Positioning Strategies in Emerging Industrial Ecosystems for Industry 4.0: A Longitudinal Study of Platform Emergence in the Agricultural Industry

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Abstract

Many incumbents have the ambition to become ecosystem leaders when transitioning to platform business models. While most prior research has studied established consumer markets, our study extends the empirical knowledge on ecosystem dynamics with a focus on platform around industrial data. In a longitudinal study, we investigate factors influencing this transition and study in particular how industrial incumbents balance value creation and capture during ecosystem emergence. In this stage, managing openness is a key strategic decision. While openness is required for value creation, the complexity and physicality of the industrial setting hampers value capture. We identify control points to manage the tension between value creation & capture and derive different transition journeys. Lastly, we propose that in industrial markets, multiple platforms can co-exist in the same ecosystem, complementing the established "winner-takes-all" paradigm. Our research identifies situations where incumbents intentionally forfeit a leadership position in favor of joining an alliance-driven ecosystem.

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1. Introduction

Platforms connect multiple sides to enable transactions or foster innovation [1, 27]. Platforms can be considered the technological architecture [46]. Based on this architecture, firms develop platform-based business models (BM)[1]. For that, they need to coordinate the network of producers and consumers [47]. Together, they build an ecosystem consisting of a central platform with multiple peripheral firms connected to it [27]. Following the dominant view in the literature, platform-based BMs are orchestrated by a central (keystone) player profiting from abnormal returns due to network effects [1, 26]. The value of the platform increases for users with the number of other users (direct network effects) [9, 32], or with a greater variety of complementary products or services (indirect network effects) [39, 42]. As a result, winner-take-all (WTA) situations arise, when the market tips towards a dominant platform [17, 43]. In WTA markets, the orchestrator of the dominant platform captures the biggest share of value [52]. Consequently, firms changing towards a platform-based BMs usually have the ambition to become the keystone player.

The motivation of our paper is to shed light into the emergence of new platform-based BMs in industrial (BtoB) settings. Prior studies conceptualize the role of a platform leader (also referred to as sponsor, keystone player, or hub; e.g., [11, 26]), who governs ecosystem alignment and usually captures most value. However, at this stage, neither the roles of the diverse actors nor the leadership position are clear [12]. Instead, the overall value proposition needs to be jointly created by the participants of the young ecosystem. This requires close coordination and alignment between the actors [12] – a sharp contrast to the later stage of a mature ecosystem, when one actor often leads the ecosystem by its dominating platform. Hence, analyzing the interdependencies and relationships between the actors provides insights into the value creation process [5, 30]. These relationships are characterized by either cooperation or competition [23]. Thus, the starting stage of a new ecosystem creates a sensitive moment of

[1] A business model (BM) describes the logic of how an organization creates, offers, and captures value regarding their customers, suppliers, and partners [8].

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critically shaping intentions and behavior of a diverse set of actors.

During this stage, incumbents in the industry try to transition from a traditional BM, often referred to as a pipe(line) BM by creating value through controlled activities along a classic value chain, to a platform-based BM [47]. For this, multiple potential ecosystem designs exist which affect competition and opportunities to capture value. Earlier literature suggests that (different degrees of) openness is the critical design element creating momentum at this stage [11, 48]. Following Eisenmann *et al.* [16], openness can be defined as the (lack of) "restrictions […] placed on participation in development, commercialization, and use". More broadly, openness refers to reducing or eliminating access restrictions, for instance from proprietary control over interfaces between the platform modules. Openness can spur platform adoption by users and complementors by fostering network effects [16], enabling new value propositions [27]. Openness in general supports value creation (and, hence, is increasing platform value) by actively allowing the integration of innovations from third-party complementors [6, 19]. Connecting with complementors by providing access to a firm's own resources drives the dynamics of ecosystem evolvement. The underlying open interfaces further fuel the competitive dynamic in the ecosystem, as they are also potential entry points for competitors [4]. Ecosystem dynamics might even lead to a convergence of markets with blurred industry boundaries [9]. In such a situation, a previously dominating actor may lose its ability to capture value. Taken together, establishing a platform in an evolving ecosystem leads to a tension between value creation and capture [48].

The objective of this paper is to study these tensions empirically. We use the context of industrial platform-based BMs for Industry 4.0,[2] without doubt a main competitive driver of our global economy [41]. Such an industrial ecosystem consists of layers of connected physical machines, communication networks, data spaces, and digital services constituting around an emergent new industrial platform [37, 40]. Here, formerly isolated companies connect via standardized interfaces and autonomous data exchange [41]. The value propositions enabled by these Industry 4.0 platforms, such as predictive maintenance or performance-based pricing, rely on some degrees of openness, as they require the integration of third-party contributors and data sharing with and among them [38, 50]. These new entrants, however, often redefine the competitive boundaries of the ecosystem and change the logic of value creation and capture, e.g., shift competition from selling physical assets towards offering data-driven services [3].

Prior studies in this context have focused on mature platforms in digital consumer markets (e.g. [31]). However, gaining a better understanding of these dynamics is especially insightful in industrial markets with high fixed-cost, where openness has a potentially high impact [3]. Yet, when studying industrial platforms and related ecosystems, the openness decision is less simple. First, these ecosystems are characterized by complex technological setups and legacy structures. The layered architecture of hardware, networks, services, and content increases the interfaces that can be opened [50]. This may support value creation but increases openness risks from (fuzzy) ecosystem interdependencies. In addition, ecosystem members operate in legacy structures, i.e. they have existing relationships and value chains which limits the decision space with regards to openness [45]. At the same time, new entrants change the existing industry architecture, potentially shifting competition to other layers and preventing the platform orchestrator from capturing value.

Second, both the development and distribution of physical machines require high investment costs. This is in stark contrast to digital platforms, like Android, which have nearly zero marginal costs for distribution. The limited global scalability of asset-heavy machines makes local clustering of network structures more likely. This in turn reduces the (global) strength of network effects [52], increasing the challenge to capture value from openness.

In this context, Dattée *et al.* [12] identified installing control points as an approach to facilitate cooperative ecosystem development while benefiting from it at the same time. Control points, also referred to as bottlenecks [4, 23], represent technical or strategic solutions to issues constraining value creation. Occupying a control point enables value capture and mitigates risks resulting from openness. In ecosystems, interfaces at module boundaries usually serve as bottlenecks [2]. To manage the relevant bottlenecks, firms can employ technical or strategic control points. Technical control points comprise technical solutions enabling or restricting access, but also legal measures such as property rights [4]. Strategic control points refer to institutional and sociological control. These intangible control points include customer access, networking ability, or branding [46].

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[2] Industry 4.0 is a commonly used label to describe the technological revolution reshaping manufacturing industries enabled by cyber-physical systems, which integrate smart devices with sensing, communication, network and autonomous acting capabilities. For a recent review, see, for instance, [41].

We study an emerging platform ecosystem in the agriculture industry, a sector where digitalization and the emergence of platforms has rather progressed [40]. To deliver the full potential to the farmer, data inputs from all stakeholders in the ecosystem are required. Ecosystem actors are currently striving to position themselves in that emerging ecosystem.

This illustrates our central research question: *How can (established) firms manage openness to design a platform that enables them to position them competitively in an emerging ecosystem?* We analyze subsequent ecosystem outcomes through the lens of the interplay between value creation and capture. For our analysis, we follow an incumbent manufacturer transitioning towards a platform-based BM, with the ambition to become the leader of the evolving ecosystem by orchestrating its dominant Industry 4.0 platform. To investigate the dynamic processes of opening and understanding the associated interdependencies, we build on extensive qualitative research [14] in the focal company, complemented by research on other relevant actors in its ecosystem like customers, suppliers, complementors, competitors, dealers, or new entrants. In total, we analyzed more than 113,000 words resulting from more than 100 hours of interviews and workshop observations. Additionally, we draw on extensive secondary data.

Our study contributes to the emerging field of platform-based BMs in industrial markets. First, we highlight the role of openness as a means for ecosystem alignment in emerging settings. However, we reveal associated risks of losing value capture. Second, we identify strategic and technical control points as a way to mitigate those risks. Third, we conceptualize a transition path of managing value creation and capture. Fourth, we propose a new type of market equilibrium – other than a pure WTA position – where incumbents intentionally forfeit a leadership position in favor of multiple co-existing platforms ("paradox of platform play"). From our case analysis, we develop propositions for theory development. Lastly, we extend the state of empirical research with an in-depth study of an industrial setting.

2. Research method

2.1. Case overview

We selected a leading European agricultural machinery company (AgCo). AgCo is a traditional manufacturing company of farming equipment (tractors, harvesters, balers, tillage equipment, etc.). While machines are still the main revenue driver for AgCo and the company is positioned upstream with only indirect customer access, it started a farm management platform in 2014, striving to become an "operating system for farmers". On the platform, all data from a farm (field, plant, but also machinery and crop protection) is integrated with other data streams (weather, crop prices, demand forecasts) to provide dedicated digital services by AgCo, but especially to spur innovation by integrating third-party complementors and facilitating interactions between farmers and complementors. In 2019, AgCo's platform was able to attract 40 third-party complementors, had 50,000 registered users of which 20% where paying users. Given an installed base of 30,000 machines with one customer typically owning more than one machine, the number of platform users exceeded the customer base of AgCo's traditional business. In addition, AgCo's own digital services, a major source of user growth for the platform, showed significant success. 8,500 machines out of the 30,000 were connected in 2019, with 4,500 new service contracts signed in the last 12 months alone. More than 80% of equipment buyers chose also the connected service offerings. Yet, the ecosystem around AgCo's farm management platform remained fragmented. The overall agricultural industry is still in a transformation phase, there is neither clear vision of all future roles of the ecosystem members, nor are governance rules and ecosystem standards established yet. In fact, most competitors of AgCo and several other ecosystem actors (like crop protection companies) offered similar platform offerings.

2.2. Data collection and analysis

We planned and executed our case study following the suggestions for rigorous case study research by Yin [49] and Gioia *et al.* [21]: a defined protocol for gathering data, data collection, and data analysis, respectively. Data collection took place in two phases: First, we focused on AgCo and its direct stakeholders. We then studied the larger ecosystem.

Our first phase of research focused on the understanding of AgCo's BM transition. We relied on extensive primary and secondary data. We conducted semi-structured interviews with 17 managers of AgCo, representing all relevant departments and areas, including the sales director, service director, management board, and product management. In addition, we interviewed 25 farmers, four contractors, and three dealers to capture the direct ecosystem. Interviews were semi-structured and adapted over the course of data collection. The interview guide was organized around the agricultural value chain with special focus on interorganizational cooperation and openness. AgCo also allowed us to participate in several strategy workshops. Further, we got access to extensive internal data and documents, including detailed numbers of connected machines, digital service usage, customer satisfaction and acceptance, internal strategy concepts, and annual reports. First discussions with AgCo started in 2014 when it launched its platform. Our data allowed us to follow a triangulation approach [18]. By combining primary with secondary data, we could relate observations and interview insights to the economic reality of the focal company based on the documents, thereby validating the plausibility.

During the second phase, we expanded our focus of the ecosystem. This dyadic design is especially suited when exploring complex relations [10, 36]. It also helps to mitigate bias by using multiple independent informants [13]. We conducted interviews with platform complementors, e.g. a manager from a leading crop protection company, with ecosystem members not yet part of the platform, including another digital platform startup, or a wholesaler. We also participated in a workshop with multiple digital startups in the agricultural space. Further, we had access to internal strategy documents and user surveys from a direct competitor of AgCo.

Our data analysis combines deductive and inductive approaches [21]. First, we observe AgCo's transitioning using axial coding [44] to link openness decisions with

associated ecosystem interdependencies. The inductive approach was carried out using open and in-vivo coding. We focused on informants' interpretations on the factors influencing the ecosystem change, company strategy, and associated interdependencies [20]. Following the research guidelines, this part was kept descriptive [24]. Second, we inductively identified strategies used by ecosystem members to manage the transition, value creation, and value capture. We mapped AgCo's key activities with the decisions to install certain control points over time (refer to Figure 1). Data analysis was done in an iterative process. To ensure validity and reliability, we triangulated our analyses with secondary data sources. We discussed our findings with selected informants to further detail our interpretations. All interviews and workshop observations were transcribed. We used both analogue and digital coding via Atlas.ti. To validate our coding further, we discussed differences in our outcomes and modified the coding after each step accordingly in a group of five researchers. We summarized our data structure according to Gioia *et al*. [21] in Fig. 1.

3. Results

Our data allowed us to analyze how AgCo manages the transition from pipeline to platform by strategically opening selected resources to other actors in the ecosystem. By following an openness strategy, AgCo is able to create value, but has to manage the associated risks of openness and ecosystem interdependencies. Installing own control points, and also recognizing control points of other ecosystem actor as being relevant for the own business, enabled AgCo to create and capture value. Inductively, we found that AgCo applied two categories of control points and identified practices for managing the anticipated value creation and capture (Fig. 1). We found that different protection mechanisms are required, depending on the layer of the closed

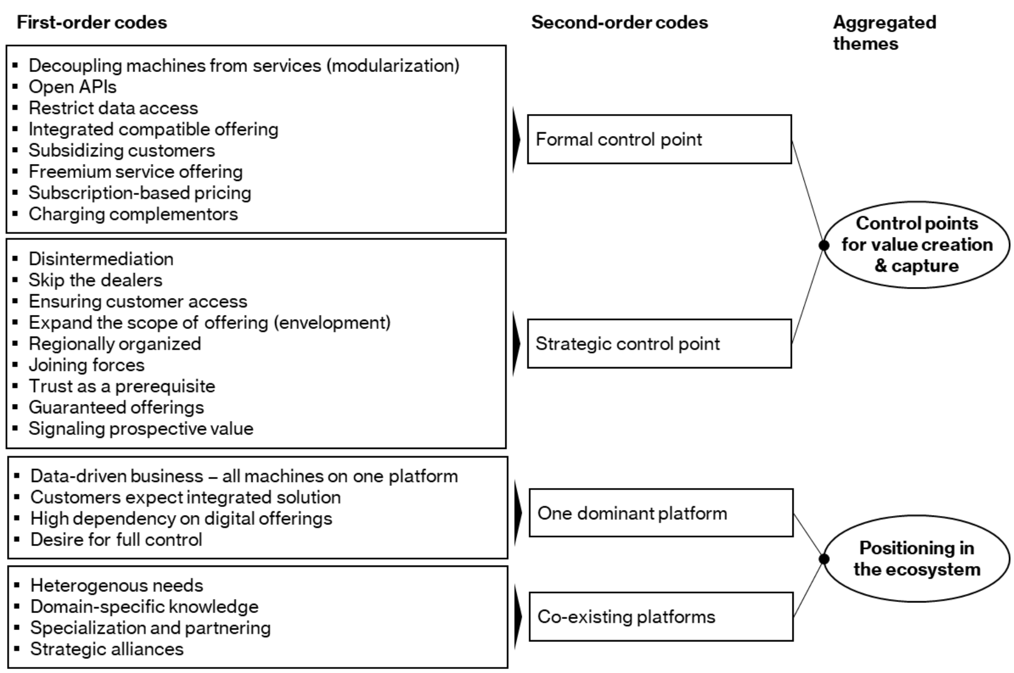

Figure 1. Data structure

resource. In traditional markets where proprietary resources determine competitive advantage, technical or formal protection mechanisms are used [4]. In platform ecosystems, the resource is most likely an interface, either on the machine, data, or service layer. For instance, the machine layer can be protected using technical solutions to control access. While technical control mechanisms are considered “strong” mechanisms, customers are already trying to circumvent this: “Thanks to these boxes, the software I use is brand agnostic. I can attach a dongle to any machine, I give it a name and the box knows which machine it’s connected to. No need for any extra software.” [Farmer] In contrast, the data and services layer are weakly appropriable, i.e. it is much more difficult to protect them using technical mechanisms. Therefore, strategic control points are required, like creating customer lock-in using network effects or establishing a powerful brand reputation.

In the case of AgCo, we identified ten control points. AgCo started with a pipeline BM selling machines and offering traditional after-sales services via dealers. In a way, AgCo’s machines could be considered a "hardware app" for other platforms, for instance for pioneering farmers who integrated their machinery into user-developed open source software systems to optimize their farms. While AgCo strived to transition from pipeline to platform, other competitors deliberately chose to position themselves as quality leaders in hardware. For instance, we could observe a premium German tractor manufacturer following this strategy, indicated as Appification (a) in Fig. 2 and 3. AgCo recognized this control point of its central competitor and enabled the other manufacturer to integrate its hardware as an “app” to AgCo’s platform. Instead of trying to protect the data and service layer, this strategy enhanced both complementarity and mobility in other parts of the value chain [28]. Thereby, especially innovation in complements is fostered.

To transition towards a platform BM, AgCo followed a modularization (b) approach. They placed this control point by decoupling hardware from services. AgCo started by offering its services for other manufacturers via a platform. This kind of modularization is the basis for ecosystem development by building network effects [27, 38]. By opening its services for other brands, the scale and scope of industrial data stored and processed on the platform increased. Machine learning algorithms as the foundation of digital services, such as predictive maintenance, benefit from these increasing amounts of data. Opening hence provided the potential to foster learning effects, similar to direct network effects [52]. The data basis made the platform more attractive for third-party developers offering adjacent services. “By joining AgCo’s platform, we can use more data to support the farmer even better in its decision-making.” [Digital manager, Crop protection company] Hence, indirect network effects could be observed. As a result, AgCo could attract 40 complementors and spur further innovation in complements developed for the platform.

At the same time, AgCo subsidized (c) its services for premium machines, thereby attracting customers and creating a lock-in. This control point enabled AgCo to finally convert more than 80% of the buyers of its machines into users of its digital services. Previously, this conversion rate was very low. The large number of (subsidized) users (machine buyers) later attracted also outside users (who did not have bought AgCo's hardware) and enabled new data-driven BMs. Subsidizing one resource to overcome chicken-and-egg issues is a commonly used strategies in consumer platform markets [7, 39], but was novel in the agro ecosystem of our case study. Here, it led to a functionally-specialized platform for farm documentation, co-existing among other platforms in the same ecosystem. Such a coexistence of two platforms in the same ecosystem (with no WTA position) challenges existing beliefs in platform theory [9, 39, 42].

In our analysis, we could identify several reasons typical for industrial BtoB markets why no dominant platform emerged at this point. First, specific regional and functional requirements demand differentiated platform offerings. As one dealer puts it: “What makes sense in Eastern Germany can already be totally wrong in Western Germany.” [Dealer] In different regions, the size of the farms, composition of soils, profitability of the produce, but also subsidies and regulations regarding documentation and use of crop protection differ. Platforms tailored to these specific needs are required, hampering their scalability. Further, agriculture deals with physical goods. The need to transport heavy and perishable goods limits the scalability of some services. “Most people forget we’re not talking about a little bit of tomato-mozzarella. We need to move tons of goods.” [VP, Platform startup] Hence, while some digital services benefit from large amounts of data, for instance predictive maintenance of machines or crop protection recommendations based on soil and weather data, services that are tied to the logistics of the physical output or that require physical access to machines have scaling restrictions – supporting the evolvement of parallel platforms in the same ecosystem.

Second, some stakeholders are convinced that different parts of the agricultural business require domain-specific knowledge, which cannot be provided by central platforms. “There is a platform which is good for documentation, one for resource allocation, and one for crop protection. It's not a one-size-fits-all approach." [Contractor] In fact, AgCo's platform focused on farm documentation while, for instance, its biggest competitor focused on machine optimization.

Third, the customers in industrial markets apparently have a much larger fear of dependency from one (machinery) company than consumers in a (digital) consumer industry. In a survey, almost 80 percent of all of AgCo's customers stated high dependency as the barrier of using digital tools. Our interviews with farmers reinforce this uncertainty: "I still want to be independent from AgCo. It would have huge power due to the data. […] Eventually, this would not provide more more uncertainty for farmers." [Farmer]

Consequently, the market moves from a pipeline model to multiple co-existing platforms. Still, the overall goal to establish one dominant platform was very much known to the actors in the ecosystem. "It is a data-driven business. For that, we need all machines on a platform. Everyone is currently trying to be the first to establish the dominant platform, no matter the cost." [Digital manager, Crop protection company]. A farm is a complex system consisting of many different types of hardware and other physical input factors, and farmers expect a platform to reflect this system. "Farmers are expecting me to provide them all the data. They want to understand exactly their production quality, quantity, what protein, nutritional elements I'm getting from the forage. One day, there will be one end-to-end solution spanning the entire value chain. For instance, one could report crop protection activities to the authorities automatically. Or a software connecting robotic milking with feeding equipment. All then feeding into the farmer's accounting." [Contractor]

Accordingly, AgCo wanted to expand its platform offering to gain more market share. In this stage of moving towards a more dominant position in the ecosystem, we observed practices to establish further control points. AgCo tried to influence users' expectation on its platform's growth by signaling (d) its superior quality [51] in ads and on trade fairs. Thereby, AgCo also increased its attractiveness for third-party innovators. In addition, AgCo's platform engaged in platform envelopment (e), as described by Eisenmann *et al.* [15], by leveraging its existing user base to expand from farm management and machine services to adjacent fields, such as crop protection recommendations. Subsequently, switching costs increased for users. "Usually, farms stick to their systems once adopted. A change is a risk, especially given the amount of data. This starts with the stored field boundaries and continues to AB lines and contour lines, which are necessary for the assisted steering systems. If we then need to re-measure 120 separate field cells, well good luck. The switching costs are just too high. Also considering acceptance by employees and the need for software training. I would only change the system if a new one provides significant advantages." [Farmer]

Lastly, AgCo built on the fact that WTA outcomes are especially salient if multi-homing costs (costs of affiliating with multiple platforms) are high [22, 34]. Hence, imposing multi-homing costs (f) increases the likelihood of tipping the market towards one platform. AgCo's platform applied a combination of freemium models and subscription-based pricing. Customers could select the services they wanted to use and pay a monthly fee depending on the size of the farm. If third-party services were selected, AgCo received a 30% revenue share, the complementor got 70%. As services were not a free complementary offering anymore, it was unlikely that users adopted multiple service platforms. At the time of our analysis, AgCo could already convert 20% of its active users to pay for additional services, counterbalancing its second control point of subsidizing. As a result the amount and variety of data collected on the platform increased, enabling stronger learning effects and creating self-reinforcing feedback loops of improved services.

Yet, AgCo's platform did not tip the market and remained one platform among several co-existing platforms in the same ecosystem. In addition to creating value, AgCo also needed control points to capture value, to mitigate risks of losing access, and to protect its proprietary resources. To ensure continued access to the open resource, we observed building architectural advantage (g) [28], in terms of managing the ecosystem's architecture to become its bottleneck [26]. This mainly relates to vertical or horizontal integration strategies. For instance, AgCo enabled a crop protection company to partially disintermediate its distribution network, thereby reducing the value chain complexity and establishing direct relationships. "One of our strategies is to digitize sales, thereby skipping the dealers." [Digital manger, Crop protection company] At the same time, AgCo gradually shifted from its approach of offering services via dealers to partially offering digital services directly to the user.

Horizontal strategies also include to establish alliances to orchestrate the platform – a clear difference to platforms in digital consumer markets where predominately one keystone player is the orchestrator [37]. Examples of such BtotB alliances include the "Industrial Data Space" consortium or the "Open Automotive Alliance". In the case of AgCo, the company entered a "machine data sharing alliance" with a few (competing) manufacturers. Another example in the industry were wholesalers of crop products, who usually cover certain regions while digital platforms span across these regions. In consequence, some wholesalers built an alliance to offer a nation-wide trading platform, while keeping their regional territories for trading the physical goods. "Agricultural wholesalers are regionally organized. However, some of the larger wholesalers start building their own platforms expanding their regional scope. Therefore, we joined forces with smaller wholesalers from other regions to build a platform." [Innovation manager, Wholesaler] Other horizontal strategies included acquisitions, e.g. crop protection companies buying seed companies [35], or massive investments in agro startups by incumbents [33]. Jointly, architectural advantage strategies secure data access which build the basis for further innovation.

To protect the proprietary resource, we further observed practices creating lock-in effects (h). To protect its machine interfaces, AgCo could block competing service providers by technical access restrictions. To protect the data and services layer, AgCo helped complementors to build a trustworthy brand by relying on AgCo's brand reputation. "Trust is a prerequisite – not only trust in the platform orchestrator, but also in the complementors." [Digital startup] In addition, AgCo's platform tried to create lock-in based on learning effects, as described before. "Due to machine learning, the service provider with the largest amount of data will win." [Digital startup] Hence, lock-in increased both the data base and attractiveness for third-party innovators.

In sum, we could map AgCo's BM transition in realizing its ambition to become a focal orchestrator in its ecosystem by managing openness through installing control points. Navigating these points can balance ecosystem innovation (value creation) with value capture and mitigate the risks associated with ecosystem interdependencies. Hence, finding the right configuration of these control points evolved from our analysis as the main lever to strategically position an incumbent in an evolving industrial ecosystem. To illustrate possible positions we derived from analyzing AgCo's journey and that of its ecosystem partners, we suggest the framework presented in Fig. 2 and 3 (the arrow in Fig 2 indicates AgCo's journey). The horizontal axis reflects the firm's value creation opportunity, i.e. its innovation path when transitioning from a pipe to platform BM. The vertical axis indicates the firm's value capture ability. Strategic and technical control points enable a firm to move within this space. Depending on the selected control point and its configuration, either value creation or capture is triggered.

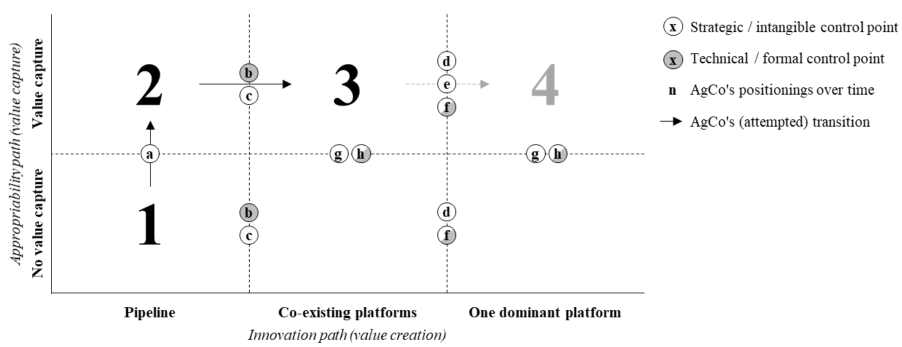

Figure 2. Control points in the industrial ecosystem framework

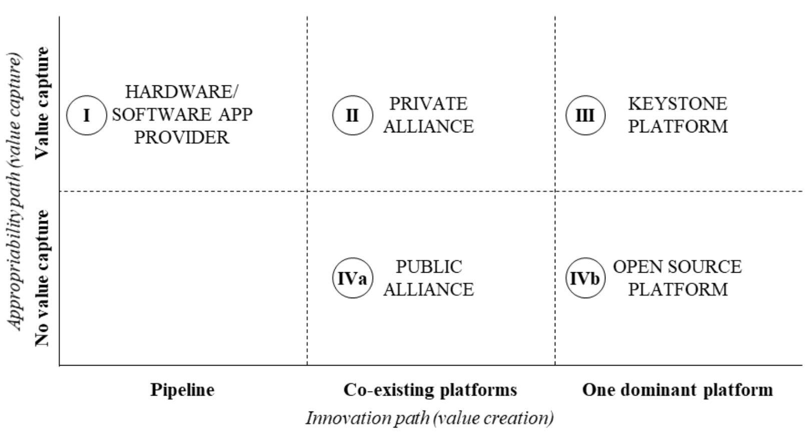

Figure 3. Positioning in the ecosystem

4. Discussion

4.1. Theoretical and practical implications

Our research has been motivated by the question how a company can find a competitive positioning in an emerging ecosystem by managing value creation and capture. In our analysis, we showed how the placement of control points helped AgCo to cope with ecosystem interdependencies and balance the openness tension. Overall, we contribute to the ecosystem literature with a differentiated view on the competitive dynamics in the case of a complex, layered industrial value constellation. Our findings allow us to propose general transition paths for firms when entering an evolving ecosystem (and innovating their BM). Based on our case analysis, we identified five potential positions with varying opportunities for value capture, as depicted in Fig. 3: (I) Hardware or Software App Provider; (II) Private Alliance; (III) Keystone Platform; (IVa) Public Alliance; and (IVb) Open Source Platform. Positions I, II, & III support value capture, while IVa & IVb hamper it.

Transitions towards these positions require movements along value creation (the ecosystem innovation path in our framework) and value capture (appropriability path). Along the ecosystem innovation path, established WTA scenarios expect actors to aspire a dominant platform position. However, for industrial ecosystems, we argue that market equilibria exist where multiple competing platforms surrounded by "app" providers (for hardware, software, or service complements) co-exist. These platforms can be orchestrated by a keystone player; however, we expect that often an alliance of several firms will be the orchestrator [37]. Incumbents in such an ecosystem will follow a differentiation strategy [34], offering functionally or regionally specialized solutions while integrating their offerings on the alliance-driven platform. The platform ecosystem then consists of different layers, similar to the modular architecture of industry platforms [19]. Jointly, the layers build a coherent industrial ecosystem covering the entire span of user needs. Competition primarily takes place on the level of each layer (e.g., among app providers) or between competing platforms (alliances) in the ecosystem. In addition, also multiple platform ecosystems can exist in one industry. This is especially salient in markets with high demand for differentiated features or local offerings [22]. Hence, a few well-known brands in each segment may dominate the segment, as opposed to a large number of complementors in a global ecosystem [9].

We call this the paradox of platform play, where incumbents intentionally forfeit ecosystem leadership. Due to technical complexity and the layered architecture, competition shifts from the ecosystem level to competition within layers. Alliances will try to establish local WTA outcomes for certain complements. Here, fair distribution of value between the alliance members is required to ensure collective health [26]. For this, integrative capabilities play a key role [25].

It is still open whether such an ecosystem constellation is an alternative to the common WTA assumption (and under which conditions), or whether it remains an intermediate step towards a mature ecosystem with one keystone player. When new entrants can leverage an existing customer base in adjacent markets or superior technological capabilities, they may seek to establish a keystone platform. The likelihood of this scenario increases if incumbents are unwilling to cooperate (wanting the WTA position themselves) or remain focused on their hardware business, hence staying in their established BM [40]. The latter position can become an interesting value proposition in an industrial ecosystem, as hardware with open machine interfaces allow their customers to connect to multiple platforms, making their machines also more attractive for third-party complementors (service providers). In turn, adoption of their hardware is supported, as more services are available. The manufacturer itself can use the increased amount of machine data to optimize its future product development [29], improving its position as quality leader. In summary, we propose that the dominant strategy for incumbents when transitioning towards platform-based BMs is an alliance-driven approach.

As described, an alliance-driven market equilibrium is prone to be attacked by new entrants, impacting the movement along the appropriability path. As a retaliation strategy, the focal company may completely open its platform, thereby commoditizing this layer in the entire ecosystem and destroying the ability to capture value for any actor [3]. Open platforms emerge, either managed by a public alliance or becoming entirely an open source platform. We expect this to happen when a firm’s openness strategy fails due to unwillingness of other incumbents to cooperate [3]. Hence, no platform ecosystem can be established. Also in cases when mistrust and fear of dependency make customers reluctant to adopt the incumbent’s platform, an open source platform can emerge [11]. Finally, regulators can demand an open platform when an initial platform orchestrator gained too much power due to network effects. Becoming an app provider then remains the only viable positioning for value capture. Consequently, we propose that openness will not only be used for coordination but also as a retaliation strategy in emerging ecosystems.

Given the rise of industrial platforms but the lack of empirical research, our findings are important for scholars and practitioners alike. We propose that identifying and installing adequate control points becomes an essential capability for firms to mitigate the tension between innovation (value creation) and subsequent value capture. Control points are even more important in emerging settings where the roles and rules for most actors are unclear [12]. We also complement van Alstyne *et al.* [47] who state the necessity to create platforms for long-term survival by showing how firms can manage their openness risks accordingly – and also can capture value from selecting the position of an "app" (complementor) with open interfaces. Our proposed propositions are intended for theory development.

4.2. Limitations and future research

Our longitudinal case study in one industry provided us rich, contextual data suitable to study a contemporary phenomenon with hard-to-measure constructs. However, this research method limits the generalizability of our findings. We explored the agricultural industry, which shares many characteristics of typical platform ecosystems in an industrial setting, such as asset heavy machinery and high fixed costs, supporting the generalizability of our propositions to other industrial contexts. Nevertheless, this industry is characterized by large regional differences, which could overemphasize some factors (e.g. regional network effects) or create idiosyncratic dynamics (e.g. subsidies in the EU).

In addition, while we incorporated data from all ecosystem stakeholders, our research lens was a focal machinery company. This may bias our perceived uncertainties due to particularities of this firm (focus on machines, being an incumbent). Future research could benefit from the use of multiple case studies in different industrial settings, cross-industry surveys, and archival data to test and validate our findings. Further, once such an ecosystem transition is completed, interdependencies between different phases of ecosystem development could be unveiled. Future research could study how to reduce risks arising from interdependencies between the phases.

As control points cannot be predicted a priori [23], future research needs to define strategies how companies can dynamically adapt their control points. A simulation study could provide interesting insights. Lastly, we could not cover the decision-making process on the individual level of management, understanding the perceptions, biases, and managerial sensemaking in an organization. This is also an important field for further research.

5. References

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