An evolutionary perspective on the dynamics of service platform ecosystems for the sharing economy

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An Evolutionary Perspective on the Dynamics of Service Platform Ecosystems for the Sharing Economy

Abstract

Drawing upon the literature on ecosystem ecology and socio-cultural evolution, the current study proposes an evolutionary framework for understanding the dynamics of service platform ecosystems. This evolutionary framework identifies three key components of the service platform ecosystem: (a) the diverse types of species, (b) the presence of both cooperative and competitive interactions within and among species, and (c) a common resource and environmental space. The evolutionary model of variation, selection, and retention is then introduced to explain how platform business models change over time. The article concludes with a discussion of directions for future research on the evolution of platform ecosystems in the sharing economy.

Keywords: services; ecosystems; evolution; networks.

An Evolutionary Perspective on the Dynamics of Service Platform Ecosystems for the Sharing Economy

1. Introduction

The emergence of the platform business model is transforming many industries globally. Platform businesses have gained widespread acceptance among customers and service providers in the sectors of transportation, housing, food, entertainment, and finance (Wirtz et al., 2019). Recent advances in new technologies have stimulated the rapid development and exponential growth of what has been described as the triadic business model (T-model) (see Andreassen et al., 2018; Kumar et al., 2018). In its basic form, such a platform-based business model aims at creating value by matching two or more groups of actors—usually buyers and suppliers of a product, service, or other resources (e.g., data)—and enabling interactions as well as transactions in a convenient way.

While there is a growing interest in the sharing economy (e.g., Benoit et al., 2017; Eckhardt et al., 2019; Wirtz et al., 2019), previous research has largely focused on examining the platform ecosystem (or its individual actors) through some cross-sectional snapshots rather than considering the ecological and evolutionary processes occurring within and between the actors that make up the ecosystem (McIntyre & Srinivisan, 2017). Platforms remain innovative largely because they constantly renew their business by managing the ecosystem composed of multiple actors whose dynamic collaboration contributes complementary resources to innovation processes over time (Andreassen et al., 2018). Platform actors interact with each other and form interdependent relationships within platform ecosystems (Kapoor et al., 2021). Against this backdrop, recent calls for more research on the multiple dynamic aspects of platform businesses have emerged, including dynamic winner-take-all battles (Eckhardt et al., 2019), dynamic pricing (Hagiu & Wright, 2020), dynamic resource allocation (Li, Shen, et al., 2021), the dynamic process of the bilateral review systems (Ke et al., 2017), as well as social dynamics between platform providers, users, and other stakeholders (Salminen et al., 2018).

To deepen our understanding of service platform ecosystems, we adopt an ecological and evolutionary perspective to examine the coevolution of actors within the platform ecosystem as well as how multilevel interactions within and among actors dynamically shape the ecosystem and industrial change. The evolving sharing platform business models are significantly changing ecosystems, markets, and consumption patterns (Wirtz et al., 2019; Zervas et al., 2017), particularly in the service and hospitality industry (So et al., 2020). We add to the growing line of research by illustrating the evolutionary dynamics of service platform ecosystems. Our framework may also apply to other platform industries in the sharing economy and serve as a basis for understanding their dynamic changes.

2. Service platform ecosystem: An evolutionary perspective

This study argues that the ecosystem ecology and evolutionary perspective provides a useful lens for understanding business changes in the sharing economy. The ecological and evolutionary tradition in social sciences can be traced back to Hawley's (1950) pioneering research on human ecology and Campbell's (1965) conceptualization of socio-cultural evolution, followed by Hannan and Freeman's (1977) population ecology of organizations and Nelson and Winter's (1982) evolutionary economics. This extensive body of work has demonstrated the utility of biological principles in studying the evolution of human social systems. However, this theoretical approach has rarely informed the literature on platform business models in the sharing economy.

The ecological and evolutionary perspective has three distinct features. First, it spans multiple levels of analysis (e.g., individuals, groups, organizations, organizational populations, and communities) and aggregation (e.g., micro- and macro-levels), thus capturing the nested and interdependent nature of social systems. Second, this perspective emphasizes the dynamic nature of social systems. In the present case, the service platform ecosystem has its own life cycle and can evolve through the stages of emergence, growth, maintenance, decline, and resurgence. Third, the perspective acknowledges that a simple application of the principles of biological evolution cannot fully explain the dynamics of social systems (Aldrich et al., 2008). Drawing on insights from social networks, complex adaptive systems, institutionalism, among others, the ecological and evolutionary approach in social sciences also considers the unique aspects of socio-cultural evolution that are inapplicable to biological evolution (Aldrich et al, 2008; Aldrich et al., 2020). For instance, animals cannot change their species, but actors in socio-cultural evolution can move from one species to another (e.g., the transformation of a customer into a driver on the Uber platform) or cross boundaries of species (e.g., prosumers of a digital platform). This flexibility in species affiliation recognizes the fluid nature of an actor's identity in the service platform ecosystem. Additionally, biological evolution in the Darwinian sense is largely driven by forces of natural selection and deemphasizes the importance of animal agency and adaptive learning. By contrast, socio-cultural evolution is typically guided by human entities to meet the requirements of external environmental conditions. This view acknowledges that the evolution of the service platform ecosystem is not simply determined by selection forces outside the control of actors.

An ecosystem, defined as a community of living organisms that interact with each other through cooperation and competition in the common resource environment (Moore, 1996), is a useful ecological metaphor to explain the evolution of the business world. The existing literature has developed three interrelated concepts: business ecosystem, service ecosystem, and platform ecosystem. Moore (1996) refers to a *business ecosystem* as "an economic community supported by a foundation of interacting organizations and individuals—the organisms of the business world" (p. 26). The birth, expansion, leadership, or self-renewal of a business ecosystem results from complex interdependence among the co-evolving member organisms (e.g., suppliers, partners, competitors, innovators, and customers). A company cannot achieve business success without simultaneously considering both cooperative and competitive strategies at different stages of ecosystem evolution. By extending the generalized business ecosystem to the specific service sector, Lusch and Vargo (2014) define a *service ecosystem* as "a relatively self-contained, self-adjusting system of resource-integrating actors that are connected by shared institutional logics and mutual value creation through service exchange" (p. 161). Guided by economic sociology and institutional economics, this framework highlights the importance of institutions in value co-creation (Vargo & Lusch, 2017). Another stream of research has treated a *platform ecosystem* as an innovation network and focused on the coevolution of platform providers, third-party developers and investors, and end-users of software and hardware platforms (Ceccagnoli et al., 2012).

Building on and complementing previous research on ecosystem ecology and socio-cultural evolution, this study proposes an evolutionary framework for understanding the dynamics of service platform ecosystems. We argue that the service platform ecosystem has three important and interrelated components: (a) the diverse types of species, (b) the presence of both cooperative and competitive interactions within and among species, and (c) a common resource and environmental space. Figure 1 presents a network of interacting species that share overlapping interests in a dynamic platform ecosystem.

--- Insert Figure 1 around here ---

2.1. Species in the service platform ecosystem

In this section, we focus on the sharing economy, characterized by platform-mediated, access-based (i.e., temporary access to resources; no transfer of ownership) sharing of under-utilized (e.g., empty bedrooms) and capacity-constrained resources (e.g., physical rooms, not online streaming services) with economic exchanges (Wirtz et al. 2019). In the sharing economy, service offerings are not provided by a single service provider or firm but are rather co-created by a myriad of different actors interacting with one another. In evolutionary terms, services are created by co-evolving species tied together by multiple relationships in an ecosystem.

As an example, a family (a platform customer) planned to order pizza on a food ordering platform. One popular restaurant (an incumbent) among local residents (non-platform customers) was not considered because it did not take orders from service platforms. The family selected another local restaurant (a service provider) from Yelp (a media outlet) and found that the restaurant was on Uber Eats (a focal platform's owner), but not on DoorDash or Grubhub (competing platforms). The chosen restaurant then prepared the order using ingredients provided by local farmers (complementors). The meal would be picked up and transported by a delivery driver (a facilitator) whose employee status was subject to change by legislative institutions (regulators). Uber Eats (the platform owner) would then take a portion of the revenue after the transaction was complete.

Figure 1 distinguishes between micro- and macro-level species. Micro-level species reside in the microenvironment: a focal platform's owner, customers, service providers, facilitators, and complementors. Macro-level species reside outside of the microenvironment but within the macroenvironment: competing platforms, non-platform customers, incumbents, media, and regulators. It is worth noting that the "competing platforms" label does not exclude potential cooperative interactions between platform providers, as evidenced by recent collaboration between Uber and Lyft on reduction in emissions, improvement in urban mobility, and self-driving and rideshare safety. Such initiatives create value for a variety of species in both micro and macro environments. In the following section, we examine micro-level species of a platform ecosystem in the sharing economy (see Table 1 for an overview of species).

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Platform owners mediate the interactions among species in local ecosystems and help participating species respond to uncertainty in the external environment. This species creates value for customers and service providers by lowering transaction costs for exchange (Rangaswamy et al., 2020). In the sharing economy, platform owners typically provide communication, payment systems, recommender systems, and other services, while matching a buyer with a provider of the core service (e.g., transportation in the case of Uber).

Platform customers (e.g., Airbnb guests) use platform services because incumbents (e.g., hotels) cannot satisfy diverse economic, convenience, social, hedonic, and environmental needs (Benoit et al., 2017). For example, some travelers prefer Airbnb to hotels due to the ability to have face-to-face interactions with local hosts. Existing platform customers may still choose incumbent hotels under certain conditions. For instance, Airbnb offerings do not always cater to business travelers.

Service providers (e.g., Lyft drivers and Airbnb hosts) share their own assets and provide customers with personalized services (Benoit et al., 2017). Service providers are driven by economic benefits, entrepreneurial freedom, and social motives (Benoit et al., 2017). They join a platform because they have an opportunity to earn extra income, offer flexible services, and meet other people.

Facilitators support core services in a platform ecosystem. Service providers do not always have direct contact with their customers. For example, a platform customer choosing a delivery option will interact with a restaurant (a service provider) indirectly through a food delivery driver (a facilitator). Facilitators become especially important because they have a direct impact on service experience.

Complementors also play an important role in a platform ecosystem. For instance, Uber bought the startup company deCarta for complementary mapping services (Parente et al., 2018). To enhance customer experience, Uber also works with external complementors such as software providers (Cusumano, 2017). Those who provide house cleaning services for Airbnb hosts can also be considered as complementors.

2.2. Cooperative and competitive service interactions

Species link to each other through cooperation and competition. In Figure 1, within-species interactions can be distinguished from cross-species interactions. A self-loop connects a species to itself, indicating the presence of cooperative and/or competitive interactions within the same species. For instance, Airbnb hosts in the same city compete for a limited number of guests during an off season. Drivers work together to urge Uber to grant employee benefits. A reciprocal line indicates cooperation and/or competition between different species. For instance, Uber and Lyft are direct competitors, but they have formed an alliance to lobby regulators to create an institutional environment conducive to peer-to-peer ridesharing. Uber and Lyft have threatened the survival of taxi companies. These incumbents favor strict regulation of ridesharing to protect their own livelihoods. To gain further insights into the dynamics of service platform ecosystems, the following sections discuss the interactions between the major micro-level species in Figure 1.

Platform-customer interactions. Platforms can work to develop interpersonal trust with their customers through direct or indirect interactions with them. By indirect we mean interactions in an environment that might, for example, protect personal information, such as an Airbnb host communicating with a guest through the Airbnb website, as opposed to texting each other directly. They earn the customers' loyalty by creating superior user experiences through better data and algorithms so that customers will go to them first. An important example outside of hospitality is Google search, where so many consumers start their searches for many products and services. Google thereby mediates the relationship between customers and providers (Malthouse et al., 2019). Platforms such as eBay have consumer trust that anonymous vendors would not have. Platform businesses, such as Airbnb and Uber, also foster interactions between customers that take place on their own platform. To build a credible trust mechanism that customers can reply on, platform businesses led the way by institutionalizing online review systems as central practices of interacting with their network, while financial services and other utilitarian service settings have lagged behind when it comes to sharing customer feedback or reviews in public (Fehrer et al. 2018). Such cooperation between customers and the platform helps the ecosystem build an online review system that offers a strategic advantage to multiple participating species. There has also been research on how user interfaces and recommender systems (RS) affect user trust (Pu & Chen 2007) and how to design RS to be robust to attacks that may reduce trust (Mobasher et al 2007).

Customer-service provider interactions. The core of the platform ecosystem is customer-service provider interactions. The possibility of interpersonal contact distinguishes between the major accommodation types (shared room vs. entire home) on Airbnb (Lutz & Newlands, 2018). To increase matching efficiency, hosts of shared rooms tend to strategically signal a preference for guests who are open to social interaction. By contrast, 'entire home' listings appeal to guests who expect a minimal element of sociality (Lutz & Newlands, 2018). Additionally, prior research has identified the level of a service provider's interpersonal skills during the post-purchase stage as an antecedent of customer loyalty in the sharing economy (Akhmedova et al., 2020). As an asymmetric form of communication, parasocial interaction also significantly drives consumer decision making. Specifically, the degree of perceived trustworthiness inferred from an Airbnb host's personal photo is positively related to both listing price and purchase probability (Ert et al., 2016).

An active area of research addresses how platforms match users and service providers. Users are typically matched to providers with a RS. Traditional RS focuses on recommending items for which the user will have high utility (or preference), but in multi-stakeholder situations there are additional considerations. Sürer et al. (2018) modify RS to include "provider constraints" stipulating that platforms should recommend each service provider at least some minimum number of times, while also maximizing user utility. Abdollahpouri et al. (2019) discuss fairness-aware RS that considers both providers and facilitators. Patro et al. (2020) propose the FairRec algorithm for achieving two-sided fairness on platforms. Abdollahpouri et al. (2020) survey the multi-stakeholder/objective literature and identify future research topics.

Incumbent-platform interactions. Incumbents (e.g., taxis) are traditional businesses that offer products and services that are increasingly in competition with platform businesses (e.g., Airbnb, Uber, and BlaBlaCar). The entry of platform businesses to the market has posed significant threats to the survival of incumbents (Abrate & Viglia, 2019). In response to competitive interactions with the new entrants, incumbents have implemented a variety of strategies including "modifying their business models to focus on segments platforms cannot serve well (e.g., business travelers who need a range of value-add services) and adopting features of platforms (e.g., launching a booking app), to launching competing platforms (often one-sided platforms), and acquiring and integrating peer-to-peer platforms (e.g., AccorHotels' acquisition of onefinestay)" (Wirtz et al., 2019, p. 465). Over time, incumbent-platform interactions have resulted in both niche separation in the service market and the diffusion of one-sided and/or peer-to-peer platforms among incumbents. The institutionalization of digital platforms does not necessarily mean that incumbents utilize the new organizational form in the same ways as platform businesses do.

Platform-service provider interactions. The relationship between a platform and a service provider on a sharing platform is different from the one between an incumbent and its employees. Platforms need to educate and train service providers to ensure consistent customer experiences and standards of service quality. Although platforms can motivate service providers to improve their skills and expertise, it is still difficult to navigate due to the nature of informal employment relationships. Service providers such as Uber drivers have expressed dissatisfaction because of inadequate compensation and the lack of non-wage benefits. Researchers have argued that platforms should address the dissatisfaction by offering a performance-based compensation system, a direct communication channel, and an insurance package (Kumar et al., 2018). For a long time, Uber drivers have not been entitled to regular employee benefits. This has resulted in ongoing court battles and prompted government actions to further regulate economic activities born in this business model. In March 2021, the company announced that it would reclassify its U.K. drivers as "workers" and grant them a minimum wage, vacation pay, and pension contributions based on the decision of the U.K. Supreme Court (Schechner & Olson, 2021).

For the ecosystem to become more efficient, it is essential for the platform to offer physical or virtual touch points for actor engagement (Brodie et al., 2019) and operational guidelines for platform governance (e.g., information included on listings, service recovery, ratings/reviews, account deactivation, privacy and data security, etc., see also Witrz et al., 2019). For instance, Airbnb (2020) launched a new set of hosting tools and resources (e.g., the Opportunities tab and the Resource Center) to help service providers to maximize their likelihood of success. Recent research has also provided guidance for increasing the number of quality interactions while reducing transaction costs (Rangaswamy et al., 2020).

2.3. Dynamic institutional and resource environment

Evolutionary theories predict that species and the relationships between them will change over time. The reason is that some species will be better adapted to the evolving business landscape than others and will therefore be more likely to thrive. By contrast, members that do not fit the resource environment will be eliminated by market selection, leading to firm failures and deaths. While environmental adaptability is considered as a competitive advantage, the major challenge is that organizations are subject to strong inertial forces that resist change (Aldrich et al., 2020). Moreover, fundamental changes in organizational structures and routines will produce unpredictable and uncertain outcomes (Hannan & Freeman, 1977).

Among the many frameworks for understanding the current business environment, PESTEL (political, economic, social, technological, environmental, and legal) will serve our purposes. Any of these factors can change over time, which will create an advantage for some species over others. In the case of a service platform ecosystem, it is possible, and even common, for some species to attempt to affect the PESTEL factors to their advantage, which is far less common in biological ecosystems. For example, regulators confer legitimacy to emerging industries and practices. Platform owners, service providers, and incumbents organize lobbying efforts to ensure an institutional environment that benefits their own interests.

An external environmental shock can drastically disrupt the market equilibrium. As an illustration, the COVID-19 pandemic may become comparable to the Chicxulub asteroid, which struck the Yucatán peninsula roughly 66 million years ago causing a mass extinction. The spread of COVID-19 and subsequent shutdown have resulted in a significant decrease in the number of guests. With a significant increase in trip cancellations and almost no increase in new reservations, many Airbnb hosts (the species of service providers) may have empty calendars for a long time and thus face severe financial uncertainty. Some hosts may be forced to make their properties available for long-term renters, which also disrupts the market equilibrium. A significant reduction in available resources has also forced many traditional hotels (the species of incumbents) to be temporarily closed during the pandemic. Similarly, the Airbnb company (the species of platform owners or competing platforms) has announced layoff plans and hiring freezes in response to financial loss. Buffet-style restaurants such as Souplantation vegetarians have lost their appeal in the current situation, as have large cruise ships.

Just as the Chicxulub asteroid created conditions that favored mammals, there are opportunities for species that can adapt. For example, the demand for rides (say Uber) dropped with the lockdowns, but consumers instantly had new needs, such as having groceries delivered. Consequently, small local retailers and restaurants that can adapt to the new conditions will do well. However, such transformations can be challenging for small businesses because they possess limited resources and budgets to buffer against environmental uncertainty. There will also be little room for survival when their occupied niches are completely disrupted by environmental shocks.

3. Evolutionary dynamics of platform business models

Research on socio-cultural evolution (e.g., Aldrich et al., 2020; Campbell, 1965) has shown that the evolutionary model of variation, selection, and retention is a useful framework for understanding the dynamics of social systems. First, variation is a deviation from tradition or routine. Variations can be introduced via existing market players through imitation and adaptive learning or via new entrants to the market. The future evolutionary trajectory of any new variation is not deterministic and often goes beyond the intentions of those who introduced the variation. Second, selection eliminates certain types of new variations while preserving the remaining ones. The selection process is determined by the fit between species and the external environment. Third, retention is the duplication, persistence, reproduction, or standardization of selected variations in the past. Driven by inertia or resistance to change, the stage of retention is necessary to generate long-term value from positively selected variations. In the next subsections, we discuss the evolutionary dynamics of platforms in light of the evolutionary processes of variation, selection, and retention.

3.1. Platform business model variations

Although platforms are not a new phenomenon, they represent an important disruptive variation of "business-as-usual" or traditional pipeline businesses, which often involve dynamic processes of market changes or even the emergence of new markets (Mair & Reischauer, 2017). Platforms can be contrasted from pipeline business models in many ways, including in terms of market economics, market-level, and firm-level characteristics (see Wirtz et al. 2019). The main distinguishing feature, or deviation from tradition, lies in the fact that cost and revenue are both to the left and the right side of the value chain in the case of platforms. As opposed to traditional pipeline businesses where value moves from left to right, platforms can collect revenue from each side (the left and right sides) and incur costs in serving both (Eisenmann et al., 2006).

Platforms also operate with diverse business models and in various forms, such as booking platforms, payment, search, or sharing economy platforms (Rangaswamy et al. 2020; Wirtz et al., 2019). Among sharing platforms, Wallenstein and Shelat (2017) identify three distinct business model variations, which differ according to the level of control exerted by the platform owner over participants (i.e., who sets the price and other conditions) as well as to who owns the asset being shared. In *decentralized* platform models (e.g., Airbnb), platforms enable transactions and match a customer with an asset owner who sets the terms and provides customers with access to her/his asset. On the opposite, *centralized* platforms own the assets being accessed and set the price and other conditions (e.g., Zipcar). Such platforms exert greater control over quality, availability, and standardization than decentralized platforms and collect a larger share of the transaction value, yet costs to scale up are usually much higher. Finally, in the *hybrid* platform business model, asset owners offer services with prices and standards set by the platform (e.g., Uber). In this variation, ownership and the associated burdens are decentralized while the offer or service level is centralized.

Platform business models can be highly dynamic and evolve to achieve a better fit with their changing institutional and resource environment (Thomas et al., 2014; Tiwana et al., 2010). Airbnb serves as a relevant example to illustrate how (sharing) platforms change over time and lead to new business model variations. Since its inception, Airbnb has opted for a decentralized variation of sharing business models by matching asset owners (hosts) with customers (guests) and offering various tangible (e.g., reduced transaction costs) and intangible (e.g., social benefits) value-in-use propositions (Akbar & Hoffmann, 2020). A few years later, however, Airbnb made the strategic decision to open the platform to boutique hotels and make it easier for them to list on the platform. This move led to the creation of a new platform variation characterized by an enhanced level of *platform openness* (Wei et al., 2019). This business model adaptation helped Airbnb further develop its supplier network, exert greater control over service quality, and attract new customers. In 2019, nearly 90 percent of guests who first used Airbnb to book a hotel room have returned and booked a room in a home for their next trip (Airbnb, 2019), which shows that Airbnb also managed to enhance network effects for guests and hosts by using this bundling solution. Another interesting evolution of the Airbnb business model occurred in 2017, when the company opened its own apartment building in partnership with a property developer, thereby becoming a more centralized sharing platform variation.

As exemplified by the Airbnb case, a platform ecosystem is evolving because variations are constantly introduced into the system by firms as solutions to problematic situations. Such moves or variations, in turn, affect the platform network's health and ultimately firm performance and survival within its ecosystem (Iansiti & Levien, 2004). However, not each variation will be accepted and survive. Certain types of new variations will be selected out due to a lack of environmental fit.

3.2. Evolutionary selection and retention of platform variations

Evolutionary theory suggests that selection eliminates certain types of new variations while preserving the remaining ones. In particular, complex systems that evolve at a faster rate and with greater diversity, robustness, and productivity would be more likely to achieve a better fit with their environment and persist in the face of external shocks (Simon, 2002). Platform markets are no exception. Many platform companies indeed want to be the next Airbnb, yet most of them fail at establishing and sustaining a sufficient level of supply and demand (Hazée et al., 2017, 2020); the common mistake is to rely on assumptions and paradigms that apply to product and services without *network effects* (Eisenmann et al., 2006).

In platform markets, strong network effects and relatively high switching costs often explain why one platform variation rapidly scales up and wins over another (Hinz et al., 2020; Katz & Shapiro, 1985). To overcome these entry barriers and successfully compete, new platforms would need to develop radical innovations and offer revolutionary functionality (Henderson & Clark, 1990), leading to successive *winner-take-all* battles (Noe & Parker, 2005). More recently, Eisenmann et al. (2011) explored a second entry path for platform providers that may not have the capabilities or willingness to innovate, namely *platform envelopment*. In the next subsections, we discuss further the winner-take-all and platform envelopment dynamics, as they both explain why certain variations of platforms, including sharing platforms, are selected and survive over time.

Winner-take-all dynamic as evolutionary selection phenomenon. The possibility of increasing returns to scale can lead to winner-take-all battles in the sharing economy, making it important for managers to understand under which conditions a market is likely to be “tipped” or served by one single platform. Prior research suggests that this selection phenomenon occurs when the following three conditions apply.

First, multi-homing (i.e., the practice of being affiliated with multiple platforms) costs are high for at least one user side. Users indeed are less likely to use multiple platforms when it is expensive, in terms of time and effort, to establish and maintain platform affiliation (Landsman & Stremersch, 2011). While recent advances in digital technologies are directed at reducing (procedural) switching and multi-homing costs, several industry-specific characteristics make it likely that such costs will be high. For instance, a platform’s verification capabilities (i.e., the ability to create trust and reassure actors in a transaction through, for instance, reputation and recommender systems; Liang et al., 2017) is a much more important, or valuable, factor for Airbnb customers and peer service providers than it is for Ubers’ users, for whom only price and speed are likely to influence their decision. Hence, in line with Burnham et al. (2003), actors would perceive higher multi-homing costs when they perceive services provided by platforms as more complex. Next to product/service complexity and formal barriers to switching platforms (e.g., contractual terms or technical restrictions), the “valuableness” of data and the way it is embedded into the platform also influence the ease with which actors switch or engage in multi-homing (Prud’homme, 2019). For instance, the user data embedded into ride hailing platform apps such as Uber and Lyft is not particularly unique or valuable to users, thereby leading to multi-homing practices and dynamic price competition among platforms (Rochet & Tirole, 2003). As we discuss in the next section, platforms can also offer various incentives for customers (or service providers) to consolidate their activities on one platform.

Second, users would converge on fewer platforms when cross-side (i.e., increasing the number of users on one side of the network makes it more or less valuable to users of the other side; indirect effects) or same-side (i.e., increasing the number of users on one side makes it more or less valuable to users on the same side; direct effects) network effects are positive and strong (Chu & Manchanda, 2016; Eisenmann et al., 2006). In line with the Efficiency Paradigm in industrial organizations research (e.g., Evanoff & Fortier, 1988; Gale & Branch, 1982), these important network effects would lead to superior “production” efficiency, greater market shares for the focal platform, and ultimately higher market concentration in the industry. Understanding and promoting network effects is crucial for platform survival, as economies of scale and enhanced productivity are typically considered as the most important measures of an ecosystem’s health (Gawer, 2014; Iansiti & Levien, 2004). It is important to note, however, that indirect network effects may reach an optimal point beyond which any increase in the network size may create within-platform competition, enhance search costs, and thereby reduce the overall platform’s network attractiveness (Cennamo & Santalo, 2013; Rochet & Tirole, 2003; Tiwana, 2015; Wirtz et al., 2019).

Third, only a few platforms survive when users have relatively homogeneous needs. By contrast, when users have unique or distinct preferences, several smaller differentiated platforms can subsist by opting for a niche strategy and focusing on satisfying these specific segments’ needs (Eisenmann et al., 2006). Put differently, dynamic competition between platforms in the ecosystem and resulting market tipping phenomena are contingent upon the level of heterogeneity among actors (Rietveld & Schilling, 2020). Altogether, these factors explain why only a few established platform providers may enjoy market power and survive over time.

Platform envelopment as evolutionary selection phenomenon. To survive and overcome entry barriers such as strong network effects and high multi-homing costs, competing platforms would either need to differentiate by providing radically new functionalities and services (Henderson & Clark, 1990), that is a new platform variation, or envelop the rival platform by building upon preexisting relationships with the rival’s customers. Platform envelopment typically refers to "entry by one platform provider into another's market by bundling its own platform's functionality with that of the target's so as to leverage shared user relationships and common components" (Eisenmann et al., 2011, p. 1271). Put differently, a platform is likely to be enveloped when its rival decides to offer the same functionality as part of a multiplatform bundle solution.

Platform providers that serve different markets often have overlapping customer bases and use similar platform components and architectures, which makes it attractive and relatively easy to swallow the network of the other and become the dominant platform variation in the ecosystem. With its recent strategic decision to offer customers the opportunity to search and book various types of properties owned by independent professionals, including boutique hotels as well as bed and breakfasts, Airbnb started offering the same functionality as traditional booking platforms such as Expedia and Booking.com, yet at a much lower price (3-5% commission for Airbnb against 25-30% for Expedia). Since then, the platform has experienced a 150 percent increase in the number of rooms available in independent hotels and similar venues (Airbnb, 2019), thereby showing that Airbnb swallowed part of its rivals' network.

While offering a multiplatform bundle solution represents an opportunity for platforms to survive within their ecosystem, envelopment attacks do not always succeed. Research suggests that this strategy is more likely to succeed when (a) the attacker's and the target platform's users overlap significantly, or (b) economies of scope are high, or (c) the attacker can appropriate value by harnessing price discrimination benefits (Eisenmann et al., 2011). Adding functionalities also adds a layer of complexity and may enhance costs for all users (Evans & Schmalensee, 2016). Against this backdrop, platforms opting for this strategy need to pay careful attention to the way value is created, that is the extent to which transaction and production costs are reduced for all users (Rangaswamy et al., 2020).

In sum, platforms are highly dynamic ecosystems that constantly evolve towards new business model variations to achieve a better fit with the changing environment and survive over competing platforms and incumbents. Selection and retention of variations in platform markets is not only contingent upon the cost or differentiation advantages of the platform, but also upon network effects and multi-homing costs, thereby creating unique winner-take-all and platform envelopment dynamics.

Notably, our evolutionary explanation does not suggest that the business models with high levels of environmental fit are the "most fitted" ones in any absolute sense. Evolutionary cycles of variation, selection, and retention are constrained by an industry's historical path and do not necessarily lead to the most efficient outcome (Aldrich et al., 2020). The retention process retains certain selected variations through replications (e.g., inter-organizational imitations) and restricts the types of intentional new variations introduced into the next round of evolution. As the sharing economy matures, limited heterogeneity of organizational forms will probably be observed in the future, but this equilibrium will be further disrupted by radical and unpredictable market changes, speeding up the rate of variations in the ecosystem.

4. The value of the evolutionary perspective

Prior research has largely focused on examining the platform ecosystem (or its individual actors) through some cross-sectional snapshots rather than considering the dynamic processes occurring within and between the actors that make up the ecosystem. Building upon previous research on ecosystem ecology and socio-cultural evolution, this article contributes to the literature on platform business models in the sharing economy by providing an ecological and evolutionary account of the dynamics of platform ecosystems. This analytical framework also offers platform managers a way to recognize how dynamics in their ecosystem may influence their platform evolution and relative fitness. Incumbent firms and platform providers have greater agency than biological species in adapting to change, and must devise and implement strategies in order to survive in the future. Doing so, however, requires having a mental model for how platform ecosystems operate and will change over time. The evolutionary approach can specifically help managers realize that their platform services are created by co-evolving actors tied together by multiple relationships. It is necessary for platform managers to develop relational capabilities and facilitate cooperative interactions between actors to secure a competitive strategic position. In addition, the evolutionary perspective alerts platform managers to the turbulent competitive conditions of the ecosystem, where threats can be posed by similar (another competing platform) or different (incumbent) species. Finally, this perspective makes platform managers aware of the conditions under which one platform variation is likely to scale up and survive over time.

5. Future research directions

The evolutionary perspective challenges traditional approaches by emphasizing the dynamics of stakeholders in platform ecosystems. As a result, it should stimulate theory building to further advance our understanding of the evolution of platforms. Research issues are grouped at a high level into substantive and methodological issues. Within the substantive category, there are questions that pertain only to micro-level species (introduced in Section 2), about macro-micro interactions (Section 3), about platform management, and downstream effects. Within the methodological category, there are pure measurement issues and questions about studying relationships over time. Figure 2 presents a visual summary of the broad directions for research that we discuss next.

--- Insert Figure 2 around here ---

We begin by now discussing substantive research questions at the micro-level, which grows from our discussion in Section 3. The first set of questions are centered around understanding how stable platform characteristics affect network measures and their changes over time. Examples include how and why capacity-constrained versus unconstrained, forprofit versus non-profit, want versus need, or single (e.g., Airbnb) versus multi-industry (e.g., Amazon) platforms create different network structures and dynamics.

The second set of questions focus on how micro-species management actions—for example, the platform's promotion, recommendation, review, collaboration, envelopment, and multi-homing policies—affect the network and its evolution. The relatively low economic switching costs from the actor's perspective also require platforms to innovate and find effective ways to drive loyalty to the platforms through tactics such as badging and incentive programs (e.g., Uber Rewards), combined with traditional loyalty drivers including satisfaction (Li, Hudson, et al., 2021), consumer value (Eckhardt et al., 2019), and trust (Ert et al., 2016). Borrowing further from the evolution literature, there are established theories that explain sexual selection and whether a species (e.g., peer service providers) practices monogamy (single-homing) versus some form of polygamy (multi-homing). For example, Emlen and Oring (1977, p. 215) cast it "in a cost-benefit analysis" where monogamous mating systems require "the economic defendability of a mate." They discuss how the particular mating systems depends on how much one sex can monopolize critical resources and other factors.

The third class of questions concerns the consequences of network measures and their evolution, such as platform market share, profitability, and abnormal returns. Network measures can be viewed as a mediator between managerial platform actions and these market outcomes: the platform adopts policies that create network effects, which result in outcomes for the platform.

Moving to macro effects, there is a need to understand how macro-species actions affect the network and its evolution, building from the discussion in section 3. An important stakeholder is the government, and research could examine how regulation and antitrust actions against platforms will affect network dynamics and their consequences for all stakeholders involved. Informing legal and regulatory policy should be research on ethical issues of platforms and the power they amass. Another important macro-species consists of incumbents, and research can understand the effects of different competitive strategies. Research can also examine the effects of *exogenous, macro-level* factors, such as the COVID-19 pandemic, global warming, or terrorism acts on the evolution of platforms.

Complicating the issue of determining what to measure is the fact that different stakeholders may have different objectives. For example, users want excellent services (or products) at a low price; providers want to be promoted and have high revenues; platforms want loyal users and providers who generate revenue over time; and legislators want to be reelected. As such, how these objectives are balanced and achieved over time could also affect the dynamic interactions among species and the evolution of the entire platform ecosystem.

We now discuss methodological issues. Research is needed to measure a network and then how it changes over time. Traditional social networks have nodes as individuals and ties as relationships, with the platform influencing tie formation (e.g., Facebook or LinkedIn recommending connections to customers). In the case of platforms, we have a bipartite graph with customers on one side, suppliers on the other, and the platform influencing connections. There may even be additional parts to the graph consisting of facilitators or complementors. How can social network measures (e.g., degree, betweenness, eigenvector, and closeness centrality and structural holes) be modified and expanded to measure the particular phenomena that arise in multi-partite platform networks? Stephen and Toubia (2010) and Vakeel et al. (2020) provide examples of how to tailor network measures.

This paper has focused on the evolution of platforms. Beyond descriptive measures, our frameworks discuss how the network will evolve over time, while testing such dynamics will require studying the change in measures (i.e., differences between discrete time points or continuous derivatives). Developing methods to study such network dynamics that either depend on exogenous and/or endogenous factors, or affect subsequent outcomes, is a fruitful area for future research. Some research questions could stem from whether and how changes are accelerating or decelerating, which would suggest studying second-order differences or second derivatives. Studying network dynamics with first- and second-derivatives/differences is the next frontier for platform research and offers many opportunities for research.

Recent advances at the intersection of network analytics and computer simulations have also enabled researchers to test hypotheses regarding the factors that drive network evolution and network-behavior coevolution on a given set of actors. In a service platform ecosystem, network evolution is manifested in longitudinal changes in interactions (ties) between actors (nodes) from the same or different species. Network-behavior coevolution reflects the changing nature of the reciprocal causal relationship between an actor's (node's) attributes and interaction patterns (network structures) over time. Currently, stochastic actor-oriented modeling (SAOM; Ripley et al., 2020), temporal exponential random graph modeling (TERGM; Leifeld & Cranmer, 2019), and relational event modeling (REM; Butts, 2008) have been employed to estimate network evolution or network-behavior coevolution. These dynamic network models treat network change as a function of both endogenous and exogenous variables. In network terminology, endogenous variables refer to "various relational properties of the focal network itself that influence the probability ties will be present and absent in the same network" (Contractor et al., 2006, p. 686). These variables capture the dynamic mechanisms of network self-organization such as preferential attachment (the tendency for already well-connected nodes to attract additional ties) and triadic closure (the tendency for nodes with shared partners to interact with each other). By contrast, exogenous variables are properties outside of a focal network that drive network changes, such as actor attributes (e.g., a service provider's motivation, reputation, and intensity of platform use) and additional relations among the same set of nodes (e.g., existing communication and friendship networks among platform customers).

6. Conclusion

Drawing upon the literature on ecosystem ecology and socio-cultural evolution, the current study builds an evolutionary framework for understanding the dynamics of service platform ecosystems. The variation-selection-retention model is also introduced to explain the evolution of platform business models. Despite the focus on the service sector, the features of the service platform ecosystem are thought to be representative in the sharing economy. The future research agenda provides scholars with a roadmap for investigating the evolution of platform ecosystems. Among others, it emphasizes the importance of network analytics and dynamical models in building theories and gaining insights.

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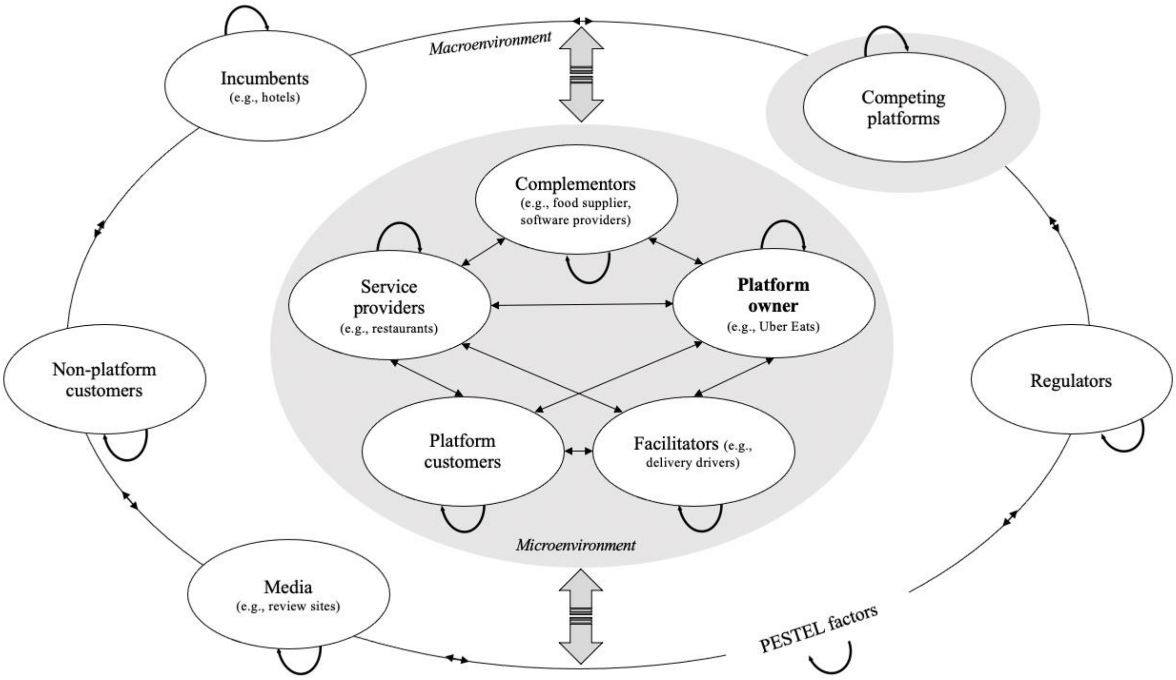
Table 1
An overview of species of a service platform ecosystem.

Species	Main activities	Examples
Platform owners	Match service providers and customers, build relationships with customers and service providers, and smooth demand and supply in peak times (Benoit et al., 2017).	Platform firms such as Airbnb and Uber Eats
Platform customers	Interact with others, provide information, and behave appropriately (Benoit et al., 2017).	Airbnb guests and Uber Eats customers
Service providers	Give access to assets and provide personalized services (Benoit et al., 2017).	Airbnb hosts and restaurants on the Uber Eats platform
Facilitators	Provide peripheral services that support core services.	Peer-to-peer drivers who deliver meals for Uber Eats
Complementors	Provide professional and complementary services.	Complementary mapping services and software providers
Competing platforms	Compete with a focal platform's owner.	Lyft as a competitor of Uber
Non-platform customers	Receive services provided by incumbents (Mody et al., 2020).	Hotel guests
Incumbents	Offer traditional products and services.	Traditional hotels
Media	Attract customers and guide their purchase decisions (Goldfarb & Tucker, 2011).	Review sites and social media
Regulators	Change laws and policies (Goldfarb & Tucker, 2011).	Legislative institutions

Fig. 1

A dynamic service platform ecosystem.



Note. Circles represent key species in the service platform ecosystem. Species within the same platform-based microenvironment are positioned in the common grey area. Reciprocal black lines within the microenvironment represent relationships between pairs of species. Self-loops indicate interactions and dynamic processes within the same species. Reciprocal grey lines show cooperative and/or competitive interdependence between micro and macro environments.

Fig. 2

Future research agenda on the evolution of platform ecosystems.