the platform ecosystem scenario and the gaps identified by extracting information from the gathered articles, this review suggests a research agenda for each building block of the proposed conceptual

model (Fig. 2). These avenues are considered important for enriching our knowledge and understanding of platform ecosystem governance. Considering the strong connections among the building blocks, research on each block is related to other blocks as well. Table 1 provides a summary of the identified avenues, specifying the research areas (building blocks), the topics within them, and the related research questions.

5.1.1. Future research on governance structure

As described in 4.1, governance structure comprises ownership, decision rights, and architecture. The interplay between ownership and decision rights gives rise to platform ecosystems with different degrees of (de)centralization. Researchers have mainly focused on centralized platform ecosystems and their focal actors, with very little attention paid to a more distributed model of organization (de Reuver et al., 2018; Saadatmand et al., 2019; Selander et al., 2013). Some exceptions are those works related to blockchain-based ecosystems (Burda et al., 2022; Pereira et al., 2019; Perscheid et al., 2020) and the work of O'Mahony and Karp (2022), which focused on collective platform governance in which those affected by the rules can participate in their making. Therefore, first, future research may investigate (more) decentralized forms of platform ecosystems. Within these decentralized platform ecosystems, collaborative platform ecosystems appear interesting for future investigation. In collaborative platform ecosystems, the governance structure (especially ownership and decision rights) is shared among multiple actors, none of which is the owner of the ecosystem, and may also be organized in some sort of consortia (Hein et al., 2020). Collaborative platform ecosystems are a new type of ecosystem that emerges around goals that are best approached in collaboration rather than in isolation. For instance, some ecosystems have been launched in the aquaculture industry in Norway to address sustainability challenges, while others have been launched in other industries, such as healthcare and oil and gas. Therefore, focusing on such ecosystems would allow us to extend our knowledge apart from centralized platform ecosystems. Doing so will also allow us to better grasp the evolving business scenario, which, aside from theoretical development, will provide more relevant guidelines for practitioners. Moreover, depending on the collaborative ecosystem's goal(s), future research may add knowledge of how digital platform ecosystems relate to issues of societal and global interest (de Reuver et al., 2018).

Different aspects could be considered when investigating such collaborative platform ecosystems. For example, it could be worth exploring how decision rights are allocated. One possible question is, "Based on what criteria (e.g., based on size or power) would roles and decision rights be allocated in a collaborative platform ecosystem?" Researchers may also focus on how value is co-created, distributed, and captured in such settings and on how value, in the first place, can be defined at the firm and ecosystem levels.

Second, researchers could investigate how governance structure affects the choice of governance mechanisms. The extant literature has been silent on this point despite the recent work of Floetgen et al. (2023) suggesting that platform ecosystems led by a single actor (incumbent or start-up) and those led by a strategic alliance (which may be seen as a decentralized ecosystem) implement different governance mechanisms. Therefore, future research may follow a multiple case study or undertake a survey across several digital platform ecosystems to explore whether and how platform ecosystems led by a single actor or by a consortium choose and employ their governance mechanisms. To address this research direction, future studies may also conduct single-case studies of collaborative platform ecosystems and investigate questions such as "Does a platform owner's entry into complementary markets make sense in a consortium-led platform ecosystem? If so, which of the companies leading a platform ecosystem, and on which basis, enter complementary markets, and how is value divided?"

Conducting research along these lines will provide us with a more in-depth understanding about whether collaborative (or more

Table 1
Research agenda.

Research area (building block)	Topic(s) of interest	Research questions
Governance structure	Collaborative platform ecosystems	Based on what criteria (e.g., based on size or power) would roles and decision rights be allocated in a collaborative platform ecosystem? How is value co-created and appropriated in collaborative platform ecosystems? Do collaborative platform ecosystems present challenges other than those of centralized platform ecosystems?
	The impact of governance structure on governance mechanisms	How does the governance structure affect the choice of governance mechanisms? Does a platform owner's entry into complementary markets make sense in a consortium-led platform ecosystem? If so, which of the companies leading a platform ecosystem and, on which basis, enter complementary markets? In this case, how is value divided?
Governance mechanisms	Strategic role and design of boundary resources	What makes boundary resources appealing for complementors? How should boundary resources be strategically designed? How can technical and social boundary resources be best combined? Do they have different impacts on complementors, or can these resources work together to stimulate complementors?
	A contingency model of governance mechanisms, contingency factors, and outcomes (comparing and combining them in different conditions)	Under what condition(s) is one governance mechanism preferred to another? How can governance mechanisms be best combined? How do governance mechanisms change across platform ecosystems and throughout the platform's life cycle?
Governance scope	Interactions among complementors Offline scope	What are the effects of (online and offline) governance mechanisms on complementors' interactions and their contributions toward collective knowledge and value co-creation?
Contingency factors	Relative importance of contingency factors, their interrelations, and their casual chains (if any)	What contingency factors matter most when building a digital platform ecosystem? What contingency factors matter most when sustaining a digital platform ecosystem?
	Governance mechanisms as contingency factors of platform participation (signaling role)	How do prospective complementors' perceptions of governance mechanisms affect their platform participation choices?
Outcomes	Outcomes at the platform level	What are the effects of governance mechanisms at the platform level?

(*continued on next page*)

Table 1 (*continued*)

Research area (building block)	Topic(s) of interest	Research questions
		Do governance mechanisms contribute to a platform ecosystem's health, integrity, and sustainability? What about the effects of governance mechanisms on the other side of a platform?
	Effects of outcomes on past governance choices	How do outcomes affect and reshape governance decisions?
	Relationship between value co-creation and value capture	How should the co-created value be best divided among actors?
		How does the value captured by a platform owner affect the stability of the entire platform ecosystem?

decentralized) platform ecosystems present governance challenges other than centralized ones, as well as how governance structure affects other governance choices down the funnel and the platform's future evolution (Burda et al., 2022).

5.1.2. Future research on governance mechanisms

Despite the large amount of attention paid to governance mechanisms, this building block requires additional investigation. First, given that many governance mechanisms are based on boundary resources, the strategic design and role of boundary resources can be explored further (Ghazawneh & Henfridsson, 2013). Not all boundary resources are mandatory to use; thus, future research may ask what makes them appealing for the development of complementary products and how platform owners should strategically design them. Mohagheghzadeh and Svahn (2016b) reported that intuitive boundary resources are an effective way to transfer design capabilities, in that they would cut down time for exploration. Weiss et al. (2023) suggested that incumbent platform owners could engage and collaborate with lead complementors in the design of these resources rather than push them into a sort of 'resistance and accommodation' (Eaton et al., 2015, p. 220). Aside from these works, however, our knowledge is limited. There are other questions that require more examination, such as "How can technical and social boundary resources best be combined?" and "Do they have a different impact on complementors, or can these resources work together to stimulate complementors?" Replying to these questions will help platform owners make more considerate choices related to their boundary resources in ways that facilitate innovation and interactions among actors.

Second, we still know little about how to choose specific governance mechanisms over others. Some researchers have compared formal and informal control and within these types, but often in simulated platform settings or have accounted for intentions rather than actual behaviors (Croitor et al., 2021; Goldbach & Benlian, 2015b; Goldbach et al., 2014, 2018; Goldbach & Kemper, 2014; Göttel, 2021). Therefore, comparing across governance mechanisms and in more real settings would enrich our understanding of the effectiveness of governance mechanisms. For instance, future researchers may compare control and resourcing or investigate how competition mechanisms (e.g., entry strategy) can be combined with other mechanisms.

Moreover, investigating the same mechanism in different types of digital platform ecosystems would also be beneficial. For example, Foerderer et al. (2018) suggested that entry may have different effects on complementors over time and may also depend on the platform ecosystem type, such as whether it is a consumer or enterprise platform. The choice of governance mechanisms along the evolution of a platform ecosystem also requires further research. There is strong agreement on using payment in the early stages; however, this cannot be taken for granted. For instance, Wang and Nandhakumar (2017) claimed that in launching platform ecosystems and growing their critical mass, startups can start with the side that is most approachable with existing resources, instead of the one that is more price sensitive.

Overall, there is a need to look at mechanisms and contingency factors (see also 5.1.4) in a more structured and comprehensive way. In this direction, a contingency model may be developed based on a quantitative study of how contingencies affect governance mechanisms and outcomes. Such a contingency model could be valuable for gaining insights into what comprises the best fit for a specific context, such as across platforms and along the platform life cycle. This knowledge would allow practitioners to make their governance decisions on a sounder basis and increase their effectiveness.

5.1.3. Future research on governance scope

Our current knowledge of how governance mechanisms shape interactions among complementors remains scant (Zhang et al., 2022). This is unfortunate because, even if interactions among complementors may not be directly associated with value co-creation (Kretschmer & Claussen, 2016; Rietveld et al., 2019), they are still relevant and can drive novel knowledge recombination and the creation of reusable knowledge and innovation in ways that can help other complementors achieve platform value co-creation (Adner & Kapoor, 2010; Wareham et al., 2014; Zhang et al., 2022). Moreover, shaping interactions among complementors toward a goal may contribute to improved management of the tension between individual versus collective identification described by Wareham et al. (2014).

Therefore, a first avenue for future research can aim at extending our knowledge of how governance mechanisms can foster complementors' interactions and their contributions to other complementors toward achieving value co-creation. Given the scant research on this theme, future studies may follow a qualitative approach to investigate the possible effects of governance mechanisms on complementors' interactions. Second, along this line of thought, future research may also investigate how adopting an offline scope (i.e., applying governance mechanisms outside the platform) may foster complementor interactions, thereby intersecting the two least investigated aspects of governance scope.

5.1.4. Future research on contingency factors

Platform owners' governance decisions must be tailored to the specific environment and needs. As shown in 4.4, the extant research has brought to the table several contingency factors at different levels. In 5.1.2, the theoretical and practical necessity of developing a contingency model that can relate the context, governance mechanisms, and outcomes has been stated. In this subsection, the first avenue for future research involves exploring the relative importance of contingency factors, their interrelations, and their casual chains (if any). Studying and evaluating these aspects may strengthen the contingency model and increase our knowledge of how to govern platform ecosystems in specific contexts throughout their evolutionary stages.

Second, future research may focus on the signaling role of governance mechanisms, i.e., how they are perceived by complementors and can act as contingency factors that affect complementors' consideration to join and participate in platform ecosystems (Adam et al., 2023; Kretschmer et al., 2022). Along the line of Adam et al. (2023), who find that a moderate degree of perceived input control maximizes prospective complementors' intention to join, future research may ask: "How does prospective complementors' perceptions of governance mechanisms affect their platform participation choice?" Answering this question may increase our understanding of how platform owners could best attract complementors, which in turn, may be useful when building and eventually sustaining an ecosystem. Moreover, addressing such a question can provide further insights into platform competition (Rietveld & Schilling, 2021).

5.1.5. Future research on outcomes

Thus far, the extant research has looked at outcomes in a narrow way. This is because the literature has generally looked at complementor-related outcomes, such as the innovations they have implemented or their stickiness to a platform (e.g., Ghazawneh & Henfridsson, 2010; Goldbach & Kemper, 2014; Göttel, 2021). However, platform ecosystem governance can do much more than this. For years, it has been recognized that platform ecosystem governance affects a platform ecosystem's evolutionary dynamics (Tiwana et al., 2010). However, our understanding of this impact is limited and untested (Mukhopadhyay & Bouwman, 2019; Song et al., 2018). Therefore, in enriching our knowledge along this line, researchers may first focus on the following questions: "Do governance mechanisms contribute to a platform ecosystem's health, integrity, and sustainability (Iansiti & Levien, 2004)?" "What about the effects of governance mechanisms on the other side of a platform?" Only a few works seem to have followed this direction. For example, Wessel et al. (2015, 2017) stated that abolishing input control, despite increasing the number of complementary products, reduces platform appeal. Song et al. (2018) and Thies et al. (2018) reported that control generates asymmetric cross-side network effects, thus undermining the idea of mutual cross-network effects between the two sides of platform ecosystems and self-sustaining growth. To increase our understanding of this research avenue, adopting a platform level of analysis may be key to accounting for the broad outcomes that platform ecosystem governance can generate. Adopting a longitudinal perspective is also fundamental in that the governance mechanisms may take time to generate outcomes and may affect the platform ecosystem's sides at different points in time (Song et al., 2018).

Second, we have limited knowledge about how outcomes affect and reshape platform ecosystem governance decisions made until that moment (e.g., governance mechanisms or scope). The abovementioned work by Wessel et al. (2015) provides some insights. In particular, the authors pointed out that measures for establishing a shared vision across all ecosystem participants (a sort of clan or informal control) were introduced to counteract the platform's reduced appeal brought about by a relaxation of formal control. Wang (2021) found that controlling complementors can benefit consumers and platform owners. Huber et al. (2017) suggested further investigating how a governance scope that targets a set of complementors and their local needs impacts other complementors, such as whether they will reduce or increase their investments in the platform due to the perception of unfair treatment or in the hope of preferential treatment. Future research can be guided by the question, "How do outcomes affect and reshape platform owners' governance decisions?"

Finally, researchers may investigate the relationship between value co-creation and value capture because value capture may undermine a platform ecosystem's stability. Researchers have pointed out that if platform owners capture a large value or distribute it unfairly, complementors' recruitment can be hindered (Jacobides et al., 2018; Sterk et al., 2022). In the context of mobile platform-mediated networks, Oh et al. (2015) proposed a bargaining model to investigate how value is likely to be captured between platform providers and app developers. However, we have scarce knowledge regarding the optimal allocation of co-created value among actors, and this limitation can be explored in future research. Moreover, it is not always possible to understand the potential outcomes because complementors adjust their value co-creation and capture strategies to respond to governance choices (Wen & Zhu, 2019). Thus, future research could focus on the dynamics of value co-creation and capture among actors during the evolution of a platform ecosystem.

Overall, platform ecosystem governance is not a one-shot decision; rather, it is dynamic and must be revised over time (Gawer, 2014; Wareham et al., 2014). Therefore, researchers may rely on longitudinal studies to investigate the topic in the suggested directions.

5.2. Practical implications

Despite the fact that this review was conducted with researchers as the main audience, the findings can be translated into managerial insights for practitioners who are willing to govern their digital platform ecosystems from the building phase to a mature one. The conceptual model lays out which components practitioners must consider to govern digital platform ecosystems in a more structured manner. Moreover, the proposed model suggests how these components are interrelated and affect one another. The three main components are strictly related and are narrowed down in a funnel, from decisions of structure, down to the mechanisms and further on to scope. When establishing a digital platform ecosystem, practitioners may initially approach these three components in a sequential way. These decisions are influenced by and must align with the context (e.g., the characteristics of the platform ecosystem, its actors, and the market) to be able to realize the intended outcome(s). Over time, given the inherently fragile nature of governance choices, managers should continuously adjust those choices while dealing with new and emergent issues (Foss et al., 2023). Subsequent choices may not follow a sequential approach; for instance, practitioners may broaden the governance scope without changing the governance mechanisms. However, practitioners should also be aware that their previous choices, capabilities, and bargaining power may affect the possibility of changing those previous governance choices, as well as their value co-creation and capture opportunities (Helfat & Raubitschek, 2018; Huber et al., 2017; Uzunca et al., 2022).

Overall, the conceptual model can be used by practitioners as a template for building and sustaining ecosystems by considering the different components, analyzing the current situation, monitoring changes, taking more informed governance choices, and adjusting them, if needed.

6. Conclusion and limitations

This multidisciplinary, systematic literature review synthesizes the extant knowledge on platform ecosystem governance. This review was guided by two research questions: "What are the building blocks of platform ecosystem governance?" and "What do we need more research on?" The answer to the first question is provided through a conceptual model of platform governance consisting of five building blocks: governance structure, governance mechanisms, governance scope, contingency factors, and outcomes. The answer to the second question is provided through the research agenda, which brings up several questions within each of the building blocks as promising avenues for future research.

This review is mainly helpful for academics. Specifically, by grouping concepts into blocks and suggesting how these blocks are related—which has not been addressed by extant research—the developed model presents a robust foundation for researchers investigating the topic of digital platform ecosystem governance for the first time. In addition, the conceptual model provides a basis for future research. Researchers may investigate the relationships among the different building blocks (or also within) of digital platform ecosystem governance through qualitative or quantitative studies.

The answer to the second question is a research agenda that derives from existing research, identified research gaps, and the evolving platform ecosystem scenario. Based on the proposed model, the research agenda suggests future research avenues and questions in each of the building blocks of digital platform ecosystem governance to enrich our knowledge of this vital topic.

Apart from motivating researchers to enhance our understanding of platform ecosystem governance, this review can also assist practitioners. In fact, the conceptual model draws attention to the building blocks and their interactions, which must be considered in building and/or sustaining a platform ecosystem in a structured manner.

Finally, this literature review follows the recommendations prescribed by Fink (2013), Okoli and Schabram (2010), and Webster and Watson (2002). Compliance with these guidelines and a focus on high-quality research give confidence in the thoroughness of the method and the identification of relevant contributions. However, some limitations still exist regarding subjective choices related to the selected keywords, the inclusion and exclusion criteria, and the time frame.

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References

*included in the literature analysis

Adam, M., Croitor, E., Werner, D., Benlian, A., & Wiener, M. (2023). Input control and its signalling effects for complementors' intention to join digital platforms. *Information Systems Journal, 33*(3), 437–466. https://doi.org/10.1111/isj.12408

Adner, R., & Kapoor, R. (2010). Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal, 31*(3), 306–333. https://www.jstor.org/stable/40587479.

* Askay, D. (2017). A conceptual framework for investigating organizational control and resistance in crowd-based platforms. In T. Bui (Ed.), *Proceedings of the 50th Hawaii international conference on system sciences (HICSS)* (pp. 1727–1736). AIS Electronic Library (AISeL). https://doi.org/10.24251/HICSS.2017.210.

* Benlian, A., Hilkert, D., & Hess, T. (2015). How open is this platform? The meaning and measurement of platform openness from the complementers' perspective. *Journal of Information Technology, 30*(3), 209–228. https://doi.org/10.1057/jit.2015.6.

* Brandwijk, N., & de Reuver, M. (2023). Do negative externalities affect platform membership conditions? The impact of moral and regulatory legitimacy on platform governance. In M. Aanestad, S. Klein, & M. Tarafdar (Eds.), *Thirty-first European conference on information systems (ECIS 2023)* (pp. 1–17). Association for Information Systems (AIS) https://aisel.aisnet.org/ecis2023_rp/313.

* Burda, M., Locca, M., & Staykova, K. (2022). Decision rights decentralization in DeFi platforms. In R. Beck, D. Petcu, & M. Fotache (Eds.), *Thirtieth European conference on information systems (ECIS 2022)* (pp. 1–15). Association for Information Systems (AIS) https://aisel.aisnet.org/ecis2022_rp/145.

* Burtch, G., He, Q., Hong, Y., & Lee, D. D. (2019). Peer recognition increases user content generation but reduces content novelty. In H. Krcmar, J. Fedorowicz, W. Fong Boh, J. M. Leimeister, & S. Wattal (Eds.), *Fortieth international conference on information systems (ICIS)* (pp. 1–17). Association for Information Systems (AIS). https://doi.org/10.2139/ssrn.3465879.

* Cenamor, J., & Frishammar, J. (2021). Openness in platform ecosystems: Innovation strategies for complementary products. *Research Policy, 50*(1). https://doi.org/10.1016/j.respol.2020.104148.

* Cennamo, C., & Santaló, J. (2019). Generativity tension and value creation in platform ecosystems. *Organization Science, 30*(3), 617–641. https://doi.org/10.1287/orsc.2018.1270.

* Chen, J., Luo, J., Hu, W., & Ma, J. (2023-a). Fit into work! From formalizing governance of gig platform ecosystems to helping gig workers craft their platform work. *Decision Support Systems*. https://doi.org/10.1016/j.dss.2023.114016 (article (in press).

* Claussen, J., Kretschmer, T., & Mayrhofer, P. (2013). The effects of rewarding user engagement: The case of Facebook apps. *Information Systems Research, 24*(1), 186–200. https://doi.org/10.1287/isre.1120.0467.

* Constantinides, P., Parker, G., & Henfridsson, O. (2018). Platforms and infrastructures in the digital age. *Information Systems Research, 29*(2), 1–20. https://doi.org/10.1287/isre.2018.0794.

* Croitor, E., & Adam, M. (2020). Perceived input control on digital platforms: An empirical investigation. In F. Rowe, R. El Amrani, M. Limayem, S. Newell, N. Pouloudi, E. van Heck, & A. El Quammah (Eds.), *Proceedings of twenty-eighth European conference on information systems (ECIS)*. Association for Information Systems (AIS) https://aisel.aisnet.org/ecis2020_rp/2.

* Croitor, E., & Werner, D. (2021). Exploring the relationship between perceived input control and complementors' perceived performance: An empirical study on Amazon. *ECIS 2021 Research Papers, 13* https://aisel.aisnet.org/ecis2021_rp/13.

* Croitor, E., Werner, D., & Benlian, A. (2021). The effects of control mechanisms on complementors' behavioral intentions: An empirical study of reward-based crowdfunding platforms. In T. Bui (Ed.), *Proceedings of the 54th Hawaii international conference on system sciences (HICSS)* (pp. 6173–6182). University of Hawaii http://hdl.handle.net/10125/71365.

* Dellermann, D., & Reck, F. (2017). The antecedents of transaction costs in digital ecosystems: A configurational view on the interplay of app architecture and platform governance. In T. Bui (Ed.), *Proceedings of the 50th Hawaii international conference on system sciences (HICSS)* (pp. 5265–5274). AIS Electronic Library (AISeL). https://doi.org/10.24251/HICSS.2017.638.

* Eaton, B., Elaluf-Calderwood, S., Sørensen, C., & Yoo, Y. (2015). Distributed tuning of boundary resources. *MIS Quarterly, 39*(1), 217–244 https://www.jstor.org/stable/26628348.

* Engert, M., Evers, J., Hein, A., & Krcmar, H. (2022). The engagement of complementors and the role of platform boundary resources in e-commerce platform ecosystems. *Information Systems Frontiers, 24*(6), 2007–2025. https://doi.org/10.1007/s10796-021-10236-3.

* Engert, M., Evers, J., Hein, A., & Krcmar, H. (2023). Sustaining complementor engagement in digital platform ecosystems: Antecedents, behaviours and engagement trajectories. *Information Systems Journal, 33*, 1151–1185. https://doi.org/10.1111/isj.12438.

* Ens, N., Hukal, P., & Blegind Jensen, T. (2023). Dynamics of control on digital platforms. *Information Systems Journal, 33*, 890–911. https://doi.org/10.1111/isj.12429.

Fink, A. (2013). *Conducting research literature reviews: From the internet to paper* (4th ed.). Sage Publications.

Floetgen, R. J., Novotny, M., Hein, A., Weking, J., Urmetzer, F., Böhm, M., & Krcmar, H. (2022). Digital platform ecosystem performance: Antecedents and interrelations. In *Proceedings of the Australasian conference on information systems (ACIS)* (pp. 1–11). Association for Information Systems (AIS). https://acis.aaisnet.org/wp-content/uploads/2022/11/ACIS_2022_paper_4.pdf.

* Floetgen, R. J., Winder, P., Fielt, E., Weking, J., Hein, A., Schreieck, M., & Krcmar, H. (2023). Ownership structures and governance strategies for digital platform ecosystems: An empirical study. In M. Aanestad, S. Klein, & M. Tarafdar (Eds.), *Thirty-first European conference on information systems (ECIS 2023)* (pp. 1–18). Association for Information Systems (AIS) https://aisel.aisnet.org/ecis2023_rp/246.

* Foerderer, J., Kude, T., Mithas, S., & Heinzl, A. (2018). Does platform owner's entry crowd out innovation? Evidence from Google photos. *Information Systems Research, 29*(2), 444–460. https://doi.org/10.1287/isre.2018.0787.

* Foerderer, J., Kude, T., Schuetz, S. W., & Heinzl, A. (2019). Knowledge boundaries in enterprise software platform development: Antecedents and consequences for platform governance. *Information Systems Journal, 29*(1), 119–144. https://doi.org/10.1111/isj.12186.

* Foerderer, J., Lueker, N., & Heinzl, A. (2021). And the winner is…? The desirable and undesirable effects of platform awards. *Information Systems Research, 32*(4), 1155–1172. https://doi.org/10.1287/isre.2021.1019.

* Foss, N. J., Schmidt, J., & Teece, D. J. (2023). Ecosystem leadership as a dynamic capability. *Long Range Planning, 56*(1), 1–16. https://doi.org/10.1016/j.lrp.2022.102270, 102270.

* Gawer, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. *Research Policy, 43*(7), 1239–1249. https://doi.org/10.1016/j.respol.2014.03.006.

* Gawer, A., & Cusumano, M. A. (2014). Industry platforms and ecosystem innovation. *Journal of Product Innovation Management, 31*(3), 417–433. https://doi.org/10.1111/jpim.12105.

* Ghazawneh, A., & Henfridsson, O. (2010). Governing third-party development through platform boundary resources. In R. Sabherwal, & M. Sumner (Eds.), *Thirty-first international conference on information systems (ICIS)* (pp. 1–17). Association for Information Systems (AIS) https://aisel.aisnet.org/icis2010_submissions/48.

* Ghazawneh, A., & Henfridsson, O. (2011). Micro-strategizing in platform ecosystems: A multiple case study. In D. F. Galletta, & T. P. Liang (Eds.), *Thirty-second international conference on information systems (ICIS)* (pp. 1–19). Association for Information Systems (AIS) https://aisel.aisnet.org/icis2011/proceedings/generaltopics/3.

* Ghazawneh, A., & Henfridsson, O. (2013). Balancing platform control and external contribution in third-party development: The boundary resources model. *Information Systems Journal, 23*(2), 173–192. https://doi.org/10.1111/j.1365-2575.2012.00406.x.

* Glaser, K. (2020). Governance of internal complementors in platform ecosystems. In J. F. George, S. Paul, R. De, E. Karahanna, S. Sarker, & G. Oestreicher-Singer (Eds.), *Forty-first international conference on information systems (ICIS)* (pp. 1–19). Association for Information Systems (AIS) https://aisel.aisnet.org/icis2020/is_development/is_development/10.

* Gol, E. S., Avital, M., & Stein, M. K. (2019a). Crowdwork platforms: Juxtaposing centralized and decentralized governance. In P. Johannesson, P. Ågerfalk, & R. Helms (Eds.), *Proceedings of the 27th European conference on information systems (ECIS)* (pp. 1–16). Association for Information Systems (AIS) https://aisel.aisnet.org/ecis2019_rp/110.

* Gol, E. S., Stein, M. K., & Avital, M. (2019b). Crowdwork platform governance toward organizational value creation. *The Journal of Strategic Information Systems, 28*(2), 175–195. https://doi.org/10.1016/j.jsis.2019.01.001.

* Goldbach, T., & Benlian, A. (2015a). How social capital facilitates clan control on software platforms to enhance App-developers' performance and success. In T. A. Carte, A. Heinzl, & C. Urquhart (Eds.), *Thirty-sixth international conference on information systems (ICIS)* (pp. 1–18). Association for Information Systems (AIS) https://aisel.aisnet.org/icis2015/proceedings/ISgov/2.

* Goldbach, T., & Benlian, A. (2015b). Understanding informal control modes on software platforms-The mediating role of third-party developers' intrinsic motivation. In T. A. Carte, A. Heinzl, & C. Urquhart (Eds.), *Thirty-Sixth international conference on information systems (ICIS* (pp. 1–19). Association for Information Systems (AIS) https://aisel.aisnet.org/icis2015/proceedings/ManagingIS/2.

* Goldbach, T., Benlian, A., & Buxmann, P. (2018). Differential effects of formal and self-control in mobile platform ecosystems: Multi-method findings on third-party

developers' continuance intentions and application quality. *Information & Management, 55*(3), 271–284. https://doi.org/10.1016/j.im.2017.07.003.

* Goldbach, T., & Kemper, V. (2014). Should I stay or should I go? The effects of control mechanisms on app developers' intention to stick with a platform. In M. Avital, J. M. Leimeister, & U. Schultze (Eds.), *Proceedings of the European conference on information systems (ECIS)* (pp. 1–15). Association for Information Systems (AIS) http://aisel.aisnet.org/ecis2014/proceedings/track15/15.

* Goldbach, T., Kemper, V., & Benlian, A. (2014). Mobile application quality and platform stickiness under formal vs. self-control—Evidence from an experimental study. In M. D. Myers, & D. W. Straub (Eds.), *Thirty-fifth international conference on information systems (ICIS)* (pp. 1–18). Association for Information Systems (AIS) https://aisel.aisnet.org/icis2014/proceedings/ProjectManagement/7.

* Göttel, V. (2021). Sharing algorithmic management information in the sharing economy–effects on workers' intention to stay with the organization. In J. S. Valacich, A. Barua, R. Wright, A. Kankanhalli, X. Li, & S. Miranda (Eds.), *Forty-second international conference on information systems (ICIS)* (pp. 1–17). Association for Information Systems (AIS) https://aisel.aisnet.org/icis2021/sharing_econ/sharing_econ/3.

Gulati, R., Puranam, P., & Tushman, M. (2012). Meta-organization design: Rethinking design in interorganizational and community contexts. *Strategic Management Journal, 33*(6), 571–586. https://doi.org/10.1002/smj.1975

* Guo, W., Straub, D., Zhang, P., & Cai, Z. (2021). How trust lead to commitment on microsourcing platforms: Unraveling the effects of governance and third-party mechanisms on triadic microsourcing relationships. *MIS Quarterly, 45*(3), 1309–1348. https://doi.org/10.25300/MISQ/2021/14349.

* Gutt, D., Neumann, J., Jabr, W., & Kundisch, D. (2019). The app updating conundrum: Implications of platform's rating resetting on developers' behavior. In H. Krcmar, J. Fedorowicz, W. Fong Boh, J. M. Leimeister, & S. Wattal (Eds.), *Fortieth international conference on information systems* (pp. 1–17). Association for Information Systems (AIS) https://aisel.aisnet.org/icis2019/mobile_iot/mobile_iot/5.

* Halckenhaeusser, A., Foerderer, J., & Heinzl, A. (2020). Platform governance mechanisms: An integrated literature review and research directions. In F. Rowe, R. El Amrani, M. Limayem, S. Newell, N. Pouloudi, E. van Heck, & A. El Quammah (Eds.), *Proceedings of the 28th European conference on information systems (ECIS)* (pp. 15–17). Association for Information Systems (AIS) https://aisel.aisnet.org/ecis2020_rp/30.

* He, S., Peng, J., Li, J., & Xu, L. (2020). Impact of platform owner's entry on third-party stores. *Information Systems Research, 31*(4), 1467–1484. https://doi.org/10.1287/isre.2020.0957.

* Heimburg, V., & Wiesche, M. (2022). Relations between actors in digital platform ecosystems: A literature review. In R. Beck, D. Petcu, & M. Fotache (Eds.), *Thirtieth European conference on information systems (ECIS 2022)* (pp. 1–21). Association for Information Systems (AIS) https://aisel.aisnet.org/ecis2022_rp/93.

Hein, A., Schreieck, M., Riasanow, T., Setzke, D. S., Wiesche, M., Böhm, M., & Krcmar, H. (2020). Digital platform ecosystems. *Electronic Markets, 30*(1), 87–98. https://doi.org/10.1007/s12525-019-00377-4

Hein, A., Schreieck, M., Wiesche, M., & Krcmar, H. (2016). Multiple-case analysis on governance mechanisms of multi-sided platforms. In *Multikonferenz wirtschaftsinformatik [Multi-conference on business informatics* (pp. 9–11). Universitätsverlag Ilmenau [Ilmenau University Press.

* Helfat, C. E., & Raubitschek, R. S. (2018). Dynamic and integrative capabilities for profiting from innovation in digital platform-based ecosystems. *Research Policy, 47*(8), 1391–1399. https://doi.org/10.1016/j.respol.2018.01.019.

* Hilkert, D., Benlian, A., Sarstedt, M., & Hess, T. (2011). Perceived software platform openness: The scale and its impact on developer satisfaction. In D. F. Galletta, & T. P. Liang (Eds.), *Thirty-second international conference on information systems (ICIS)* (pp. 1–20). Association for Information Systems (AIS) https://aisel.aisnet.org/icis2011/proceedings/onlinecommunity/13.

* Hirsch, F., Alizadeh, A., Wiener, M., & Cram, A. W. (2023). Algorithmic control in platform and traditional work settings: An updated conceptual framework. In M. Aanestad, S. Klein, & M. Tarafdar (Eds.), *Thirty-first European conference on information systems (ECIS 2023)* (pp. 1–16). Association for Information Systems (AIS) https://aisel.aisnet.org/ecis2023_rp/247.

* Huber, T. L., Kude, T., & Dibbern, J. (2017). Governance practices in platform ecosystems: Navigating tensions between cocreated value and governance costs. *Information Systems Research, 28*(3), 563–584. https://doi.org/10.1287/isre.2017.0701.

* Hurni, T., & Huber, T. (2014). The interplay of power and trust in platform ecosystems of the enterprise application software industry. In M. Avital, J. M. Leimeister, & U. Schultze (Eds.), *Proceedings of the Twenty-second European conference on information systems (ECIS)* (pp. 1–15). Association for Information Systems (AIS) https://aisel.aisnet.org/ecis2014/proceedings/track15/19/.

* Hurni, T., Huber, T. L., & Dibbern, J. (2022). Power dynamics in software platform ecosystems. *Information Systems Journal, 32*(2), 310–343. https://doi.org/10.1111/isj.12356.

* Hurni, T., Huber, T. L., Dibbern, J., & Krancher, O. (2021). Complementor dedication in platform ecosystems: Rule adequacy and the moderating role of flexible and benevolent practices. *European Journal of Information Systems, 30*(3), 237–260. https://doi.org/10.1080/0960085X.2020.1779621.

Iansiti, M., & Levien, R. (2004). Strategy as ecology. *Harvard Business Review, 82*, 68–81.

* Ingram Bogusz, C., & Kashyap, S. (2022). The carrot and the stick: Open banking platform governance in the shadow of PSD2. In R. Beck, D. Petcu, & M. Fotache (Eds.), *Thirtieth European conference on information systems (ECIS 2022)* (pp. 1–14). Association for Information Systems (AIS) https://aisel.aisnet.org/ecis2022_rp/113.

* Inoue, Y. (2021). Indirect innovation management by platform ecosystem governance and positioning: Toward collective ambidexterity in the ecosystems. *Technological Forecasting and Social Change, 166*(120652), 1–15. https://doi.org/10.1016/j.techfore.2021.120652.

* Islam, H. A., Farrell, M., Nair, A., & Zhang, J. (2023). Understanding transaction platform governance and conflicts: A configuration approach. *Technological Forecasting and Social Change, 189*(122382), 1–12. https://doi.org/10.1016/j.techfore.2023.122382.

* Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. *Strategic Management Journal, 39*(8), 2255–2276. https://doi.org/10.1002/smj.2904.

* Jiang, J. (2023). Covert resistance against algorithmic control of online labor platforms – a systematic literature review. In M. Aanestad, S. Klein, & M. Tarafdar (Eds.), *Thirty-first European conference on information systems (ECIS 2023)* (pp. 1–17). Association for Information Systems (AIS) https://aisel.aisnet.org/ecis2023_rp/272.

* Jovanovic, M., Kostić, N., Sebastian, I. M., & Sedej, T. (2022a). Managing a blockchain-based platform ecosystem for industry-wide adoption: The case of TradeLens. *Technological Forecasting and Social Change, 184*(121981), 1–14. https://doi.org/10.1016/j.technovation.2020.102218.

* Jovanovic, M., Sjödin, D., & Parida, V. (2022b). Co-evolution of platform architecture, platform services, and platform governance: Expanding the platform value of industrial digital platforms. *Technovation, 118*(102218), 1–14. https://doi.org/10.1016/j.technovation.2020.102218.

* Kindermann, B., Salge, T. O., Wentzel, D., Flatten, T. C., & Antons, D. (2022). Dynamic capabilities for orchestrating digital innovation ecosystems: Conceptual integration and research opportunities. *Information and Organization, 32*(3), 1–16. https://doi.org/10.1016/j.infoandorg.2022.100422, 100422.

* Koo, W. W., & Eesley, C. E. (2021). Platform governance and the rural–urban divide: Sellers' responses to design change. *Strategic Management Journal, 42*(5), 941–967. https://doi.org/10.1002/smj.3259.

Kretschmer, T., & Claussen, J. (2016). Generational transitions in platform markets – the role of backward compatibility. *Strategy Science, 1*(2), 90–104. https://doi.org/10.1287/stsc.2015.0009

* Kretschmer, T., Leiponen, A., Schilling, M., & Vasudeva, G. (2022). Platform ecosystems as meta-organizations: Implications for platform strategies. *Strategic Management Journal, 43*(3), 405–424. https://doi.org/10.1002/smj.3250.

* de Lima Fontão, A., dos Santos, R. P., & Dias-Neto, A. C. (2019). Exploiting repositories in mobile software ecosystems from a governance perspective. *Information Systems Frontiers, 21*(1), 143–161. https://doi.org/10.1007/s10796-018-9861-8.

* Lin, F., Tian, H., Zhao, J., & Chi, M. (2023). Reward or punish: Investigating output controls and content generation in the multi-sided platform context. *Internet Research, 33*(2), 578–605. https://doi.org/10.1108/INTR-05-2021-0292.

* Luo, D., Fang, Y., Song, P., & Wang, C. (2019). The impact of digital platform rapid release strategy on app update behavior: An empirical study of Firefox. In H. Krcmar, J. Fedorowicz, W. Fong Boh, J. M. Leimeister, & S. Wattal (Eds.), *40th International conference on information systems (ICIS 2019)* (p. 1807). Association for Information Systems (AIS) https://aisel.aisnet.org/icis2019/is_heart_of_innovation_ecosystems/innovation_ecosystems/7.

* Mei, J., Zheng, G., & Zhu, L. (2022). Governance mechanisms implementation in the evolution of digital platforms: A case study of the Internet of Things platform. *R&D Management, 52*(3), 498–516. https://doi.org/10.1111/radm.12494.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). SAGE Publications.

* Miric, M., Ozalp, H., & Yilmaz, E. D. (2023). Trade-offs to using standardized tools: Innovation enablers or creativity constraints?. *Strategic Management Journal, 44*(4), 909–942. https://doi.org/10.1002/smj.3457.

* Mohagheghzadeh, A., & Svahn, F. (2016a). Shifting design capability to third-party developers: An affordance perspective on platform boundary resources. In *Twenty-second Americas conference on information systems (AMCIS)* (pp. 1–10). Association for Information Systems (AIS) https://aisel.aisnet.org/amcis2016/Open/Presentations/8.

* Mohagheghzadeh, A., & Svahn, F. (2016b). Transforming organizational resource into platform boundary resources. In *ECIS proceedings* (Vol. 9)Research Papers http://aisel.aisnet.org/ecis2016_rp/9.

* Möhlmann, M., Zalmanson, L., Henfridsson, O., & Gregory, R. W. (2021). Algorithmic management of work on online labor platforms: When matching meets control. *MIS Quarterly, 45*(4), 1999–2022. https://doi.org/10.25300/MISQ/2021/15333.

Mukhopadhyay, S., & Bouwman, H. (2019). Orchestration and governance in digital platform ecosystems: A literature review and trends. *Digital Policy, Regulation and Governance, 21*(4), 329–351. https://doi.org/10.1108/DPRG-11-2018-0067

* Niedermayer, A. (2013). On platforms, incomplete contracts, and open source software. *International Journal of Industrial Organization, 31*(6), 714–722. https://doi.org/10.1016/j.ijindorg.2013.07.003.

Oh, J., Koh, B., & Raghunathan, S. (2015). Value appropriation between the platform provider and app developers in mobile platform mediated networks. *Journal of Information technology, 30*, 245–259. https://doi.org/10.1057/jit.2015.21

Okoli, C., & Schabram, K. (2010). A guide to conducting a systematic literature review of information systems research. *Social Science Research Network, 10*(26), 1–49. https://doi.org/10.2139/ssrn.1954824

* O'Mahony, S., & Karp, R. (2022). From proprietary to collective governance: How do platform participation strategies evolve?. *Strategic Management Journal, 43*(3), 530–562. https://doi.org/10.1002/smj.3150.

Pawson, R., Tilley, N., & Tilley, N. (1997). *Realistic evaluation*. Sage Publishing.

* Pereira, J., Tavalaei, M. M., & Ozalp, H. (2019). Blockchain-based platforms: Decentralized infrastructures and its boundary conditions. *Technological Forecasting and Social Change, 146*, 94–102. https://doi.org/10.1016/j.techfore.2019.04.030.

* Perscheid, G., Ostern, N. K., & Moormann, J. (2020). Determining platform governance: Framework for classifying governance types. In J. F. George, S. Paul, R. De, E. Karahanna, S. Sarker, & G. Oestreicher-Singer (Eds.), *Forty-First international*

conference on information systems (ICIS) (pp. 1–16). Association for Information Systems (AIS) https://aisel.aisnet.org/icis2020/governance_is/governance_is/8.

Pidun, U., Reeves, M., & Schüssler, M. (2020). *Why do most business ecosystems fail?* Boston Consulting Group. https://www.bcg.com/publications/2020/why-do-most-business-ecosystems-fail. (Accessed 20 September 2023).

Rainey, H. G., Backoff, R. W., & Levine, C. H. (1976). Comparing public and private organizations. *Public Administration Review, 36*(2), 233–244. https://doi.org/10.2307/975145

Reeves, M., Lotan, H., Legrand, J., & Jacobides, M. G. (2019). How business ecosystems rise (and often fall). *MIT Sloan Management Review, 60*(4), 1–6. https://sloanreview.mit.edu/article/how-business-ecosystems-rise-and-often-fall/.

de Reuver, M., Sørensen, C., & Basole, R. C. (2018). The digital platform: A research agenda. *Journal of Information Technology, 33*(2), 124–135. https://doi.org/10.1057/s41265-016-0033-3

* Riasanow, T., Burckhardt, F., Soto Setzke, D., Böhm, M., & Krcmar, H. (2018). The generic blockchain ecosystem and its strategic implications. In *Twenty-fourth Americas conference on information systems (AMCIS)* (pp. 1–10). Association for Information Systems (AIS) https://aisel.aisnet.org/amcis2018/StrategicIT/Presentations/13.

* Rickmann, T., Wenzel, S., & Fischbach, K. (2014). Software ecosystem orchestration: The perspective of complementors. In *Twentieth Americas conference on information systems* (pp. 1–14). Association for Information Systems (AIS) https://aisel.aisnet.org/amcis2014/e-Business/GeneralPresentations/7.

Rietveld, J., & Schilling, M. A. (2021). Platform competition: A systematic and interdisciplinary review of the literature. *Journal of Management, 47*(6), 1528–1563. https://doi.org/10.1177/0149206320969791

* Rietveld, J., Schilling, M. A., & Bellavitis, C. (2019). Platform strategy: Managing ecosystem value through selective promotion of complements. *Organization Science, 30*(6), 1232–1251. https://doi.org/10.1287/orsc.2019.1290.

* Saadatmand, F., Lindgren, R., & Schultze, U. (2019). Configurations of platform organizations: Implications for complementor engagement. *Research Policy, 48*(8). https://doi.org/10.1016/j.respol.2019.03.015.

* Schreieck, M., & Wiesche, M. (2017). How established companies leverage IT platforms for value co-creation–insights from banking. In I. Ramos, V. Tuunainen, & H. Krcmar (Eds.), *Proceedings of the 25th European conference on information systems (ECIS)* (pp. 1726–1741). Association for Information Systems (AIS) https://aisel.aisnet.org/ecis2017_rp/111.

* Schreieck, M., Wiesche, M., & Krcmar, H. (2016). Design and governance of platform ecosystems–key concepts and issues for future research. In *ECIS proceedings* (Vol. 76) Research Papers https://aisel.aisnet.org/ecis2016_rp/76.

* Schreieck, M., Wiesche, M., & Krcmar, H. (2021). Capabilities for value co-creation and value capture in emergent platform ecosystems: A longitudinal case study of SAP's cloud platform. *Journal of Information Technology, 36*(4), 365–390. https://doi.org/10.1177/02683962211023780.

* Schulze, L., Trenz, M., & Nickerson, R. C. (2021). Fingers in the pie: Characterizing decision rights partitioning on digital labor platforms. In J. S. Valacich, A. Barua, R. Wright, A. Kankanhalli, X. Li, & S. Miranda (Eds.), *Forty-second international conference on information systems (ICIS)* (pp. 1–17). Association for Information Systems (AIS) https://aisel.aisnet.org/icis2021/is_future_work/is_future_work/1.

* Selander, L., Henfridsson, O., & Svahn, F. (2013). Capability search and redeem across digital ecosystems. *Journal of Information Technology, 28*(3), 183–197. https://doi.org/10.1057/jit.2013.14.

* Shi, R., Aaltonen, A., Henfridsson, O., & Gopal, R. D. (2023). Comparing platform owners' early and late entry into complementary markets. *MIS Quarterly* (in press).

* Song, P., Xue, L., Rai, A., & Zhang, C. (2018). The ecosystem of software platform: A study of asymmetric cross-side network effects and platform governance. *MIS Quarterly, 42*(1), 121–142.

* Sterk, F., Heinz, D., Peukert, C., Fleuchaus, F., Kölbel, T., & Weinhardt, C. (2022). Fostering value co-creation in incumbent firms: The case of Bosch's IoT ecosystem landscape. In R. Beck, S. Petter, & T. Blegind Jensen (Eds.), *Forty-third international conference on information systems (ICIS)*. Association for Information Systems (AIS), 17 https://aisel.aisnet.org/icis2022/governance_is/governance_is/16.

* Suvivuo, S., Rinta-Kahila, T., & Tuunainen, V. K. (2023). Building and sustaining communities in online labour platforms. In M. Aanestad, S. Klein, & M. Tarafdar (Eds.), *Thirty-first European conference on information systems (ECIS 2023)* (pp. 1–15). Association for Information Systems (AIS) https://aisel.aisnet.org/ecis2023_rp/398.

* Tang, X., Wang, P., & Zhu, Z. (2021). Effects of centralized and distributed quality control on sales of experience goods in a transaction platform ecosystem. In *Twenty-seventh Americas conference on information systems (AMCIS)* (pp. 1–10). Association for Information Systems (AIS) https://aisel.aisnet.org/amcis2021/strategic_is/strategic_is/8.

* Thies, F., Wessel, M., & Benlian, A. (2018). Network effects on crowdfunding platforms: Exploring the implications of relaxing input control. *Information Systems Journal, 28*(6), 1239–1262. https://doi.org/10.1111/isj.12194.

Tiwana, A. (2013). *Platform ecosystems: Aligning architecture, governance, and strategy*. Elsevier Science.

* Tiwana, A. (2015). Evolutionary competition in platform ecosystems. *Information Systems Research, 26*(2), 266–281. https://doi.org/10.1287/isre.2015.0573.

* Tiwana, A., Konsynski, B., & Bush, A. A. (2010). Research commentary—platform evolution: Coevolution of platform architecture, governance, and environmental dynamics. *Information Systems Research, 21*(4), 675–687. https://doi.org/10.1287/isre.1100.0323.

Tiwana, A., Konsynski, B., & Venkatraman, N. (2013). Information technology and organizational governance: The IT governance cube. *Journal of Management Information Systems, 30*(3), 7–12. https://doi.org/10.2753/MIS0742-1222300301

* Uzunca, B., Sharapov, D., & Tee, R. (2022). Governance rigidity, industry evolution, and value capture in platform ecosystems. *Research Policy, 51*(7), 1–15. https://doi.org/10.1016/j.respol.2022.104560, 104560.

* Van Dyck, M., Lüttgens, D., Piller, F. T., Diener, K., & Pollok, P. (2021). Positioning strategies in emerging industrial ecosystems for industry 4.0: A longitudinal study of platform emergence in the agricultural industry. Universitätsbibliothek der RWTH Aachen. In T. Bui (Ed.), *Proceedings of the 54th Hawaii international conference on system sciences (HICSS)* (pp. 6153–6162). University of Hawaii http://hdl.handle.net/10125/71363.

* de Vasconcelos Gomes, L. A., Flechas, X. A., Facin, A. L. F., & Borini, F. M. (2021). Ecosystem management: Past achievements and future promises. *Technological Forecasting and Social Change, 171*, 1–15. https://doi.org/10.1016/j.techfore.2021.120950, 120950.

Vesselkov, A., Hämmäinen, H., & Töyli, J. (2019). Design and governance of mHealth data sharing. *Communications of the Association for Information Systems, 45*(1), 18. https://doi.org/10.17705/1CAIS.04518

* Wang, J. (2021). Do birds of a feather flock together? Platform's quality screening and end-users' choices theory and empirical study of online trading platforms. *International Journal of Industrial Organization, 75*(102698), 1–28. https://doi.org/10.1016/j.ijindorg.2020.102698.

* Wang, G., & Nandhakumar, J. (2017). Strategic swaying: How startups grow digital platforms. In Y. J. Kim, R. Agarwal, & J. K. Lee (Eds.), *Thirty Eighth international conference on information systems (ICIS)* (pp. 1–17). Association for Information Systems (AIS) https://aisel.aisnet.org/icis2017/Strategy/Presentations/17.

* Wareham, J., Fox, P. B., & Cano Giner, J. L. (2014). Technology ecosystem governance. *Organization Science, 25*(4), 1195–1215. https://doi.org/10.1287/orsc.2014.0895.

* Weber, M., Remus, U., & Pregenzer, M. (2022). A new era of control: Understanding algorithmic control in the gig economy. In R. Beck, S. Petter, & T. Blegind Jensen (Eds.), *Forty-third international conference on information systems (ICIS)*. Association for Information Systems (AIS), 17 https://aisel.aisnet.org/icis2022/is_futureofwork/is_futureofwork/1.

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly, 26*. xiii–xxiii https://www.jstor.org/stable/4132319.

Weill, P., & Ross, J. W. (2004). *IT governance on one page*. SSRN Scholarly Paper No. ID 664612, Social Science Research Network https://papers.ssrn.com/sol3/papers.cfm?abstract_id=664612. (Accessed 20 July 2023).

* Weiss, N., Schreieck, M., Wiesche, M., & Krcmar, H. (2023). Lead complementor involvement in the design of platform boundary resources: A case study of BMW's onboard apps. *Information Systems Journal*, 1–33. https://doi.org/10.1111/isj.12449.

* Wen, W., & Zhu, F. (2019). Threat of platform-owner entry and complementor responses: Evidence from the mobile app market. *Strategic Management Journal, 40*(9), 1336–1367. https://doi.org/10.1002/smj.3031.

* Werner, J., Frost, S., & Zarnekow, R. (2020). Towards a taxonomy for governance mechanisms of blockchain-based platforms. In F. Rowe, R. El Amrani, M. Limayem, S. Newell, N. Pouloudi, E. van Heck, & A. El Quammah (Eds.). *ECIS proceedings* (Vol. 26). Research Papers https://aisel.aisnet.org/ecis2020_rp/26.

* Wessel, M., Thies, F., & Benlian, A. (2015). The effects of relinquishing control in platform ecosystems: Implications from a policy change on Kickstarter. In T. A. Carte, A. Heinzl, & C. Urquhart (Eds.), *Thirty-sixth international conference on information systems (ICIS)* (pp. 1–19). Association for Information Systems (AIS) https://aisel.aisnet.org/icis2015/proceedings/EconofIS/2.

* Wessel, M., Thies, F., & Benlian, A. (2017). Opening the floodgates: The implications of increasing platform openness in crowdfunding. *Journal of Information Technology, 32*(4), 344–360. https://doi.org/10.1057/s41265-017-0040-z.

* Wiener, M., Cram, W., & Benlian, A. (2021). Algorithmic control and gig workers: A legitimacy perspective of Uber drivers. *European Journal of Information Systems, 32*(3), 485–507. https://doi.org/10.1080/0960085X.2021.1977729.

* Zhang, Y., Li, J., & Tong, T. W. (2022). Platform governance matters: How platform gatekeeping affects knowledge sharing among complementors. *Strategic Management Journal, 43*(3), 599–626. https://doi.org/10.1002/smj.3191.

* Zhang, Y., Pinkse, J., & McMeekin, A. (2020). The governance practices of sharing platforms: Unpacking the interplay between social bonds and economic transactions. *Technological Forecasting and Social Change, 158*, 1–13. https://doi.org/10.1016/j.techfore.2020.120133, 120133.

* Zhu, F., & Liu, Q. (2018). Competing with complementors: An empirical look at Amazon.com. *Strategic Management Journal, 39*(10), 2618–2642. https://doi.org/10.1002/smj.2932.

Article 2

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RESEARCH PAPER

Building digital platform ecosystems through standardization: an institutional work approach

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Abstract

In this paper, we investigate the development of standards for technologies and work practices in a digital platform ecosystem. Standards are needed for technical and organizational compatibility across the actors' different systems, technologies, data, and business processes. However, little is known about how actors achieve common standards in collaborative ecosystems where a clear platform leader is missing. Based on a longitudinal, qualitative case study of a digital platform ecosystem within the Norwegian aquaculture industry, we examined how the actors collaborated on building a digital platform ecosystem with the aim of fighting sea lice on salmon through standardization. We contribute to research and practice by providing a preliminary framework of four institutional work practices for standardization in digital ecosystems and three key lessons learned for guidance for practitioners.

Keywords Digital platform ecosystems · Standardization · Standards · Longitudinal case study

JEL classification O3 · L15 · M1

Introduction

Digital platforms have attracted increasing interest and have been approached from different perspectives, such as the market-oriented perspective and the technical perspective (Gawer, 2014). In this paper, we take an organizational lens and focus on digital platform ecosystems, considered open, evolving meta-organizations that coordinate actors through means other than a hierarchy (Gawer, 2014; Gulati et al., 2012; Jacobides et al., 2018). Digital platform ecosystems are often governed by a focal actor, such as Facebook, Apple, and Amazon, that controls the rules and interfaces with which the ecosystem's actors must comply. Our focus is different as we examine collaborative digital platform ecosystems where independent companies in a business sector come together and, as a joint effort, develop and govern a platform and an ecosystem for mutual benefit. The development of these ecosystems faces a key challenge; the participating actors' existing work practices and technological solutions are seldom harmonized. Consequently, for the ecosystem to succeed, standards must be developed and implemented, which is challenging in the absence of a clear platform leader (Miller & Toh, 2020).

As standards play a fundamental role in supporting the success of digital platforms (Wiegmann et al., 2017), it is timely and necessary to conduct research that contributes new knowledge about standardization in this context (Hanseth & Bygstad, 2015; Lyytinen & King, 2006; Tuczek et al., 2018; Wiegmann et al., 2017). Researchers have often overlooked the interwoven relationship between standard development and standard diffusion (Fukami & Shimizu, 2018), which is especially challenging in the absence of a focal actor that can enforce them. Moreover, focusing on standards

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as governing mechanisms may contribute to the discourse on whether digital platform ecosystems are emerging structures or whether they can be consciously designed (de Reuver et al., 2018). Based on this, we ask the following research question: *How can standards be developed for a digital platform ecosystem when there is no focal actor and where the actors' existing technological solutions and work practices differ?*

To answer this question, we conducted a longitudinal, qualitative case study that followed the development of standards within a digital platform ecosystem in the Norwegian aquaculture industry. The aim of the ecosystem was to address the parasite sea lice, the industry's most severe environmental challenge. This setting was relevant because of the heterogeneity in terms of technologies and work practices, the absence of a clear platform leader, and the actors' previous opposition to cooperation. For our investigation, and specifically, to frame the actions involved in the standardization process, we rely on institutional work theory (Lawrence & Suddaby, 2006), and we consider standards as institutions that can be created through purposive actions (Lawrence & Suddaby, 2006; Lawrence et al., 2011). This theory sees agency as a distributed phenomenon, which we consider key for our case's collective standardization effort, where the internal ecosystem's members combine their skills and resources with other actors.

This study contributes to the literature on digital platform ecosystems and standardization, both theoretically and practically. Based on institutional work theory, we provide a preliminary framework for standardization in ecosystems without a focal owner and offer strategies and lessons learned for practitioners working in this area.

Theoretical background

Digital platform ecosystems

Originating within biology, the ecosystem perspective has shifted from focusing on competition among firms to coopetition, where actors jointly and simultaneously compete and cooperate (Hein et al., 2019). Ecosystems are perceived in different ways by different research streams (see Adner, 2017), but they can be defined as "an interdependent network of self-interested actors jointly creating value" (Bogers et al., 2019, p. 2).

Digital platform ecosystems are typical instantiations of ecosystems (Riasanow et al., 2021). Digital platform ecosystems are spreading widely and attracting considerable interest from practitioners and researchers within the fields of information systems, strategic management, economics, and marketing because these ecosystems change established business models in markets and industries (Asadullah et al., 2018; de Reuver et al., 2018; Hein et al., 2020).

Digital platforms have been approached from different perspectives. The market-oriented perspective—rooted within economics—has focused on two- or multi-sided platforms, where two or multiple groups of users are brought together (Bazarhanova et al., 2019; Otto & Jarke, 2019; Schreieck et al., 2016). The focus has been on network externalities and how the value of the platform on one side is dependent on the size of the other (Hein et al., 2020). The technical perspective considers digital platforms in terms of software and hardware as extensible codebases offering core functionalities that can be extended and supplemented through modular architecture and boundary resources, reaching economies of scale and scope (Asadullah et al., 2018; Hein et al., 2020; Schreieck et al., 2016). The focus is on co-creating value through the dynamics between the core functionalities and the developers' capabilities rather than on enabling transactions among the different groups (Asadullah et al., 2018; Schreieck et al., 2016).

Although these perspectives are often considered separately, research may benefit from their integration (Gawer, 2014; Hein et al., 2020; Schreieck et al., 2016). With such an approach, digital platform ecosystems are evolving meta-organizations that coordinate actors, which can innovate and compete, and comprise technologies and associated work practices (Blaschke et al., 2019; Gawer, 2014; Schreieck et al., 2016). Thus, investigating how platforms integrate and govern an ecosystem of actors has become relevant (Hein et al., 2020).

Governing digital platform ecosystems is challenging due to the multiple different interests that must be balanced (de Reuver et al., 2018; Miller & Toh, 2020; Wiegmann et al., 2017). Governance has usually been referred to as the mechanisms that platform owners use to orchestrate their ecosystems (Halckenhaeusser et al., 2020; Schreieck et al., 2016; Tiwana et al., 2010, 2013). This research angle works best in traditional transaction-oriented platform ecosystems, where the platform owner establishes mechanisms (such as standards) to govern interactions within the ecosystem. However, the platform owner perspective is not suitable for illuminating the diverse platform landscape, where governance is increasingly a collective endeavor (de Reuver et al., 2018; Otto & Jarke, 2019). Investigating governance mechanisms for designing and building a digital platform ecosystem with distributed authority, decision making, and resource ownership is a challenging task that may benefit from a focus on boundary resources (de Reuver et al., 2018; Grant & Tan, 2013; Otto & Jarke, 2019; Schreieck et al., 2016). Boundary resources have been defined as resources that facilitate the interactions and the relationships between the actors (Ghazawneh & Henfridsson, 2013; Otto & Jarke, 2019) and are a useful angle from which to investigate patterns

of interaction among the actors (Henfridsson & Bygstad, 2013). Various types of boundary resources have been suggested by the literature, including Application Programming Interfaces (APIs), Software Development Kits (SDKs), data, and standards.

Standards and standardization

Standards are the result of a standardization process that aims at harmonizing entities such as technologies and work practices (de Vries, 1998). According to Brunsson et al. (2012), standards have four key characteristics. First, standards are explicitly formulated, and thus, they differ from implicit social norms. Second, standards regulate individual and collective behavior to achieve social order. Third, the decision to conform to standards is up to potential adopters. Standards' regulatory power may depend not on the authority of a state but on the legitimacy and relevance that actors assign to them or on third-party pressure. Fourth, standards are meant for common use for a broad set of actors, even if, in some cases, groups of organizations, as consortia, may define standards applicable only to their own activities.

Standards have been classified in multiple ways. Without aiming for a comprehensive overview, we rely on the work of de Vries (1998) to highlight standard classifications. In relation to entities, standards can be categorized as basic standards or requiring standards. *Basic standards* offer structured descriptions of interrelated entities to facilitate human communication about these entities, such as terminology, classifications and/or codes, and descriptions of entity architecture. *Requiring standards* are a broad set that comprises, among others, quality standards (which set requirements to ensure a certain level of quality) and compatibility standards (which focus on the interrelation among entities).

Standards can also be classified according to their functions: intrinsic, extrinsic, and subjective (de Vries, 1998). Intrinsic functions refer to the description, record, and explanation of the agreed solutions to a certain problem. Extrinsic functions refer to the provision of transparency, interoperability, interchangeability, and information exchange. Subjective functions are related to specific actors' interests, such as cost reduction and process facilitation.

Research considers the development of standards to be a dilemma that must be handled carefully (Fukami & Shimizu, 2018; Markus et al., 2006). Broad involvement is necessary but difficult to achieve, as standardization requires time and resources (Markus et al., 2006; Van de Kaa et al., 2015; Zhao et al., 2011). However, too many participants may slow down the process or make the standard too complex. Moreover, the heterogeneity of the stakeholders' interests may hamper the speed of standardization, but if the interests of those involved are not sufficiently represented, the standard may not be adequately developed or diffused (Markus et al., 2006; Zhao et al., 2011). Standard development and standard diffusion are failure-prone processes, and research suggests that solutions which address the former may fail to address the latter. However, researchers often overlook the interwoven relationship between standard development and diffusion (Fukami & Shimizu, 2018), an especially relevant issue for a digital platform ecosystem without a focal actor.

Institutional work

To examine how standards were developed in the present case, we use *institutional work theory* as the theoretical lens, a theory originating in the seminal work of Lawrence and Suddaby (2006). Institutions are fundamental elements of social life that affect individual and collective beliefs and behavior, and institutional work is used to examine purposive actions aimed at creating, maintaining, and disrupting institutions (Lawrence et al., 2011). Work is seen as a physical or mental effort to reach a goal; it is characterized by a future-oriented intentionality with the strategic aim of reshaping institutions (Lawrence et al., 2011).

Compared to an institutional perspective focused on the macrodynamic (i.e., the processes that lead to large-scale social and economic change), institutional work is concerned with the lived experiences of individuals and organizations, and their link to the institutions that shape and are shaped by them (Lawrence et al., 2011). Agency is not confined to institutional entrepreneurs with considerable resources and skills. Instead, a distributed perspective is adopted by including a wider set of actors that support and facilitate the creation of institutions (Lawrence & Suddaby, 2006; Lawrence et al., 2011).

For our analysis, we draw on the seminal work of Lawrence and Suddaby (2006), in which the authors provide examples of *practices* that actors can purposely use to create institutions. Actors *construct identities* (i.e., reconfigure group beliefs), which can come from within or outside the group and are often linked to the development of professional identities. Regarding this practice, Oakes et al. (1998), cited by Lawrence and Suddaby (2006), examined how the government department responsible for museums, by introducing business planning, encouraged museum personnel to see themselves as business workers and entrepreneurs who had more agency and could take more risks instead of as only researchers, educators, or curators. Further, actors *construct normative networks*, that is, interorganizational connections that can be established alongside extant institutional arrangements and that can mimic or simply supplement and support the state's regulatory activities. These networks can represent the relevant peer group with respect to which practices can be sanctioned or judged as compliant. Guler et al. (2002) explained how ISO 9000 practices were

diffused through the promotion and network established by engineers and production managers.

Moreover, actors *educate* to provide skills and knowledge to support the creation of the new institution. This is usually done by large dominant actors but can also be conducted by marginal actors acting collectively. An example is the institutionalization of recycling programs at American universities, which was achieved by educating a large student population through workshops, guidelines for action, and access to success stories at other universities. Another cognitive type of institutional work is *mimicry*, which leverages extant taken-for-granted practices, technologies, and rules with which to associate new practices, legitimate them, and ease their adoption. For instance, to institutionalize electric light, Edison designed the bulbs to be indistinguishable from the familiar existing gas systems and kept the wattage aligned with that of gas bulbs (even if bulbs could have produced more light). Actors can *advocate* to acquire legitimacy through trustworthy and relevant resources and agents. It can be valuable for marginal actors to be able to effect new institutions; and creating cognitive legitimacy for the new institution can take several forms, such as lobbying, advertising, litigating, and coercing. For example, Holm (1995) showed how the close relationship between the Fisherman's Association and the Labor Party helped preserve fishermen's interests in Norway's Herring Act. In this study, we used institutional work as a theoretical lens to frame the practices for standardization that we recognized in the analysis of our case.

Methodology

To address the research question, we followed an in-depth, longitudinal, qualitative case study approach. Case studies are considered appropriate for understanding complex social phenomena (Yin, 2014) and topics on which research and theory are in their early stages (Benbasat et al., 1987). We investigated the development of a digital platform ecosystem within the Norwegian aquaculture industry. We selected this platform for several reasons. First, it operates within a traditional industry, where the actors have a long history. Second, the case involves heterogeneous actors, practices, interests, data, and technologies. Third, actors have previously shown resistance to sharing data and their internal practices. Finally, the platform does not have a leader; governance is shared among ecosystem members.

The setting

The selected case platform began operating in 2017 to address the parasite sea lice, the industry's most severe environmental challenge. Because sea lice spread very quickly

Table 1 Standardization workflows within the case

Standardization workflow	Standards (to be) developed	Reasons why it was considered important	Type of standards and function (de Vries, 1998)
Sensor data	Sensor infrastructure standard for sea farms below the water based on the Open Platform Communications (OPC) Unified Architecture	Data across facilities were not comparable. The data were stored in proprietary systems, and their value was not fully realized. Different technologies and systems could not be integrated	Architecture (basic standards), Compatibility (requiring standards) Enabling interoperability and interchangeability
Environmental data	Practices and methods related to measurements taken inside the pens	Data comparability was not possible, because the data were collected differently across farmers, at different times and positions in the cage, with different equipment	Quality (requiring standards) Enabling performance
Fish health data	Definitions, meanings, classifications, and industry language	Different classifications (e.g., of causes of fish death) made it difficult to make proper operational decisions and to respond to the pressures of authorities and researchers	Terminology and classification and/or codes (basic standards) Providing transparency

and can easily affect adjacent farming companies, joint efforts and data sharing were considered fundamental to prevent outbreaks. Based on data from farmers' cages collected through different technologies (such as sensors and cameras) and through big data analytics, algorithms, and artificial intelligence, the central platform creates two-week sea lice forecasts. In the beginning, the data were manually entered into the platform; later, they were pulled automatically through APIs. The core platform is managed by a technical partner, whereas the entire ecosystem is facilitated—but not controlled—by an innovation cluster consisting of a set of partners and members collaborating and sharing knowledge. The ecosystem's governance is shared among its members.

In 2019, the ecosystem's members acknowledged that the data quality was not good enough. This lack of quality had a negative impact on forecast trustworthiness, and thus, on achieving the sustainability goal. Therefore, the need for standardization emerged. The scope of standardization embraces technologies and work practices, comprising architecture, compatibility, quality, and terminology standards (de Vries, 1998), as shown in Table 1.

With the experience gained and the interest that external actors had begun to show in the data generated by the ecosystem, the members understood that the platform could develop into a hub for the entire industry. Government authorities could benefit from a better understanding of the industry's status to align policies and regulations. Research institutes could benefit from quality data for their studies. Service and product innovators could benefit from developing new services (e.g., automatic sea lice counting). Figure 1 provides an overview of the ecosystem's actors.

Looking at digital platform ecosystems as evolving meta-organizations (Gawer, 2014), the case moves from facilitating interaction within a single group of users (i.e., sea farmers) to enabling interaction across multiple groups (i.e., sea farmers, authorities, researchers, and innovators; Staykova & Damsgaard, 2015). In this setting, standards represent a governance mechanism that can subsidize both sides.

Data collection

We collected data through semi-structured interviews, documents provided by informants, online articles, and participation in a professional aquaculture industry course. Interviews were the main data source. We conducted 19 interviews from fall 2019 until spring 2021, divided into two rounds. In the first round, we focused on the launch and context of the digital platform ecosystem and what led to the need for standardization. In the second round, we focused on the standardization process. Questions in the first round concerned the actors' roles, their reasons for and perspectives on their involvement in the ecosystem, technologies and organizational solutions, their evolution over time, and the challenges that led to standardization. In the second round, questions concerned the standardization process, how it was structured, the actors involved, and their actions.

We followed purposeful sampling (Marshall, 1996), interviewing actors who could provide us with key and useful information because of their involvement or interest in the standardization work. We interviewed actors with different roles (e.g., technical development personnel, senior innovation managers, and researchers) in different companies (e.g., the cluster, sea farms, research institutes, and the technical partner) to secure a variety of viewpoints. Some respondents were interviewed more than once. An overview of the informants is provided in Table 2.

The interviews lasted between 30 and 90 minutes and were based on an interview guide, which left room for the exploration of new areas. Most of the interviews were conducted and recorded digitally due to the Covid-19 pandemic and transcribed verbatim. Using documentation from informants and online archival data, we crosschecked the interview data and collected relevant contextual information about the case and the aquaculture industry. On this last point, the first author was involved in a professional sustainability and digitalization course within the industry.

Data analysis

The data analysis was conducted in six steps, as shown in Table 3.

First, we independently read transcripts, notes, and documents several times to familiarize ourselves with the data. Second, together, we created a chronology of each standardization workflow by writing narratives, which served as a data organization device for further analysis (Langley, 1999). Third, we independently coded the data to identify key aspects of the standards under development (i.e., the actors involved, how the work was organized, their strategies, and the challenges along the way). Fourth, we created a visual timeline of the overall standardization work and compared the different workflows to derive practices to use to achieve common standards. Fifth, through an abductive approach (Dubois & Gadde, 2002), we independently moved back and forth between the case analysis and the theoretical lens (i.e., institutional work theory; Lawrence & Suddaby, 2006) to frame the practices used by informants in the standardization work. Sixth, we compared and reconciled our individual interpretations. In the next section, we present the findings according to the theoretical lens.

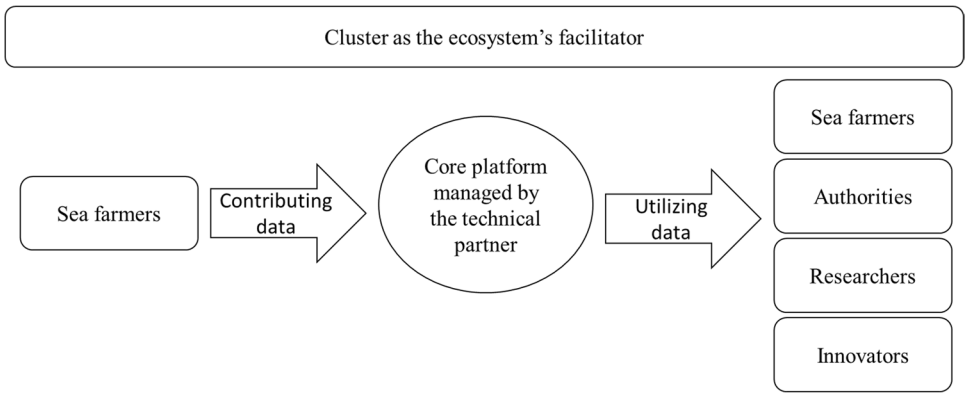

Fig. 1 The ecosystem's actor groups

Findings: standardization work

We structure the findings in terms of the four institutional work practices that we uncovered in this case.

Constructing identities

The Norwegian aquaculture industry has long been characterized by an uncontrollable and inaccessible flow of sensor data stored in closed, proprietary systems, which makes it difficult to share data within the ecosystem. Even within a single company, data from different facilities can be in different formats. Moreover, data quality was not assured because the data were without context. Some data were captured by sensors, while others were captured manually. In addition, the data were stored in proprietary formats determined by the individual vendor, making it impossible to combine or compare data from systems from different vendors.

This situation with proprietary and incompatible systems was well summarized by the digitalization director of Sea Farm C: "The history here in our industry is that there have been two big Norwegian vendors of management systems that had their own proprietary platforms that kind of locked you in as soon as you selected one of those players."

As part of an ecosystem aimed at fighting sea lice, the farmers became more aware of the locked-in situation and its consequences, and they decided to take a more active role in developing technology. Because they were big and valuable customers, they understood that they should use their buying power to require open standards and system interfaces. Moreover, given the increasing interest in the data generated by the ecosystem, the farmers understood that through standardization, they could move toward a knowledge-based industry and get more attention:

> It is tremendously easier to duplicate the fact-based knowledge than the experience-based knowledge (…) And it is also much easier to kind of nurture the curios-

Table 2 Informants

Informant	Organization	Role	Comment
1	Sea Farm A	Project Manager, Leader – Sensor Data Standardization	Interviewed twice
2	Sea Farm B	IT Business Partner Feed and Farming	
3	Sea Farm C	Digitalization Director	Interviewed twice
4	Cluster	Innovation Manager, Leader – Environmental Data Standardization	Interviewed three times
5	Technical Partner	Project Manager	Interviewed twice
6	Sea Farm C	Chief Technical Officer	
7	Cluster	Ecosystem's Project Manager	
8	Innovation Center	Senior Project Manager Innovation	
9	Cluster	Chairman	
10	Consulting company	Project Leader – Fish Health Data Standardization	
11	Supplier	Solution Manager	
12	Sea Farm A	Technical Development Manager/Head of R&D on Sea Farms	
13	Research Institute	Senior Researcher	
14	Sea Farm A	Head of IT & Systems	

Table 3 Data analysis steps

Step	Activity	Output
1	Reading transcripts, notes, and documents	Familiarization with the data and the case
2	Analyzing the chronological development of standards	Written narratives of each standardization workflow
3	Coding data for each workflow separately	Identification of actors and their individual activities for standardization
4	Comparing the different workflows; creating a visual timeline of the standardization process	Identification of practices used to achieve common standards
5	Abductively analyzing the case through the empirical data and the theoretical lens	Framing of the case's practices used in the standardization work
6	Comparing and reconciling researchers' individual interpretations	Agreement on the case's interpretation

> ity culture that we actually want to foster in the industry as such because you can nurture the curiosity by facts. (Digitalization Director, Sea Farm C)

Through this realization, the sea farmers were socially constructing a new identity and reconfiguring their beliefs: The farmers became aware that together, and with the cluster, they could reverse the power relationship to access more and better-quality data for a more sustainable environment. To this end, the farmers decided to initiate a standardization program following an open, voluntary approach.

Constructing normative networks

To build the standards within an industry-wide collaboration of interested actors and to access a broad set of competences, the ecosystem's members sent out an invitation in a post on the cluster's website and followed up with newsletters. Although participation was voluntary and based on competence and capacity for the sensor standardization workflow, within two weeks, 47 actors had signed up, and more participated in the kick-off event that followed.

However, despite the anticipated benefits that standardization could bring, at first farmers were reluctant to share sensitive information and their in-house practices with their competitors. This "fear of sharing" contradicted the principle of openness, which meant that any input and suggestions for the standards should be publicly available and openly scrutinized. A senior researcher explained:

> This openness is very hard for aquaculture. The aquaculture industry doesn't want to share data (…) And they (the sea farmers) don't want to necessarily reveal the inner working of what they do. In the first meeting I was in, there was a discussion about this, about the fact that, in some cases, you might be revealing much more than you want to your competitors.

To overcome this resistance, meetings and leveraging previous working relationships were key. In addition to the farmers, and to secure an industry-wide engagement, the two dominant software vendors of management systems were brought onboard. This involvement was also important in preparing them for the work they needed to do to implement the standards in their systems. Moreover, for one of the standardization workflows, the recruited project manager had previously worked for one of the two software vendors.

Overall, the informants explained that for this industry-wide collaboration to succeed, shared ownership was fundamental. Shared ownership meant that each actor could influence the direction of the standards under development and was considered crucial for diffusing and implementing the standards. Shared ownership was achieved through the way standardization was organized. Each workflow (see Table 1) was organized with one working group and one reference group. The working group was responsible for writing a first-draft document for the standard. This draft document was then sent "on hearing" to the reference group for feedback. If there were comments and suggestions, a new draft document was developed. This cycle was repeated until consensus was reached. The final standard was not influenced by the actors' size or power in the industry but was based on value, competences, and supporting arguments.

Educating

To further smooth the standardization work, the ecosystem's members provided all the actors involved with knowledge and mutual understanding for developing common standards. In addition to meetings to handle feedback on drafts sent on hearing, other meetings and webinars were organized to nurture a broad interest in the ecosystem, what standardization could bring and solve, and the consequences of not standardizing.

For instance, the ecosystem's steering committee considered it important to align the farmers' different perceptions of standardization and the way it was (more or less) prioritized across them. "If they don't have the same priority for this, then it's even more difficult to achieve what you need. Communication is key to find a common priority, a balance"

(Head of IT & Systems, Sea Farm A). Meetings were also important to shape a positive attitude toward standardization, which is often considered to limit freedom for innovation. People's attitudes, more than the use of new technologies, were perceived as critical. The digitalization director, Sea Farm C, clarified:

> And that's the biggest change in digitalization. It is not the technology that is the problem; it is the people. That is step number one, but this is actually the hardest one (…) So we have to put efforts into that so that they see the benefits for themselves and for the industry.

Beyond communication and transparency to enhance standards development, the ecosystem's members were taking steps to foster the subsequent diffusion and acceptance of the standards. Members were aware of the importance of developing user guidelines to assist practically in implementing the standards. Moreover, the farming companies organized internal training to align work practices with the new standards. Overall, educating was key for developing and diffusing the standards, which our informants described as "very much connected" (Senior Researcher, Research Institute).

Mimicry and advocacy

Standardization was not new in the aquaculture industry, but previous attempts failed for several reasons due to low technological maturity and poor standards. However, it was understood that previous work could be leveraged and revised. There was no need to reinvent the wheel; instead, the ecosystem's members worked on coordinating existing standards and putting them into a system. Specifically, some aquaculture standards developed in 2012 by the national standardization body were considered the starting point, and they were revised under the auspices of the national body.

The project leader for the fish health data workflow clarified:

> We are participating in an industry project with the entity called Standard Norway making different kinds of standards for different industries, and in aquaculture, there are several standards, but one of these standards is called NS9417 that is a standard for (…) definitions used, and special names and processes, and definitions used in the industry, a kind of industry language. And we also work with the seafood association. So, it is important to get involved with different stakeholders in the industry, like fish health services, laboratories.

Moreover, the standardization work leveraged other industries' knowledge and practices. For instance, with the aim of defining codes related to fish health and causes of death, the project leader for the fish health data workflow stated:

> For aquaculture, it is important to obtain standards from outside, used in other industries (…) In the fish health workflow, we have looked at agriculture and animal husbandry, what kinds of classifications for diseases and causes of death exist. And in medicine, you have this (…) international standard of classification of causes of death of people. In our project, we kept an eye on this because there is no need for us to start from zero.

Involving external experts was considered key in creating high-quality standards. For instance, some of the business and academic people involved in the standardization work in 2012 were engaged. Moreover, in the sensor data workflow, involving biologists allowed for useful add-ons to the technology. A senior researcher who was invited to participate in the sensor standardization explained, "I have worked towards adding other elements such as light, better light quality data because (…) light is the biggest driving force of biology. I mean, it is more important than temperature."

Another example is that, for the fish health standardization workflow, most work was conducted by employees at the Veterinary Institute and the Norwegian University of Life Sciences:

> Inside that group, there are people educated in the fish health science, but also people working as fish health professionals or managers in fish farms, so they have the practical experience, and some have been 40–50 years in the industry both in the academics and out in the field. So, they know very well the needs, and they also have experience from animal husbandry and also from fish farms, fish health services for many years (…) So, they also have the trust. (Project Leader for fish health data standardization workflow, Consulting Company)

Overall, existing standards, broad involvement, and participation among the ecosystem's members, together with knowledge from academics and experts in other industries, were utilized and combined to develop the standards. This approach not only helped legitimize the standards but also contributed to their implementation and use. Table 4 provides an overview of the different institutional works that were put in place to jointly build and diffuse industry-wide standards in an ecosystem where there is no focal actor.

Discussion

This study was guided by the research question, *how can standards be developed for a digital platform ecosystem when there is no focal actor and where the actors' existing technological solutions and work practices differ?* To

Table 4 Overview of the institutional works

Institutional work	Importance in the standardization work	Issues raised	Actors	Outcome
Constructing identities	Preparatory work – Standard development	Low data quality, availability, and comparability	Internal ecosystem's members	Reconfigured beliefs, awareness of possibility of reverting power relationship with dominant software vendors
Constructing normative networks	Standard development and diffusion	Open standards can benefit the whole industry and allow for integration of the systems	Internal ecosystem's members and researchers, software vendors, other farmers	A standardization network where all industry actors could participate and influence the standards under development
Educating	Standard development and diffusion	Different perceptions and attitudes about the value of standardization	Ecosystem' steering committee	A common and positive attitude toward the standards
Mimicry and Advocacy	Standard development and diffusion	Increase legitimacy and quality of standards	Internal ecosystem's members and national standardization body, University of Life Sciences, and Veterinary Institute	New standards based on extant standards and knowledge

answer this question, we investigated a platform ecosystem where multiple companies came together to solve a common problem that they understood could not have been solved by each actor alone. The short answer is that standardization is a gradual consensus process, encompassing four institutional work practices.

Standardization in collaborative platform ecosystems

By looking at standards as a product of institutional work (Lawrence & Suddaby, 2006), this study contributes by uncovering the practices involved in standardization. We found that standardization is a dynamic process with activities influencing beliefs, values, understanding, and the roles of those involved. Moreover, in line with the work of Slager et al. (2012), this study shows how a broad set of internal and external actors can combine their experience, competences, and skills to move the standardization process forward. *Constructing identities* allowed a group of actors of the same type (i.e., sea farmers) to acknowledge their role and joint power in initiating a standardization process and challenging the status quo, characterized by a lock-in in the vendors' proprietary systems. Farmers understood that only together could they increase compatibility among and across their own facilities and attain improvement to achieve their sustainability goal. *Constructing a normative network* was relevant for creating a collaboration that spanned multiple groups of actors. In this case, the initiative was made public through the cluster's website, newsletters, and events and was open to anyone who wanted to contribute. Shared ownership was key in creating an environment in which any actor, despite its size, could have a say in and a voting right to influence the direction of the standards in the making. Actors with divergent interests, such as dominant software vendors, were not excluded; instead, their engagement was considered pivotal from the very beginning. Overall, shared ownership and engagement allowed not only to create an arena for collaboration but also to make the standards easier to subsequently accept due to participation in the development phase. This is in line with existing research that has shown IT vendors' contribution benefits users in ensuring that the standards under development will be technically feasible (Zhao et al., 2011). Farmers' participation also ensures that resources spent by software vendors in adjusting their software and technologies are not wasted. *Educating* allowed for building mutual knowledge and understanding of standardization to reduce divergences in terms of priorities or perceptions. Moreover, this institutional work also aimed at smoothing the adoption of the standards under development by working on user guidelines and arranging internal training. *Mimicry and advocacy* considered existing standards, including those in other industries, as valuable sources on

which to build standards for the aquaculture industry; this institutional work also emphasized the importance of relying on trustworthy and authoritative actors (e.g., experts and the official standardization body) that could increase the legitimacy of the standards under development.

Our analysis suggests that the development and diffusion of standards are highly intertwined, a relationship that has often been overlooked in the literature (Fukami & Shimizu, 2018). Standard diffusion was addressed from the beginning, and attempts to deal jointly with development and diffusion were put into practice, such as relying on shared ownership, fostering a common understanding, and engaging trustworthy actors. This finding confirms the findings of Markus et al. (2006) and is different from most research (as described in Markus et al., 2006) that usually suggests different solutions to tackle the two processes individually. Moreover, this case stresses the relevance of broad involvement, contrasting the regulated actor approach that research on the consortia mode has considered successful (e.g., Weiss & Cargill, 1992 in Markus et al., 2006). We argue that inclusiveness, rather than exclusiveness, may promote standardization.

Furthermore, involving a broad set of actors in creating the standards increased acceptance of them. Participants may also become advocates, pushing future suppliers and customers to adopt the standards (Boh et al., 2007). In this way, the ecosystem will be able to scale up with more and different user groups that can easily join and build value based on the data provided.

This study suggests that, in addition to compatibility standards, additional types, such as quality, terminology, and classification standards, are also relevant for the development of ecosystems. These standard types fit the sociotechnical features of platform ecosystems. In studying standardization, we recommend a shift from seeing it as a pure technical study object and discourse to a more comprehensive one. This comprehensive approach is in line with the fact that standards are growing rapidly in variety (Hanseth & Bygstad, 2015). As previously suggested by Nickerson and Muehlen (2006), there is a need for a focus on ecologies of standards instead of individual ones.

Implications for practice

The implications for practice can be summarized in the following three key lessons learned.

Engage and inspire a broad set of key actors

This case shows that it is necessary for members of a digital platform ecosystem without a dominant player to collaborate broadly within the industry. An open approach will give the ecosystem access to a broad and diverse set of external competences and skills. Collaborating with representatives from various external stakeholders (including software suppliers) increases the success rate of development and subsequent diffusion (Markus et al., 2006; Zhao et al., 2011). Involving a broad set of actors and key players may strengthen the perception that standards have been developed by accounting for costs and impacts on all relevant actors (Boh et al., 2007). This has a strong influence on the standards' legitimacy, which can be augmented through mobilization of political and regulatory support (Lawrence & Suddaby, 2006). As shown in this case, the ecosystem's members worked under the auspices of influential external actors (i.e., national standardization bodies and academic institutions). In ecosystems lacking a focal, dominant actor, engaging with external actors with knowledge and authority will increase the legitimacy of the standardization process and the standards (Lawrence & Suddaby, 2006), which will enhance the subsequent adoption and increase the ecosystem's value.

Leverage extant standards and knowledge

Developing standards does not have to come from a tabula rasa approach. This case shows that revising extant industry standards and aligning them with the current business scenario can be a viable approach. This approach has also proved to be successful in previous standardization works. For example, the Norwegian health sector followed a pragmatic approach by first making use of available standards and then modifying them when necessary (Hanseth et al., 2012). The present case also shows that it may be a good strategy to use knowledge matured in other industries and to leverage actors (individuals and organizations) with experience in previous standardization processes. Grafting (i.e.,

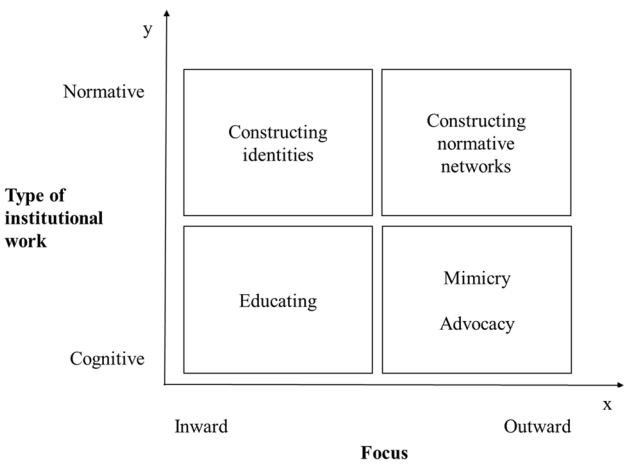

Fig. 2 A preliminary framework for standardization in digital platform ecosystems

defining standards based on extant standards to improve their functionality and usefulness) and extension (i.e., adding new elements to extant standards) represent useful strategies for changing and revitalizing previous standardization attempts (Egyedi & Blind, 2008).

Develop standards with diffusion in mind

This study makes it evident that standard development and standard diffusion are highly interwoven. The development phase should be managed with the subsequent implementation phase in mind. An inclusive, transparent, and open approach in the development phase may shape a positive attitude among the ecosystem's members toward implementing the standards in their technologies and work practices. Shared ownership was found to be a pivotal element in ensuring the ecosystem members' acceptance because it is easier to accept, conform to, and advocate for using standards one has contributed to (Boh et al., 2007). As standards play such an important role in the success of digital platform ecosystems (Wiegmann et al., 2017), their acceptance can make a difference regarding the ecosystems' development and reputation, especially for ecosystems without a focal actor.

A preliminary framework for standardization in ecosystems

Based on our analysis and institutional work theory, we propose the following preliminary framework for standardization within digital platform ecosystems, as shown in Fig. 2.

The proposed framework has two dimensions. On the x-axis is the focus that the standardization process can adopt, inward-looking or outward-looking (including external stakeholders). On the y-axis are the institutional work practices that can act as normative (i.e., on beliefs, values, and roles) or cognitive (i.e., on meanings).

The framework suggests that to standardize, an ecosystem can leverage well-known institutional work practices starting with the preparatory work of *constructing identities*, serving as a tool for reconfiguring the beliefs of the ecosystem's current members, with the aim of building shared awareness (Lawrence & Suddaby, 2006). This is in line with previous research that has acknowledged users' coalitions as a means of ensuring users' involvement in standardization efforts (Foray, 1994 in Markus et al., 2006). Then, actors can leverage the three other institutional work practices. The outward-looking practice of *constructing normative networks* allows external actors to be involved in standardization, whereas the inward-looking practice of *educating* ensures shared knowledge and understanding, thus building up support for standard development. *Mimicking* available standards and knowledge in the industry (outward focus) provides a baseline for exploring new possibilities (Lawrence & Suddaby, 2006). Mimicry legitimizes the new practices, whereas advocacy helps marginal actors shape cognitive legitimacy for participating in standardization (Lawrence & Suddaby, 2006). Although there is no unique way to develop standards (Biddle, 2016), we argue that a standardization process involving the four institutional work practices in an iterative way is appropriate for designing a digital platform ecosystem with no focal owner.

Limitations and further research

Standardization in digital ecosystems is an emerging field, and although many insights from standardization research are valid, some aspects of digital ecosystems present new theoretical and practical challenges. One is the question of how standardization in such regional ecosystems, as presented in this study, can be scaled up to encompass an entire sector and interconnect with other ecosystems. This issue may be investigated within an industry with several parallel platform ecosystems to gain insight into the strategies for merging or combining them at the industry level. Another issue is how the "non-generic complementarity" (Jacobides et al., 2018) of digital ecosystems affects standardization. It could be worth investigating whether non-generic complementarities may smooth collaboration and coordination in developing standards and whether they may reduce or increase the relevance of some of the institutional work practices that we identified in our case. Finally, we call for additional empirical research to validate and further enhance the preliminary framework.

Conclusion

This study investigates standardization within a collaborative digital platform ecosystem. Building on institutional work theory and our analysis, we envisage that standardization is a dynamic and gradual consensus process based on four institutional work practices that address standard development and diffusion. We organized these practices in a preliminary framework. We also provide three key lessons learned for practitioners involved in standardization for collaborative digital platform ecosystems.

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References

Adner, R. (2017). Ecosystem as structure: An actionable construct for strategy. *Journal of Management, 43*(1), 39–58. https://doi.org/10.1177/0149206316678451

Asadullah, A., Faik, I., & Kankanhalli, A. (2018). Digital platforms: A review and future directions. *PACIS 2018 Proceedings*, 248. https://aisel.aisnet.org/pacis2018/248

Bazarhanova, A., Yli-Huumo, J., & Smolander, K. (2020). From platform dominance to weakened ownership: How external regulation changed Finnish e-identification. *Electronic Markets, 30*(3), 525–538. https://doi.org/10.1007/s12525-019-00331-4

Benbasat, I., Goldstein, D. K., & Mead, M. (1987). The case research strategy in studies of information systems. *MIS Quarterly, 11*(3), 369–386. https://doi.org/10.2307/248684

Biddle, B. (2016). *No standard for standards: Understanding the ICT standards development ecosystem*. https://doi.org/10.2139/ssrn.3023650.

Blaschke, M., Haki, K., Aier, S., & Winter, R. (2019). Taxonomy of digital platforms: A platform architecture perspective. *14th International Conference on Wirtschaftsinformatik,* 572–586. https://aisel.aisnet.org/wi2019/track06/papers/3/

Bogers, M., Sims, J., & West, J. (2019). What is an ecosystem? Incorporating 25 years of ecosystem research. *Academy of Management Proceedings, 2019*(1), 1–29. https://doi.org/10.2139/ssrn.3437014

Boh, W. F., Soh, C., & Yeo, S. (2007). Standards development and diffusion: A case study of RosettaNet. *Communications of the ACM, 50*(12), 57–62. https://doi.org/10.1145/1323688.1323695

Brunsson, N., Rasche, A., & Seidl, D. (2012). The dynamics of standardization: Three perspectives on standards in organization studies. *Organization Studies, 33*(5–6), 613–632. https://doi.org/10.1177/0170840612450120

de Reuver, M., Sørensen, C., & Basole, R. C. (2018). The digital platform: A research agenda. *Journal of Information Technology, 33*(2), 124–135. https://doi.org/10.1057/s41265-016-0033-3

de Vries, H. (1998). The classification of standards. *Knowledge Organization, 25*(3), 79–89.

Dubois, A., & Gadde, L. E. (2002). Systematic combining: An abductive approach to case research. *Journal of Business Research, 55*(7), 553–560. https://doi.org/10.1016/S0148-2963(00)00195-8

Egyedi, T. M., & Blind, K. (2008). *The dynamics of standards*. Edward Elgar Publishing.

Fukami, Y., & Shimizu, T. (2018). Innovating through standardization: How Google leverages the value of open digital platforms. *PACIS 2018 Proceedings*, 208. https://aisel.aisnet.org/pacis2018/208

Gawer, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. *Research Policy, 43*(7), 1239–1249. https://doi.org/10.1016/j.respol.2014.03.006

Ghazawneh, A., & Henfridsson, O. (2013). Balancing platform control and external contribution in third-party development: The boundary resources model. *Information Systems Journal, 23*(2), 173–192. https://doi.org/10.1111/j.1365-2575.2012.00406.x

Grant, G., & Tan, F. B. (2013). Governing IT in inter-organizational relationships: Issues and future research. *European Journal of Information Systems, 22*(5), 493–497. https://doi.org/10.1057/ejis.2013.21

Gulati, R., Puranam, P., & Tushman, M. (2012). Meta-organization design: Rethinking design in interorganizational and community contexts. *Strategic Management Journal, 33*(6), 571–586. https://doi.org/10.1002/smj.1975

Guler, I., Guillén, M. F., & Macpherson, J. M. (2002). Global competition, institutions, and the diffusion of organizational practices: the international spread of iso 9000 quality certificates. *Administrative Science Quarterly, 47*(2), 207–232. https://doi.org/10.2307/3094804

Halckenhaeusser, A., Förderer, J., & Heinzl, A. (2020). Platform governance mechanisms: An integrated literature review and research directions. *ECIS 2020 Research Papers*, Paper 30. https://aisel.aisnet.org/ecis2020_rp/30

Hanseth, O., & Bygstad, B. (2015). Flexible generification: ICT standardization strategies and service innovation in health care. *European Journal of Information Systems, 24*(6), 645–663.

Hanseth, O., Bygstad, B., Ellingsen, G., Johannessen, L. K., & Larsen, E. (2012). ICT standardization strategies and service innovation in health care. *Thirty-Third International Conference on Information Systems,* 1–17.

Hein, A., Schreieck, M., Riasanow, T., Setzke, D. S., Wiesche, M., Böhm, M., & Krcmar, H. (2020). Digital platform ecosystems. *Electronic Markets, 30*(1), 87–98. https://doi.org/10.1007/s12525-019-00377-4

Hein, A., Weking, J., Schreieck, M., Wiesche, M., Böhm, M., & Krcmar, H. (2019). Value co-creation practices in business-to-business platform ecosystems. *Electronic Markets, 29*(3), 503–518. https://doi.org/10.1007/s12525-019-00337-y

Henfridsson, O., & Bygstad, B. (2013). The generative mechanisms of digital infrastructure evolution. *MIS Quarterly*, *37*(3), 907–931. https://www.jstor.org/stable/43826006

Holm, P. (1995). The dynamics of institutionalization: Transformation processes in norwegian fisheries. *Administrative Science Quarterly, 40*(3), 398–422. https://doi.org/10.2307/2393791

Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. *Strategic Management Journal, 39*(8), 2255–2276. https://doi.org/10.1002/smj.2904

Langley, A. (1999). Strategies for theorizing from process data. *Academy of Management Review, 24*(4), 691–710. https://doi.org/10.5465/amr.1999.2553248

Lawrence, T. B., & Suddaby, R. (2006). Institutions and institutional work. In S. R. Clegg, C. Hardy, T. B. Lawrence, & W. R. Nord (Eds.), *The Sage handbook of organization studies* (pp. 215–254). SAGE.

Lawrence, T., Suddaby, R., & Leca, B. (2011). Institutional work: Refocusing institutional studies of organization. *Journal of Management Inquiry, 20*(1), 52–58. https://doi.org/10.1177/1056492610387222

Lyytinen, K., & King, J. L. (2006). Standard making: A critical research frontier for information systems research. *MIS Quarterly, 30*, 405–411. https://doi.org/10.2307/25148766

Markus, M. L., Steinfield, C. W., & Wigand, R. T. (2006). Industry-wide information systems standardization as collective action: The case of the US residential mortgage industry. *MIS Quarterly, 30*, 439–465. https://doi.org/10.2307/25148768

Marshall, M. N. (1996). Sampling for qualitative research. *Family Practice, 13*(6), 522–526. https://doi.org/10.1093/fampra/13.6.522

Miller, C. D., & Toh, P. K. (2020). Complementary components and returns from coordination within ecosystems via standard setting [special issue]. *Strategic Management Journal, 1–36*. https://doi.org/10.1002/smj.3143

Nickerson, J. V., & Muehlen, M. Z. (2006). The ecology of standards processes: Insights from internet standard making. [special issue]. *MIS Quarterly, 30*, 467–488. https://doi.org/10.2307/25148769

Oakes, L. S., Townley, B., & Cooper, D. J. (1998). Business planning as pedagogy: Language and control in a changing institutional field. *Administrative Science Quarterly, 43*(2), 257. https://doi.org/10.2307/25148769

Otto, B., & Jarke, M. (2019). Designing a multi-sided data platform: Findings from the international data spaces case. *Electronic Markets, 29*(4), 561–580. https://doi.org/10.1007/s12525-019-00362-x

Riasanow, T., Jäntgen, L., Hermes, S., Böhm, M., & Krcmar, H. (2021). Core, intertwined, and ecosystem-specific clusters in platform ecosystems: Analyzing similarities in the digital transformation of the automotive, blockchain, financial, insurance and IIoT industry. *Electronic Markets, 31*(1), 89–104. https://doi.org/10.1007/s12525-020-00407-6

Schreieck, M., Wiesche, M., & Krcmar, H. (2016). Design and governance of platform ecosystems—Key concepts and issues for future research. *ECIS 2016 Proceedings,* 76. https://aisel.aisnet.org/ecis2016_rp/76

Slager, R., Gond, J. P., & Moon, J. (2012). Standardization as institutional work: The regulatory power of a responsible investment standard. *Organization Studies, 33*(5–6), 763–790. https://doi.org/10.1177/0170840612443628

Staykova, K. S., & Damsgaard, J. (2015). A typology of multi-sided platforms: The core and the periphery. *ECIS 2015 Completed Research Papers, Paper, 174* http://aisel.aisnet.org/ecis2015_cr/174

Tiwana, A., Konsynski, B., & Bush, A. A. (2010). Platform evolution: Coevolution of platform architecture, governance, and environmental dynamics (research commentary). *Information Systems Research, 21*(4), 675–687. https://doi.org/10.1287/isre.1100.0323

Tiwana, A., Konsynski, B., & Venkatraman, N. (2013). Information technology and organizational governance: The IT governance cube. *Journal of Management Information Systems, 30*(3), 7–12. https://doi.org/10.2753/MIS0742-1222300301

Tuczek, F., Castka, P., & Wakolbinger, T. (2018). A review of management theories in the context of quality, environmental and social responsibility voluntary standards. *Journal of Cleaner Production, 176*, 399–416. https://doi.org/10.1016/j.jclepro.2017.12.161

van de Kaa, G., van den Ende, J., & de Vries, H. J. (2015). Strategies in network industries: The importance of inter-organisational networks, complementary goods, and commitment. *Technology Analysis & Strategic Management, 27*(1), 73–86. https://doi.org/10.1080/09537325.2014.951320

Wiegmann, P. M., de Vries, H. J., & Blind, K. (2017). Multi-mode standardisation: A critical review and a research agenda. *Research Policy, 46*(8), 1370–1386. https://doi.org/10.1016/j.respol.2017.06.002

Yin, R. K. (2014). *Case study research: Design and methods* (3rd ed.). SAGE Publications.

Zhao, K., Xia, M., & Shaw, M. J. (2011). What motivates firms to contribute to consortium-based e-business standardization? *Journal of Management Information Systems, 28*(2), 305–334. https://doi.org/10.2753/MIS0742-1222280211

Article 3

Title: Identifying Governance Mechanisms for Data Sharing in Collaborative Platform Ecosystems

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Identifying governance mechanisms for data sharing in collaborative platform ecosystems

Research Paper

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Abstract

The fish farming industry is one of the fastest-growing industries and will be one of the most important businesses in the future. However, more salmon than ever died prematurely in Norway in 2021, mainly due to disease and lice treatments. To improve this situation, sharing data related to lice is crucial. However, to facilitate data sharing, a platform for storing data, data comparability, and trustworthy relationships must be secured. Sharing data poses challenges that require proper governance. Based on a longitudinal, qualitative case study of a collaborative platform ecosystem in the Norwegian aquaculture industry, we identify governance mechanisms that enable data sharing and develop a model for the gradual maturation of data sharing. Our insights from a collaborative platform ecosystem within a traditional industry complement the extant research, mainly focused on centralized platform ecosystems. We also provide guidance for practitioners who want to enable data sharing in their ecosystems.

Keywords: Governance mechanisms, Data sharing, Collaborative ecosystems, Collaborative governance.

1. Introduction

The fish farming industry is one of the fastest-growing industries in Norway. Fish farming will also be one of the most important businesses in the future (Ministry of Industry and Fisheries, 2021). At the same time, although many farming companies are striving for more sustainable production, fish mortality in Norway is extremely high, with more than 80 million fish deaths in 2021 (Norwegian Veterinary Institute, 2021). Thus, the health and welfare situation of Norwegian farmed fish is a hot topic. The seriousness of the situation mainly comes from diseases and treatments for the parasite sea louse, which continues to be among the industry's biggest challenges (Norwegian Veterinary Institute, 2021). The sea louse problem is more easily solved in collaboration, through sharing data such as the number of sea lice, water temperature, and oxygen content in the cages.

Data are a strategic asset that facilitates more informed decisions (DAMA International, 2009; Eckartz et al., 2014). Data sharing, understood as the exchange of data between different stakeholders (Nokkala et al., 2019), is deemed necessary. However, the Norwegian aquaculture industry is closed. Farming companies are not used to sharing data, and to some extent, are also reluctant. The lack of a data-sharing culture, mainly due to data confidentiality, makes improvement challenging. Sharing sensitive data can undermine a company's competitive advantage (Dahlberg and Nokkala, 2019; Eckartz et al., 2014; Gelhaar, Gürpinar et al., 2021). Moreover, it can result in a breach of anti-trust regulations. Overall, data sharing across

organizational boundaries represents a difficult practical problem. In fact, there is tension between fears of sharing (and thus, willingness to retain control over data) and willingness to share and solve common challenges (Lis and Otto, 2020). Therefore, investigating how to overcome skepticism and protectionism and stimulate companies to share data requires a focus on data governance. Data governance broadly refers to the processes, policies, roles, structures, and technologies used to control data (Lee et al., 2017; Schreieck et al., 2016; Simons, 1994). Governance mechanisms, at their core, encourage actors to share data by assigning accountabilities and rights for value realization (Abraham et al., 2019; Benfeldt et al., 2020).

It has been acknowledged that platform ecosystems facilitate data sharing (Gawer and Cusumano, 2014). These evolving meta-organizations coordinate actors through means other than a hierarchy (Gawer, 2014; Jacobides et al., 2018). Researchers have usually examined centralized platform ecosystems led by a single platform owner. We focus on collaborative platform ecosystems established and governed by a group of actors. The literature has provided initial data governance frameworks, governance mechanisms, and factors (e.g., data ownership, quality, access, and usage) to account for when data are shared in ecosystems (Gelhaar, Gürpinar et al., 2021; Lee et al., 2017; Lis and Otto, 2020; Nokkala et al., 2019). However, how to effectively implement these factors, how to properly manage data, or how to shape a trustworthy and reliable environment is often not clear (Gelhaar, Gürpinar et al., 2021; Lee et al., 2017). The literature also suggests that platform ecosystems, as new forms of organization, require a broader perspective and new types of governance (Jagals and Karger, 2021; Lis and Otto, 2020). Some authors also point out that there is a lack of understanding of how data governance is established over time (Abraham et al., 2019; Rupek, 2021). Overall, although data sharing within an organization is considered an established practice, sharing data in platform ecosystems is an emergent topic about which we still know little (de Prieëlle et al., 2020; Lis and Otto, 2020; Nokkala et al., 2019).

Therefore, we ask the following question: *What are the data governance mechanisms in the process of enabling data sharing in collaborative platform ecosystems?*

To answer this question, we conducted a longitudinal, qualitative case study of a collaborative platform ecosystem in the Norwegian aquaculture industry characterized by a reluctance to share data. This study contributes to the literature on governance mechanisms for data sharing in the context of collaborative platform ecosystems, both theoretically and practically. Based on the case analysis, we identify the governance mechanisms that enable data sharing during the ecosystem's evolution. We also inductively develop a model for the gradual maturation of data sharing in ecosystems. This study of a collaborative business-to-business/government (B2B/G) platform ecosystem in a traditional industry complements the extant literature, which is mainly focused on centralized, business-to-consumer (B2C) platform ecosystems led by digital natives. In addition, we provide two lessons learned for practitioners that highlight the importance of deciding what to share and with whom, and of considering governance as an ongoing process.

2. Theoretical background

In this section, we elaborate on data sharing and the role of governance in addressing its challenges. Then, we discuss governance mechanisms for data sharing of platform ecosystems and suggest a new perspective in the context of collaborative platform ecosystems.

2.1. Data sharing and its governance

The term data sharing emerged in relation to whether researchers should share data from uncompleted research and moved to other contexts in which government and/or business actors

are involved (Enders et al., 2020; Rupek, 2021). Data sharing can be understood as the exchange of data between different stakeholders (Nokkala et al., 2019). Sharing data allows individuals and organizations to access complementary data sources. Combining data from various sources brings up new insights that can, for example, allow for innovation, more effective decision making, and increased efficiency and sustainability (DAMA International, 2009; Eckartz et al., 2014; Gholami et al., 2016). Data sharing has potential benefits but comes with risks and fears of how competitors may use the data (Klievink et al., 2018; Zeiringer, 2021). For instance, when moving data from internal silo systems to the cloud, where the data will be handled by third parties, companies experience a loss of control over their data and data ownership, security, privacy, and quality concerns (Al-Ruithe et al., 2019). Internal factors, such as a poor data-sharing culture and lack of trust in other organizations and/or technologies, may also affect willingness to share data (Dahlberg and Nokkala, 2019). If data sharing includes data that are confidential and sensitive, companies must also maintain their own competitive positions and compliance with anti-trust regulations (Dahlberg and Nokkala, 2019; Eckartz et al., 2014; Gelhaar, Gürpinar et al., 2021). Challenges related to data sharing occur at the organizational level when different departments need to manage company-wide data. Even more challenges occur when companies engage with external actors.

Data governance focuses on these challenges, and refers to the processes, policies, roles, structures, and technologies for controlling data (Lee et al., 2017; Schreieck et al., 2016; Simons, 1994). Governance aims at encouraging actors' desirable behavior to share data, treat them as a resource, and assign accountability and decision rights over the data (Abraham et al., 2019; Benfeldt et al., 2020). At the company level, it is usually clear who owns the data and for what purpose the data are used. Thus, governance mechanisms for data sharing mainly refer to the management of "ilities," such as data privacy, security, availability, etc. (Lee et al., 2017). Data governance manifests in organizational structures as hierarchies, and the establishment and monitoring of principles and guidelines for data (Weber et al., 2009). Many frameworks for governing data, information, and IT (data) exist at the company level (Khatri and Brown, 2010; Weber et al., 2009; Weill and Ross, 2004, 2005). However, the current business scenario is increasingly characterized by inter-organizational settings in which new forms of data governance are needed, as traditional mechanisms do not extend beyond organizational borders (de Prieëlle et al., 2020; Jagals and Karger, 2021; Lis and Otto, 2020).

2.2. Governance mechanisms for data sharing in platform ecosystems

Platform ecosystems are spreading widely and attracting the interest of practitioners and researchers as they change the way in which business is conducted (Bazarhanova et al., 2020; de Reuver et al., 2018). Platform ecosystems can be understood as evolving meta-organizations that coordinate interdependent yet autonomous actors through means other than a hierarchy (Gawer, 2014; Gulati et al., 2012; Hein et al., 2020; Jacobides et al., 2018). These ecosystems consist of a technological platform and actors interacting on that platform (Gawer and Cusumano, 2014). This perspective recognizes the dynamic nature of platform ecosystems, in which actors can take on different roles, and in which new groups of actors and new sides can be added over time (Gawer, 2014). Moreover, this perspective allows us to examine the technical and social aspects of platform ecosystems, such as architecture, application programming interfaces (APIs), and actors, processes, rules, and standards (de Reuver et al., 2018).

Platform ecosystems are considered a medium for sharing aggregated data for mutual or customers' benefit (Nokkala et al., 2019). However, sharing data in such a context is more challenging than at the organizational level. In fact, ownership and access, usage and value, and

data stewardship are not governed under a single hierarchy but need to account for the different interests and roles of several actors (Nokkala et al., 2019; Otto and Jarke, 2019). The first study on governance mechanisms for data sharing dates back to 2017, when Lee et al. (2017) identified seven data governance factors organized in data ownership/access and data usage. Based on four platforms and governance models in industry and academia, Lee et al. (2017) also found that mechanisms for data ownership and access rights of platform users are not clearly defined, nor are mechanisms that support the visibility of data flow and data providers' efforts. Building on Lee et al. (2017), Nokkala et al. (2019) suggested a preliminary framework for platform data governance consisting of five domains: original data quality, ownership and access, stewardship, platform data quality, and value of data usage. Lis and Otto (2020) mapped the differences between data governance at the intra- and inter-organizational levels in different aspects, such as scope, purpose, goals, roles, and governance instruments. With a multiple-case study, they demonstrated that inappropriate data governance can hinder data platform adoption. Lis and Otto (2020) also showed how the range of governance mechanisms depends on actors' positions, highlighting that compared to users, platform owners are favored by controlling the infrastructure. As it is not always clear what data providers gain from offering their data, Gelhaar, Gürpinar et al. (2021) developed a taxonomy of incentive mechanisms that illustrate their key dimensions and characteristics. For instance, the reward dimension refers to whether data providers are compensated in the form of money or reputation or not for the shared data. The authors also suggested further investigation of how trust between actors and across the entire ecosystem can be established. Despite gaining momentum, however, research on data governance in platform ecosystems is still in its infancy (de Prieëlle et al., 2020; Lis and Otto, 2020; Nokkala et al., 2019). Moreover, given the variety of ecosystem types, there is a need to go beyond the investigation of centralized platform ecosystems led by digital natives, often with a strong B2C focus, to increase generalizability (Hein et al., 2020; Lis and Otto, 2020).

2.3. Governance mechanisms for data sharing in collaborative platform ecosystems

Today, more decentralized platform ecosystems, where ownership and governance mechanisms are in the hands of a group of actors, are emerging (de Reuver et al., 2018; Hein et al., 2020; Otto and Jarke, 2019). An example of such decentralized settings is collaborative platform ecosystems. In these ecosystems, independent actors join forces to establish and govern a platform ecosystem for a common goal and mutual benefits (Costabile et al., 2022; Iden et al., 2021). Contrary to centralized platform ecosystems, such collaborative settings are often non-profit, especially if they are established to address common societal challenges.

The lack of a focal owner who chooses the governance mechanisms to orchestrate the ecosystem makes governance even more challenging within collaborative platform ecosystems. Collaborative governance originating in the context of public administration research can provide insights into how to govern such collaborative ecosystems. Collaborative governance is a governing arrangement characterized by a collective, formal, consensus-oriented, and deliberative decision-making process that aims at making policy or at managing public assets through the interaction of different kinds of actors, usually public and non-public (Ansell and Gash, 2008, 2018). Collaborative governance is a delicate process due to the co-production of goals and strategies and the sharing of responsibilities and resources (Ansell and Gash, 2018). It is also quite new for the Information Systems field of research, resulting in few examples in extant literature. For instance, Constantinides and Barrett (2015) built on Ostrom (1990) to investigate the development of information infrastructures using a bottom-up approach and highlighted the importance of engaging different stakeholders and arranging governance in

nested layers. Collaborative platform ecosystems may be better governed through a collective, evolving, and bottom-up approach, which accounts for changes and growth in complexity in the context and actors' needs (Constantinides and Barrett, 2015; Hanseth and Lyytinen, 2010). When implemented (IT) governance is improved, the concept of maturity is often brought to the table. For instance, a maturity model determines improvement measures by focusing on the current state and the gaps, if any, with the desired state (Becker et al., 2009; Steuperaert et al., 2021). We understand maturity not only in relation to evolving governance mechanisms but also in the evolving attitude toward the area (e.g., data sharing) on which these mechanisms focus. Thus, we prefer to speak of maturation. Overall, we still know little about collaborative governance mechanisms that foster value co-creation and balance the different interests of those involved in leading the ecosystems' trajectories (Lis and Otto, 2020).

3. Methodology

For the research design, we follow a single-case research strategy (Yin, 1994), which is considered adequate for understanding complex social phenomena with limited knowledge (Benbasat et al., 1987; Yin, 1994). A single-case study is also appropriate for our case, which is unique for several reasons. Contrary to most known and studied platform ecosystems established and governed by a single focal company, such as Facebook and Apple (e.g., see Claussen et al., 2013; Ghazawneh and Henfridsson, 2013), the selected case was built and is led by the joint effort of a set of competing companies. In addition, the selected case is a B2B/G platform ecosystem, which complements the usual B2C perspective. Moreover, because the case focuses explicitly on data and data sharing in the context of reluctance to share data, we believe it is a good candidate to illuminate the governance mechanisms for data sharing in collaborative ecosystems.

3.1. Case description

AkvaEco is a collaborative platform ecosystem based on data launched in 2017 in the Norwegian aquaculture industry. The platform ecosystem was conceived at the end of 2016 at a conference where a group of farming companies and an innovation cluster discussed one of the industry's most severe environmental challenges, the parasite salmon louse. Fish farming in open cages is highly affected by this threat because open cages increase the number of susceptible hosts and the spread of parasites across farms. These parasites also limited production from expanding; therefore, proving that infestations are controlled was considered crucial for farming companies.

> Because sharing will be the key for this industry to be sustainable and compatible with the land-based industry as such (...) And I can't sit and laugh and look at my competitor. It's only again a matter of time that it would hit me as well, right? (...) If we do not start collaborating and sharing more, we are about to disrupt ourselves for the competitors that are building facilities on land. (Informant 9)

Informant 11 said, "It is all about how you will use this data and how you can use the data. I think a lot of innovation will come out."

The group of farming companies and the cluster envisioned the creation of a data platform that collects and analyzes data from farming companies' cages as necessary for making proactive decisions and counteracting infestations. Over time, the scope of this collaborative ecosystem has broadened to become the industry's hub for data-driven innovation. The ecosystem has seen an increase in the number of farming companies contributing data, as well as new actors gravitating to it as users of the data (e.g., researchers, authorities, and service suppliers).

3.2. Data collection

This paper is based on several data sources: interviews, archival data, participation in a professional course about the Norwegian aquaculture industry, and several seminars/webinars about the selected ecosystem. We conducted 19 interviews from September 2020 to June 2022 with 17 informants. To ensure a variety of viewpoints, we interviewed informants with different roles in the ecosystem (e.g., managers and technical personnel from different farming companies, an innovation manager from the cluster, the chairman of the cluster's board, researchers, and a supplier). To select informants, we followed purposeful sampling (Marshall, 1996); that is, we interviewed those who could provide us with key and useful information, based on their involvement or interest in the topic of our investigation. Each interview lasted between 30 and 90 minutes, and was based on a general interview guideline, which was adapted according to the informants' interests, concerns, competences, and perspectives. We asked questions related to the start of the ecosystem and its aim, organizational structure, shared data, challenges encountered along the way, technology, standardization, and formal contracts. Most of the interviews were conducted online because of the Covid-19 pandemic, recorded, and transcribed promptly to ensure accuracy and to immediately reflect on the major insight from each informant. We gathered more (contextual) information about the case through archival data, such as documentation about the case available online (e.g., the ecosystem's website and social pages, online press articles, and podcasts) or provided by informants, and through participation in different arrangements. With these sources, we enriched our understanding and triangulated the primary data.

3.3. Data analysis

In analyzing the data, inspired by Bygstad et al. (2016), we followed a four-step process, shown in Table 1. This process includes empirical and integration of the theoretical perspective, as well as the outcome of the analysis.

Table 1. Data analysis process.

Step	Activity	Outcome
1	Describing a timeline for AkvaEco	A timeline demonstrating the evolution of the case and of the data shared, Figure 1
2	Establishing a chronological narrative of the case	The case description, Section 3.1, which creates a structure for Section 4
3	Identifying three governance mechanisms for data sharing	Section 4
	Identifying related research with a limited literature review	Section 2
4	Describing a governance model for gradual maturation	A maturation model for data sharing demonstrating its evolution in an increasingly trustworthy environment, Section 5

First, we described a timeline for AkvaEco's evolution (see Figure 1). During the coding of the data, we recognized a gradual improvement in how the data were handled, which could explain the maturation to share data. Second, we established a chronological narrative of the case (Langley, 1999), which was the basis for organizing the case description in Section 3.1 and the findings in Section 4. Third, to explain the causes of the evolution of data sharing, we performed a retroductive process in which candidate mechanisms were suggested and confirmed or

discarded (Bygstad et al., 2016). Examples of discarded mechanisms are economic competition, strong actors, and innovation. Through this analysis, we identified three governance mechanisms for data sharing in three different phases. We discussed and reconciled our interpretation and decided to keep mechanisms that could explain continual data sharing. We also identified related research through a limited literature review using the query "data sharing" OR "data exchange" AND "incentive" OR "mechanism" AND "platform OR "ecosystem" in all fields on the e-library of the Association for Information Systems. Finally, based on the previous steps, we inductively created a process model for the maturation of data sharing, which is presented in Section 5.

4. Governance mechanisms for data sharing

In this section, we present our findings. The timeline that we elaborated on in the first phase of the data analysis is shown in Figure 1. In the following subsections, we present the governance mechanisms identified in the third step of the analysis. These mechanisms were adopted to counteract or address the challenges experienced in the case for continual data sharing.

4.1. Phase 1 (since 2016): Data platform and collaboration

For several generations, Norway has profited from rich fish deposits along long coasts, clear and cold water, and a healthy climate, which have led the country to a strong global position in seafood production (Innovation News Network, 2022; Norwegian Seafood Council, 2021). In 2021, 71% of the exported seafood production value came from aquaculture (Norwegian Seafood Council, 2021).

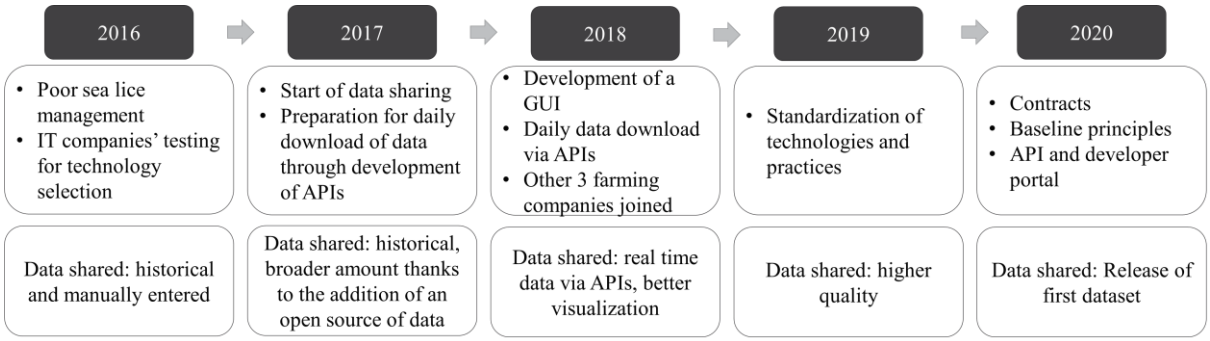

Figure 1. Timeline of the case's evolution with a focus on the data shared.

Despite the importance of the industry to the country, aquaculture's growth has also led to serious environmental challenges, including the parasite sea louse (Institute of Marine Research, 2020). Until 2016, farming companies faced this challenge in isolation and in a reactive manner, handling infestations as best they could once they occurred. This silo situation did not prove to be of any help, as these aggressive parasites can spread easily across open cages in adjacent farms, increasing the seriousness of the problem. A conference at the end of 2016 was the starting point for change. With farms and operations in the same waters, a group of four farming companies and an innovation cluster discussed the need for increased communication and collaboration, and to join forces to confront the sea lice problem. They envisioned a platform ecosystem based on data from cages collected via technology (e.g., sensors and cameras) to predict sea louse outbreaks on which they could act proactively. However, there was a poor data-sharing culture. Informant 3 referred clearly to the farming companies' perceptions of the data:

> It's my data, it's mine. It has always been here. I have always seen the borders around it. I'm not really sure what the data are, or what is the real value of the data, but at least it was mine. I stored it in my own server, in my own data center, in my own basement historically, in the office building.

To realize the vision, the group decided to collaborate by establishing a steering committee with representatives from farming companies and the cluster to govern the data sharing, set priorities, and lead the way forward. Through recurring meetings, this collaborative structure instilled openness and communication and was the first step in overcoming skepticism about sharing data. The group also decided to test several technological vendors for six months. The vendors analyzed historical data to make forecasts. The group landed on a central cloud platform with specific characteristics. The key elements of this architecture were data zones and a relational database for data storage. Data zones refer to separate containers in which each farming company could make its own data inaccessible to others. Data could be provided to other farming companies only in an anonymized and aggregated form. Moreover, the chosen central platform was equipped with machine learning capabilities for big data analysis. Informant 9 pointed out:

> We are not sharing raw data; we are putting data in our own kind of containers in the database, and no one can access the data that (my company) is putting in it. There is no one who can access that, only the technical partner and the algorithms.

The collaborative governance structure and the chosen platform served as key governance mechanisms for data sharing. In fact, they ensured data ownership and the confidentiality of the sensitive data collected from the cages. With these mechanisms in place, farming companies started putting historical data from their production systems on the central platform. In 2017, a collaborative platform ecosystem based on the data was created with farming companies on both sides as providers and users of the data. Overall, the new central platform received data from the farming companies' production systems. First, data were entered manually from the farming companies' production systems in the central platform. Later, to ease data sharing, APIs were developed for automatic and real-time data transfer. The Graphic User Interface (GUI) improved data visualization, which was considered relevant for data analysis.

4.2. Phase 2 (since 2019): Standardization to optimize data quality

In 2019, after some experimentation with predictions based on historical and daily data, the cluster, the initial farming companies, and three other companies that joined the ecosystem recognized that the accuracy of predictions of parasite outbreaks to enable quick intervention had not reached a satisfactory level. The sea lice warnings reached 70% certainty. Data quality became the main problem the ecosystem had to address. Farming companies had different practices for data collection, as one clearly stated: "We realized that there is a huge diversion in the data both individually and in the different companies" (Informant 9). For instance, for environmental data such as oxygen, temperature, etc., the depth of the measurements inside the cages could vary, for instance, between 1, 3, and 10 meters or 1, 3, and 15 meters. Environmental data from different depths could not be compared. Moreover, sometimes the data did not have context; for example, it was not clear what cage the data came from or the day on which the data were collected. Furthermore, the farming companies did not have common terminology for classifying fish deaths and diseases. In addition, the companies became aware that their data were locked inside the vendors' proprietary technologies. Proprietary technologies meant that the flow of data was not controllable by and entirely accessible for farming companies, and that communication across different vendors' technologies was poor. Not being able to get full access to their data puts the farming companies' data security and ownership at risk. In fact, some vendors' security standards risked

making some data open and accessible to others. Informant 5 reported, "The ownership is diffused (…) Data is spread across suppliers' systems. There is no real ownership; it is hard to control data security." The lack of communication among technologies made it difficult to combine, compare, and analyze the data, even across the facilities of a single farming company that used sensors from different suppliers to collect data.

Poor data quality and the risk of security and ownership led the group to focus on another governance mechanism for data sharing: standardization of technologies and practices for more effective usage of the shared data. For technologies, the focus was on developing a sensor infrastructure standard that could ensure interoperability and interchangeability. Farming companies also wanted to increase their flexibility in using sensors and other technologies from different vendors for their operations and data collection. For practices, the farming companies wanted to harmonize their methods for collecting data, such as at what depths and how to take measurements inside the pens. Moreover, the companies deemed it relevant to have a common language for fish health (e.g., defining common causes of fish death) to state not only how many fish died but also why. The standardization work was organized openly and collaboratively. The farming companies invited interested actors in the entire industry to participate voluntarily. For instance, technological vendors and suppliers and researchers participated in defining the standards. The work was structured in three workflows and based on consensus between a working group (responsible for writing the draft) and a reference group (responsible for commenting on the draft). According to informants, with standardization, the availability of a company's data was guaranteed, and data quality and security were built into the standards. Moreover, with such an open approach to standardization, the ecosystem aimed at fostering broader interest in data sharing and in the ecosystem as a catalyst for data-driven innovation.

4.3. Phase 3 (since 2020): Contracting to formalize relationships

With higher-quality data and broader interest because of the work on standardization, the ecosystem could better serve as the industry's data hub for innovation. It was time to take steps to share data with actors other than farming companies that could innovate or conduct research for their own benefit, the benefit of the farming companies and that of the entire industry. Informant 3 stated, "We need to change the rate of tangible results—this is crucial. Tangible results mainly refer (…) to sharing data sets." Sharing data with actors outside the farming companies' group posed additional challenges regarding what and how much to share and how to control the data flow. For instance, as Informant 9 explained:

> As soon as the fish have left the water, and it is actually on the way to customers, then it is okay to give away the data, but when we have the fish in the sea, that is part of our inventory and the value of the company as such. And that is stock-sensitive information that we can't share.

Many decisions had to be made to make this happen in the right way and to regulate the parties' rights and obligations. For instance, because the farming companies were competitors, they needed to comply with competition rules—which regulate competitors' information exchange—to keep the market functioning well.

With the help of lawyers, the ecosystem defined more formal governance mechanisms for data sharing, such as baseline principles and contracts. Baseline principles categorized the data along a continuum from private data (accessible only to the farming companies) to restricted data (accessible to some other actors) to open the data to any legal entity. This classification was based on data type, aggregation, and age. For instance, the more aggregated the data, the more they could be shared openly. Or sharing older data was deemed easier, meaning that the value of the data decreased over time. Contracts formally regulated the relationships between the

farming companies contributing data and the ecosystem and between the ecosystem and users of its data (e.g., research institutes). Specifically, these contracts reinforced and clarified the idea that the farming companies remained the owners of the data provided. In addition, contracts regulated data collection (e.g., data format and frequency). Furthermore, they regulated the right to access the data and the purposes of usage through a license granted by the farming companies to the ecosystem and data users. These mechanisms were developed in such a way that they could be changed, if needed. For instance, additional, specific user terms could be included, or new data classifications could be created in the case of an increased data scope, which may lead to other considerations. Informant 3 pointed out:

> And I think, in general, when we start to use this more extensively, we will learn. And when you learn, you typically see the need for change (…) And this corresponds very well with the journey of AkvaEco, which has been a journey on maturation of thinking and a cultural shift I would say, in how you act in collaborations, in how you act in sharing, how you viewed data.

Although the data classifications and the parties' rights and obligations were defined in the contracting mechanism, a brand-new developer portal and APIs were developed to implement them technically. The portal was a sort of front end to make datasets available to entities interested in the data from the central platform. Norwegian legal entities could register on the portal, accept the data access license, and obtain datasets via APIs. The first dataset was released in 2021.

The three governance mechanisms are briefly summarized in Table 2.

Table 2. Governance mechanisms for data sharing.

Governance mechanism	**Definition**	**Outcome**
Data platform and collaboration	Digital infrastructure for data collection, storage, and use combined with shared decisions rights and ownership	Enables data sharing in the first place
Standardization	Common solutions for technologies and business practices	Improves effectiveness of data sharing
Contracting	Baseline principles for data categorization and contracts for rights and obligations	Formalizes and sustains data sharing with a larger number of actors

5. Discussion

In the following subsections, we discuss the findings and provide the study's theoretical and practical implications. We make one main contribution, which has theoretical and practical implications. The main contribution is a process model that describes gradual maturation for data sharing. In Section 5.1, we delineate the process model before providing the practical implications.

5.1. A process model for maturation of data sharing

The literature on governance mechanisms for data sharing in the context of platform ecosystems is gaining momentum. Researchers have referred to the literature on data governance at the firm level as a point of departure (Lis and Otto, 2020; Nokkala et al., 2019). Concepts such as data ownership, security, quality, access, and usage are still relevant in the platform ecosystem

setting. However, the ways in which these concepts can be effectively and efficiently addressed and implemented require more attention (Gelhaar, Both, and Otto, 2021; Lee et al., 2017; Nokkala et al., 2019). Moreover, as these concepts are no longer in the hands of a single actor but spread across multiple actors with different roles and interests, the literature has pointed out that sharing data in inter-organizational settings requires new forms of governance and a trustworthy environment (de Prieëlle et al., 2020; Jagals and Karger, 2021; Lis and Otto, 2020). The present study builds on and adds to the extant literature on data sharing and governance in platform ecosystems. By answering the question, what are the governance mechanisms in the process of enabling data sharing in collaborative platform ecosystems?, through a longitudinal, qualitative case study, this study makes four contributions to the literature.

First, we identified different types of governance mechanisms for data sharing in collaborative platform ecosystems. Collaboration refers to the shared allocation across the actors leading the platform of decision-making authority related to data governance. The data platform is a central infrastructure for storing and processing collected data. Standardization ensures communication and interoperability across technologies, and harmonization of business practices and terminology. Contracting ensures that the data sharing complies with guidelines and regulations. It also formalizes actors' roles, obligations, and rights related to the shared data. These governance mechanisms for data sharing refer to roles and structure (e.g., collaboration and contracting), technologies (e.g., the data platform), and processes (standardization) and address technological, organizational, and legal aspects (Abraham et al., 2019; Lis and Otto, 2020; Simons, 1994). The study results confirmed that the definition of governance mechanisms for data sharing relies on data and on the involved actors and systems through which data are collected, managed, and used, which together shape the data and decide where they will go (Eckartz et al., 2014; Enders, 2018; Janssen et al., 2020).

Second, the results provide insights into the ways in which data ownership, quality, access, and usage can be effectively implemented in ecosystems (Lee et al., 2017; Nokkala et al., 2019). The farming companies' data ownership was clearly stated from the start. However, at first, the implementation was embedded in separate containers of the data platform, then improved through standards that allowed real availability and access to a company's data, and further strengthened by formally regulation of the farming companies' data licensing to the ecosystem. As for data access and usage, they were first implemented through the data platform's containers and reinforced with legal contracts, registration, and APIs on the developer portal. Data quality was implemented through an open approach to standardization. Although data quality is often considered the data provider's responsibility (Khatri and Brown, 2010; Nokkala et al., 2019), larger improvements can be achieved when there is feedback between data providers and users (Gelhaar, Both, and Otto, 2021).

Third, inspired by Henfridsson and Yoo (2014), and based on the analysis of the case, we inductively developed a model of gradual maturation for data sharing within the context of collaborative ecosystems. The process model is shown in Figure 2. Table 3 provides definitions of the different concepts included in the process model.

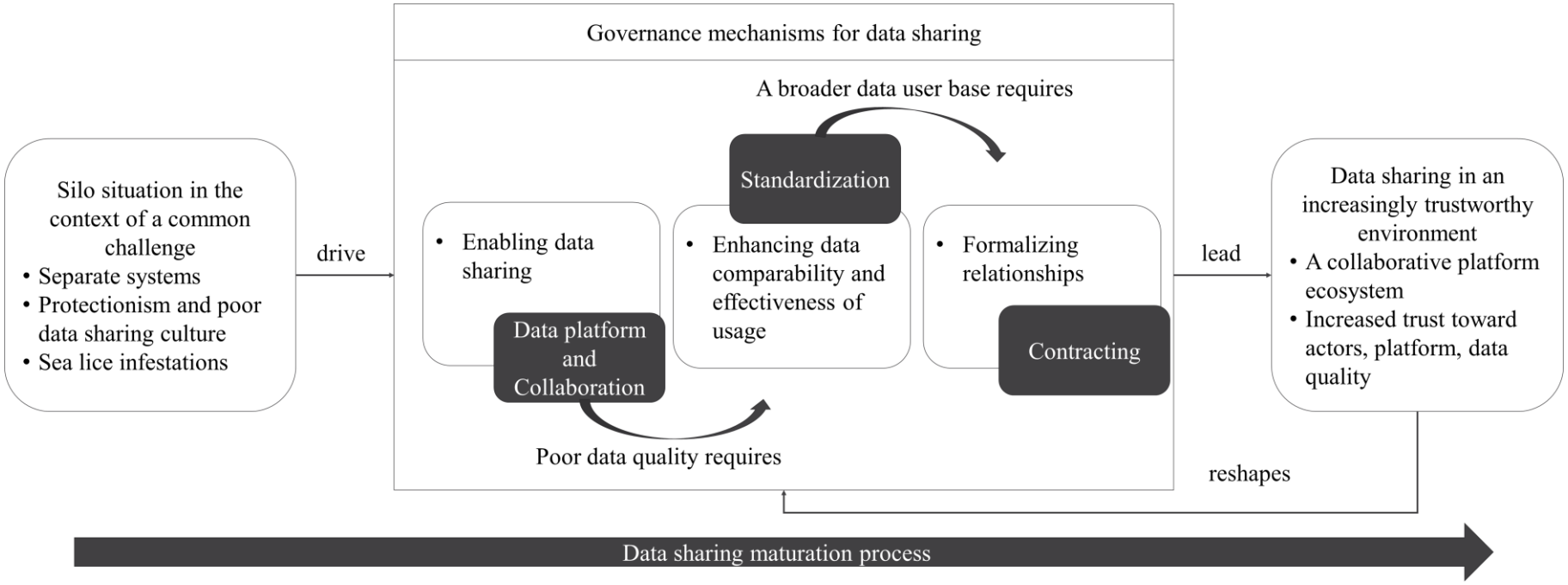

Figure 2. A process model for maturation of data sharing.

Table 3. Definitions of concepts included in the process model.

Concept	Definition
Silo situation in the context of a common challenge	A situation characterized by a poor culture or reluctance to share data with others, where companies protect their data in separate systems. A common challenge that is hard to tackle in isolation—such as sea lice infestations—can reverse the situation
Data platform and collaboration	A central digital infrastructure that facilitates data collection, storage, and use complemented by collaboration in terms of shared decision rights and ownership of a collaborative ecosystem. It enables data sharing in the first place
Standardization	The activity of establishing common solutions for technologies and practices to harmonize the relationships in collaborative platform ecosystems. It can increase data comparability and effective usage
Contracting	The activity of establishing contracts, guidelines, and rules to formalize relationships (e.g., actors' rights and obligations) in collaborative ecosystems
Data sharing in an increasingly trustworthy environment	A situation characterized by data sharing within a collaborative platform ecosystem, where trust is increasing with respect to other actors, the central platform, and the ecosystem's data quality
Maturation	The process of developing a collaborative attitude to sharing data by improving the way (i.e., governance mechanisms for data sharing) in which data sharing is handled

The proposed process model focuses on (a) the silo situation in the context of a common challenge that drives actors to take actions, (b) the definition of governance mechanisms that establish and sustain data sharing in a collaborative platform ecosystem, and (c) the outcome of such mechanisms.

Silo situation in the context of a common challenge. In cases where actors do not collaborate, are not ready, or are reluctant to share data, the poor performance of a silo situation in confronting a common challenge can lead to changes. Our research on AkvaEco showed that the current silo situation has reversed because of a common sustainability issue that cannot be solved in isolation. Farming companies recognized the need to share data from their cages to better handle the situation, thus taking the first steps to share data.

Governance mechanisms for data sharing. Several governance mechanisms lay the foundation for data sharing and move it forward. All do not need to be in place when launching a collaborative platform ecosystem, but they are all necessary for data sharing because they strengthen each other. The case shows that governance mechanisms can be developed in three phases. In the first phase, *Data platform and collaboration* lessen the skepticism around data sharing in the first place. A data platform that secures raw data in separate silos—accessible only to data owners—and offers aggregated or processed data among actors represents a viable method for addressing data ownership and confidentiality. At the same time, collaboration in terms of diffused decision rights regarding the data to be shared incentivizes data sharing (Abraham et al., 2019; Eckartz et al., 2014). In the second phase, *Standardization* aims at further dealing with ownership and security as well as improving data quality, thus increasing the effectiveness of data sharing. Standards ensure that the data representation, execution of data-related activities, and terminology used are consistent and harmonized within a platform ecosystem (DAMA International, 2009). Cooperating and agreeing on standards beyond the leading collaborative structure can be key in the development of ecosystems (Gelhaar and Otto, 2020). In fact, as this case shows, an open approach to standardization may increase interest in

the ecosystem, which, in turn, leads to a large base of data users. *Contracting* is the governance mechanism of the third phase, when data are shared with additional and more variegated user groups. Contracting aims to formalize the relationships because when an ecosystem deals with a larger number of actors, its complexity increases (Van den Broek and van de Veenstra, 2015). Contracts and baseline principles are two examples of contracting with which to restate ownership and decide who can access and use what type of data for what purpose.

Outcome. Successful governance mechanisms lead to a collaborative attitude toward data sharing. Moreover, they shape an increasingly trustworthy environment. Trust refers to actors' reliance on other actors' integrity and honesty. Trust also refers to actors' reliance on the platform and the technology used. Furthermore, trust can be put into the quality of the shared data.

The proposed model confirmed that sharing data is not a one-time decision, but a dynamic process that must be established and sustained through ongoing data governance (Abraham et al., 2019; DAMA International, 2009; Priego and Wareham, 2014). Moreover, the proposed model adds insight into the establishing process of data governance, which we still know little about (Abraham et al., 2019; Rupek, 2021). The model also provides insights into the establishment of trust in ecosystems (Gelhaar, Both, and Otto, 2021; Gelhaar, Gürpinar et al., 2021) through the design of an adequate technical infrastructure and the definition of standards, roles, and contracts. Our understanding of what trust entails and its importance for ecosystems align with previous works (Gelhaar, Both, and Otto, 2021; Gelhaar, Gürpinar et al., 2021; Hurni and Huber, 2014). Furthermore, as governance mechanisms for data sharing align with areas of interest of governance of an entire platform ecosystem, such as roles, control, and trust (Lee et al., 2017), we believe that through governance mechanisms for data sharing, it is possible to govern platform ecosystems based on data.

Fourth, by investigating a collaborative platform ecosystem in a traditional sector with a B2B/G focus, this study complements extant research, mainly focused on digital natives and B2C perspectives. This case shows that setting up governance mechanisms for data sharing in such contexts is a collective process. This finding aligns with the literature on collaborative governance (Ansell and Gash, 2018; Constantinides and Barrett, 2015), in which a bottom-up approach and the engagement of all interested actors are key. Thus, this study provides insight into how collaborative governance mechanisms can foster common goals while protecting the interests of the actors (Lee et al., 2017; Lis and Otto, 2020).

5.2. Implications for practice

This study's practical implications consist of two lessons learned. These lessons learned can assist the leading companies in a data-based ecosystem and data providers. Policymakers may also benefit from these lessons when improving a certain industry (e.g., making it cleaner) through data sharing.

5.2.1. Decide what to share, how to share, and with whom

Business data are not all equal, and this matters when they are shared (Dalhberg and Nokkala, 2019). Businesses can find it easier to share some types of data (e.g., related to invoices) than other types (e.g., internal process data; Dahlberg and Nokkala, 2019). Therefore, deciding between what and how to share, and with whom is key. These are collective decisions when multiple owners share data for a common goal. The case highlights the need to classify data along a continuum from private to restricted to open. In classifying data, their type, timeliness, and level of aggregation must be considered. Similar considerations are found in other contexts. In data collaboratives, Klievink et al. (2018) suggested that working with raw and real-time

data is more challenging than with processed data. Within scientific communities, Priego and Wareham (2020) proposed the mechanisms of time dilation (a sort of embargo period from the data generation time point to its publication) and modularity (embedded in an infrastructure with a hidden layer containing raw data, accessible only to data owners, and a public layer with data to share in an aggregated fashion). Some preliminary findings in the context of open data mention selectively revealing data based on dataset metrics (e.g., currentness) and decision criteria (e.g., competitiveness; Enders et al., 2020).

5.2.2. Defining governance mechanisms for data sharing is a dynamic process

Defining governance mechanisms for data sharing is an evolving process (Abraham et al., 2019). One does not have to have complete data governance in place from day one. However, governance is a broad concept (Lee et al., 2017; Schreieck et al., 2016; Simons, 1994), whose facets can be purposefully used to manage the different challenges (technological, organizational, and legal) that may arise when sharing data. The case suggests that a collaborative platform ecosystem employs governance mechanisms related to technologies, roles, structures, and processes to enable and sustain data sharing. In the early stage, governance mechanisms should satisfy conditions such as data ownership and data confidentiality to instill initial trust in sharing the data. Over time, other mechanisms can strengthen these basic conditions and address others, such as data quality. Data quality is often regarded as the data owner's responsibility (Khatri and Brown, 2010). However, in collaborative platform ecosystems, common standards (on technologies, business practices, and terminology) defined by all involved actors may better ensure data quality. When dealing with additional groups of actors, formalizing and securing the new relationships may be needed for proper data access and usage. Formalizing, mainly performed with contracts, may be implemented through APIs that allow access to the platform's datasets. Overall, there is a need to define flexible and adjustable governance mechanisms to fit the ecosystem's evolution and changing conditions.

6. Conclusions and limitations

This study investigated the governance mechanisms that enable and sustain data sharing within a collaborative platform ecosystem. Based on the analysis of the case, we identified three mechanisms that can be developed over time, but all must be in place for data sharing in such contexts. The study showed that data sharing in such contexts matures over time because of the strengthened governance mechanisms and increased trust. In addition, this collaborative case in a traditional industry complements extant research focused on centralized platforms launched by digital native companies. This study also offers two lessons learned for practitioners who want to foster data sharing in their collaborative ecosystems.

The study has limitations in that it focused on a single case in a specific industry. Therefore, additional longitudinal studies of collaborative platforms in other industries are needed. These studies could identify other governance mechanisms for data sharing and add to how these mechanisms are collectively defined. Different industries may define governance mechanisms differently. For instance, collaborative platform ecosystems in digital native industries may be more structured and focus at first on standardization, against the emergent and bottom-up approach that our case from a traditional industry displays. As there is no one-size-fits-all approach, investigating the impact of contextual factors (e.g., industry or size) on the definition of governance mechanisms for data sharing is relevant (Abraham et al., 2019; Al-Ruithe et al., 2019). In doing so, future research may also confirm or improve the suggested process model. Moreover, the external validity of this model may be evaluated against existing international

frameworks and standards. This case also touches on psychological aspects (e.g., trust and fear of losing control of data), which may be investigated more deeply in future research.

7. References

Abraham, R., Schneider, J., and Vom Brocke, J. (2019). "Data governance: A conceptual framework, structured review, and research agenda," *International Journal of Information Management* 49, *424-438.*

Al-Ruithe, M., Benkhelifa, E., and Hameed, K. (2019). "A systematic literature review of data governance and cloud data governance," *Personal and Ubiquitous Computing* 23 (5), 839-859.

Ansell, *C.* and Gash, A. (2008). "Collaborative governance in theory and practice," *Journal of Public Administration Research and Theory* 18 (4), 543-571.

Ansell, C. and Gash, A. (2018). "Collaborative platforms as a governance strategy," *Journal of Public Administration Research and Theory 28 (1), 16-32.*

Bazarhanova, A., Yli-Huumo, J., and Smolander, K. (2020). "From platform dominance to weakened ownership: How external regulation changed Finnish e-identification," *Electronic Markets 30 (3), 525-538.*

Becker, J., Knackstedt, R., and Pöppelbuß, J. (2009). "Developing maturity models for IT management," *Business & Information Systems Engineering* 1 (3), 213-222.

Benbasat, I., Goldstein, D. K., and Mead, M. (1987). "The case research strategy in studies of information systems," *MIS Quarterly* 11 (3), 369-386.

Benfeldt, O., Persson, J. S., and Madsen, S. (2020). "Data governance as a collective action problem," *Information Systems Frontiers* 22 (2), 299-313.

Bygstad, B., Munkvold, B. E., and Volkoff, O. (2016). "Identifying generative mechanisms through affordances: A framework for critical realist data analysis," *Journal of Information Technology* 31 (1), 83-96.

Claussen, J., Kretschmer, T., and Mayrhofer, P. (2013). "The effects of rewarding user engagement: The case of Facebook apps," *Information Systems Research* 24 (1), 186-*200.*

Constantinides*, P. and Barrett, M. (2015). "*Information infrastructure development and governance as collective action," *Information Systems Research* 26 (1), 40-56.

Costabile, C., Iden, J., and Bygstad, B. (2022). "Building digital platform ecosystems through standardization: an institutional work approach," *Electronic Markets* 32, 1877-1889.

Dahlberg, T. and Nokkala, T. (2019). "Willingness to share supply chain data in an ecosystem governed platform-An interview study," in: Pucihar, A., Borštnar, M. K., Bons, R., Seitz, J., Cripps, H., & Vidmar, D. (eds.) *Bled eConference*, Bled, Slovenia.

DAMA International (2009). *The DAMA guide to the data management body of knowledge (DAMA-DMBOK guide)*. Bradley Beach: Technics Publications, LLC.

de Prieëlle, F., De Reuver, M., and Rezaei, J. (2020). "The role of ecosystem data governance in adoption of data platforms by Internet-of-Things data providers: Case of Dutch horticulture industry," *IEEE Transactions on Engineering Management 69 (4), 1-11.*

de Reuver, M., Sørensen, C., and Basole, R. C. (2018). "The digital platform: A research agenda," *Journal of Information Technology* 33 (2), 124-135.

Eckartz, S. M., Hofman, W. J., and Veenstra, A. F. V. (2014). "A decision model for data sharing," in: Janssen, M., Axelsson, K., Glassey, O., Klievink, B., Krimmer, R., Lindgren, I., Parycek, P., Scholl, H. J., & Trutnev, D. (eds.) *International Conference on Electronic Government*, Dublin, Ireland.

Enders, T. (2018). "Exploring the value of data–A research agenda," in: Satzger, G., Patrício, L., Zaki, M., Kühl, N., & Hottum, P. (eds) *Exploring service science. IESS 2018. Lecture Notes in Business Information Processing*, Volume 331. Springer, Cham.

Enders, T., Wolff, C., and Satzger, G. (2020). "Knowing what to share: Selective revealing in open data," in: Rowe, F., Amrani, R. E., Limayem, M., Newell S., Pouloudi, N., van Heck, E., & Quammah, A. E. (eds.) *European Conference on Information Systems*, Marrakesh, Morocco.

Gawer, A. (2014). "Bridging differing perspectives on technological platforms: Toward an integrative framework," *Research Policy* 43 (7), 1239-1249.

Gawer, A. and Cusumano, M. A. (2014). "Industry platforms and ecosystem innovation," *Journal of Product Innovation Management* 31 (3), 417-433.

Gelhaar, J., Gürpinar, T., Henke, M., and Otto, B. (2021). "Towards a taxonomy of incentive mechanisms for data sharing in data ecosystems," in: Vogel, D., Shen, K. N., Ling, P. S., Ravishankar, M. N., & Zhang, J. X. (eds.) *Pacific Asia Conference on Information Systems*, Dubai, UAE.

Gelhaar, J., Both, J., and Otto, B. (2021). "Requirements for incentive mechanisms in industrial data ecosystems," in: *Proceedings of Second Conference on Production Systems and Logistics*, Hannover, Germany.

Gelhaar, J. and Otto, B. (2020). "Challenges in the emergence of data ecosystems," in: Vogel, D., Shen, K. N., Ling, P. S., Hsu, C. W., Thong, J. Y., L., de Marco, M., Limayem, M., & Xu, S. X. (eds.) *Pacific Asia Conference on Information Systems*, Dubai, UAE.

Ghazawneh, A., and Henfridsson, O. (2013). "Balancing platform control and external contribution in third-party development: the boundary resources model," *Information systems journal* 23 (2), 173-192.

Gholami, R., Watson, R. T., Hasan, H., Molla, A., and Bjorn-Andersen, N. (2016). "Information systems solutions for environmental sustainability: How can we do more?," *Journal of the Association for Information Systems* 17 (8), 521-536.

Gulati, R., Puranam, P., and Tushman, M. (2012). "Meta-organization design: Rethinking design in interorganizational and community contexts," *Strategic Management Journal* 33 (6), 571-586.

Hanseth, O. and Lyytinen, K. (2010). "Design theory for dynamic complexity in information infrastructures: The case of building Internet," *Journal of Information Technology* 25 (1), 1-19.

Hein, A., Schreieck, M., Riasanow, T., Setzke, D. S., Wiesche, M., Böhm, M., and Krcmar, H. (2020). "Digital platform ecosystems," *Electronic Markets* 30 (1), 87-98.

Henfridsson, O., and Yoo, Y. (2014). "The liminality of trajectory shifts in institutional entrepreneurship," *Organization Science* 25 (3), 932-950.

Hurni, T. and Huber, T. (2014). "The interplay of power and trust in platform ecosystems of the enterprise application software industry," in: Avital, M., Leimeister, J. M., & Schultze, U. (eds.) *European Conference on Information Systems*, Tel Aviv, Israel.

Iden, J., Bygstad, B., Osmundsen, K. S., Costabile, C., and Øvrelid, E. (2021). "Digital platform ecosystem governance: Preliminary findings and research agenda," in: *Norsk IKT-konferanse for forskning og utdanning* (No. 2).

Innovation News Network (2022). *The road ahead to a sustainable aquaculture industry in Norway*. URL: https://www.innovationnewsnetwork.com/the-road-ahead-to-a-sustainable-aquaculture-industry-in-norway/24698/ (visited on October 17, 2022).

Institute of Marine Research (2020). Topic: Sea lice. URL: https://www.hi.no/en/hi/temasider/species/sea-lice/ (visited on October 17, 2022).

Jacobides, M. G., Cennamo, C., and Gawer, A. (2018). "Towards a theory of ecosystems," *Strategic Management Journal* 39 (8), 2255-2276.

Jagals, M. and Karger, E. (2021). "Inter-organizational data governance: A literature review," in: *Proceedings of Twenty-Ninth European Conference on Information Systems*, Marrakesh, Morocco.

Janssen, M., Brous, P., Estevez, E., Barbosa, L. S., and Janowski, T. (2020). "Data governance: Organizing data for trustworthy artificial intelligence," *Government Information Quarterly* 37 (3), 1-8.

Khatri, V. and Brown, C. V. (2010). "Designing data governance," *Communications of the ACM* 53 (1), 148-152.

Klievink, B., Van Der Voort, H., and Veeneman, W. (2018). "Creating value through data collaboratives," *Information Polity* 23 (4), 379-397.

Langley, A. (1999). "Strategies for theorizing from process data," *Academy of Management Review* 24 (4), 691-710.

Lee, S. U., Zhu, L., and Jeffery, R. (2017). "Data governance for platform ecosystems: Critical factors and the state of practice," in: Alias, R. A., Ling, P. S., Bahri, S., Finnegan, P., & Sia, C. (eds.) *Pacific Asia Conference on Information Systems*, Langkawi, Malaysia.

Lis, D. and Otto, B. (2020). "Data governance in data ecosystems–Insights from organizations," in: Anderson, B. B., Thatcher, J., Meservy, R. D., Chudoba, K., Fadel, K. J., & Brown, S. (eds.) *Americas Conference on Information Systems*, Virtual Conference.

Marshall, M. N. (1996). "Sampling for qualitative research," *Family Practice*, *13*(6), 522-526.

Ministry of Industry and Fisheries (2021). *Et hav of muligheter - regjeringens havbruksstragei* [A sea of possibilities - the government's aquaculture strategy]. URL: https://www.regjeringen.no/contentassets/e430ad7a314e4039a90829fcd84c012a/no/pdfs/et-hav-av-muligheter.pdf (visited on March 6, 2023).

Nokkala, T., Salmela, H., and Toivonen, J. (2019). "Data governance in digital platforms," in: *Proceedings of Twenty-Fifth Americas Conference on Information Systems*, Cancun, Mexico.

Norwegian Seafood Council (2022). *Record high Norwegian seafood exports in 2021*. URL: https://en.seafood.no/news-and-media/news-archive/record-high-norwegian-seafood-exports-in-2021/#:~:text=A%20strong%20year%20for%20aquaculture&text=The%20export%20value%20derived%20from,compared%20with%20the%20previous%20year (visited on October 17, 2022).

Norwegian Veterinary Institute (2021). *Norwegian fish health report*. URL: https://www.vetinst.no/rapporter-og-publikasjoner/rapporter/2022/fish-health-report-2021 (visited on October 5, 2022).

Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge: Cambridge University Press.

Otto, B. and Jarke, M. (2019). "Designing a multi-sided data platform: Findings from the International Data Spaces case," *Electronic Markets* 29 (4), 561-580.

Priego, L. P. and Wareham, J. (2020). "The stickiness of scientific data," in: George, J. F., Paul, S., De', R., Karahanna, E., Sarker, S., & Oestreicher-Singer, G. (eds.) *International Conference on Information Systems*, Virtual Conference, India.

Rupek, T. (2021). "Establishing governance structures for analytics-driven interorganizational data sharing networks-Designing a framework based on a qualitative study," *LWDA* 2993, 242-257.

Schreieck, M., Wiesche, M., and Krcmar, H. (2016). "Design and governance of platform ecosystems–Key concepts and issues for future research," in: *Proceedings of Twenty-Fourth European Conference on Information Systems*, İstanbul, Turkey.

Simons, R. (1994). "How new top managers use control systems as levers of strategic renewal," *Strategic Management Journal* 15 (3), 169-189.

Steuperaert, D., Huygh, T., De Haes, S., and Poels, G. (2021). "Exploring the dimensions and attributes of a maturity model for it governance organizational structures," in: *Proceedings of Fifty-Fourth Hawaii International Conference on System Sciences*, Kauai, Hawaii, USA.

Van den Broek, T. and van Veenstra, A. F. (2015). "Modes of governance in inter-organizational data collaborations," in: Becker, J., vom Brocke, J., & de Marco, M. (eds.) *European Conference on Information Systems*, Münster, Germany.

Weber, K., Otto, B., and Österle, H. (2009). "One size does not fit all—A contingency approach to data governance," *Journal of Data and Information Quality* 1 (1), 1-27.

Weill, P. and Ross, J. W. (2004). *IT governance on one page*. SSRN Scholarly Paper No. ID 664612, Social Science Research Network.

Weill, P., and Ross, J. (2005). "A matrixed approach to designing IT governance," *MIT Sloan Management Review* 46 (2), 26-34.

Yin, R. (1994). *Case study research: Design and methods*. Beverly Hills: Sage Publishing.

Zeiringer, J. P. (2021). "Tackling knowledge risks in data-centric collaborations: A literature review," in: Vogel, D., Shen, K. N., Ling, P. S., Ravishankar, M. N., & Zhang, J. X. (eds.) *Pacific Asia Conference on Information Systems*, Dubai, UAE.