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Opportunity Complementarity in Data-Driven Business Models

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Abstract

Business model research typically focuses on value co-creation and co-capture logic to study business models in the ecosystem. To understand the "ex-ante" source of ecosystem-based value creation/capture, this paper proposes opportunity complementarity as a key antecedent for the ecosystem-based value creation and capture in data-driven business ecosystems.

Introduction

Digitalization has been driving the transformation of traditional industries (e.g. healthcare, energy). A key characteristic of this transformation is digital convergence, namely the convergence of Information and communication technologies (ICTs), data and new (digital) business models. The digital convergence requires to open the business research inquiry from the development of individual products and business models to business models created within business ecosystems (Teece, 2018). Since the inception of the business ecosystem concept introduced by Moore (1993), the ecosystem has gained popularity in different domains, such as Vargo, Akaka and Vaughan's (2017) service ecosystem as a complex system of actors that are interconnected by shared institutional arrangements and mutual value creation targets (Pikkarainen, Huhtala, Kemppainen, & Häikiö, 2019). The theoretical connection between business models and business ecosystems has also been established (Gomes, Kemppainen,

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Pikkarainen, & Koivumäki, 2019). Business ecosystems are deemed as a network of business models (Jansson, Ahokangas, Iivari, Perälä-Heape, & Salo, 2014), where the firms seek various business models (e.g. bundled or hybrid) to aggregate services from different parts of the digital ecosystem (Iivari, Ahokangas, Komi, Tihinen, & Valtanen, 2016). Furthermore, the ecosystem discussion has been connected to platforms, for instance, Xu, Ahokangas, Turunen, Mäntymäki and Heikkilä (2019) examined the ecosystemic business models for AI (artificial intelligence) platforms. Jacobides, Cennamo and Gawer (2018) distinguish ecosystem and platform, suggesting that a "business ecosystem" centres on a company and its environment, while a "platform ecosystem" considers how actors organize around a (technical) platform. Thus, while all platforms can be considered as ecosystems, not all ecosystems are platforms. So far, business model research in ecosystems mainly focuses on the value aspect and advantage aspect of business models. For instance, the value perspective considers value co-creation and co-capture as a key characteristic for digital businesses in ecosystems (Nenonen & Storbacka, 2010). The advantage perspective suggests that joint open innovations are essential for the sustained competitive advantages of the actors involved (Chesbrough, Lettl, & Ritter, 2018).

However, so far the literature has looked at the fundamental driver of such co-creation and co-capture within ecosystems only rarely. Teece (2018) suggests complementarity as a new way to form the phenomenon that tech companies jointly create and capture value in an ecosystem, arguing that complementarity should not be solely seen as value capture mechanisms, rather it is a key requirement or prerequisite for the technology and business model to fun in the digital age. Building on Teece's (2018) complementarity thinking, this study proposes opportunity complementarity as a new construct and driver for the co-creation and co-capture actions in the digital ecosystems from the opportunity perspective.

The concept of opportunity has been widely recognized in the business literature. The existing study suggests that companies need to explore and exploit business opportunities to survive in the long term (Benitez, Llorens, & Braojos, 2018). Opportunity has been characterised as a cognition that emerges in the creative process (Alvarez & Barney, 2010), an objective phenomenon that exists and is independent of the company (Shane, 2003) and as a realization of something that brings value to the customer (Sridhar & Corbey, 2015). However, the opportunity is implicitly considered as a singular/atomistic construct, and little investigation has been conducted on complementary opportunities in business model and ecosystem literature. For example, previous study (Gomes, Iivari, Pikkarainen, & Ahokangas, 2018) suggests that business ecosystems need to be organized around only a specific broad business opportunity. However, this study argues that there can be multiple opportunities in an ecosystem. The opportunities are characterized as a social construction bringing value to the customer that are jointly explored and exploited by public and private actors in two data-driven ecosystems in the study.

The study investigates the opportunity complementarity in the context of data-driven business ecosystems. As data has become a valuable resource for companies and their business models, the data-driven aspect is an inherent characteristic of digital businesses (Hartmann, Zaki, Feldmann, & Neely, 2016). In data-driven business models, the value is created and captured within an ecosystem (Shafer, Smith, & Linder, 2005) by using data as the key resource in the business activities (Hartmann et al., 2016). Data-driven business models such as Amazon or Netflix are designed around collecting, organizing, and summarizing data, with the goal of better identifying the unmet customer needs and other opportunities in the market (Sorescu, 2017). Overall, this study contributes to the concept of complementarity from the opportunity perspective to the business model literature to enhance theoretical and empirical understanding of ecosystemic opportunity exploration and exploitation in the context of data-driven businesses.

Approach

The review of business model literature shows that the business model can be conceptualized through three important aspects that connect the business models to the business context, the value perspective that concerns with the value proposition, value creation and capture (Xu, Ahokangas, & Reuter, 2018), the opportunity perspective focusing on opportunity exploration

and exploitation (Teece, 2018) and the perspective of competitive advantage (Priem, Wenzel, & Koch, 2018).

The concept of complementarity was proposed in Teece's (1986) seminal PFI (Profit from Innovation) framework. PFI framework stresses the importance of complementarity from resource and capability perspectives, suggesting that complementary technologies and assets are key to the success of the business model. Recently, six streams of complementarity have been identified (Teece, 2018): 1) *Production complementarity*, which means that complementarity happens when a decrease in the price of one factor leads to an increase in the quantity used of its complements in production (Hicks, 1970); 2) *Consumer complementarity*, which means that two products are complements in consumption if the utility of consuming them together is greater than consuming each product separately (Edgeworth, 1925); 3) *Input complementarity* that means that two products can have complementarity with each other if they are used together but sold by separate companies (Teece, 2018); 4) *Asset price complementarity*, which suggests that an actor can speculate on complementary assets likely to increase in value in the futures market (Hirshleifer, 1971); 5) *Technology complementarity*: in technology systems, there are complementary components within the systems and the technical complementarity relation between different components (Holgersson, Granstrand, & Bogers, 2018); 6) *Innovation complementarity* that occurs when improvements in a general-purpose technology increase the productivity in downstream sectors (Teece, 2018).

The new type of complementarity: opportunity complementarity

Overall, economic literature looks at most of the complementarities as market-related phenomena. Only technology and innovation complementarities are related to the advantage perspective of business models. This study identifies a new type of complementarity, namely the opportunity complementarity, as a key antecedent of the business model, especially in ecosystem settings.

Opportunity research has its root in entrepreneurship studies, being mostly defined as as "situations in which new goods, services, raw materials, markets and organizing methods can be introduced through the formation of new means, ends, or means-ends relationships" (Eckhardt & Shane, 2003:336). Research on the opportunity can be divided into two major streams. First, the discovery stream considers opportunity as an objective phenomenon that exists in the external world, independent of the actors (Eckhardt & Shane, 2003). Instead, the creation perspective considers an opportunity as linked to entrepreneurial cognition and emerging due to a creation process (Alvarez & Barney, 2010). Regarding opportunity and business models, an opportunity would provide a basis for value creation (Atkova, 2018).

The concept of complementary opportunity can be seen in mathematical social sciences (Herrero, Iturbe-Ormaetxe, & Nieto, 1998) through the notions of (i) opportunity profiles, e.g. individual or atomistic opportunity that is the opportunity specifically for individual actor and is not complementary to other actors' opportunities, and (ii) the common opportunity (or complementary opportunity) available in the society. In our definition, opportunity complementarity means that business actors (especially in an ecosystem) can have opportunities that are complementary to each other, which can lead to the creation and the capture of value in a collective manner, namely to an ecosystemic value co-creation and co-capture. Evidently, opportunity complementary is different from the complementarities in economic studies such as production complementarity or consumer complementarity. It is particularly important to address the difference between technology complementarity and opportunity complementarity: 1) The former focus on the modular technical systems that require two or more modules to be combined so the overall system will function properly, such as software (e.g. Windows operating system) for hardware (personal computers). Without the correct and well-defined specification, the technology complementarity can barely work; 2) the latter suggests that business actors can create and capture value from complementary opportunities for individual or collective benefits. There is no rigid lock-in for the opportunities.

The categorisation of data-driven business models on scale and scope

Data-driven business models can be categorized based on whether they are scale- or scope-oriented. In scale-oriented business models, the companies in the

ecosystem partner with one another to integrate data and create data-driven products or services by focusing on the economics of scale. In a scope-oriented business model, the companies in the ecosystem aim for a platform model that allows a higher level of technology integration to enable the companies to create innovations in variety to address the needs and opportunities in the market (Pikkarainen, Ervasti, Hurmelinna-Laukkanen, & Nätti, 2017), thus, the economies of scope.

Research methodology

This study employs a multi-method and interpretive case study (Walsham, 2006). We include and cross-examine two data-driven business ecosystems from essentially un-related industries, in particular, one from the European Union (EU)'s energy innovation project (P2P-SmartTest) and the other from the Finnish national healthcare innovation project (Icory). In doing so, we aim at enhancing the findings' reliability and demonstrating the wide presence of data-driven business models. The EU's P2P-SmartTest project investigates a smarter electricity distribution system integrated with advanced ICT, regional markets and innovative business models. The project has 10 partners (5 companies and 5 public players) to develop four data-driven business model archetypes (Figure 1): conventional utility model, ESCO (energy service company) model, shared network access model and the P2P platform model. The Icory project aims for creating an intelligent and customer-driven solution for orthopaedic and paediatric surgery journey in collaboration with companies, hospitals and researchers in Finland and Singapore. The project has 18 partners (9 companies and 6 public players) who jointly identified four business model archetypes: the conventional healthcare model, the health service platform model, the health data integration model and health innovation ecosystem model.

During the workshops, the data business model archetypes were developed and a systematic way of generating the opportunity scenarios was applied similarly in both projects. For instance, both projects adopt an ecosystem approach to involve and engage the key actors and stakeholders in the ecosystem, including both public and private partners. The ecosystem approach seeks complex problem solving from the partner's diverse background and heterogeneous contributions. Thus, the benefits of such systems are the creation of alternative or complementary solutions to the opportunity (exploration and exploitation) and (value creation and capture) aspects of the business model.

Key insights

The business model cases collected from the two projects are mapped on the opportunity complementarity map based on the type of opportunity source and from the perspective of data-driven business (Figure 1).

From the two case studies, some common findings emerge. First, atomistic opportunities exist to be mainly beneficial to certain actors with the closed data model (single-source data to create a targeted application) or the single-sided data platform model that only benefits the platform operator. In the Icory project, the closed data model was the only option due to the healthcare-related data protection issues. Second, both cases confirm the presence of opportunity complementarity before the creation of business models. The opportunity complementarity brings the public and private partners together to explore and exploit the opportunities with digital technologies and more innovative business models like the data integration model, in which partners integrate technology and share data to create scale-oriented applications or the multi-sided platform incorporating different technologies and data sources for diverse applications. It is key to note that as both cases involve digital technology, therefore the technology complementarity and opportunity

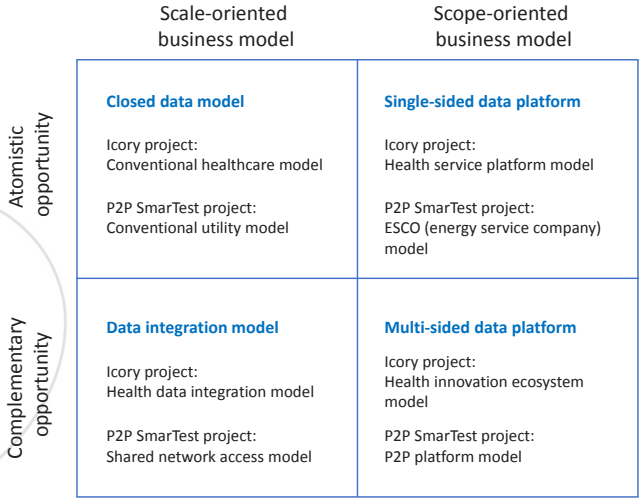

Figure 1: Opportunity complementarity mapping

complementarity can be observed as intertwined in each case. As such, the integration of data and technical interoperability (technology complementarity) facilitates the new ways of collaborative value creation and capture for new markets and business models (opportunity complementarity).

Specifically, the Icory project enables small and medium-sized companies and hospitals with the help of researchers to find opportunities for more customer-centred and innovative business models. Instead of one business model, in this case, the ecosystem consists of different companies with various offerings and different opportunity complementarities have been identified. Instead of pursuing atomistic opportunities, the companies aim for creating value together for the hospitals and patients and seizing complementarity opportunity with both a health data integration model and a multi-sided platform model. In the health data integration model, companies - such as patient engagement platform provider, data analysis provider and video communication provider - aim to integrate their resources for addressing the needs of the healthcare providers and patients. In the multi-sided platform model (health innovation ecosystem model), we found even more collaboration happening in the ecosystem, where all the ecosystem participants form a portfolio of services that are connected and integrated to create more value for the healthcare providers. In the Icory case, several complementarities are observed: 1) the companies created consumer complementarity by combining the digital solutions with typical medical treatment to enhance the patient experience; 2) the product complementarity is created as individual solution are targeting different stages in the care pathway, but complementing each other in the patient journey; 3) input complementarity can be seen when two companies jointly provide codes and data for a new bundled patient solutions that are sold separately by the two companies; 4) technology complementarity is achieved through integration of APIs (Application programming interface) from different companies; 5) the innovation complementarity is visible as the use of AI and data analytics improve the front-end user applications; 6) the opportunity complementarity not only enables the collaborative value creation and capture but also motives the public sector to overcome the institutional barrier and status quo to co-create new digital solutions and innovations with the startups and small healthcare companies, which is an unconventional practice of the public hospitals.

In P2P SmarTest, a key driver for the co-creation of the smart energy business models is the complementary opportunities from actors positioned in different domains of the ecosystem (e.g. electricity distribution, energy service, energy forecasting and energy trading). The opportunities are complementary to each other, so these actors can integrate their technical capabilities, utilizing assets and redirecting resources to co-develop new business models with the focus of scalability, replicability and business sustainability. The study identifies that a traditionally centralized utility with a closed business model (closed data model) starts to shift its focus towards the open business model (multi-sided data platform model) in the data-driven smart energy ecosystem. This would not have happened without the recognition of shared opportunities that are complementary to and from other energy ecosystem actors.

Another key finding of the research is the non-static nature of opportunity complementarity. The opportunity complementarity can affect the choice of business models while the choice or design of the business model can also affect the opportunity complementarity. For instance, in P2P SmarTest, the complementary opportunities in the emerging smart grids domain drive the energy ecosystem actors to embrace more open business models (e.g. sharing network access model and the P2P platform model) over the atomistic models (e.g. closed data model). In contrast, when energy utilities choose a business model (or design of business model), the opportunity complementarity changes significantly. More specifically, the shared network access model provides complementary opportunities for energy network operators who traditionally have closed and non-cooperative model with each other to generate new revenue streams by sharing their own data. The P2P platform model enables better opportunity complementarity between peer energy producers and energy service companies while it does not create complementarity for energy network operators anymore.

In the Icory case, addressing the unique nature of these particular cases as public-private partnerships

would also be useful. In Icory, three companies used the health innovation ecosystem model to address the opportunity in the public sector. In the first company, the national players in the international market helped them to modify their solution to be complement with the regulatory rules. They also worked together helping the company to co-create a solution content so that it is more complementing the needs at the public hospitals and among the patients. In the other case company, the discussions with the public international partners helped them to sell their solutions in a way that it is better to fit the targeted market. In the third company, the discussions with the public international players started as a multi-sided manner but it stopped suddenly because the solution does not fill the patient needs in the target country. This means that the collaborators did not anymore see the complementarity of their opportunities. The Icory case shows that despite the structural constraints of the hospitals as a type of key public actor in the healthcare ecosystem, the opportunity complementarity helps reduce the conflict and barriers (due to high safety and security requirements for healthcare products and services) that the small healthcare solution companies typically face when commercializing their solutions. However, it is also visible that institutional arrangements, such as data privacy and protection in healthcare institute do hinder the opportunities to be truly complementary.

Discussion and conclusions

The business model literature, and particularly research based on the perspective of value creation and capture, has evolved from single-actor models to multi-actor models, such as platform business models and ecosystem-oriented business models in the context of industry convergence and digitalisation. This paper presents two case studies of large-scale digitalization projects at EU and Finnish national levels with data-driven business models that are created within the two ecosystems.

This paper provides several contributions. *First*, it enriches the business model literature by proposing the opportunity complementarity as a new construct and antecedent prior to the creation of business models in the ecosystem setting. In particular, this paper adds to the literature by distinguishing the atomistic and complementary opportunities that are conceived and perceived by different ecosystem actors. This contributes to a deeper understanding of the ecosystem actors' rationale of engaging in value co-creation and co-capture processes in (digital) ecosystems, which is opportunity complementarity as an important factor. Furthermore, without a proper logic for value capture, even a ground-breaking opportunity is of no practical value due to its detachment from the business reality. To bring opportunities into business reality, actions are required to build business models through value co-creation and co-capture processes.

Second, this study investigates the data-driven business models in two large and established industries that are undergoing a digital transformation, proposing four data-driven business model archetypes. When an ecosystem adopts a scope-oriented business model, the players embrace a more integrated approach (e.g. connecting individual digital systems through platforms) to pursue the common opportunities, sharing data, knowledge, and technical resources. When dealing with scale-oriented data business models, companies are less likely to opt-in for a common platform and prefer to reserve their own data in silos.

Third, the study adds to the emerging platform research filling in a relevant research gap by explaining the opportunity complementary as an "ex-ante" driver for the creation of a platform business model. In doing so, we bring the concept of complementarity from economic literature to offer a novel understanding to address the research gap in understanding the drivers of business ecosystems in business model literature from the opportunity perspective by proposing the concept of opportunity complementarity that unites ecosystem and entrepreneurship studies.

Fourth, this research contributes to the ecosystem and platform research by showing that business platforms typically have ecosystem revolving around them or "platform ecosystem" per se (Jacobides et al., 2018). However, not all platforms are open. In fact, the non-existence of opportunity complementarity can lead to closed or "semi-closed" platforms, such as the single-sided data platform model in the research (Figure 1).

Fifth, from the empirical cases, six types of complementarities (including opportunity complementarity)

are observed. The only missing one is the production complementarity. The potential explanation is that the solutions within the two cases are mainly digital applications rather than physical products. The increased supply and use of data as an input did not lead to a decrease in the solution price but enhanced solution quality. Such finding may support the further investigation on the economics and complementarity of data in the digital age.

The research limitation is the missing of longitudinal perspective. The Icory case of the research shows that the opportunity complementarity may change over time as the opportunity itself has a fluid nature and is context-dependent: the old opportunity may lose its effect while new opportunities may emerge. Hence, the dynamic nature and longitudinal aspect of the opportunity complementarity and its impact on the business model require further research endeavour. Furthermore, this study acknowledges that opportunity complementarity is not static and further investigation is needed to understand the formation and dynamics of opportunity complementarity.

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