

Innovation adoption in inter-organizational healthcare networks – the role of artificial intelligence

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Abstract

Purpose – This paper explores innovation adoption in inter-organizational healthcare networks. The authors develop theoretical speculations to investigate better the role of artificial intelligence (AI) as an innovative tool to improve buyer-supplier relationships, creating better performance outcomes.

Design/methodology/approach – The research is based on a theoretical investigation aiming at exploring the role of AI-based solutions for managing buyer-supplier relationships. The conceptual approach allows us to identify some research streams (e.g. co-working collaborations in supply chain management) by proposing a matrix that helps clarify the analysis's directions.

Findings – The results show the importance of AI that can help the operator in accessing supplier information, including current prices, available stocks, and delivery status, thereby reducing the risk of information asymmetry. AI is intended not only as a technology tool but also as an innovative solution to promote business relationships and support vertical alliances through the value chain between buyer and supplier.

Originality/value – This paper can help healthcare actors examine the choices behind their operational strategies by providing transparency of the activities and availability of information in real-time. Finally, our study reflects the future directions to enhance the cooperation and innovation adoption among healthcare operators.

Keywords Innovation adoption, Buyer-supplier relationships, Inter-organizational healthcare networks, Artificial intelligence

Paper type Literature review

1. Introduction

The shock caused by the COVID-19 pandemic continues to propagate globally posing a worldwide public health emergency. The healthcare scenery is shifting, and the entire ecosystem is faced with enormous challenges regarding the innovations adoptions to manage



the vast array of data available and the competence to extract the important set of information that will truly support intelligent decision-making. For instance, to optimize processes as inventory availability, most healthcare organizations are approaching the use of vendor-managed inventory (VMI) to make the best in a system dynamic perspective (Tyan and Wee, 2003; Angulo *et al.*, 2004; Klein, 2012). This business model represents a cooperative strategy at the most efficient cost to reduce the bullwhip effect in a buyer-supplier collaboration within inter-organizational networks. For these reasons, the human element, including behaviors and skills, is considered as a key factor to implement the strategic alliance and make it work (McHugh and Brotherton, 2000; Adams, 2001; Kumar *et al.*, 2012). The adoption of VMI is surely one of the most striking examples of what we are analyzing (Klein, 2012).

In this vein, vertical alliances are important tools from which companies can benefit, but stability is a fundamental element for this to happen. Buyers maintain friendly relationships with suppliers; they constantly measure the satisfaction level of their suppliers. Effectively, an unsatisfied actor (seller or buyer or both) will attempt to move to a more satisfactory practice and this may influence the stability of the collaboration (McHugh *et al.*, 2003). Best buyers' practice-knowing suppliers' business more than suppliers' own employees. The skill is to implement efficient co-working collaborations in order to develop competitive advantages. McHugh *et al.* (2003) argued that powerful buyers can seriously damage organizational health. The authors provide evidence that it is fundamental to promote communication structures that motivate dialogue, consultation, and employee participation in decision-making.

On the other hand, the changes in innovation adoption have encouraged reflection on the transformation of the industry, its characteristics, and dynamics. These innovative practices in the health context are a significant opportunity to face several industry issues and create value (Christensen *et al.*, 2009). This statement is based on the need to make the sector more efficient, gaining improved operational flexibility to face better the unprecedented disruption caused by the COVID-19 emergency (Yu *et al.*, 2020). Thus, the coronavirus pandemic requires excellent effort from the healthcare sector, which has to deal with considerable uncertainties in supply and demand. The risk usually does not affect only one organization, but it has a broader impact (Ahlqvist *et al.*, 2020). For these reasons, the importance of inter-organizational cooperation through the support of innovative tools (e.g. artificial intelligence) is becoming more and more relevant, especially for the existence of uncertainty in maintenance services and performance-based services (Kreye, 2019). Among other things, specific forms of interaction include increased investments in the healthcare context and effective co-modality (e.g. vertical alliances) in creating international innovation networks (McHugh *et al.*, 2003; Biemans, 2018). Previous research has not been focused on exploring non-care directed IT solutions in the healthcare industry. Nowadays, ICTs adoption provides knowledge-sharing benefits to increase and support vertical channel strategies among buyers and suppliers involved in complex systems (Roberts, 2000; Landaeta Olivo *et al.*, 2016; Lenka *et al.*, 2017).

This study focuses the attention on the role of artificial intelligence (AI) solutions for improving the buyer-supplier relationships in traditional practices of e-healthcare programs emphasizing the patient and the personalization of his care (Meskò *et al.*, 2018; Wehde, 2019; Leone *et al.*, 2021) and helping the development of the industrial revolution (Makridakis, 2017). Indeed, the research question is: "how AI-based solutions within the healthcare sector may contribute to the buyer-supplier relationships?". To reach this goal, we followed different steps. First, we structured a theoretical background about innovation generation and adoption. After we developed theoretical speculations (King and Walsh, 1993) focusing on the role of AI as IT-based services that improve the numerous forms mentioned above of cooperation in the healthcare sectors. Indeed, the results show how AI-based solutions are fundamental to improving buyer-supplier relationships in the healthcare sector. Our study stresses the importance of this technology that can help the operator in accessing supplier information, including current prices, available stocks, and delivery status, thereby reducing

the risk of information asymmetry. Research about these topics has evolved through different research perspectives, including the use of AI not only as just technology tools but also as an innovative solution that can promote business relationships and support vertical alliances through the value chain between buyer and supplier.

The following sections are organized as follows: after illustrating the theoretical background (Section 2), we developed theoretical speculations (Section 3) by exploring AI-based solutions to support the strategic alliances among different actors involved in the inter-organizational healthcare networks. Section 4 reports the discussion of our study and proposed a conceptual model for future studies. In the last sections of the paper, the implications for future research (Section 5) and the main conclusions (Section 6) are described.

2. Theoretical background

Healthcare industry innovation has long been recognized. Despite significant advances in medical services and technologies, the sector continues to provide opportunities for innovation and new product development (Herzlinger, 2006; Leone *et al.*, 2021; Schiavone *et al.*, 2021). These opportunities, differently from other industries, were not always recognized due to the lack of interactions among the users/actors in the healthcare system.

Before deep in the analysis of the importance of inter-organizational networks in the innovation process, a focus on what is innovation is needed. Schumpeter (1934) suggests the existence of five types of innovation: introduction of a new good, opening a new market, acquiring a new source of supply, introducing a new method of production, and the organization of an industry, while other studies (Evangelista and Sirilli, 1995; Cooper *et al.*, 1994) define innovation if the service or product is new to the company. Part of the literature argues that innovation is divided into two parts: innovativeness and capacity to innovate (Rogers, 1995; Tamayo-Torres *et al.*, 2010) while Lynn and Gelb (1997) argues that innovation is the “tendency of an individual consumer to adopt new products before large numbers of others do”.

If we consider the role and objectives of the healthcare actors, we could agree that innovation in healthcare could be defined as Thakur *et al.* (2012) attested as “*those changes that help healthcare practitioners focus on the patient by helping healthcare professionals work smarter, faster, better and more cost-effectively*”.

In conclusion, many authors tried to explain what is innovation in healthcare and their definitions were moving into a range going from something very broad to the most specific technical innovations (Suanj, 2000), moving from the adoption phase and focusing on the actors that are included in it.

Based on this first introduction, our theoretical background will proceed with a focus on the generation and adoption process of innovation while including the context of the inter-organizational networks.

2.1 Generating and adopting innovation in inter-organizational networks

Innovation is considered as a process divided into different phases, i.e. generation, implementation, and adoption, including multiple interactions created by different actors (Doloreux, 2004; Omachonu and Einspruch, 2010).

Starting from the generation process, it includes ideas and creativity to give birth to an idea and the initial pilot test of the innovation. The implementation is the moment that states the transaction from the idea to the action, including the new in the routine and facing the challenges in order to implement and improve the initial idea. This is particularly important for the adoption in what is including the spread of the innovation not only internally but to the whole healthcare system, spreading it across organizations (Rogers, 1995; Plsek, 2003).

In the past, innovation generation was mostly related to the ideas within a firm, not considering the outside environment or customer/patients. Nowadays, it is not a surprise that

many ideas are generated directly from the users, who are better aware of the weaknesses or the gaps to be filled to improve the service/product (Schiavone, 2020; Escobar *et al.*, 2021).

It should be noted that an invention's success mostly requires access to assets that are complementary to creative assets (Tece, 1986). For this reason, inter-organizational and cross-sectoral networks started to be considered as a critical strategy (Dewick and Miozzo, 2004) to achieve economies of scale or merge and integrate diverse skills, technologies, and competencies (Mancinelli and Mazzanti, 2009; Kaminski *et al.*, 2008) and speed up innovation widening the access to expertise and resources. In particular, there has been tremendous growth in the use of external networks by firms of all sizes (Hagedoorn, 2002) to adopt new technologies by innovation managers (Kalantari, 2017; Huesig and Endres, 2018). Networking with external actors (suppliers, customers, and other partners) dramatically affects the degree of innovation novelty (Nieto and Santamaria, 2010) and are fundamental in all the phases of innovation creation but it affects deeply the creation/generation processes (Bullinger *et al.*, 2004), and more generally, on innovation achievement (Becker and Dietz, 2004) and adoption.

Inter-firms networking can have different forms (Hadjimanolis, 1999; Kaufmann and Todtling, 2002; Doloreux, 2004), and the inter-organizational linkages of this collaboration could be vertical, horizontal, or lateral (Hadjimanolis, 1999). Different types of partners have other effects and results on the innovation process (Tether, 2002). For example, some studies suggest that cooperation forms with ones located downstream and upstream in the value chain are conducive to embodied innovation spillover through commercial trading and the value-adding process (Rao, 2001).

Organizational learning plays a fundamental role in generating innovation and even more when different players interact, promoting knowledge sharing (Fang and Zou, 2010; Roberts *et al.*, 2012). Some exciting research underlines the value of the well-known concept of absorptive learning capability (Cohen and Levinthal, 1990) and the joint learning capability, two different types of learning capacity, in enhancing the creation of Innovation (Clauß, 2012; Choi *et al.*, 2019).

In the healthcare industry, characterized by complexity and uncertainty, partners need to create a shared vision to take advantage of opportunities for change, encouraging innovative practices while managing risk (MacLeod *et al.*, 2019). It is exciting to reflect on the different actors of the buyer-supplier relationship in generating and adopting the innovation. Nowadays, innovating in products, organizations, and supply chains is the key to success and holding a competitive advantage for firms. Vertical cooperation is a way to create value and achieve impossible goals in isolation and obtain resources. This meaning has a more excellent value in this specific industry, contributing to HC organizational performance and customer satisfaction (Justino *et al.*, 2019).

2.2 Interorganizational networks and buyer-supplier relationships in the healthcare context

Following the conceptual analysis, it is evident that the primary literature about inter-organizational and cross-sectoral networks is related to supply chain management (SCM). The reason is associated with the fact that vertical interfirm networks are often analyzed by many authors using an SCM background. The aim is to improve the understanding of multiple and different elements, such as the strategic role of an alternative organizational form other from vertical integration to reduce costs and the relationship that a company develops with its suppliers (McHugh *et al.*, 2003) and the way to evaluate and improve it (Knight *et al.*, 2017). This stream of literature has emphasized the need to improve supply chain practices to achieve the best results to the large number of benefits resulting from vertical channel strategies (Grundischi *et al.*, 2014; Salema and Buvik, 2016; Kros *et al.*, 2019). For instance, the need to balance efficiency and effectiveness, especially in inventory management and implementation and adoption of new operational initiatives, pushed the

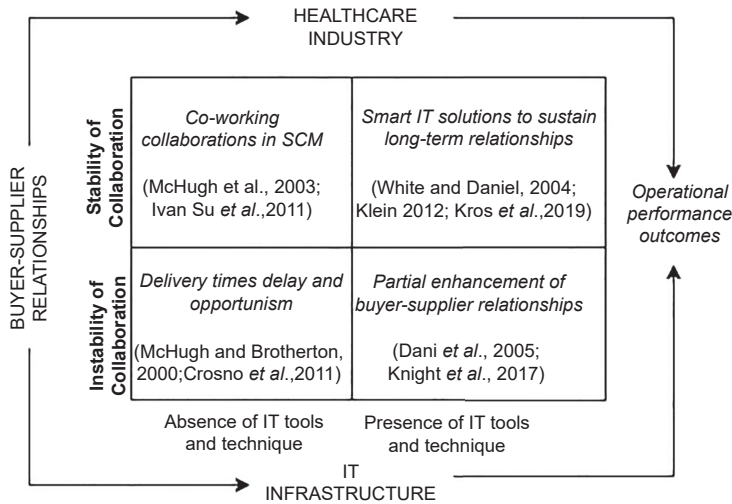
healthcare managers to install industrial dispensers (IVMs Industrial Vending Machines), commonly known as automatic drug dispensing systems (Kros *et al.*, 2019). This technology replies to the need to improve supply chain management operationally and because it has a positive influence on healthcare operator performance. First, the machines provide healthcare operators with immediate access to standard and critical healthcare supplies, combining them with inventory control and monitoring. These latter are crucial in the healthcare industry for multiple reasons: technology and regulation in this area are rapidly changing, creating obstacles to developing inventory forecasts. In addition, healthcare is characterized by the uncertainty that derives from the different mix of patients and emergencies that cannot be known in advance.

Many scholars tried to focus on the impact that buyers and suppliers have on innovative processes. Azadegan and Dooley (2010) argue that suppliers are becoming more responsible in supporting innovative practices, both at a product and process level. On the other hand, buyers propel suppliers' creative attitudes, encouraging them to adopt innovation (Henke and Zhang, 2010). This effort positively influences information sharing and communication among the partners in the Supply Chain (Kim and Chai, 2017). If we look closer at the healthcare sector, cooperation between buyer and supplier is a positive factor. Indeed, some studies find that "*continuous improvements in innovation with the cooperation of supplier could result in the implementation of SC management successfully*" (Fongtanakit *et al.*, 2019). This topic has become even more crucial because of the pandemic.

For this reason, managers should face the trade-off between standard routines and critical inventory, which can affect service levels and endanger patient care improving an efficient purchasing system (Salema and Buvik, 2016). Knight *et al.* (2017) argued that strategic relationships could eliminate the number of repetitive purchases made by an organization, identifying logistical processes external to the purchasing process that translates into savings. At the same time, these vertical channels involve a significant amount of information that could be better managed using new technologies whose importance is based on this awareness, as we argued in this paper. Indeed, Kros *et al.* (2019) also affirmed that future scholars should explore how healthcare operators work in innovative ways with suppliers to address new topics in healthcare supply chain management. On the other hand, limited commitment to cooperation will lead to a less effective performance by suppliers. This is even more common when VAs are international, including partners from different countries. Indeed, Dani *et al.* (2005) explored electronic reverse auctions (E-RA's), a coveted supply contract where suppliers from across the world can participate. This type of global outsourcing has gained immense popularity in the purchasing community, especially for buyers under pressure from their companies to reduce supplier prices.

Furthermore, we identified four research directions depending on the stability or instability of collaboration and the presence or absence of IT tools and techniques for the adoption of innovation (see Figure 1).

For example, co-working collaboration between both actors is also necessary to maintain satisfaction and stability. For these reasons, immediate action needs to be taken when either side detects a problem because the ability of supply personnel to implement effective strategic alliances is fundamental to get the most out of its supplier force (McHugh *et al.*, 2003). Following this research direction, Ivan Su *et al.* (2011) attested the importance of the logistics innovation process model may include not just customers but also suppliers and may serve as an alternative to outsourcing. On the other hand, recent scholars analyzed the instability of collaboration by investigating the factors in the buyer-supplier relationship which influence the perception of seller's opportunism when the latter engages in unclear selling acts (Crosno *et al.*, 2020). This may lead to delay in delivery times by creating uncertainty of the healthcare routines in the vertical channel strategy and negatively influencing the parties' perceptions involved in the cooperation.



Source(s): Our elaboration

Figure 1.
A matrix for research
directions of buyer-
supplier relationships
in healthcare

3. Theoretical speculations about the role of artificial intelligence

Healthcare sectors show the influence of e-marketplaces on dyadic buyer-supplier relationships (White and Daniel, 2004). As for the consequences that this technology creates and the impact on performance, as previously mentioned, the IVM solves the higher costs that typically characterize hospitals that maintain higher inventory levels than other industries, creating inefficiencies without improving patient care. Companies can also offer a solid social and economic service and build innovative solutions between customer and supplier firms to increase value, lower total costs and achieve mutual benefits with trust and commitment (Kros et al., 2019). Drawing on the research model attested by Klein (2012), who deepen the analysis of internet-based purchasing applications for facilitating buyer-supplier relationships, we focus on the antecedents of IT infrastructure and operational performance outcomes. More specifically, we explored particularities and features of the role of AI that are worth being studied concerning inter-organizational relations in the healthcare sector. As described in the theoretical background, some research directions focus on the impact of AI on the world of work from an operational, strategic, and economic point of view, while others look at the application of these technologies and their consequences in buyer-supplier relationships. Some scholars have chosen to deepen only one of these lenses, while others have made the effort to use both in such a way as to understand the extent of the use of AI not only at the level of technology and services, but also to understand how this has gone to redesign the workplace and to create vertical alliances within the healthcare system.

In order to design a well-structured analysis, it is necessary to develop theoretical speculations about the role of AI in inter-organizational healthcare networks. This primary step is crucial, in our opinion, to develop an understanding of how AI and AI-based services are to be considered factors with an essential role for the vertical channel strategies in the healthcare industry. There are many AI tools and techniques that assist either actor in moving to efficient positions. These innovative instruments can relatively less purchase time and effort required to establish price, reducing owner skill level of procurement personnel required (Dani et al., 2005). A risk could be that the supplier is not motivated to invest time for long-term relationships and energy to develop the buyer's products. Referring to the stability

of the collaboration in inter-organizational healthcare networks and the presence of IT tools, Klein's work (2012) argued that IT infrastructure is an innovative instrument for supporting the business practices' daily operations. These tools can improve operational performance derived from several variables such as the delivery times, the reduction of transaction costs, and the improvements in purchasing contracts. The author argued that the organization's ability to access information promptly is a strategic initiative to solve problems in the supply chain of existing users, such as understaffed customer service.

As Klein (2012) showed, the IT infrastructure is a relevant resource that affects systems assimilation. Drawing on these assumptions, AI is the solution to improve operational performance in hospitals through a direct and fast buyer-supplier relationship. As Cockburn *et al.* (2018) argued, "Artificial intelligence may greatly increase the efficiency of the existing economy. But it may have an even larger impact by serving as a new general-purpose 'method of invention' that can reshape the nature of the innovation process and the organization of R&D". The implementation of collaborative SCM practices by healthcare actors can support inventory challenges. The sharing of key success factors such as information, technology, and experience, can help the organization through improved quality management (Klein, 2012; Stefani *et al.*, 2019; Kros *et al.*, 2019). AI could be the best innovative solution to create value for different actors (e.g. buyer, supplier, patients, physicians) (Lehoux *et al.*, 2014; Huang and Rust, 2018; Leone *et al.*, 2021).

AI elaborates documents in a digital format, which can be accessed by computer means at any time, and it's playing a fundamental role to improve buyer-supplier relationships in a value co-creation perspective. Specifically, the use of AI technologies could improve clinical and financial outcomes for many of our partners of health system helping the overall patient experience for those who are served by the systems we interact with (e.g. buyer and supplier) (Makridakis, 2017; Meskò *et al.*, 2018; Chen and Decary, 2019). For these reasons, AI support several types of strategic alliances (Min, 2010; Song *et al.*, 2010; Quan *et al.*, 2018; Montes and Goertzel, 2019) with actors involved in B2B service systems to improve their operations and co-create value. On the other hand, value creation depends on the complete understanding of patients' present and future necessities and meeting the needs better than competitors. Indeed, these machines can also impact the well-being of older people (Hill *et al.*, 2015).

Therefore, we can argue that AI is of crucial importance as it is an innovative driver able to implement the operational performance of companies involved in vertical alliances and address the challenges that the dynamic and international context poses to entrepreneurs. This aspect is even more true since the healthcare sector is an area in which numerous and different innovations can emerge.

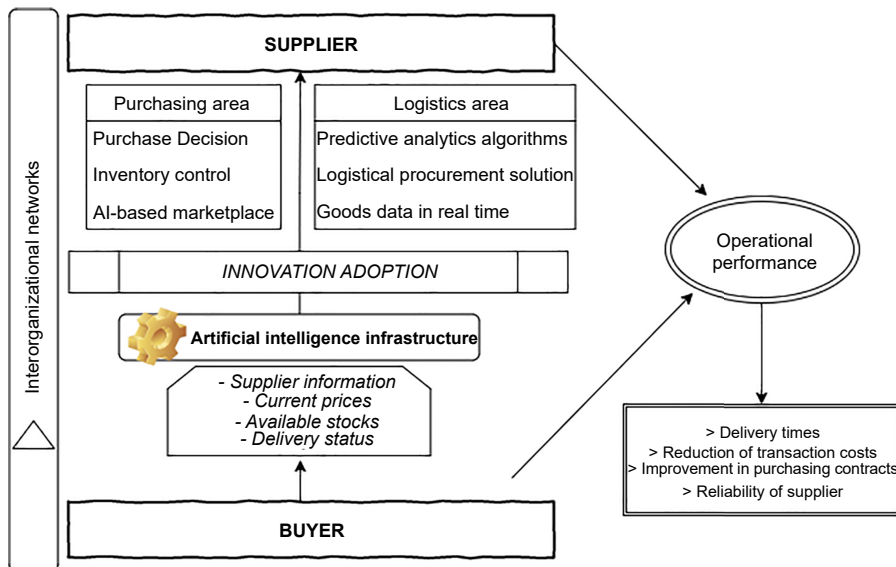
4. Discussion

Many research papers deepen the analysis of the evolution in buyer-supplier relationships in inter-organizational healthcare networks (McHugh *et al.*, 2003; Klein, 2012; Kros *et al.*, 2019). Technological changes influence the vertical channel strategy and improve operational performance (Klein, 2012; Carr, 2015). Therefore, IT solutions are key factors of business process management since furnish inputs to each step of the process lifecycle. This study attempts to revise management literature by deepening the innovation studies regarding the role of AI-based solutions in buyer-supplier relationships in healthcare.

The conceptual analysis attested that a solid field of literature is related to the adoption of new technologies within inter-organizational networks (Salema and Buvik, 2016; Kros *et al.*, 2019; Makridakis, 2017; Leone *et al.*, 2021). This evidence is shown on the topic of vertical alliances that are often investigated by many scholars using a SCM organizing framework to improve the comprehension of multiple and different perspectives, such as the strategic or operational role of an alternative alliance form to reduce costs and achieve a competitive

advantage. We explored the role of AI-based solutions in this field by examining literature that attests to the SCM's improvement as an effective consequence that future buyer-supplier relationships can improve efficiency performance using the data provided by this technology. With our article, we highlight the complexity of the vertical interfirm alliances to help healthcare operators be aware of the great importance of these relations on their performance outcome, developing the right strategy to implement their competitive positions involving AI tools to manage them better. Indeed, we contribute to extending previous studies (Adams, 2001; McHugh *et al.*, 2003; Oumlil and Williams, 2011; Klein, 2012) exploring the future use of AI systems as technology tool of collaborations in the vertical channel strategy. The analysis also explores the opportunities regarding this AI use that contains a great number of information to collect and codify in order to reduce the risk of errors and information asymmetry during the buyer-supplier cooperation (see Figure 2).

Specifically, the analysis supported by theoretical speculations for future practices attested AI helps health professionals have direct access to supplier information, including current prices and reducing delivery times. AI is a widely discussed subject today because of the technological advances that have affected the various sectors (Makridakis, 2017; Mesko *et al.*, 2018; Tubaro and Casilli, 2019). As a matter of fact, the AI is increasingly used in service contexts, reshaping and innovating it (Casares, 2018; Huang and Rust, 2018; Leone *et al.*, 2021). Among the many envisaged future research, we outline and contribute to this one by deriving a conceptual model to understand how AI-based solutions can support buyer-supplier relationships (Figure 2). Since healthcare is one of the industries most impacted by AI-based solutions, we focus on this service context to analyze the support of AI in the vertical channel strategy. Our conceptual approach also shows many different researchers are interested in understanding how this particular technology is overcoming the limits among digital, physical and biological areas. That AI is having a tremendous and pervasive impact on many industries is a matter of fact. It suffices to look at the deluge of academic articles, reports and white papers, news in the media, and success stories over the internet,



Source(s): Our elaboration

Figure 2.
The future of buyer-
supplier relationships
adopting AI
infrastructure: a
conceptual model

and one can immediately grasp the magnitude of such an industrial revolution (Becerra-Fernandez and Sabherwal, 2011; Meskó *et al.*, 2018; Huang and Rust, 2018; Leone *et al.*, 2021). What is not clear, however, is how it is doing so, and what is the impact in the future of digital buyer-supplier relationships in service business contexts and this represents the contribution of our article in the literature about innovation adoption in inter-organizational networks. Digital transformation in the vertical channel strategy describes the deep-seated changes in purchasing (Gobbi and Hsuan, 2015) and logistic areas, especially regarding the industrial and organizational activities, processes, and competencies. This aspect is required to seize the opportunities and respond to the challenges engendered by the new digital paradigm (see Figure 2). Their impact in operational performance is multifaceted: from reducing transaction costs to the improvements in purchasing contracts through reliability and the traceability of the supplier. AI infrastructures allow monitoring the delivery status by showing available stocks and supplier information. For these reasons, buyer-supplier relationships can improve by using these digital solutions as enablers of value co-creation in complex service systems and providing organizations with the key critical inputs for each step of their lifecycle.

5. Implications for future research

Drawing on the above-reported results and conceptual model, some implications for future research can be advanced. Healthcare is one of the main business contexts in which many organizations worldwide started to adopt and use such smart IT solutions in order to improve their diagnostics, processes, and operations. The healthcare industry constitutes a rather unique range of adjacent business networks (e.g. pharmaceuticals, patients care, medical equipment) whose main actors could regularly interact through long-term buyer-supplier relationships. As affirmed by Leone *et al.* (2020), there have been changes in the market access process to combat the COVID-19 emergency in order to maintain the efficacy of the medicines made available for COVID-19 patients. Indeed, the authors showed the application of a digitalized process during this pandemic which reduced bureaucracy by overcoming the hierarchical structure of the market access in order to have a more flexible collaboration among the national agency and the local hospitals. These are proofs of the close relation between healthcare performance and the use of IT solutions to support buyer-supplier relationships to sustain the health level of society and its economic development (McHugh *et al.*, 2003; White and Daniel, 2004; Klein, 2012). Hence, the choice to start our analysis from Klein's paper (2012) who underlined the importance of IT from an operational point of view, considering the consequences on this buyer-supplier relation.

Part of the literature of our analysis focused on the various strategic alliance orientations, dynamics, and effects in the corporate buying sector of healthcare institutions (White and Daniel, 2004; Oumlil and Williams, 2011). Healthcare has been rarely investigated from the industrial and innovation perspective, emphasizing how the relations between buyer and supplier are developed and implemented. This study offer implication for scholars involved in innovation and management studies by presenting a conceptual framework that shows the adoption of AI-based solutions to improve buyer-supplier relationships within the inter-organizational networks in the healthcare context. Actors involved in these relationships need to face the rapid technological change and the uncertainty that characterize the healthcare sector. Thus, a close collaboration among the actors of the vertical channel could be essential for the successful development and the future adoption of the right AI-based industrial services able to satisfy a specific market need or to exploit a given business opportunity. As we previously described, an important implication for healthcare practitioners could be the correct use of these smart IT solutions as tools to diminish the operational distance among actors involved in the supply chain. Hence, the great opportunity to avoid informative asymmetry causes time and performance loss. These issues are crucial for the healthcare sector which due

to the unique mix of elements characterizing it – is influenced by a rapid change in technology and regulation. Healthcare operators need to face uncertainty and volatility to better manage the impossibility of creating forecasts and making plans. As some authors argued, one of the critical issues distinguishing this industry is the need to solve the trade-off between standard routines and new practices (Salema and Buvik, 2016). In addition, the reduced distance among actors can implement knowledge transfer and acquisition, supporting the creation of new technology and sustaining the use of AI-based services to generate a superior performance level and enforce the innovation propensity to create and use innovation.

6. Limitations and future research

This study is not without limitations. Firstly, theoretical speculation could be proven in the future by analyzing case studies to investigate the actual improvement in the actors' performance. Moreover, given the great importance of regulation for the healthcare sector, case analysis could highlight the variations in AI-based services for different operators who are subjected to different rules. A cross-country study or a more specific one focusing on a precise stage of the supply chain can add precious knowledge to better examine the role and importance of AI in healthcare vertical interfirm relations.

On the other hand, the analysis allowed us to add an overview of the literature production and consequent temporal change characterizing this topic. This analysis will deepen the issue by examining the literature production in these fields, understanding its growth and characteristics, to explore future practices. Thus, future research could regard the exploitation and the study of the Industry 4.0 technologies (e.g. big data, cloud computing, and so on) to explore the different types of value exchanged among buyers and suppliers. This is an important element to consider for implementing vertical alliances between these different actors involved in service sectors as healthcare. Other scholars have not in-depth analyzed the healthcare industry's usage of non-care directed IT solutions. AI machines can support the operational performance in hospitals, developing predictive models to prevent errors and facilitating inter-organizational interaction in the vertical channel strategy.

7. Conclusions

Many of the papers we collected stressed the importance of new technologies that can help the operator access supplier information, including current prices, available stocks, and delivery status, thereby reducing the risk of information asymmetry (see Figure 2).

The interaction between buyer and supplier happens for various reasons, such as the timely exchange of essential products at a competitive price (McHugh *et al.*, 2003; Dani *et al.*, 2005). Indeed, a positive effect is the availability of many suppliers and a stable supply market. This is even more important because individual strategic purchasing opportunities could translate into collaborative relationships to improve purchasing processes within the organization (Gobbi and Hsuan, 2015; Knight *et al.*, 2017). AI-based solutions can face some complex problems, especially in the healthcare sector: risks and control costs are high, and there is a need for quality care. These aspects are crucial because the "risk perception influences communication, trust, and the governance of a collaboration[...] and collaboration fluency affect collaboration fluency" (Grudinschi *et al.*, 2014).

Finally, yet importantly, this study aims at implementing the knowledge about the topics of VAs in the healthcare sectors, analyzing the state-of-art of literature, and deepening the understanding in order to give a clear research framework. In our opinion, this latter can help researchers to have a clear examination of the contributions on these topics. This paper underlines not only the characteristics and dynamics of the paper contribution in the previously chosen period, but it presents also the most important streams of research that

were – and still are – used in order to investigate the past, present, and future of the vertical collaborations in the selected industry. Thanks to this study, researchers can improve the analysis of the next directions that these collaborations should follow and how this latter can be implemented through the use of AI to create positive effects on the supply chain management and on firms – and more in general actors’ – performance.

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