New emerging capabilities for managing data-driven innovation in healthcare: the role of digital platforms

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Abstract

Purpose – This article aims to understand the role of intermediaries that manage innovation challenges in the healthcare scenario. More specifically, it explores the role of digital platforms in addressing data challenges and fostering data-driven innovation in the health sector.

Design/methodology/approach – For exploring the role of platforms, the authors propose a theoretical model based on the platform's dynamic capabilities, assuming that, because of their set of capabilities, platforms may trigger innovation practices in actor interactions. To corroborate the theoretical framework, the authors present a detailed in-depth case study analysis of Apheris, an innovative data-driven digital platform operating in the healthcare scenario.

Findings – The paper finds that the innovative data-driven digital platform can be used to revolutionize established practices in the health sector (a) accelerating research and innovation; (b) overcoming challenges related to healthcare data. The case study demonstrates how data and intellectual property sharing can be privacy-compliant and enable new capabilities.

Originality/value – The paper attempts to fill the gap between the use of the data-driven digital platform and the critical innovation practices in the healthcare industry.

Keywords Digital platform, Innovation management, Dynamic capabilities, Healthcare industry, Case study

Paper type Case study

1. Introduction

Innovation in healthcare has adapted to the new realities of artificial intelligence (AI) and big data reshaping how to generate innovation. Digital technologies are changing the healthcare industry in a data-based industry (Madsen, 2014), but not always hospitals, pharmaceuticals or biomedical companies are able to exploit the wealth of their information. Descriptions of resilient performance in healthcare services usually emphasize the role of skills and knowledge of caregivers. At the same time, managerial studies often frame digital technologies as sources

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of brittleness (Valentina *et al.*, 2021). In addition, some scholars state that do not have a sufficient amount of data and information to exploit the potentialities of digital technology, making informed decisions or innovating (Trabucchi and Buganza, 2018). Overcoming these issues requires collaboration and sharing, however, the healthcare industry is highly regulated, capital intensive, and has significant educational requirements for those who participate (Wehde, 2019). Healthcare companies have still had very tightly controlled or protected domains of data. Each healthcare center maintains its own data sets. There is very limited sharing of data – typically through inherently manual processes including faxes and email. In this sense, low data sharing in the health industry can limit innovation processes for all involved actors. However, healthcare organizations are starting to rethink their data management approach supported by new intermediaries that unlock innovation among incumbents. Innovation intermediaries have become key actors in open innovation (OI) contexts. Research has improved the understanding of the managerial challenges inherent to intermediation in situations in which problems are rather well defined (Agogue *et al.*, 2017). New stakeholders now jump into the healthcare domain supporting healthcare incumbents in the data-driven transformation. Some scholars and practitioners foresee over the next decade it is likely that many of the major platform companies will move into healthcare to collect data in the cloud bringing them accessible and shareable for everyone (Van Dijck and Poell, 2016; Schiavone *et al.*, 2020; World Health Organization, 2020). For instance, Google, Amazon and Microsoft are establishing agreements with American hospitals for access to patient records and developing healthcare algorithms to innovate medical practices and business models (Powles and Hodson, 2017; Hermes *et al.*, 2020). This means non-healthcare companies, particularly platform providers, offer ideas and technology to unlock the power of data and innovation. Digital platforms are in fact exerting an increasing role in the healthcare industry (Lo Presti *et al.*, 2019; Klein *et al.*, 2020).

By definition, digital platforms are a socio-technical environment that mediates interactions between actors (Parker *et al.*, 2016) and exploit data streams to create individual and community value (Trabucchi *et al.*, 2017), inducing business users and providers to re-think or innovate their business models. Studies on digital platforms are wide and multidisciplinary (De Reuver *et al.*, 2018; Trabucchi and Buganza, 2021) and concern information systems, economics and managerial aspects. In the management field extensively is known about the role of the platform in fostering innovation. Such as recently literature contributions concern, (a) The relevance of the digital platform in managing and promoting innovation (Trabucchi *et al.*, 2021); (b) The link between platform capability and innovation practices (Helfat and Raubitschek, 2018; Cenamor *et al.*, 2019). In the development stage of digital platform, healthcare is an industry centered on people's health, especially in the severe situation of aging of the world population and the ravages of specific diseases (such as the COVID-19 pandemic), which makes the healthcare industry urgently need to use digital platform for innovative management. In this industry, new platform intermediaries are contributing to supporting the innovation management of multiple actors, thus theoretical contributions are needed to better understand and improve their role in accelerating and diffusing innovation practices in an industry full of challenges.

More precisely, the main gap between the past literature is found in the literature on platform intermediaries and data-driven industry enlarging the set of capabilities required to lead innovation at multiple levels of actors. Furthermore, the entire healthcare industry, especially in this big background in the COVID-19 pandemic, has gained management researchers' attention that gives rise to a self-standing research field addressing several issues such as innovation management, operations and marketing. In this sense, we also contribute to the healthcare literature, referring precisely to the strand of healthcare innovation. We position the paper in these fields, exploring how platforms can drive data innovation in the healthcare industry and how to manage innovation challenges?

Our paper intends to dwell on these aspects striving to comprehend the role of new intermediaries. Such as digital platforms – in managing innovation challenges in the healthcare scenario. More precisely, we explore the role of digital platforms in addressing data challenges and in fostering data-driven innovation in the healthcare industry. To put it plainly, our research question is how do digital platforms support healthcare actors in accelerating and managing challenges of data-driven innovation?

To address this issue, we draw from Helfat and Raubitschek's (2018) analysis on dynamic capabilities of platforms. Helfat and Raubitschek (2018) provide a theoretical analysis that explains three dynamic capabilities of platform leaders – innovation, sensing and integration. This theoretical framework helps us to comprehend the role of the platform (personified by platform leader) in addressing data challenges and fostering data-driven innovation at multiple levels of analysis. In this era, the data is driven into an industrial empowerment, especially in the field of healthcare, and current medical institutions are still low, doctors need to record patient data, this is a huge and important data set, this process often occupies a lot of time, through healthcare data innovation can easily handle and identify existing information, the application is very widespread. For example, clinical decision support, intelligent health management, etc. which has greatly reduced medical costs and improves the therapeutic effect. We explore platform capability effects on platform participants and beneficiaries by building a seminal model. Based on the author's contribution and considering that platform leaders have a variety of strategic choices (e.g. Cenamor *et al.*, 2019; Gawer and Cusumano, 2002), we develop assumptions about how platforms impact on users, providers and the entire industry capabilities. In accordance with De Reuver *et al.* (2018) we expect infact that digital platforms have the ability in transforming and innovating entire industries.

The contributions of this study are twofold: (1) we extend the literature on platform capabilities analyzing external effects triggered by dynamic capabilities of platform leaders in overcoming challenges and fostering data-driven innovation at the owner, user and industrial level; (2) we provide a discussion on the role of digital platforms in fostering innovation in healthcare from the practical viewpoint by presenting a real case.

To address these issues, we adopt a case study methodology analyzing a data-driven platform operating in the European healthcare industry. The case study part of this paper adopts a single case study and uses qualitative methods to explore the innovative role of data-driven platform for Apheris AI GmbH.

The paper is organized as follows. Section 2 is organized in four subsections. Firstly, we provide an illustration of a data-driven scenario, describing characteristics and problems. Secondly, we provide an overview of the digital platform concept focusing in the last part on digital platform in healthcare. Thirdly we discuss existing contributions on the role of the platform in the innovation processes. Section 3 describes the methodology adopted and the case study selected. Sections 4 and 5 present respectively results and discussions. Section 6 presents conclusions and implications.

2. Theoretical framework

2.1 Data-driven innovation

In 2014 the European Union anticipated the "new oil" trend–data, inviting firms to re-think key resources for competitive success. Data were already theorized by Perez (2002) as an inexpensive resource, apparently inexhaustible, applicable to various products, processes and sectors. With the convergence of many technologies such as sensors and devices, certain firms have leveraged digital tools to facilitate the capture, exchange and analysis of data (Klingenberg *et al.*, 2019). Scholars show data improve efficiency and promoting significant change in terms of product development (Davenport *et al.*, 2012; Porter and Heppelmann, 2014); industry (i.e. diagnoses of health problems in Chen *et al.* (2013) or precision agriculture

in Porter and Heppelmann (2014) or manufacturing); and society (Brynjolfsson and McAfee, 2014). At the same time, data-driven smart sustainable cities are being instrumented, datafied and computerized so as to improve, advance and maintain their contribution to the goals of sustainable development through more optimized processes and enhanced practices (Bibri, 2019). The diffusion of digital technology has contributed to generating a tremendous amount of data not always sufficient in terms of quality and helpful format to exploit the potential of analytic tools. Furthermore, the use of collected data is often still limited to several problems related to the complexity of the data-based application and structural limitations of some organizations that are not able to leverage on data power.

Big data driven management practices have contributed to business innovations and performance improvement for industrial organizations. Chen *et al.* (2013) list a group of challenges links to data strictly related to the big data characteristics:

(1) Volume: scarcity vs. big volume

(2) Velocity: speed vs. delay in updating

(3) Variety: various vs. single source

Moreover, the challenges vary in different application scenarios. Particularly, the healthcare scenario manages predominantly scientific data collected from data-intensive experiments or applications (Chen *et al.*, 2013). These data are very application-dependent, ranging from structured data (e.g. time-series data) to semi-structured data (e.g. Extensible Markup Language (XML) data) and unstructured data (e.g. images) (Zhou *et al.*, 2019). Industry challenge concerns the difficulty of handling multiple sources of data (Despotovic *et al.*, 2018), small dataset typical of fragmented healthcare organizations (Cao *et al.*, 2014); privacy and protection rules that obstacle the implementation of flexible and modular approaches to matching minimal data from different organizations (Kaushik and Raman, 2015).

2.2 Digital technology in industrial sector

A digital technology is defined as a set of information technology artifacts augmented by third-party peripheral derivatives such as hardware and software systems that facilitate the integration of business resources with those of the business ecosystems (De Reuver *et al.*, 2018). It is a digital environment where actors of different natures exchange information, goods and services.

Digital technologies are mainly discussed in three fields of research - information systems, economies, and management – that promote various conceptualizations of digital platforms. However, none of each conceptualization can understand the phenomenon completely. Indeed, the convergence of different discipline studies is relevant to define digital platforms' characteristics and evolution.

Information system studies are focused on digital infrastructures, architectures and technology. Information system scholars define digital platforms as technical artifacts where the platform is an extensible codebase offered at a third-party that can complement this codebase integrating modules (Tiwana *et al.*, 2010; Boudreau, 2012). Pervasive digitization gives birth to a new type of product architecture: the layered modular architecture. This new architecture instigates profound changes in the ways that firms organize for innovation in the future (Yoo *et al.*, 2010). German academic and industrial circles believe that the concept of Industry 4.0 is the fourth industrial revolution led by intelligent manufacturing. Digital technology plays a certain role in promoting industrial digital transformation. Such as digital twin (DT) is one of the most promising enabling technologies for realizing smart manufacturing and Industry 4.0. DTs are characterized by the seamless integration between the cyber and physical spaces. Many DT applications have been successfully implemented in different industries, including product

design, production, prognostics and health management, and some other fields (Tao *et al.*, 2019). In the extent of Industry 4.0, there are two recurring topics: individualization and integration (within the value chain and across the value system). The developments of Industry 4.0 within the literature and reviews were described by (Brettel *et al.*, 2017), those in the four areas of individualized production, end-to-end engineering in a virtual process chain and production networks were analyzed in eight journals and the implementation of Industry 4.0 were introduced by (Ortt *et al.*, 2020). Digital platforms are relevant as they impact the second topic. Digital platforms can stimulate knowledge sharing (Scuotto *et al.*, 2017).The configuration of artifacts enables the interrelation among users, providers and third parties, inevitably impacting the style of control and governance of the platforms. For instance, blockchain technology is promoting decentralized platforms introducing a new paradigm of governance and control.

Economies studies have focused on the theorization of digital platforms as of multi-sided markets, particularly exploring effects generated by multiple user groups in terms of network externalities (Rochet and Tirole, 2003; Boudreau and Hagiu, 2009; Evans and Schmalensee, 2013). The value-capture problem for innovators in the economy involves some different challenges from those in the industrial economy. It inevitably requires understanding the dynamics of platforms and ecosystems (Teece, 2018a, b). Network externalities were found to have a wide impact on the technology's usefulness, increasing as its installed base of users increases (Katz and Shapiro, 1985; Arthur, 1989; Shapiro and Varian, 1998). Moreover, at the same time, the technology's usefulness invites actors with different interests to share exigencies and interest in a win-win logic.

Managerial studies mainly focus on the platform's ability to change firms' business models, stimulating innovation and ecosystem development. Managerial studies on platforms contribute to considering digital platforms as socio-technical phenomena rather than technical phenomena due to their property in stimulating business networks (De Reuver *et al.*, 2018) and ecosystem dynamics (Hein *et al.*, 2020). For instance, Tiwana and Bush (2014), Evans and Schmalensee (2013) and Parker *et al.* (2016) provide multiple perspectives on platforms' ability in shaping business, organizational models and entire economies. Industry 4.0 provides new paradigms for the industrial management of SMEs (small and medium enterprises). SMEs do not exploit all the resources for implementing Industry 4.0 and often limit themselves to the adoption of cloud computing and the internet of things (Moeuf *et al.*, 2018). Digital platforms in fact, challenge traditional business propositions by offering hardware or software tools that simulate the definition of co-created value, inducing a set of new rules, standards and organizational processes to coordinate consumers, suppliers and partners (De Reuver *et al.*, 2018; McIntyre and Srinivasan, 2017).

According to the managerial literature, digital platforms enable platform agents to share and use shared resources and knowledge while leveraging unique resources. In this respect, the recent advancements of digital technology in collecting, analyzing and interpreting information have boosted the adoption of digital platforms as facilitators of interactions and have placed information and network management at the center of many business models (McAfee *et al.*, 2012; Van Alstyne *et al.*, 2016). In other terms, platform configurations were able to develop multilateral links among business actors (e.g. customers, suppliers and partners) and stimulate network and ecosystem innovation (Ciborra, 1996; Gupta *et al.*, 2007). Within these networks, digital platforms mediate interactions between actors (Parker *et al.*, 2016) and leverage innovation (Yoo *et al.*, 2010).

Several scholars have tried to classify platforms. De Reuver *et al.* (2018) distinguish platforms according to the industry connection:

(1) Social media platforms based on people interaction and experience sharing (e.g. Facebook).

(2) Operating system platforms based on the combination of operative systems that provide parallel or combined processes (e.g. Android and iOS in the Telco industry).

(3) Payment platforms that aim to simplify payment processes (e.g. PayPal, Apple Pay in the financial industry).

(4) Peer-to peer digital platforms to undercut the role of intermediaries in traditional transactions from mobility industry to tourism to finance (e.g. Uber, Airbnb).

Blaschke *et al.* (2019) execute a taxonomy of platforms identifying three archetypes classified on four-layered dimensions—namely, infrastructure, core, ecosystem and service dimensions (Kazan *et al.*, 2018; Karhu *et al.*, 2018). The infrastructure could be with a direct, indirect and open access (Constantinides *et al.*, 2018; Henfridsson and Bygstad, 2013). Respectively the infrastructure owner allows access, and intermediaries allow access, infrastructure devoid of permission. Core dimension refers to core artifacts of software and hardware. Karhu *et al.* (2018) distinguish in access openness and resource openness, indicating the access of third parties respectively to use the core artifacts to create platform augmenting derivatives and access core resources by forfeiting related intellectual property rights for the advantage of platform improvement. The ecosystem dimension refers to the complex network of the platform – owner, partner, end-user and provider – (Wareham *et al.*, 2014), differentiating the network in federated and private networks (De Reuver *et al.*, 2018). Despite the abundance of research in open innovation, few contributions explore it at inter-organizational level, and particularly with a focus on healthcare ecosystem, characterized by a dense network of relationships among public and private organizations (hospitals, companies and universities) (Secundo *et al.*, 2019). Respectively an open-loop ecosystem that mobilizes varied platform-augmenting third-party actors distributing value among federated; closed-loop ecosystems comprising an exclusive selection of private actors with the scope to protect services from unauthorized actors. Service dimension is intended as the benefits of one party (Williams *et al.*, 2008). Platforms could have an exchange orientation or a design orientation. The exchange orientation (Bapna *et al.*, 2017) corresponds to reducing transaction costs in direct actor-to actor exchanges. Design orientation (Karhu *et al.*, 2018) aimed to enable third parties to design platform derivatives and disseminate them to a large audience.

Based on the described variables, the taxonomy distinguishes in:

(1) orchestration platform;

(2) amalgamation platform;

(3) innovation platforms.

Orchestration platforms assemble federated networks with high levels of openness—both access or resource openness—derivatives. They rely on indirect access to existing digital infrastructures and are orientated to design.

Amalgamation platform assembles a private network of few private actors that cultivate and grow private businesses without the intervention of third parties. However, they are contingent on specific resources and capabilities to make the platform self-sustainable. They rely prevalently on direct access to existing digital infrastructures and are orientated to exchange.

Innovation platforms are a hybrid form of platform. They are prevalently open in including actors, in sharing resources and in adopting infrastructure. They aim to embrace process innovation to deliver digital service distinctively different from traditional industry's dominant process logic.

2.3 Digital platform driven innovation management model

Recent researchers state that one of the most important factors for achieving innovation performance in the digital economy are digital platforms (Jacobides *et al.*, 2019; Yudina and

Geliskhanov, 2019). Trabucchi *et al.* (2021) propose a framework to conceptualize the platform-driven innovation phenomenon, describing different platform roles in the innovation processes. Authors classify platforms as simplifiers, catalysts and enablers of innovation.

(1) Simplifiers homogenize pre-existing transactions, for example, re-value existing assets (Dell'Era *et al.*, 2021).

(2) Catalysts reveal to potential providers/buyers the existence of an unexploited market, facilitating matchmaking and the removal of frictions.

(3) Enablers create new forms of content and interactions. Usually, this innovation happens outside the platform owner, however allowing others to adopt innovation.

Previous scholars had developed more in-depth research of platform dynamics that lead innovation, exploring platform capability prevalently in influencing platforms users such as end-users, providers, owners or the entire industries. More precisely, a group of scholars refers to digital platform capability for describing the platform's role in capturing innovation for multiple platform stakeholders (Alegre and Chiva, 2008; Rai and Tang, 2010; Gawer and Cusumano, 2002; Jun *et al.*, 2021).

Yoo *et al.* (2012) affirmed the innovation of digital platform technology at the user and provider levels , arguing its relationship was based on the capabilities of digital platform due to the platform's ability to enable networking, data diffusion and knowledge absorption (Constantinides *et al.*, 2018). For instance, Cenamor *et al.* (2019) assess the indirect but positive effect of platforms on SMEs' performance via network capability. Digital platforms turn the focus of value creation toward the network, entailing a shift toward an externally oriented organization (Parker *et al.*, 2016).

In a similar vein, Rai and Tang (2010), Teece (2017, 2018a, b), Nambisan *et al.* (2017) sustain that digital platform capabilities enable and promote innovation performance in participant organizations, integrating key knowledge and using internal and external resources of the organization. Authors hint at an innovative effect also at the industry level since platforms help organizations face the rapid changes of the market efficiently and respond better to highly changeable market needs (Helfat and Raubitschek, 2018; Teece, 2018a, b). De Reuver *et al.* (2018) provided a similar intuition, sustaining the platform's ability to transform and innovate entire industries.

Helfat and Raubitschek (2018) analyze the dynamic capabilities of platform leaders/owners. According to Kroh *et al.* (2018) and Ravichandran (2018) digital platform capability may not improve firm performance directly but rather through dynamic capabilities. Helfat and Raubitschek (2018) provide a theoretical analysis that explains three dynamic capabilities of platform leaders – innovation, environmental scanning/sensing and integrative, explaining how these capabilities impact on innovation performance of the platform owner. Howells (2006) defined the innovation intermediary agency, "organization or body, which acted as an agent or intermediary between two or more parts in any aspect of the innovation process." Particularly innovation capability refers to the organizational or individual capability to set routines and practices that stimulate product, services and process innovation. This capability improves the ability of platform leaders to take advantage of innovation opportunities and threats. The environmental scanning/capability refers to the organizational or individual capacity to recognize emerging patterns in the environment and interpret these data accurately and quickly (Helfat and Peteraf, 2015). This means adequate product and services to environmental opportunities. Integrative capability refers to designing and transforming their business models, products, and ecosystems as a consequence of cross-side network effects. As an intermediary, digital platform carries out digital innovation in a dynamic ecosystem, and the

three complement each other and operate together. This capability supports interactions and relationships with external parties, enabling firms to align activities and products, resources and capabilities, investments and objectives with their partners, in addition to facilitating internal coordination within firms (Chen *et al.*, 2017). Most of the studies of these scholars focused on the role of dynamic capabilities of digital platforms, but in the evolving enterprises (such as healthcare), digital platforms were not enough to manage their data innovation research.

Recent research shows that digital platform capability can also positively affect an organization's other internal capabilities and transform industries. We propose a theoretical model (Figure 1) that considers in an overall manner the impact on platform dynamic capability on the user side and industry side. The efficient management of internal and external information flows facilitates opportunity discovery at the industry level and accelerates innovation at the user level (Mikalef and Pateli, 2017; Shu and Steinwender, 2019).

3. Methodology

3.1 The case study approach

We conducted a qualitative and explorative study in order to answer our research question on how digital platforms support firms in managing data innovation challenges. According to Yin (2003), the research method of the pilot case study is used as the first step of exploratory research to support studies in which the authors have not already defined specific propositions and hypotheses – as in this instance. This case adopts the abduction research scheme. Furthermore, other authors in the literature argue that a single case study can be useful to validate theoretical developments (Eisenhardt, 1989; Easton, 1998) by focusing on a special unit (Jacobsen and Sandin, 2002) to explore a new phenomenon in order to understand it (Cousin, 2005). In particular, there are studies that focus on a single case study, which can validate the development of new theories (Eisenhardt, 1989; Yin, 1994). In agreement with the statement, we focused on a special unit – a data-driven platform – validating the theoretical development of the effect of platform dynamic capabilities and trying to understand the role of the platform in managing innovation challenges.

We select a case of relevant importance, unique in its nature, to conspicuously explain a phenomenon still under investigation. We have defined this company as unique in that they have developed a data-driven platform operating in the health sector as we will describe in detail below. The selected case was Apheris AI GmbH which well represents the innovative role of data-driven platforms. The platform operated across a wide range of industries, such

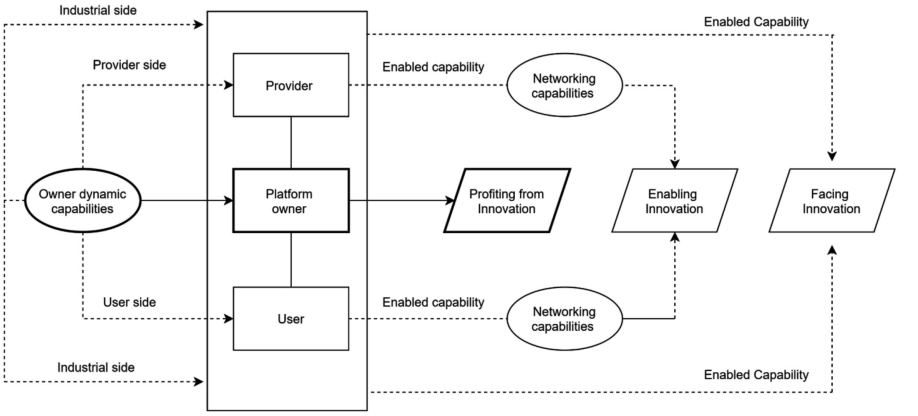

Figure 1.
Theoretical model

as Manufacturing, Material Sciences, Chemistry and Automotive, but the healthcare industry was the main focus of the platform. The choice was based on the fact that we were looking for a data-driven platform, operating in the health sector with the aim to propose innovative solutions for data management. In particular, the selection of this case was based on the fact that there are no other data-driven platforms capable of managing data in the health sector while protecting patient privacy. Apheris AI GmbH in fact, combines AI and innovation in data management, dealing with data challenges linked to privacy and protection. It acts as a bridge in the adoption and management of innovation in the complex European healthcare system (the General Data Protection Regulation), where data are hardly shared due to endogenous factors (i.e. Privacy, Intellectual property), while it proposes solutions to improve and speed up research and knowledge sharing. The European context, with respect to the American context, is more complex concerning privacy, protection and security aspects, thus offering a wide casuistry of data-driven innovation barriers and opportunities. For instance, healthcare privacy laws in the USA allow hospitals to share information with contractors and allow researchers to analyze patient data without express permission from those patients. Healthcare companies can use that information in any way they see fit, including to boost profits. In Europe, this is not the case.

Multiple sources of data collection were adopted to gain an in-depth understanding of the Apheris's dynamics. The documentation involved consisted of semi-structured, indirect interviews, company documents taken from the official company website, the official page of the social network (e.g. LinkedIn, Twitter) and online pitches on the YouTube channel. Based on this qualitative research approach conducted using primary and secondary data, we used multiple sources of evidence to triangulate data (Yin, 2003).

Semi-structured interviews were addressed to the founder and the marketing director. Using this sort of research instrument, we also gained the opportunity for the discussion to include areas that had not been planned by the interviewer. We wanted to provide a theoretical model and enrich them with a case study.This meant that we adopted an abductive research protocol. Distinctions between abduction and induction, and between phronesis and theory, were often elided in methodological discussion about case study. Making these distinctions clear offered a pathway for the better conduct of case study and for a less apologetic stance in its use. Case study can more unselfconsciously look to the anatomy of narrative for the justification of its processes and its conclusions (Thomas, 2010).

The data collected from the interview was compared with data collected from other secondary sources thus improving the validity of the data coding sources (Patton, 1999). First of all, we carried out a text analysis on the documents related to the case study. Secondly, we compared them with other information collected from the official social pages of the brand. In this way we were able to ask more specific questions during the interviews in order to get more details and information. Finally, we triangulated the data to strengthen the contextuality of our analysis model.

The data analysis was developed in a very precise and outlined order, using NVivo© 12 software to transcribe interviews and video pitches and to code and label data. The NVivo© 12 tool was also useful to discard data, not of interest with the reference literature (e.g. automotive data, chemistry data) and to identify key constructs from data. More specifically, we have followed the below process.

Interviews and pitches were transcribed, while other documents were directly uploaded on Nvivo as qualitative notes. After this phase, we coded data and then proceeded toward reducing codes into categories and concepts. Categories have given rise to enabled capabilities and innovation impacts, while concepts have given platform dynamic capabilities. The Nvivo model tools have supported us in creating a whole vision of platform capabilities, enable capabilities, level of action and impacts.

To discuss the role of the digital platform we firstly analyze platforms' characteristics according to Blaschke *et al.* (2019), secondly, we explore the platform's capabilities according to Helfat and Raubitschek (2018). In addition, we adopt the theoretical model proposed in Figure 1 to investigate the platform capability effect in terms of enabled capability and innovation impact on users, providers and the industry.

3.2 The case finding

Apheris AI Gmbh founded in Berlin, Germany by Robin Röhm and Michael Höh in 2019 presents itself as a start-up that enables companies to collaborate and analyze data without compromising privacy. The platform enables secure data analysis between organizations while keeping proprietary information private. With Apheris, organizations can build new data solutions and unlock entirely new insights from multi-party distributed data without compromising security and ownership. The company's mission is "*fundamentally change how companies collaborate securely and extract value from data"*. In fact, very often large amounts of very important data remain "locked" in the hands of the data owner due to factors such as privacy, legal or security, slowing down technological development, innovation and denying valuable progress. This is especially true in the health sector in Europe, where it is almost unthinkable to share data from one hospital to another due to very restrictive privacy regulations that treat such data as sensitive.

The team of Apheris AI GmsbH is composed of highly educated, very technical and scientific people with 60% having a Ph.D. The startup given the innovative idea has managed to achieve excellent results and be awarded among the best startups in numerous competitions and rankings. In fact, among the various rankings, it is reported that in 2020 it manages to place 18th out of 50 according to the ranking top 50 startups (https://www.top50startups.de/start-ups/ranking/2020/apheris) and in 2021 it is placed as 25th out of 30 startups according to the Forbes ranking (Forbes, 2021). Furthermore, CEO Robin Röhm stated that, given the surprising innovation in such a delicate sector, he managed to obtain financial support from leading European and US investors including LocalGlobe, MuleSoft founder Ross Mason's Dig Ventures and well-known faces such as Patrick Pichette, former CFO of Google and current board chairman for Twitter.

The Apheris AI platform has established several partnerships to innovatively propose solutions to existing problems. For example, on the occasion of the COVID-19 pandemic, it established a partnership with Openmined. Using specific technologies (e.g. Cryptography, Private Set Intersection), it was possible to transform the tracking data of people affected by the virus, preserving their privacy and generating an increase in the speed of information and response to reduce contagion. Another important partnership was made with Gaia-x, to propose a "Semantic Platform for Intelligent Decision Making and Operational Support in Control Centres and Situation Management" enabling resource planning, emergency communication, resource overload prediction, scenario simulation, advanced situation management and mitigation of critical supply chains with the privacy and data protection guaranteed by Apheris AI that will provide secure and privacy-compliant machine learning on distributed data.

4. Result

In this section, we provide an overview of representative quotes from the interviews and secondary data related to the analysis framework that allowed us to highlight the platform owner dynamic capabilities (innovation, scanning and sensing and integrative) emerged as key concepts from the quotations analysis that have given rise to enabled capabilities at various levels of actors involved (i.e. user, provider and industry). From an accurate analysis of collected data we also derived the impact of a new innovation or a response to challenge

linked to innovation. In particular, the analysis of the results showed that the platform dynamics capabilities, in particular innovation and integrative capabilities, enables learning capabilities (a) for different actors. In fact, for providers, the following quote is of particular interest: "*The MedTech company can continuously deploy new AI features and services to improve their products*" and for users and industry "*Through federated and privacy preserving training on diverse data from multiple hospitals, the anomaly detection models are more accurate and reliable, leading to clinical decision support systems suitable for precision medicine implementations*". These learning capabilities are capable of enabling innovation as they bring technological progress that creates a competitive advantage for the corresponding actors. The results show that the entire set of platform owner dynamic capabilities, enable networking capabilities (b) between different actors. In fact, using this platform, it is evident that there can be a collaboration between competing providers "*Valuable data spread out across many different companies who can share it due to regulatory constraints or fear of losing their intellectual property*". Radically innovating the health industry, lowering costs and reducing the time spent in finding new solutions "*The MedTech company avoids inefficiencies of complex legal and compliance reviews, thereby saving time and money*". Finally, by creating technological and non-technological innovations for different actors, the platform has proven to be an enabler of organizational capabilities (c) for different actors "*Apheris enables your organisation to carry out the complete range of data science operations on distributed, not directly accessible data and supports any data of any format*" creating new opportunities and challenges to be taken up in order to advance scientific and technological progress in the sector "*There's an untapped opportunity for organizations and that's gaining controlled access to high quality data that is owned by multiple parties so what we are building is a world where a data scientist can start using third party data*".

Concerning the innovation impact linked to enabled platform capabilities results show the role of platforms as an intermediary in (1) enabling innovation; (2) facing innovation; (3) overcoming challenge. Quotations, in fact, reveal that – in accordance with existing theoretical models – externalities of platform capabilities mainly regard the enabling of innovation and facing innovation at different levels. The enabling of innovation is triggered at the user, provider and industry levels; while the facing of innovation is mainly at the industry level. For instance, the founder states "*what we are building is a world where a data scientist can start using third party data" referring to enabling innovation at the user level or "[Apheris enables] potential follow-up initiatives for joint research between the partnering companies to further improve and accelerate drug discoveries*" referring also at industry level. New evidence concern the ability of the platform in overcoming innovation challenges. For instance, the Apheris manager states "*The MedTech company avoids inefficiencies of complex legal and compliance reviews, thereby saving time and money*" referring to the challenge of compliance; or states "*Apheris enables your organization to carry out the complete range of data science operations on distributed, not directly accessible data and supports any data of any format*" referring to multiple data source and format; or "*Apheris enables organizations to securely analyze distributed data while preserving the privacy and intellectual property and that means companies can save time and money*" referring to privacy and intellectual capital.

Table 1 contains the most representative quotes.

5. Discussion

Healthcare industry is a heterogenous, complex and fragmented network built on a large group of different specialists, and knowledge intensive actors. Accordingly, the implementation of digital platforms is an unstoppable transition. Several studies (Chen, 2019; Kuchler, 2020; Pearl, 2019) have investigated new value creation paths inhabited by digital platform applications. Extant studies emphasized the rising of new worth interactions within the systems and the

Platform owner dynamic capabilities	Representative quotes	Source	Levels of action (users, provider, industry)	Enabled capability	Innovation impact
Innovation capabilities	"Apheris AI breakdown the classical dependency on centralize data by cryptographic techniques and federated analytics"	Interview	-	-	Profiting from innovation
	"The Apheris Platform enables a more holistic patient view allowing for a personalized treatment approach (e.g. a genetic profile dependent medication choice and dosing scheme)"	Official site	Users and industry	Learning capability; organizational capability	Overcoming challenge; facing innovation
	"The MedTech company can continuously deploy new AI features and services to improve their products"	Official site	Provider	Learning capability	Enabling innovation
	"Through federated and privacy preserving training on diverse data from multiple hospitals, the anomaly detection models are more accurate and reliable, leading to clinical decision support systems suitable for precision medicine implementations"	Official site	Users and industry	Networking capability; learning capability	Overcoming challenge; facing innovation
	"Apheris enables your organization to carry out the complete range of data science operations on distributed, not directly accessible data and supports any data of any format"	Official site	User and provider	Organizational capability	Overcoming challenge
	"A higher discovery-rate of superior drug candidates by our big data approach leads to accelerated and more successful drug development	Official site	Industry	Learning capability	Facing innovation

Table 1.
Representative quotes

(*continued*)

Platform owner dynamic capabilities	Representative quotes	Source	Levels of action (users, provider, industry)	Enabled capability	Innovation impact
Scanning and sensing capabilities	"Apheris enables organizations to securely analyze distributed data while preserving the privacy and intellectual property and that means companies can save time and money"	Interview	User	Organizational capability	Overcoming challenge
	"Datasets containing medical images are highly sensitive and are siloed across multiple healthcare institutions (e.g. two different hospitals). They cannot share sensitive patient data because of compliance and security constraints"	Official site	User and industry	-	-
	"The MedTech company avoids inefficiencies of complex legal and compliance reviews, thereby saving time and money"	Interview	Provider and industry	Networking capability	Overcoming challenge
	"Valuable data spread out across many different companies who can share it due to regulatory constraints or fear of losing their intellectual property"	Official site	User and industry	Networking capability	Overcoming challenge
	"There's an untapped opportunity for organizations and that is gaining controlled access to high quality data that is owned by multiple parties so what we are building is a world where a data scientist can start using third party data"	Interview	Users	Organizational capability	Enabling innovation
	"Organizations today often lack access to the right data and typically lose time and money and very complex compliance processes"	Official site	Provider and industry	Organizational capability	Enabling innovation; overcoming challenge

(*continued*)

Table 1.

Platform owner dynamic capabilities	Representative quotes	Source	Levels of action (users, provider, industry)	Enabled capability	Innovation impact
Integrative capabilities	"Data powers everything in analytics and artificial intelligence. Large and diverse datasets are critical to building accurate machine learning models."	Interview	Industry	Networking capability	Facing innovation
	"Apheris partners with Gaia-X to shape the future of data ecosystems"	Official site	Provider	Networking capability	-
	"Analyzing a broad set of EHR and genomic data combinations can reveal new scientific insights potentially leading to new therapies"	Official site	Users and industry	Organizational capability; networking capability	Enabling innovation; overcoming challenge
	"Using the Apheris Platform, the two pharma companies can jointly train best-in-class protein-ligand interaction-models on their complementary data, resulting in highly generalizable models with strong interpretability"	Official site	Users and industry	Networking capability	Overcoming challenge
	"Apheris services are GDPR ready and feature capabilities that enable our customers, and their data collaboration partners to comply with GDPR and other laws and regulations."	Official site	Industry	-	-
	"Apheris Ai empowers your company to leverage the full potential of your most valuable asset data"	Official site	User	Organizational capability Learning capability	Overcoming challenge
	"Potential follow-up initiatives for joint research between the partnering companies to further improve and accelerate drug discoveries"	Official site	Users and industry	Networking capability	Enabling innovation

Table 1.

emergence of new procedures and standards for boosting innovation processes (Gleiss *et al.*, 2021). Although the existing literature does not provide evidence about the exploitation of data-driven innovation when a digital platform is adopted. In other words, the data play a crucial role within the process of platform implementation and development, therefore a large debate is needed about the way a healthcare network might harness the value-added generated by data.

Based on the analysis of the research results, this paper concludes that the dynamic capabilities of digital platforms (innovation capabilities, scanning perception capabilities and integration capabilities) stimulate new capabilities to a certain extent, build an effective network of healthcare participants and actively respond to the challenges of medical management innovation.

Despite the critical importance of development of data-driven applications for the healthcare industry, few studies have explored the role of certain capacity for driving the data-driven transition. The healthcare industry is very challenging for the exploitation of data-driven applications and experiments. A prominent issue is the scarcity of data. In fact, a single healthcare institution such as a hospital or a pharmaceutical company, should gather a certain amount of data for successfully running a new innovative data-driven application. This kind of difficulty is labeled by Chen *et al.* (2013) as a problem of data volume. The authors state that a data-driven application might address the issue of big volume or at the opposite the restricted amount of available data.

As we mentioned above, Chen *et al.* (2013) highlighted the trait of data dependency with the applications. Indeed, the authors named the data as structured data (e.g. time-series data), semi-structured data (e.g. XML data) and unstructured data (e.g. images). This segmentation enables us to emphasize the need to put attention on efficiently managing data by developing certain capabilities for a successful exploitation. Furthermore, a paramount challenge is coping with heterogenous sources of data (Despotovic *et al.*, 2018) or even worse the fragmentation of data. The recent debate on digital platforms faces the issue of complexity (Yunis *et al.*, 2018). Several lines of investigation have been adopted for understanding the concept. On the one hand, a group of researchers defends the thesis that digital technologies are not able, on their own, to provide direct advantages. In short, a firm or a network should take in consideration the need of information and communications technology (ICT)-based capabilities for implementing technologies and generating organizational change (Giotopoulos *et al.*, 2017; Mohd Salleh *et al.*, 2017). Just a couple of studies have faced the issue of ICT-based capabilities from the point of view of dynamic capabilities (Parida *et al.*, 2016; Ravichandran, 2018).

Although, the authors did not put the focus on the way we can better manage data, especially for certain application such as machine learning, which needs a particular data setting configurations, in this light, we have adopted the Helfat and Raubitschek's (2018) perspective for discovering how digital platform capability may drive a new reformulation of data-driven network management.

Drawing from extant literature we developed a theoretical model for investigating the research question and analyzing the case study of Apheris (Figure 1). Before proceed with the capabilities analysis we have defined the dimension and archetype of the Apheris AI platform. By adopting the Blaschke *et al.*' s study (2019)we have defined Apheris as a direct access platform, as it requires access fees and coordination between platform and infrastructure owners (Henfridsson and Bygstad, 2013); Apheris AI results to be a digital platform with access openness in the core dimension (Karhu *et al.*, 2018) since his logic is to spark innovation within the platform ecosystem and induce third-part actors (i.e. user/provider and industry) to use this new knowledge to co-innovate and thus also a federated network in the ecosystem dimension (Tiwana and Bush, 2014). Finally, it is a exchange-oriented platform, in the service dimension, as there is an exchange of data (i.e. intellectual property, electronic health records) in complex sectors (i.e. health and pharma sector) and between multiple actors (Tan *et al.*, 2015). The analysis of the dimensions also allowed us to analyze the platform archetype that corresponds to Apheris AI. In fact, it turned out to be an innovative-orchestration digital platform. Therefore, a hybrid between innovation and orchestration archetype enables co-opetition in particularly exclusive sectors by eliminating structural gaps and entry barriers, thus enabling learning capabilities and networking

capabilities between different players. Contributing to defining the platform as a hybrid was also the fact that it performs operations different from its core business to try to respond to the needs of the community and end-users. For example, it has developed a tool/app for tracking people in order to contain the spread of coronavirus infections, the source code of which has been made available free of charge to all, developers and companies alike, in open-source mode.

While, by adopting Helfat and Raubitschek approach (2018) we explore the platform's capability to generating innovation, while in response to the Cenamor *et al.* (2019), Gawer and Cusumano (2002) and De Reuver *et al.* (2018)'s propositions investigate if platforms capability triggers new capability to better manage innovation practices of platforms users and providers. We identify three dynamic capabilities, innovation, scanning and sensing and integrative. Some of these capabilities possessed by Apheris AI platform turned out to be able to activate new capabilities in platform actors: a) learning capability; b) networking capability; c) organizational capabilities.

Figure 2 shows the empirical model and illustrate new capabilities enabled indirectly by the platform's owner capabilities, such as organizational and learning capabilities. Furthermore, the figure offers a model that enriches the literature on innovation healthcare. Differently from Leone *et al.* (2021) and Schiavone *et al.* (2021) that provide evidence of how technologies (i.e. AI and digital tools) support in an innovative way the value creation of the entire healthcare system and the business model innovation; we illustrate a set of platforms' capabilities that enable, face and overcome innovation challenge involving key actors of the healthcare systems. The case of Apheris has been extremely interesting for the capacity to clearly show the contribution of enabled capabilities not only in enabling innovation but most of all, in overcoming the data-driven challenges in the healthcare industry. Specifically, the case study suggests that, starting from innovation, scanning and sensing, and integrative capabilities held by the platform owner, the level of action through the innovation process is reconfigured are at

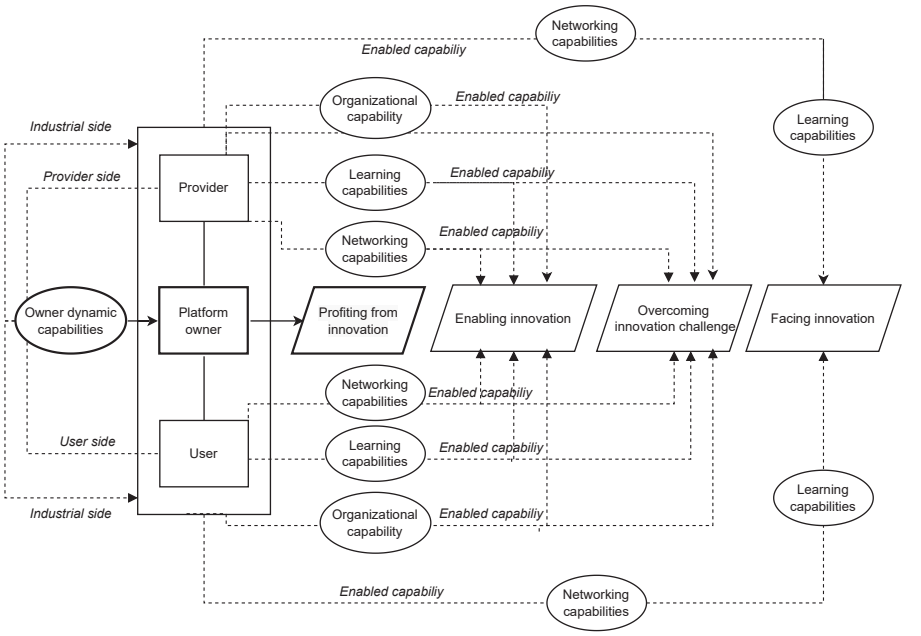

Figure 2.
The empirical model

three levels: industry and user and provider. These results confirm the complexity of platform networks because of the non-linearity of data-managing processes. In fact, the data flow is affected by a high degree of fuzziness. Therefore, a deep comprehension of enabled capacity has been needed. For instance, the quote "*Analyzing a broad set of Electronic Health Record (EHR) and genomic data combinations can reveal new scientific insights potentially leading to new therapies"* clearly reveals a new capability that is not only in favor of a single actor network. At the opposite, the quote unveils capabilities that affect and support at least two levels of action: specifically, provider and industry. Such contribution is full of novelty because the other studies did not concentrate the attention on the level of action so much as not overcoming the challenge of data-driven platform complexity.

Furthermore, our research highly contributes to the limited knowledge on the link between level of action and enabled capabilities. Indeed, the case study shows a deep relation with new capabilities such as learning, networking and organizational capabilities. The case study quote "*The Apheris Platform is architected and built for big data processing and supports cloud, multi-cloud and hybrid environments*" confirms that organizational capability plays a paramount role for overtaking one of the healthcare platform challenges, such as the adaptation to new hybrid and multifaceted milieu. The learning capability is even more clear from the case study evidence, in fact because of owner dynamic capabilities the other action level can train several new attitudes and expertise. At the base of this re-newment our research highlights the role of the learning capabilities in stimulating new positive and systemic effects. This is the case of creation of a private set of intersection data library that enhances several times the challenge of data privacy, data scaring, data scarcity and what matter the most the quality of data.

Especially, based on the literature on digital platform management employees' reactions to entrepreneurial leadership, our study underscores the crucial role of necessary capabilities in overcoming new innovation challenges especially for digital healthcare networks.

6. Conclusion

6.1 Theoretical implications

This research holds several contributions to the prevailing theory. It enriches the existing literature on innovation in healthcare. Schiavone *et al.* (2021) developed a multi-level framework for the healthcare ecosystem rearranging, extending the value co-creation process beyond coordination between different types of stakeholders and emphasize the results of digital networks. This paper contributes to the theory by adopting a new lens of analysis for coping with innovation challenges within the digital healthcare network. In fact, the investigation of Apheris case study has provided evidence for formulating a new theoretical perspective. By analyzing the dynamic capabilities of digital platforms, a healthcare ecosystem covering healthcare enterprises, participants and digital healthcare networks is constructed, so as to coordinate the entire ecosystem with data-driven innovation, which is conducive to the healthcare industry to actively respond to the challenges of data innovation management to a large extent. The digital technologies transition should be carried out, starting from owner capabilities, at all network levels of action. Such interpretation enables exploiting new additional and useful capabilities, specifically learning, organizational and network capabilities. This evidence might be supportive for new additional studies which pretend to zoom each effect per enabled capabilities. Secondly, this paper also provides a different interpretation of the innovation challenges of healthcare network. In the context of rapid digital development, healthcare, as an important livelihood industry, plays a self-evident role, but at the same time, it is also experiencing some innovative challenges. Among them, the most important is the management of medical data and information. Medical data and information are characterized by various forms, wide distribution and complex sources. How to deal with

these data and information is the focus of medical care industry. Furthermore, this paper can support digital transition management studies in complex environments. In other words, the healthcare sector is characterized by a great level of complexity and a high quality degree of knowledge. Under these circumstances we can draw evidence on digital platforms in complex environments. We provide a new point of view to tackle the study of digital platforms and value creation under the circumstances of knowledge intensive industry, sensitive data production and high level technologies. This article through to the digital platform used in medical care show the dynamic capability of multi-faceted analysis, from the website and interview to collect the data of information collecting and analysis, it is concluded that health care network innovation challenge is implemented based on the management of the whole system, and this kind of data management is needed to drive. In other words, this paper seeks to expand the literature on healthcare digital platforms by driving the innovation process through data-driven management refinement. The paper provides a new theoretical interpretation of innovation challenges for healthcare networks. In short, the paper moves the attention on data-driven innovations. This approach is full of novelty, the novelty comes from adopting digital platform dynamic capabilities for managing the healthcare data rather than technological or infrastructural points of view.

6.2 Managerial implications

This paper also advocates various managerial implications. Starting from the point of view of a single actor healthcare network, the investigation has expanded the perimeter of analysis beyond the lens of analysis of platform owners in favor of an overall overview of actors' networks. That kind of approach provides practical implications in supporting several healthcare players. First of all, the hospitals should harness the idea that new capabilities might come from the platform owner for filling the lack of expertise in data-driven innovation management. The scarcity of data, the heterogeneity of data or the data access are only a part of a tricky and complex scenario around the transition of hospitals toward digital platforms. The paper seeks to provide new helpful guidelines for structuring effective and coordinated networks of healthcare players. Furthermore, this kind of consideration concerns also the pharmaceutical companies that might be providers and consumers of data. The incidence of management innovation in the health care system is also a category to be considered. To a large extent, the incidence of management innovation in the health care system provides a reference. The case study remarks support this evidence in fact the interview overscores the needs of leveraging the full potential of the company's most valuable asset data. Results present data-driven platforms as intermediaries able to trigger actors' capabilities in overcoming industrial challenges linked to a data-driven scenario and in enabling innovation practice. Over mentioned capabilities unlock in fact participants in terms of networking, learning and organizing capability respect to innovation. Furthermore, their role is reflected also on the industry capability to face innovation issues. The results generate several implications in favor of new business model developers. In fact, the study of capabilities put the attention on specific value creation activities that might be considered for starting a new business model. Our work might be supportive in clarify what area of healthcare digital platform are ready to be more innovative and disruptive. That kind of phenomena is not full of novelty, although our paper put the attention on the possible driver tied to the capabilities for business model generation within healthcare systems.

The paper conceptualizes potential capabilities emerging from the healthcare network. This result is not only useful for the single actors but most of all for the management of public or private healthcare systems. In fact, the entire system gets higher and higher performance by providing fluidity to data-driven flow by fostering the data sharing or by enhancing the

standardization of data. The performance improvement concerns patient care, financial stability and innovation development.

6.3 Limitations and future research direction

Several limitations of the current research should be taken into consideration. Firstly, in this research, the data are collected from the perspective of a single actor network. On one hand, this is the most consistent point of strength, because Apheris is a health care start-up, it can collect data while keeping the company private. Although, on the other hand, this restricted point of view could not be effective for investigation on other players such as hospitals. This issue is just in part addressed in this paper by Apheris interview that albeit indirectly takes into consideration its partners' comments, opinions and remarks. Another limitation might affect the generalizability of finding beyond healthcare digital platforms. The paper must be positioned in the vein of study of healthcare innovation management. Although several findings might be extended to digital platforms of other industries, the healthcare scenario is full of specific features such as the higher level and number of specialists, or the heterogeneity of needed knowledge that suggests avoiding generalization beyond the healthcare innovation processes. Although that limitation might be a starting point for new future research concerning other industries. Furthermore, this paper is an explorative study for digging new evidence about data-driven innovation within healthcare systems. New further studies seem to be necessary, especially for investigating the impact of emergent new capabilities per each challenge. This paper opens the avenue to new quantitative studies that intend to measure and assess the performance of new digital platform configuration within healthcare systems.

References

Agogue, M., Berthet, E., Fredberg, T., Le Masson, P., Segrestin, B., Stoetzel, M., Wiener, M. and Ystroem, A. (2017), "Explicating the role of innovation intermediaries in the "unknown": a contingency approach", *Journal of Strategy and Management*, Vol. 10 No. 1, pp. 19-39.

Alegre, J. and Chiva, R. (2008), "Assessing the impact of organizational learning capability on product innovation performance: an empirical test", *Technovation*, Vol. 28 No. 6, pp. 315-326.

Arthur, W.B. (1989), "Competing technologies, increasing returns, and lock-in by historical events", *The Economic Journal*, Vol. 99 No. 394, pp. 116-131.

Bapna, R., Gupta, A., Rice, S. and Sundararajan, A. (2017), "Trust and the strength of ties in online social networks: an exploratory field experiment", *Management Information Systems Quarterly*, Vol. 41 No. 1, pp. 115-130.

Bibri, S.E. (2019), "The anatomy of the data-driven smart sustainable city: instrumentation, datafication, computerization and related applications", *Journal of Big Data*, Vol. 6 No. 1, pp. 1-43.

Blaschke, M., Haki, K., Aier, S. and Winter, R. (2019), "Taxonomy of digital platforms: a platform architecture perspective", *14th International Conference on Wirtschaftsinformatik, February 24-27, 2019*, Siegen.

Boudreau, K.J. (2012), "Let a thousand flowers bloom? An early look at large numbers of software app developers and patterns of innovation", *Organization Science*, Vol. 23 No. 5, pp. 1409-1427.

Boudreau, K.J. and Hagiu, A. (2009), "Platform rules: multi-sided platforms as regulators", *Platforms, Markets and Innovation*, Vol. 1, pp. 163-191.

Brettel, M., Friederichsen, N., Keller, M. and Rosenberg, M. (2017), "How virtualization, decentralization and network building change the manufacturing landscape: an industry 4.0 perspective", *FormaMente*, Vol. 12, pp. 47-62.

Brynjolfsson, E. and McAfee, A. (2014), *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, Norton and Company, New York, London, pp. 1-9.

Cao, Y., Steffey, S., He, J., Xiao, D., Tao, C., Chen, P. and Müller, H. (2014), "Medical image retrieval: a multimodal approach", *Cancer Informatics*, Vol. 13, CIN-S14053.

Cenamor, J., Parida, V. and Wincent, J. (2019), "How entrepreneurial SMEs compete through digital platforms: the roles of digital platform capability, network capability and ambidexterity", *Journal of Business Research*, Vol. 100, pp. 196-206.

Chen, A. (2019), "As tech companies move into health care, here's what to watch in 2019", *The Verge*, available at: https://www.theverge.com/2019/1/3/18166673/technology-health-care-amazon-apple-uber-alphabet-google-verily (accessed 22 June 2021).

Chen, J., Chen, Y., Du, X., Li, C., Lu, J., Zhao, S. and Zhou, X. (2013), "Big data challenge: a data management perspective", *Frontiers of Computer Science*, Vol. 7 No. 2, pp. 157-164.

Chen, T., Qian, L. and Narayanan, V. (2017), "Battle on the wrong field? Entrant type, dominant designs, and technology exit", *Strategic Management Journal*, Vol. 38 No. 13, pp. 2579-2598.

Ciborra, C.U. (1996), *Teams, Markets and Systems: Business Innovation and Information Technology*, Cambridge University Press, Cambridge.

Constantinides, P., Henfridsson, O. and Parker, G.G. (2018), "Introduction—platforms and infrastructures in the digital age", *Information Systems Research*, Vol. 29 No. 2, pp. 381-400.

Cousin, G. (2005), "Case study research", *Journal of Geography in Higher Education*, Vol. 29 No. 3, pp. 421-427.

Davenport, T.H., Barth, P. and Bean, R. (2012), "How'big data'is different", *MIT Sloan Management Review*, Vol. 54 No. 1, pp. 21-24.

De Reuver, M., Sørensen, C. and Basole, R.C. (2018), "The digital platform: a research agenda", *Journal of Information Technology*, Vol. 33 No. 2, pp. 124-135.

Dell'Era, C., Trabucchi, D. and Magistretti, S. (2021), "Exploiting incumbents' potentialities: from linear value chains to multisided platforms", *Creativity and Innovation Management*, Vol. 30 No. 1, pp. 31-46.

Despotovic, V., Walter, O. and Haeb-Umbach, R. (2018), "Machine learning techniques for semantic analysis of dysarthric speech: an experimental study", *Speech Communication*, Vol. 99, pp. 242-251.

Easton, G. (1998), "Case research as a methodology for industrial networks: a realist apologia", in Naude, P. and Turnbull, P. (Eds), *Network Dynamics in International Marketing*, Pergamon, Oxford, pp. 73-87.

Eisenhardt, K.M. (1989), "Building theories from case study research", *Academy of Management Review*, Vol. 14 No. 4, pp. 532-550.

Evans, D.S. and Schmalensee, R. (2013), *The Antitrust Analysis of Multi-Sided Platform Businesses (No. W18783)*, National Bureau of Economic Research, Cambridge, MA.

Forbes (2021), available at: https://www.forbes.at/artikel/forbes-ki-30-dach-2021-die-liste.html.

Gawer, A. and Cusumano, M.A. (2002), *Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation*, Harvard Business School Press, Boston, MA, Vol. 5, pp. 29-30.

Giotopoulos, I., Kontolaimou, A., Korra, E. and Tsakanikas, A. (2017), "What drives ICT adoption by SMEs? Evidence from a large-scale survey in Greece", *Journal of Business Research*, Vol. 81, pp. 60-69.

Gleiss, A., Kohlhagen, M. and Pousttchi, K. (2021), "An apple a day–how the platform economy impacts value creation in the healthcare market", *Electronic Markets*, Vol. 31 No. 4, pp. 849-876.

Gupta, A.K., Tesluk, P.E. and Taylor, M.S. (2007), "Innovation at and across multiple levels of analysis", *Organization Science*, Vol. 18 No. 6, pp. 885-897.

Hein, A., Schreieck, M., Riasanow, T., Setzke, D.S., Wiesche, M., Böhm, M. and Krcmar, H. (2020), "Digital platform ecosystems", *Electronic Markets*, Vol. 30 No. 1, pp. 87-98.

Helfat, C.E. and Peteraf, M.A. (2015), "Managerial cognitive capabilities and the microfoundations of dynamic capabilities", *Strategic Management Journal*, Vol. 36 No. 6, pp. 831-850.

Helfat, C.E. and Raubitschek, R.S. (2018), "Dynamic and integrative capabilities for profiting from innovation in digital platform-based ecosystems", *Research Policy*, Vol. 47 No. 8, pp. 1391-1399.

Henfridsson, O. and Bygstad, B. (2013), "The generative mechanisms of digital infrastructure evolution", *Management Information Systems Quarterly*, Vol. 37 No. 3, pp. 907-931.

Hermes, S., Riasanow, T., Clemons, E.K., Böhm, M. and Krcmar, H. (2020), "The digital transformation of the healthcare industry: exploring the rise of emerging platform ecosystems and their influence on the role of patients", *Business Research*, Vol. 13 No. 3, pp. 1033-1069.

Howells, J. (2006), "Intermediation and the role of intermediaries in innovation", *Research Policy*, Vol. 35 No. 5, pp. 715-728.

Jacobides, M.G., Sundararajan, A. and Van Alstyne, M. (2019), "Platforms and ecosystems: enabling the digital economy", Briefing Paper World Economic Forum.

Jacobsen, D.I. and Sandin, G. (2002), *Vad, hur och varför: om metodval i företagsekonomi och andra samhällsvetenskapliga ämnen*, Studentlitteratur AB, Lund.

Jun, W., Nasir, M.H., Yousaf, Z., Khattak, A., Yasir, M., Javed, A. and Shirazi, S.H. (2021), "Innovation performance in digital economy: does digital platform capability, improvisation capability and organizational readiness really matter?", *European Journal of Innovation Management*, Vol. ahead-of-print No. ahead-of-print.

Karhu, K., Gustafsson, R. and Lyytinen, K. (2018), "Exploiting and defending open digital platforms with boundary resources: android's five platform forks", *Information Systems Research*, Vol. 29 No. 2, pp. 479-497.

Katz, M.L. and Shapiro, C. (1985), "Network externalities, competition, and compatibility", *The American Economic Review*, Vol. 75 No. 3, pp. 424-440.

Kaushik, A. and Raman, A. (2015), "The new data-driven enterprise architecture for e-healthcare: lessons from the Indian public sector", *Government Information Quarterly*, Vol. 32 No. 1, pp. 63-74.

Kazan, E., Tan, C.W., Lim, E.T., Sørensen, C. and Damsgaard, J. (2018), "Disentangling digital platform competition: the case of UK mobile payment platforms", *Journal of Management Information Systems*, Vol. 35 No. 1, pp. 180-219.

Klein, J.D., Koletzko, B., El-Shabrawi, M.H., Hadjipanayis, A., Thacker, N. and Bhutta, Z. (2020), "Promoting and supporting children's health and healthcare during COVID-19–international paediatric association position statement", *Archives of Disease in Childhood*, Vol. 105 No. 7, pp. 620-624.

Klingenberg, C.O., Borges, M.A.V. and Antunes, J.A.V., Jr. (2019), "Industry 4.0 as a data-driven paradigm: a systematic literature review on technologies", *Journal of Manufacturing Technology Management*, Vol. 32 No. 3, pp. 570-592.

Kroh, J., Luetjen, H., Globocnik, D. and Schultz, C. (2018), "Use and efficacy of information technology in innovation processes: the specific role of servitization", *Journal of Product Innovation Management*, Vol. 35 No. 5, pp. 720-741.

Kuchler, H. (2020), "Can we ever trust Google with our health data?", *Financial Times*, London, available at: https://www.ft.com/content/4ade8884-1b40-11ea-97df-cc63de1d73f4 (accessed 16 June 2020).

Leone, D., Schiavone, F., Appio, F.P. and Chiao, B. (2021), "How does artificial intelligence enable and enhance value co-creation in industrial markets? An exploratory case study in the healthcare ecosystem", *Journal of Business Research*, Vol. 129, pp. 849-859.

Lo Presti, L., Testa, M., Marino, V. and Singer, P. (2019), "Engagement in healthcare systems: adopting digital tools for a sustainable approach", *Sustainability*, Vol. 11 No. 1, p. 220.

Madsen, L.B. (2014), *Data-driven Healthcare: How Analytics and BI Are Transforming the Industry*, John Wiley & Sons, New York.

McAfee, A., Brynjolfsson, E., Davenport, T.H., Patil, D.J. and Barton, D. (2012), "Big data: the management revolution", *Harvard Business Review*, Vol. 90 No. 10, pp. 60-68.

McIntyre, D.P. and Srinivasan, A. (2017), "Networks, platforms, and strategy: emerging views and next steps", *Strategic Management Journal*, Vol. 38 No. 1, pp. 141-160.

Mikalef, P. and Pateli, A. (2017), "Information technology-enabled dynamic capabilities and their indirect effect on competitive performance: findings from PLS-SEM and fsQCA", *Journal of Business Research*, Vol. 70, pp. 1-16.

Moeuf, A., Pellerin, R., Lamouri, S., Tamayo-Giraldo, S. and Barbaray, R. (2018), "The industrial management of SMEs in the era of Industry 4.0", *International Journal of Production Research*, Vol. 56 No. 3, pp. 1118-1136.

Mohd Salleh, N.A., Rohde, F. and Green, P. (2017), "Information systems enacted capabilities and their effects on SMEs' information systems adoption behavior", *Journal of Small Business Management*, Vol. 55 No. 3, pp. 332-364.

Nambisan, S., Lyytinen, K., Majchrzak, A. and Song, M. (2017), "Digital Innovation Management: reinventing innovation management research in a digital world", *Management Information Systems Quarterly*, Vol. 41 No. 1, pp. 223-238.

Ortt, R., Stolwijk, C. and Punter, M. (2020), "Implementing Industry 4.0: assessing the current state", *Journal of Manufacturing Technology Management*, Vol. 31, pp. 825-836.

Parida, V., Oghazi, P. and Cedergren, S. (2016), "A study of how ICT capabilities can influence dynamic capabilities", *Journal of Enterprise Information Management*, Vol. 29 No. 2, pp. 179-201.

Parker, G., Van Alstyne, M.W. and Jiang, X. (2016), "Platform ecosystems: how developers invert the firm", Research Paper (2861574), Boston University Questrom School of Business, Boston.

Patton, M.Q. (1999), "Enhancing the quality and credibility of qualitative analysis", *Health Services Research*, Vol. 34, 5 Pt 2, p. 1189.

Pearl, R. (2019), "Why big tech companies won't solve healthcare's biggest challenges", *Forbes*, available at: https://www.forbes.com/sites/robertpearl/2019/12/16/big-tech/ (accessed 20 June 2021).

Perez, C.E. (2002), "Health status and health behaviour among immigrants [Canadian community health survey-2002 annual report]", *Health Reports*, Vol. 13, p. 89.

Porter, M.E. and Heppelmann, J.E. (2014), "How smart, connected products are transforming competition", *Harvard Business Review*, Vol. 92 No. 11, pp. 64-88.

Powles, J. and Hodson, H. (2017), "Google DeepMind and healthcare in an age of algorithms", *Health and Technology*, Vol. 7 No. 4, pp. 351-367.

Rai, A. and Tang, X. (2010), "Leveraging IT capabilities and competitive process capabilities for the management of interorganizational relationship portfolios", *Information Systems Research*, Vol. 21 No. 3, pp. 516-542.

Ravichandran, T. (2018), "Exploring the relationships between IT competence, innovation capacity and organizational agility", *The Journal of Strategic Information Systems*, Vol. 27 No. 1, pp. 22-42.

Rochet, J.C. and Tirole, J. (2003), "Platform competition in two-sided markets", *Journal of the European Economic Association*, Vol. 1 No. 4, pp. 990-1029.

Schiavone, F., Leone, D., Sorrentino, A. and Scaletti, A. (2020), "Re-designing the service experience in the value co-creation process: an exploratory study of a healthcare network", *Business Process Management Journal*, Vol. 26 No. 4, pp. 889-908.

Schiavone, F., Mancini, D., Leone, D. and Lavorato, D. (2021), "Digital business models and ridesharing for value co-creation in healthcare: a multi-stakeholder ecosystem analysis", *Technological Forecasting and Social Change*, Vol. 166, 120647.

Scuotto, V., Caputo, F., Villasalero, M. and Del Giudice, M. (2017), "A multiple buyer – supplier relationship in the context of SMEs' digital supply chain management", *Production Planning and Control*, Vol. 28, pp. 1378-1388.

Secundo, G., Toma, A., Schiuma, G. and Passiante, G. (2019), "Knowledge transfer in open innovation A classification framework for healthcare ecosystems", *Business Process Management Journal*, Vol. 25 No. 1, pp. 144-163.

Shapiro, C. and Varian, H.R. (1998), "Versioning: the smart way to", *Harvard Business Review*, Vol. 107 No. 6, p. 107.

Shu, P. and Steinwender, C. (2019), "The impact of trade liberalization on firm productivity and innovation", *Innovation Policy and the Economy*, Vol. 19 No. 1, pp. 39-68.

Tan, B., Pan, S.L., Lu, X. and Huang, L. (2015), "The role of IS capabilities in the development of multi-sided platforms: the digital ecosystem strategy of Alibaba. com", *Journal of the Association for Information Systems*, Vol. 16 No. 4, p. 2.

Tao, F., Zhan, H., Liu, A. and Nee, A.Y.C. (2019), "Digital twin in industry: state-of-the-art", *IEEE Transactions on Industrial Informatics*, Vol. 15 No. 4, pp. 2405-2415.

Teece, D.J. (2017), "Dynamic capabilities and (digital) platform lifecycles", in *Entrepreneurship, Innovation, and Platforms*, Emerald Publishing.

Teece, D.J. (2018a), "Business models and dynamic capabilities", *Long Range Planning*, Vol. 51 No. 1, pp. 40-49.

Teece, D.J. (2018b), "Profiting from innovation in the digital economy: enabling technologies, standards, and licensing models in the wireless world", *Research Policy*, Vol. 47 No. 8, pp. 1367-1387.

Thomas, G. (2010), "Doing case study: abduction not induction, phronesis not theory", *Qualitative Inquiry*, Vol. 16 No. 7, pp. 575-582.

Tiwana, A. and Bush, A.A. (2014), "Spotting lemons in platform markets: a conjoint experiment on signaling", *IEEE Transactions on Engineering Management*, Vol. 61 No. 3, pp. 393-405.

Tiwana, A., Konsynski, B. and Bush, A.A. (2010), "Research commentary—platform evolution: coevolution of platform architecture, governance, and environmental dynamics", *Information Systems Research*, Vol. 21 No. 4, pp. 675-687.

Trabucchi, D. and Buganza, T. (2018), "Data-driven innovation: switching the perspective on big data", *European Journal of Innovation Management*, Vol. 22 No. 1, pp. 23-40.

Trabucchi, D. and Buganza, T. (2021), "Landlords with no lands: a systematic literature review on hybrid multi-sided platforms and platform thinking", *European Journal of Innovation Management*, Vol. 25 No. 6, pp. 64-96.

Trabucchi, D., Buganza, T. and Pellizzoni, E. (2017), "Give away your digital services: leveraging big data to capture value new models that capture the value embedded in the data generated by digital services may make it viable for companies to offer those services for free", *Research-Technology Management*, Vol. 60 No. 2, pp. 43-52.

Trabucchi, D., Buganza, T., Muzellec, L. and Ronteau, S. (2021), "Platform-driven innovation: unveiling research and business opportunities", *Creativity and Innovation Management*, Vol. 30 No. 1, pp. 6-11.

Valentina, M.d.R., Abreu, S.T., Luz, T.G., Fogliatto, S.F., Tonetto, M.L. and Daniel, S. (2021), "Digital technologies: an exploratory study of their role in the resilience of healthcare services", *Applied Ergonomics*, Vol. 97, pp. 1-13.

Van Alstyne, M.W., Parker, G.G. and Choudary, S.P. (2016), "Pipelines, platforms, and the new rules of strategy", *Harvard Business Review*, Vol. 94 No. 4, pp. 54-62.

Van Dijck, J. and Poell, T. (2016), "Understanding the promises and premises of online health platforms", *Big Data and Society*, Vol. 3 No. 1, 2053951716654173.

Wareham, J., Fox, P.B. and Cano Giner, J.L. (2014), "Technology ecosystem governance", *Organization Science*, Vol. 25 No. 4, pp. 1195-1215.

Wehde, M. (2019), "Healthcare 4.0", *IEEE Engineering Management Review*, Vol. 47 No. 3, pp. 24-28.

Williams, K., Chatterjee, S. and Rossi, M. (2008), "Design of emerging digital services: a taxonomy", *European Journal of Information Systems*, Vol. 17 No. 5, pp. 505-517.

World Health Organization (2020), "Digital health platform handbook: building a digital information infrastructure (infostructure) for health", available at: https://apps.who.int/iris/handle/10665/337449.

Yin, R. (1994), *Case Study Research*, 2nd ed., Sage Publishing, Beverly Hills.

Yin, R. (2003), *Case Study Research*, 3rd ed., Sage Publishing, Beverly Hills.

Yoo, Y., Henfridsson, O. and Lyytinen, K. (2010), "The new organizing logic of digital innovation: an agenda for information systems research", *Information Systems Research*, Vol. 21 No. 4, pp. 724-735.

Yoo, Y., Boland, R.J. Jr, Lyytinen, K. and Majchrzak, A. (2012), "Organizing for innovation in the digitized world", *Organization Science*, Vol. 23 No. 5, pp. 1398-1408.

Yudina, T. and Geliskhanov, I. (2019), "Features of digital platforms functioning in information-digital economy", *IOP Conference Series: Materials Science and Engineering*, IOP Publishing, Vol. 497, No. 1 p. 012104.

Yunis, M., Tarhini, A. and Kassar, A. (2018), "The role of ICT and innovation in enhancing organizational performance: the catalysing effect of corporate entrepreneurship", *Journal of Business Research*, Vol. 88, pp. 344-356.

Zhou, F., Lim, M., He, Y. and Pratap, S. (2019), "What attracts vehicle consumers' buying: a Saaty scale-based VIKOR (SSC-VIKOR) approach from after-sales textual perspective?", *Industrial Management and Data Systems*, Vol. 120 No. 1, pp. 57-78.

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