Technovation xxx (xxxx) xxx

Contents lists available at ScienceDirect

Technovation

journal homepage: www.elsevier.com/locate/technovation

Blockchain for value creation in the healthcare sector

Rosanna Spanò [a,*], Maurizio Massaro [b], Silvia Iacuzzi [c]

[a] Department of Economics, Management, Institutions, Federico II University of Naples, Naples, Italy
[b] Department of Management, Ca' Foscari University of Venice, Venice, Italy
[c] Department of Economics and Statistics, University of Udine, Udine, Italy

ARTICLE INFO

Keywords:
Value
Value creation
Value appropriation
Healthcare
Digital transformation
Blockchain

ABSTRACT

The healthcare sector is a complex ecosystem in which multiple stakeholders have to interact, and digital transformation is providing new ways for those actors to cooperate. Among the different new technologies, blockchain is one of the most discussed in a confrontation between true believers and skeptics. To shed light on the question of how blockchain technology can contribute to value creation in the healthcare sector, this paper investigates 33 companies from a sample of 2404 enterprises founded by professional incubators and accelerators. Whitepapers, websites, and weblog discussions are analyzed using content analysis. Focusing on companies financed by professional investors reduces the noise coming from short-term investments and frauds that sometimes follow blockchain initiatives. The findings show four different approaches to value creation: endogenous hedonistic value, public-private conflict mitigation, utilitarian/instrumental value, and social value.

1. Introduction

Although the existing literature has improved our understanding of diverse aspects of digital transformation, a detailed picture of the existence and consequences of the phenomenon remains missing in several contexts (Bagnoli et al., 2019; Dal Mas et al., 2021; Secundo et al., 2021). According to Sebastian et al. (2017, p. 198), "Most big old companies' digital transformations are at an early stage … [and] … in most industries, the vast majority of established companies' revenues still come from traditional products and services." The healthcare sector is no exception, and despite the growing number of publications on the topic, the entrepreneurial and managerial implications of digital transformation remain unclear (Cobianchi et al., 2020; Elia et al., 2020a; Kraus et al., 2021; Nambisan, 2017).

Blockchain has been defined as an "open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way. The ledger itself can also be programmed to trigger transactions automatically" (Iansiti et al., 2017, p. 2). In the healthcare sector, blockchain has been considered one of the most promising technologies due to its capability of handling, sharing, and processing personal health information (Tandon et al., 2020a). Interestingly, despite being considered a "foundational technology" (Iansiti and Lakhani, 2017), several scholars have highlighted that the expectations around blockchain might be exaggerated, and companies should take a conservative approach (Petersen et al., 2021). Although blockchain has been recognized as one of the most interesting technologies within the digital transformation hype, a skeptical approach has emerged (Farnoush et al., 2021; Lee et al., 2020).

One of the main problems recognized by scholars is the actual ability of blockchain to create value and define how different organizations will benefit from the value created (Dal Mas et al., 2020; Mačiulienė and Skaržauskienė, 2021; Schlecht et al., 2021). Within the healthcare sector, value creation is even more complex due to the interaction of multiple actors in a co-creation process (Ramaswamy and Ozcan, 2018) and to the hybrid nature of such knowledge intensive organizations, operating at the boundaries between the private, public, and nonprofit domains (Campanale et al., 2021; Grossi et al., 2019; Vakkuri and Johanson, 2020; de Waele et al., 2021). Interestingly, value creation in the healthcare sector is still contested due to the multiplicity of goals, interests, and values at play (Meynhardt and Jasinenko, 2020; Cabral et al., 2019; Porter, 2010).

Ensuring that public, profit, and nonprofit organizations collaborate to create value is a significant challenge in the healthcare sector, and blockchain technology could facilitate the collaboration of different actors in providing healthcare services. However, skeptical positions are emerging from various research fields (Nguyen et al., 2021). For

* Corresponding author.,
E-mail addresses: rosanna.spano@unina.it (R. Spanò), maurizio.massaro@unive.it (M. Massaro), silvia.iacuzzi@uniud.it (S. Iacuzzi).
URL: https://www.docenti.unina.it/rosanna.spano (R. Spanò).

https://doi.org/10.1016/j.technovation.2021.102440
Received 2 August 2021; Received in revised form 8 November 2021; Accepted 12 December 2021

example, Lord (2018, p. 1) has stated: "Beyond security and privacy, there are numerous important challenges related to blockchain that we must discuss as an industry, such as the financial and environmental costs of implementing these systems, the need for a single blockchain standard or the challenges of compounding misdiagnoses and low-quality care over time, exacerbating disparities in underserved populations."

To shed light on this topic, this research aims to answer the following research question: "*how can blockchain be used within the healthcare sector to create value among different actors?"* This paper thus investigates how value is created through blockchain and who can benefit from it. It can therefore be framed within the general research question of the special issue: "digital transformation of the healthcare industry," providing a specific view on blockchain technology and how this technology can create value for public, profit, and nonprofit organizations.

To answer the research question, we employ a qualitative study technique that attempts to construct rather than test theory. We selected 33 cases from the database Crunchbase. The paper is novel for several reasons. First, new technologies lack a track record of practical implementation, and actors shape value standards based on their potential rather than proof of execution (Borup et al., 2006). Within emerging technologies, distinguishing between hopes and real opportunities can be difficult. To solve this problem, this paper focuses on incubators' investments in profit and nonprofit startups that are employing blockchain as a key element of their value proposition. We believe that focusing on startups financed by professional organizations could help us consider the most promising aspects of blockchain and reduce the noise of pure hope. Investigating how blockchain can create value and who can benefit from the value created could help the literature by providing new perspectives on its implementation.

The results indicate that blockchain value creation potential in healthcare covers a wide range of areas, achieving greater compliance, efficiency, and collaboration among actors, organizations and institutions, as well as greater quality, trust, and accountability. This allows us to argue that blockchain can be regarded as a real contributor to healthcare ecosystems development for the foreseeable future.

The rest of the paper is organized as follows. The next section provides an overview of previous studies on the complex and multifaceted debate on value creation in healthcare, while also considering the hybrid nature of these organizations, and highlights the potential of blockchain applications in the field. The methods used are described in the following section. The key outcomes are shared in the finding and discussion sections. The paper ends with a conclusion section.

2. Value creation in healthcare: The potential of blockchain

2.1. The nuanced concept of value in healthcare

Over the last few years, rising pressures have put health systems worldwide under scrutiny due to the challenges derived from rising costs and scientific, political, and economic changes, or ethical issues and demands for greater patient safety and care for human well-being (Kirkpatrick et al., 2009; Kuhlmann and Annandale, 2012). In addition, an aging population is increasing the burden on national programs and reinforces the emphasis on more efficient and more effective health systems (Yang and Hsiao, 2009). Healthcare services are thus increasingly dealing with issues relating to the quality that any system is (or should be) able to offer to its citizens (Simpson, 2002; Tait and Lester, 2005) and their evolving role from mere users to co-producers of value (Porter, 2010). In the healthcare domain discourses of value have become widespread, often recalling what Meynhardt (2009, p. 212) has comprehensively discussed:

> "Public value is value for the public. Value for the public is a result of evaluations about how basic needs of individuals, groups and the society as a whole are influenced in relationships involving the public. Public value then is also value from the public, i.e. 'drawn' from the experience of the public. The public is an indispensable operational fiction of society. Any impact on shared experience about the quality of the relationship between the individual and society can be described as public value creation. Public value creation is situated in relationships between the individual and society, founded in individuals, constituted by subjective evaluations against basic needs, activated by and realized in emotional-motivational states, and produced and reproduced in experience-intense practices."

Along with this view, a countervailing debate about public value and public value creation has developed in recent years, with several interesting elements. For example, Cabral et al. (2019) in the introductory editorial to their special issue, comment upon the complexity and nuanced interpretation of public value and public value creation. They show how the articles included in the volume may suggest directions for further research to define value, and how private and public value creation may differ. In particular, they highlight interesting areas that deserve attention, relating to the fact that public value creation evolves endogenously. It can also be created at multiple interacting levels and horizons. Finally, it can be pursued by actors in private institutions as well as being derived by contractual arrangements shaping public-private interactions. Moreover, they highlight that public value creation depends upon effective governance of resources and collaborations. The authors conclude that a greater understanding of public value is crucial for the progress of society and that more research on comprehending in full the above-cited dynamics is highly recommended.

Meynhardt and Jasinenko (2021) take Meynhardt (2009) conceptualization of public value and develop and validate a twelve-item public value scale, empirically applying it to assess its potential. The above conceptualization provides subjectively based micro-foundations of public value that are theoretically connected to the macro-level (i.e., the public level) and are structured in four psychologically based dimensions: the moral-ethical, political-social, utilitarian-instrumental, and hedonistic-aesthetic. As the authors clarify, this conceptualization of public value based on basic needs is not bound to any specific institutional sector or cultural context. They test their model in four different sectors, on the one hand arguing its broad applicability and on the other hand contending that more empirical applications in diverse settings are relevant for future advancements.

Bearing in mind the importance of these conceptualizations, the complexity of healthcare necessitates taking into account a greater multiplicity of perspectives and a more nuanced conception of value(s), beyond the public dimension briefly touched upon above. Indeed, if the comprehension of value and valuation-related issues generally requires distinguishing between processes of assessment (in which things undergo judgements of value) and processes of production (in which things are produced so as to be of value) (Vatin, 2013), this is even more intriguing and intricate in healthcare, where organizations operate at the intersection between the public, private, and nonprofit sectors (Moore, 2000).

These circumstances allow us to qualify healthcare organizations as hybrid organizations, which combine different and not necessarily converging objectives, logics, funding systems, professionals, types of control (both financial and social), and values related to different institutional logics, possibly (and often) competing and diverging (Campanale et al., 2021; Grossi et al., 2019; Vakkuri and Johanson, 2020). Hybrid healthcare organizations attempt to pursue heterogeneous values such as financial returns delivered to shareholders and use value delivered to customers, the achievement of the politically mandated mission of the organization, and the fulfillment of citizens' aspirations, as well as the achievement of social purposes and the satisfaction of donors' desires. Healthcare is also a domain that features multiple knowledge-intensive dynamics (Secundo et al., 2019a,2019b)

that lead to highly peculiar organizations with special traits that make them unique but hardly complicate the full understanding of value-related issues (Grossi et al., 2019; de Waele et al., 2021). Coherently, the debate around value(s) in healthcare is still in turmoil due to the skepticism still spreading among the various actors in the healthcare field.

On the one hand, what counts as quality and value in health, especially in light of the persistent and pervasive push towards cost-reduction and effectiveness, is still under contention (Lee, 2010). On the other hand, issues of treatment and prevention, the quality of clinical/surgical/therapeutic procedures, the greater focus on rehabilitation, and life-after-treatment have progressively acquired more importance (Porter, 2010). In hybrid healthcare organizations, actors struggle with conflicting targets and overlapping sets of priorities and pressures from public opinion that mainly relate to issues of access to services, profitability, high quality, cost containment, safety, convenience, the centrality of the individuals, and patient satisfaction (Galvagno and Dalli, 2014; Grönroos, 2012; McHugh et al., 2016; Porter, 2010). Over the last few years, the words *value* and *quality* have progressively acquired a meaning beyond simplistic economic or financial savings. They include the need to reduce expenses in light of the outcomes and to prevent any adverse effects in terms of ineffective care in its broadest sense (Ken Lee et al., 2016; Porter, 2010). These outcomes are multidimensional and need to be conceived and interpreted considering the context-specific conditions of access to care and equity of treatment, the whole care cycle, and exogenous aspects relating to patient behaviors (e.g., adherence to recommendations and patient reports and monitoring), comorbidities, involvement of care givers, other stakeholders' role, and perceived degree of patient satisfaction and well-being (Ken Lee et al., 2016; Khodadad-Saryazdi, 2021; Wegner, 2016). Consequently, fulfilling improved levels of quality and at the same time securing cost containment is the key to achieving high and multifaceted value in healthcare for all of the actors involved and supporting the sustainability of any health system (Porter, 2010).

Value creation, in such a broad sense, implies that crucial dimensions relate to ethical dilemmas and emotional involvement of patients and caregivers; the need for accessible, complete, and timely clinical and personal information; the demand for greater coordination between institutions, specialist centers, physicians, other healthcare professionals, and patients. Full availability of data concerning the alternatives available, as well as the need for shared and accepted programs, procedures, and indicators to evaluate the quality and the costs of services, can no longer be neglected (Spanò et al., 2018).

Along with such an awareness, the healthcare domain has progressively acknowledged a new approach based on the involvement of patients, playing an active and aware role in value creation processes (Janamian et al., 2016a; Janamian et al., 2016b; van Woezik et al., 2016; Zhang et al., 2015). This debate is far from over. For example, how to fulfil the expectation for improved value creation in healthcare through patient involvement is still under contention, especially considering that service innovation in healthcare is highly complex (Yang and Hsiao, 2009). The literature advises also that this is not only a matter relating to patients: it touches upon a broad number of subjects and institutions that could and should better cooperate and progressively recognize the nature of ecosystems in healthcare services (Frow et al., 2016; Joiner and Lusch, 2016; McColl-Kennedy et al., 2017).

Literature thus warns that even if there has been a proliferation of studies highlighting the role of patients, other types of actors are likely to affect value creation processes. The separation between providers and patients is being overcome, and a strict logic of closeness for healthcare ecosystems is consolidating rapidly (Joiner and Lusch, 2016; Russo Spena and Mele, 2019). From this perspective, the constitutive and consolidating role of digital technologies in healthcare ecosystems is clearly paramount in the broad and solid value creation processes that include, but are not limited to, greater efficiency and effectiveness (Yang and Hsiao, 2009).

2.2. The role of digital technologies: A focus on blockchain potential benefits ad unintended effects

Several studies have devoted attention to revolutionary technologies' potential and disruptive impact on entrepreneurship, organizational management and control practices, and individual behaviors and performance (Cohen et al., 2017; Elia et al., 2020b; Nambisan, 2017). Digital technologies enable the automation of data processes to completely reshape decision-making processes in a broad range of fields and increasingly permeate organizations and foster a paradigm shift in their functioning (Giones and Brem, 2017; Lombardi, 2019; Rippa and Secundo, 2019).

Before tapping into the specific benefits relating to the reliance on digital technologies in healthcare, it is worth acknowledging that such technologies (e.g., artificial intelligence, big data, and blockchain) have also a "dark side" and may have "unintended effects," especially in the case of hybrid entities operating at the intersection between the public, private, and nonprofit sector. Hybrid organizations, among which healthcare organizations play a pioneering role, increasingly embrace innovative principles and implement digital transformation strategies to improve service delivery in terms of increased transparency, improved efficiency, and better communication with and engagement of users (Yoo et al., 2010). Nevertheless, factors such as low literacy and income levels, geographical restrictions, lack of physical access to technology, the digital divide, inner cultural adversity to radical changes in given contexts and cultures are likely to power a divide that forces many individuals and/or organizations to remain excluded (Hinings et al., 2018; Spicer et al., 2021).

Healthcare investments in digital technologies pave the way for newer models of healthcare delivery, positively affect the levels of productivity, and offer foundations to consolidate coordination and collaboration among the many different stakeholders involved, as well as providing new, extensive, custom-made, ubiquitous, integrated, and seamless services at any time and at lower costs for possibly greater numbers of patients (Yang and Hsiao, 2009). These kinds of potential benefits explain why healthcare providers have moved rapidly into digital technological innovation (Gong and Ribiere, 2021) that can reduce the power of distance as a critical factor; help overcome information and communication barriers' ease diagnosis, treatment, and prevention; reduce time and occasions of hospitalization; improve adherence; and enhance follow-up and education (Khodadad-Saryazdi, 2021). Several authors also highlight digital technologies that play a relevant role in healthcare, beyond the strict medical and health context by constituting a proper market for health (Chen et al., 2014; Oropallo et al., 2021). This is a development long wished for but never fully achieved through reforms, especially in the European context, and could push towards improved performance of the whole system.

Among all the digital technologies that have appeared over the last 15 years, the debate on the benefits and threats of blockchain in healthcare has recently gained momentum. Interestingly, most of the studies' efforts have "focused on blockchain application in healthcare belong to the hard sciences, while the focus on the managerial implications remains limited" (Massaro, 2021, p. 9). Additionally, the literature ascribes different types of benefits, either patient or organization related, to blockchain in the healthcare domain (Massaro, 2021).

Regarding the patient side, the literature (Abu-elezz et al., 2020; Beinke et al., 2019; Esmaeilzadeh and Mirzaei, 2019; Hylock and Zeng, 2019) emphasizes the value of blockchain as this system enhances the security of health information by securing patient data over decentralized peer-to-peer networks, minimizing the chances of a data breach, and securing identity and authentication. Beyond these types of advantages, which are strictly related to the intrinsic characteristics of the technology and applicable to many different settings, blockchain constitutes a viable solution for personalized medicine and could ease the sharing of information with and from different actors. Accordingly, other advantages lie in the improved ability of physician to track

patients and monitor their health status and take immediate action in case of an emergency.

Regarding organization-related benefits, previous studies (Abu-elezz et al., 2020; Beinke et al., 2019; Esmaeilzadeh and Mirzaei, 2019; Hylock and Zeng, 2019; Mackey et al., 2019; Tanwar et al., 2020) have highlighted that blockchain can support the secure sharing and exchange of patient information, ease the management of clinical trials, improve the traceability for the pharmaceutical supply chain management, and contribute to improving the medical insurance industry.

At the time of writing, the COVID-19 pandemic is in its fourth wave, and the systemic complexity of this crisis is showing how blockchain can help build together organizational and patient-side value creation. Unexpected, systemic, and complex events require emergent knowledge strategies (Bratianu and Bejinaru, 2021), which, interestingly, see knowledge sharing as a fundamental step (Secundo, del Vecchio et al., 2019; Secundo et al., 2019). During the COVID-19 pandemic, Europe was forced to confront the effect of a lack of shared infrastructure for data sharing as most of the contact-tracing solutions were unable to gain trust among citizens or share data among European nations (Lewis, 2020). Similarly, the management of chronic diseases, which account for the most deaths and greatest healthcare-related costs, suffers from poor information-sharing and monitoring systems (Bardhan et al., 2020). All of these are problems that blockchain could help solve, as discussed in a report by the OECD (2020).

From the above, it appears that blockchain has the relevant potential, not yet wholly appreciated, to act as a binding and constitutive force for health ecosystems in overall value creation processes. It is worth noting that even if this potential is increasingly recognized, the debate on these issues remains poor, especially for the healthcare domain. Research has often adopted compartmental, if not strictly technical, approaches to investigating blockchain applications, instead of adopting a holistic point of view to inquire how this technology may impact organizations, business models, and value-creation processes (Mačiulienė and Skaržauskienė, 2021). This paper bridges this gap by ascertaining how blockchain can be used within the healthcare sector to create value among different actors.

3. Research method

Due to the specific research question and the novelty of the blockchain phenomenon, we chose a qualitative study technique. Indeed, in digital contexts, how "business decision-makers and practitioners operate has been accompanied by a transition to more complex research methodologies, which seems to favor recourse to qualitative methods of investigation" (Gummesson, 2006, pp. 170–171). Our work was exploratory and attempted to construct rather than to test theory, reflecting the developing nature of our empirical and theoretical setting. Our study was based on an analysis of 33 cases that were created using a variety of predominantly qualitative data sources. Inductive coding was used to generate theories, which stressed iterative "back and forward" comparison between emergent empirical data and established theoretical structures (Miles et al., 2013). The following are the main steps of our methodological process.

3.1. Research context

Research within the European Patent Office (EPO) revealed that it has granted only 26 patents based on blockchain. Among those patents, only 14 belong to applicants registered as organizations. At the same time, the implementation of blockchain by public entities seems to still be in its infancy (Pólvora and Nascimento, 2021). Several companies have, however, used blockchain to implement "Initial Coin Offering" initiatives to collect money from potential investors. However, not all of these projects have been successful, and discriminating between valid enterprises and pure frauds can be difficult (Hornuf et al., 2021). To collect data, we decided to focus on new ventures financed by incubators and accelerators. Indeed, professional business investors focus on long-term returns, rather than the short-term profit favored by speculative investors. Additionally, firms that receive money from professional investors have a higher likelihood of survival (Croce et al., 2018). Thus, by focusing on startups financed by incubators and accelerators, we aim to reduce the noise coming from invalid entrepreneurial initiatives or pure frauds.

3.2. Data collection and data analysis

We collected data from the database Crunchbase, which is a leading provider of data from the community of contributors and partners[1] and has previously been used in similar research (Cong et al., 2021; Croce et al., 2018). First, we selected companies that were able to receive at least one financing round, obtaining a list of 138,034 companies. We then filtered by companies that declared use of Blockchain technology, which yielded a total of 2404 companies. Finally, we selected only companies focused on the healthcare sector, obtaining a list of 33 companies, as shown in Table 1. For each company, we searched for the company's whitepapers, which are documents used to describe a company's business model to potential investors and are very common in blockchain startups (Chalmers et al., 2021). To increase our data source, we also searched the company's websites and specialized blockchain weblogs as "bitcointalk."

The collected data were analyzed using a content analysis methodology, which systematically analyses text to extract significant chunks of information (Krippendorff, 2013). To develop our analysis, we first collected and grouped all of the material in an NVivo file. An in-vivo coding approach was used to collect data. Initial coding was then grouped to determine second-order themes, which were then reduced to aggregated dimensions pointing to the overall value created by blockchain technology (Table 2). Such dimensions result from the compromise within hybrid organizations between the financial values pursued as private organizations, and the social and non-financial values advocated as public and nonprofit organizations. The codes developed were discussed by all of the authors to reach consensus and ensure reliability.

4. Results

The results of the content analysis clarify the multiple values asso-

Table 1
Main focus of selected startups

Main focus	No. of startups	Name of startups
Electronic Medical/ Health Records/(EMR/ EHR)	5	Exochain, Med Stack, Nebula Genomics, Patientory, YouBase
EMR/EHR for study/ testing purposes	6	Embleema, Human Scape, ImmynifyMe, Safety Health, Ophidia, Tamarin Health
Health journey/ healthcare coordination	9	Alternate Health, BurstIQ, Covolution, dClinic, Hempstreet, Medical Chain, Mitesco, Solve Care, Witty Health
Payment/contract/ insurance coordination	5	AltThirtySix, Curisium, Candor, Health Bridge, Integrated CBD
Supply chain transaction automation	4	Chronicled, Hashed Health, Professional Credentials Exchange, Tilkal
Telemedicine	1	Docademic
Other	3	Inspecto, Millennium Blockchain, My Next Watch
Total	33	

[1] Please see: https://about.crunchbase.com/about-us/, accessed July 27, 2021.

Table 2
Data codification example

First-order concepts	Second-order concepts	Aggregated dimension: compromising multiple values
Easy to meet Federal CBD compliance	Compliance achievements	Public vs. private value conflicts
Full integration into the California Bureau of Cannabis Control's Metric Track-and-Trace system		
Lives saved from faster rollout of clinical trial and vaccine delivery	Shared value creation	

ciated with blockchain technology, which span across the private and public domains. They point to both value creation, as well as "unintended" potential value destruction (Hinings et al., 2018; Massaro, 2021; Spicer et al., 2021), which need to be fostered and mitigated, respectively, for multiple values to be created.

Twenty companies report that blockchain technology creates value by improving healthcare management. The companies analyzed declared that blockchain can improve "access to information, […] cutting out all layers and processes that currently are stumbling blocks in care coordination" (Reference ID 0601). Similarly, blockchain can be used to enable end-to-end integration of information scattered across data silos, thus reducing operation time (Reference ID 0626, 0615, 0629, 0637). According to a recent literature review, scholarly attention has focused on managing medical records and data through blockchain in healthcare (Tandon et al., 2020a). Some of the blockchain applications among those analyzed not only help improve transactional managerial aspects, but also support clinical facets. In particular, they directly help reduce the risk of infection or similar:

> "Dispensaries can reduce the amount of employee-patient interaction by using Alt Thirty Six for digital payments. This eliminates the risk of transmission through cash exchanges and reduces the need for excessive interaction during the transaction" (ID Reference 0611)

Blockchain technology also allows compliance with guidelines and regulations for data and privacy protection such as the DSCA (Drug Supply Chain Security Act) and/or HIPAA (Health Insurance Portability and Accountability Act), because "there will always be a verifiable, time-stamped record of data […], which is crucial from a compliance and liability standpoint" (Reference ID 0110). This means cost reductions in the supply chain; ten companies specifically highlighted this point, but with some implications for patients and their relatives as well:

> "These institutions' activities based on patients' personal health records can offer actual benefits to those with incurable diseases and alleviate the financial burden facing their families due to insurance costs, etc." (Reference ID 0238)

A few other solutions have an impact on the costs of overall public health services. Three companies specifically addressed this topic: "We believe that by empowering people to choose how they access healthcare, we can reduce the burden on public health services" (Reference ID 0207).

It needs though to be remembered that if, on the one hand, increased efficiencies are one of the most celebrated benefits of digital technologies (Kraus et al., 2021), one of the drawbacks of blockchain technology emphasized in the literature (Mačiulienė and Skaržauskienė, 2021) is the cost associated with executing a blockchain framework. It would therefore be important to consider and promote the net savings achieved by implementing a blockchain application rather than simply talking about cost reduction. None of the sampled companies takes this broader perspective and fail to recognize the potential unintended effect of blockchain technology on stakeholders when assessing overall costs. Only in one case is it mentioned that blockchain "requires patient education and patience from employees who have to explain how a new process works" (ID Reference 0611). Yet neither a total cost estimation nor a cost-benefit analysis or solution is offered.

The literature also identifies concerns related to the disputed security and technical limitations of blockchain (Abu-elezz et al., 2020; Tandon et al., 2020a), which erode trust in this technology. Companies appear to recognize this potential threat, which could destroy value, and try to mitigate it by emphasizing the level of security enabled by the cryptographic elements incorporated in their solutions in terms of both data protection and integrity:

> "An immutable trust and validation solution for digital signatures and document workflows." (Reference ID 1124)

> "Exochain will demonstrate these capabilities, as well as its unique capacity to function as a catalyst for trust between entities. In the context of clinical research, this means allowing for trusted adjudications and attestations, patients to trust that their data will be better protected (through data sovereignty), and clinical researchers to have greater trust in the integrity of data." (Reference ID 1133)

Digital technologies also help create share value among actors who can securely "trade" access to what they care about and create new service and business models in a "revolutionary" and "disruptive" fashion (Mackey et al., 2019, p. 1), as reported in the following cases:

> "… the platform goes beyond a simple health information exchange (HIE) or personal health record (PHR). BurstIQ has built an ecosystem where individuals can fully manage their data: they can share it or use it in exchange for access to products and services they care about" (Reference ID 0814)

> "dClinic uses blockchain to assist and reward consumers for their participation and adherence to their care plans. Thus, dClinic is poised to disrupt the healthcare industry by introducing a new model of healthcare which encourages collaborative efforts for positive healthcare outcomes." (Reference ID 0819)

These "exchanges" are possible because blockchain technology allows smart contracts that automate processes, not only saving time, but ensuring explicit consent by all parties. This is similar to the blockchain architecture designed and discussed by Beinke et al. (2019) and reported in the following statements:

> "Smart contracts will automate and thereby accelerate data purchases." (Reference 0908)

> "Third-party patient apps can access Embleema Health Blockchain Version 2 through open smart-contract APIs and offer personalised services to patients by using their health history with their prior and explicit consent." (Reference 0912)

For this to work, seven of the analyzed startups recognize that it is paramount that blockchain technology reduces mistakes by providing "duplicate, error and outlier detection" (Reference ID 0702). Such mistakes can be transactional errors, or they may concern medical records as such:

> "Ensure your business rules are enforced for data and transactions you receive from trading partners, fixing mistakes at the source." (Reference ID 0701)

> "… services that provide users with tools to receive ongoing medical education, reduce diagnosis errors and increase ROI." (Reference ID 0710)

> "… decreased risk of errors associated with inaccurate or unobtainable medical records." (Reference ID 0709)

In some cases, six amid those analyzed, blockchain technology

creates value by, among other things, reducing fraud:

> "Solve.Care's revolutionary platform will significantly improve care outcomes by […] substantially reducing the opportunity for duplication, waste, abuse and fraud. We expect to […] delegate authority to individual stakeholders while empowering payers regarding cost control and oversight." (Reference ID 0509)

Some startups specify that they meant blockchain solutions would allow for more data transparency, hence making it auditable and trackable to avoid any fraud by the data owner: "Fulfills verification requirements for saleable returns and suspect products under the Drug Supply Chain Security Act" (Reference ID 0504). Other companies maintained that blockchain would help data security by avoiding alterations:

> "We protect your data, and both the people and that contribute to it and use it." (Reference ID 0508)

> "Fraudsters can use this data to create fake IDs to buy medical equipment or drugs, or combine a patient number with a false provider number and file fictional claims with insurers. With Patientory's app, when administered and implemented correctly, there is zero possibility that any unauthorised access to patient data can be gained." (Reference ID 0503)

One startup referred to both guaranteeing transparency and security, as emphasized in the literature (Hylock and Zeng, 2019) and reported the following example:

> "Specifically, the collection of data from the parties involved via a blockchain network, which is decentralised, makes it possible to guarantee both that the information is auditable and that it has not been altered, and also makes each party accountable for doing what they have said they will. This guarantee of evidence-based transparency gives substance to the promises made by the brand. The consumer gains real-time knowledge of 'who did what, where, when and how' to the product they're holding in their hands." (Reference ID 0506)

Other ways in which blockchain technology creates value are less popular; these concern not so much the business model of the organizations involved, as most cases in the literature explore (Schlecht et al., 2021; Tanwar et al., 2020), but rather "the way in which we collaborate as a society" (Mačiulienė and Skaržauskienė, 2021, p. 330). In a few of the selected startups, value is created by blockchain solutions through the development of shared services, the promotion of distributed autonomous organizations, and by supporting charities and developing countries.

> "Medicalchain will start by integrating with Apple HealthKit and common wearables, before moving to add support for diagnostic tests, IoT, and other digital health." (Reference ID 0302)

> "These products each act as an ecosystem of resources for the respective discipline. We have focused on building streamlined workflows and a network of support for the most challenging conditions that have the highest utilisation rates." (Reference ID 0404)

> "Humanscape allows patient associations to register and conduct various activities for its operation. With the exception of some large-scale patient associations, it is difficult for patient associations to make sufficient investments in online infrastructure such as websites, as they generally operate with membership fees and donations." (Reference ID 1001)

> "The blockchain-based Humanscape community may help narrow the healthcare gap between developed and developing countries and improve the health of people in developing countries." (Reference ID 1002)

Table 3 summarizes the main findings discussed above.

5. Discussion

The taxonomy presented in Table 3 helps to answer the initial research question: how blockchain can be used within the healthcare sector to create value among different actors? It sheds light on both value creation and appropriation and shows how blockchain technology allows for the creation of both tangible and intangible value in healthcare both for individual firms, but also for patients, other organizations in the supply chain, and other stakeholders in general—that is, for healthcare ecosystems as a whole.

As mentioned in the Research Methods section above, the eleven contributions to value creation that emerged from the analysis were further categorized in overall dimensions to help appreciate how blockchain solutions can create value in healthcare, in an attempt to reconcile the differences among private, public, and nonprofit aims and to contribute to the development of a theoretical framework about value creation in public services that see the interaction of public, private, and hybrid organizations (Abu-elezz et al., 2020; Cabral et al., 2019; Mačiulienė and Skaržauskienė, 2021; Tandon et al., 2020a). In particular, four dimensions were identified (Table 3). First, blockchain solutions create endogenous value (Cabral et al., 2019) by reducing fraud and mistakes and by promoting trust and integrity (Tandon et al., 2020a). This value is created by a startup for its own needs from a self-centered perspective, which recalls what Meynhardt and Jasinenko (2020) identify as the "hedonistic-aesthetic" dimension of public value creation. Second, blockchain technology helps mitigate public-private conflicts by favoring interactions at multiple levels (Cabral et al., 2019), thus creating value by developing shared services across organizations and favoring compliance achievement (Massaro et al., 2020). Such behavior is labelled by Meynhardt and Jasinenko (2020) as the "moral-ethical" dimension of public value creation, because in solving public-private conflicts, organizations have to behave fairly, justly, ethically, or at least decently. Third, value is created by acting more effectively and efficiently in a "utilitarian-instrumental" perspective (Meynhardt and Jasinenko, 2020) both through better resource management as such (Cabral et al., 2019) — that is, by reducing costs or improving healthcare management in other ways (Abu-elezz et al., 2020) — or by forcing contractual arrangements (Cabral et al., 2019) such as smart contracts and distributed autonomous organizations. Lastly, organizations can support value creation through blockchain solutions in healthcare by considering others first and pursuing public value beyond what appears to be in their own self-interest (Cabral et al., 2019). Hence, they also act for political or social reasons (Mačiulienė and Skaržauskienė, 2021; Meynhardt and Jasinenko, 2020) such as supporting charities and developing countries or creating value that can also be shared by other actors in the pursuit of both private and public values. Table 4 illustrates the main dimensions of the multiple value creation processes discussed above.

It is interesting to notice how companies seem to appreciate and attempt to deal solely with the unintended effects directly associated with blockchain technology, but they fail to consider the broader "dark sides" of technology, which are related either to the overall cost of process innovation or to the technological "divides" traditionally mentioned in the literature (Hinings et al., 2018; Massaro, 2021; Spicer et al., 2021), such as low literacy and income levels, geographical restrictions, lack of physical access to technology, the digital divide, and the inner cultural adversity to radical changes in given contexts and cultures. This may be implicit for innovative start-ups, which in their own nature take for granted a certain level of technology penetration and acceptance. Failing to consider basic threats to innovation might, however, be fateful for many of these initiatives in the long run. Finally, while smart contracts can automate the decision-making processes making them faster, they also make it mechanical, eliminating the human part with all of the ethical implications that this brings. As

Table 3
Taxonomy of blockchain contributions to value creation

Contribution (Parent node)	Further specification (Child node)	No. of startups	Name of startups*
1. Compliance achievement		18	Alternate Health, AltThirtySix, BurstlQ, Chronicled, Curisium, dClinic, Docademic, Embleema, Exochain, Medical Chain, MedStack, Mitesco, Patientory, Professional Credentials Exchange, Safety Health, Solve Care, Tamarin (0110), Tilkal
2. Cost reduction		15	
	For patients	5	Docademic, Human Scape (0238), Medical Chain, Nebula Genomics, Patientory
	For supply chain	10	Alternate Health, BurstlQ, Chronicled, Curisium, dClinic, Docademic, Exochain, Medical Chain, Professional Credentials Exchange, Solve Care
	For public health services	3	Medical Chain (0207), Ophidia, Witty Health
3. Development of shared services		2	dClinic, Medical Chain (0302)
4. Distributed autonomous organizations		3	dClinic, Professional Credentials Exchange, Witty Health (0404)
5. Fraud reduction		6	
	Data transparency	4	Chronicled (0504), Professional Credentials Exchange, Tikal (0506)
	Data security	3	Exochain (0508), Patientory (0503), Tikal (0506)
6. Improved healthcare management		20	
	Transactional improvements	17	Alternate Health (0626), BurstlQ, dClinic, Docademic, Embleema, Exochain, Human Scape (0615), Medical Chain (0637), MedStack, Mitesco, Nebula Genomics (0629), Patientory (0601), Professional Exchange Credentials, Solve Care, Tamarin Health, Tilkal, Witty Health
	Direct clinical improvements	3	AltThirtySix (0611), Ophidia, Safety Health
7. Mistake reduction		7	
	Transactional data	4	Chronicled (0701), Curisium (0702), Professional Credentials Exchange, Solve Care
	Medical records	3	Docademic (0710), dClinic, Medical Chain (0709)
8. Shared value creation among actors		12	BurstlQ (0814), Curisium, dClinic (0819), Embleema, Hashed Health, Hempstreet, Human Scape, Ophidia, Patientory, Professional Credentials Exchange, Solve Care, Witty Health
9. Smart contracts		11	Chronicled, Curisium, dClinic, Docademic, Embleema (0912), Exochain, Medical Chain, Nebula Genomics (0908), Patientory, Professional Credentials Exchange, Solve Care
10. Technology to support charity		1	Human Scape (1001, 1002)
11. Trust and integrity		14	BurstlQ, Chronicled, dClinic, Embleema, Exochain (1133), Hashed Health (1124), Health Bridge, Med Stack, Medical Chain, Nebula Genomics, Patientory, Professional Credentials Exchange, Safety Health, Solve Care

*Numbers in brackets refer to the number of the coded reference.

Table 4
Main dimensions of value creation

Blockchain contributions	Multiple value creation dimensions
Fraud reduction Mistake reduction Trust and integrity	Endogenous hedonistic value
Development of shared services Compliance achievement	Public-private conflict mitigation
Cost reduction Improved healthcare management Smart contracts Distributed autonomous organizations	Utilitarian/instrumental value
Technology to support charity Shared value creation among actors	Social value

suggested by Bratinau et al. (2021, p. 306), "integrating emotional and spiritual knowledge in the decisional equation may become a pivotal input to making good managerial decisions regardless of the level of regulation and standardization in the field."

6. Conclusion and final remarks

The current paper addressed the still flawed debate on the managerial implications of digital transformation in healthcare (Kraus et al., 2021). In particular, it focused on the potential of blockchain for the healthcare domain (Tandon et al., 2020b) and its possible advantages for patients (Abu-elezz et al., 2020; Beinke et al., 2019; Esmaeilzadeh and Mirzaei, 2019; Hylock and Zeng, 2019) and organizations (Abu-elezz et al., 2020; Beinke et al., 2019; Esmaeilzadeh and Mirzaei, 2019; Hylock and Zeng, 2019; Mackey et al., 2019; Tanwar et al., 2020). This paper acknowledged that, in this domain, the actual ability of blockchain to create value and define how different organizations will benefit from the multiple values created (Mačiulienė and Skaržauskienė, 2021; Schlecht et al., 2021) is still under-investigated, not least because of the hybrid nature of healthcare organizations, which operate at the boundaries between the private, public and nonprofit domains (Campanale et al., 2021; Grossi et al., 2019; Vakkuri and Johanson, 2020; de Waele et al., 2021). Thus, the present study aimed to ascertain how blockchain can be used within the healthcare sector to create value among different actors. For this purpose, the research adopted a qualitative exploratory stance, reflecting the developing nature of the specific empirical and theoretical setting. The study relied upon the analysis of 33 cases that were created using a variety of qualitative data sources analyzed using a content analysis methodology based on an inductive open coding strategy.

The results offer a solid basis to tap into how and for whom blockchain technology contributes to value creation in healthcare in various

ways and from multiple, simultaneous perspectives. Blockchain technology unveils potential for value creation in healthcare through compliance achievements, cost reduction, development of shared services, distributed autonomous organizations, fraud reduction, improved management, mistake reduction, shared value creation among actors, smart contracts, technology to support charity, and greater trust and integrity. The findings allow us to argue that blockchain fosters the creation of multiple tangible and intangible values in the domain under scrutiny for both individuals and organizations in the whole ecosystem of reference. However, refinement is still needed to deal with unintended effects, especially when they concern a broader perspective, rather than simply the direct implications of blockchain.

On this basis, we can contend that the contributions of the paper are manifold. First, it is possible to consider this work as a relevant contribution to both the current debate on the potential of blockchain in healthcare (Abu-elezz et al., 2020; Beinke et al., 2019; Esmaeilzadeh and Mirzaei, 2019; Hylock and Zeng, 2019; Mackey et al., 2019; Tanwar et al., 2020) and also to the still contentious attempts to conceptualize and define public value and public value creation in complex and hybrid settings (Cabral et al., 2019; Campanale et al., 2021; Mačiulienė and Skaržauskienė, 2021). More specifically, this paper paves the way for broader comprehension and understanding of the potential of blockchain for multiple value creation and co-creation and, conversely, of the "dark side" (or unintended effects) of blockchain in healthcare (Massaro, 2021). More precisely, this paper bridges two often compartmentalized streams of research—namely, patient-side studies and organizational related research—and fosters further thoughts on the interactions and relationships among different kinds of actors, stakeholders, and organizations. Such relevance goes beyond purely theoretical analysis and speculation, while it potentially permeates practical approaches and impacts policymaking choices.

Second, this paper also adds relevant dimensions of interpretation and analysis to the domain of studies on digital transformation in healthcare, offering fresh theoretical insights into a wide variety of phenomena that could drive future research on further technological innovations in the field. This contribution, however, also extends to the practical and policymaking dimensions, providing new perspectives on the implementation of technology. In this regard, it should be noted that this paper's results are important because by focusing only on startups that professional organizations have financed, it has been possible to grasp the most promising aspects of blockchain while reducing the noise of pure wishful thinking.

Notwithstanding the contributions cited above, the study is not free from several limitations. The first limitation relates to the fact that Crunchbase collects data mainly from advanced economies. Interesting insights could come from the analysis of emerging countries. Second, while our analysis focused on the main benefits of blockchain in terms of value creation in the healthcare sector, they might not have the same importance, as some aspects could be more important than others. Third, although Crunchbase is widely used and represents both profit and nonprofit organizations, we do not know if the sample is balanced or if some types of organizations are misrepresented. A predominance of profit vs. nonprofit organizations might influence, for example, the generalizability of our results due to the complex nature of value discussed in the paper. However, beyond the limitations briefly touched upon above, it is also important to consider the whole set of implications that can be derived from the paper and could affect future research pathways and foreseeable practical and policymaking debates and efforts.

First and foremost, the results stress that greater attention needs to be devoted to the specificities relating to the contextual and cultural features of any healthcare setting, to encompassing the crucial (and unique) dimensions of institutional design, governance mechanisms, and accountability to achieve a full understanding of the value creation dynamics at play. The cultural and contextual influences should also be carefully taken into account to understand how they shape healthcare ecosystems and their readiness and willingness to embrace digital transformation, while also considering the issues of companies' localization, funding, and the country of origin of their founders.

In addition, it could also be relevant to further deepen our understanding of blockchain value creation in healthcare by considering the behavioral aspects of those involved (e.g., relying on models such as the theory of planned behavior, the unified theory of acceptance and use of technology, or the technology acceptance model). Both company founders and the wide range of potential users should be included in any analysis to better understand their intentions, motivations, and risk perceptions, thus ascertaining whether and how it is possible to detect pathways to ease and hasten the blockchain transformation process in healthcare ecosystems.

References

Abu-elezz, I., Hassan, A., Nazeemudeen, A., Househ, M., Abd-alrazaq, A., 2020. The benefits and threats of blockchain technology in healthcare: a scoping review. Int. J. Med. Inf. 142 https://doi.org/10.1016/j.ijmedinf.2020.104246.

Bagnoli, C., Dal Mas, F., Massaro, M., 2019. The 4th industrial revolution. Int. J. E Serv. Mobile Appl. 11 (3), 34–47.

Bardhan, I., Chen, H., Karahanna, E., 2020. Connecting systems, data, and people: a multidisciplinary research roadmap for chronic disease management. MIS Q.: Manag. Inf. Syst. 44 (1), 185–200.

Beinke, J.H., Fitte, C., Teuteberg, F., 2019. Towards a stakeholder-oriented blockchain-based architecture for electronic health records: design science research study. J. Med. Internet Res. 21 (10) https://doi.org/10.2196/13585.

Borup, M., Brown, N., Konrad, K., van Lente, H., 2006. The sociology of expectations in science and technology. Technol. Anal. Strat. Manag. 18 (3–4), 285–298.

Bratianu, C., Bejinaru, R., 2021. COVID-19 induced emergent knowledge strategies. In: Knowledge and Process Management, 28. John Wiley and Sons Ltd, pp. 11–17, 1.

Bratianu, C., Vătămănescu, E.M., Anagnoste, S., Dominici, G., 2021, 59. Management Decision, Emerald Group Holdings Ltd, pp. 306–323, 2.

Cabral, S., Mahoney, J.T., McGahan, A.M., Potoski, M., 2019, 40. Strategic Management Journal, John Wiley and Sons Ltd, pp. 465–475, 4.

Campanale, C., Cinquini, L., Grossi, G., 2021. The role of multiple values in developing management accounting practices in hybrid organisations. Br. Account. Rev. https://doi.org/10.1016/j.bar.2021.100999.

Chalmers, D., Matthews, R., Hyslop, A., 2021. Blockchain as an external enabler of new venture ideas: digital entrepreneurs and the disintermediation of the global music industry, 125. Journal of Business Research, Elsevier Inc., pp. 577–591

Chen, S.H., Wen, P.C., Yang, C.K., 2014, 34. Technovation, Elsevier Ltd, pp. 513–524, 9.

Cobianchi, L., Dal Mas, F., Piccolo, D., Peloso, A., Secundo, G., Massaro, M., Takeda, A., et al., 2020. "Digital Transformation in Healthcare. The Challenges of Translating Knowledge in a Primary Research, Educational and Clinical Centre", *International Business Information Management Conference (35th IBIMA)*. IBIMA, Seville.

Cohen, B., Amorós, J.E., Lundy, L., 2017. The generative potential of emerging technology to support startups and new ecosystems. Bus. Horiz. 60 (6), 741–745.

Cong, Y., Du, H., Vasarhelyi, M.A., 2021. Cloud computing start-ups and emerging technologies from private investors' perspectives. J. Inf. Syst. 35 (1), 47–64.

Croce, A., Guerini, M., Ughetto, E., 2018. Angel financing and the performance of high-tech start-ups. In: Journal of Small Business Management, 56. Blackwell Publishing Ltd, pp. 208–228, 2.

Dal Mas, F., Bagnoli, C., Massaro, M., Biazzo, S., 2021. Smart Technologies and New Business Models: Insights from Artificial Intelligence and Blockchain. https://doi.org/10.1007/978-3-030-80737-5_21.

Dal Mas, F., Dicuonzo, G., Massaro, M., Dell'Atti, V., 2020. Smart contracts to enable sustainable business models. A case study. Manag. Decis. 8, 1601–1619.

Elia, G., Margherita, A., Passiante, G., 2020a. Digital entrepreneurship ecosystem: how digital technologies and collective intelligence are reshaping the entrepreneurial process. Technol. Forecast. Soc. Change 150. https://doi.org/10.1016/j.techfore.2019.119791.

Elia, G., Margherita, A., Passiante, G., 2020b. Digital entrepreneurship ecosystem: how digital technologies and collective intelligence are reshaping the entrepreneurial process. Technol. Forecast. Soc. Change 150. https://doi.org/10.1016/j.techfore.2019.119791.

Esmaeilzadeh, P., Mirzaei, T., 2019. The potential of blockchain technology for health information exchange: experimental study from patients' perspectives. J. Med. Internet Res. 21 (6) https://doi.org/10.2196/14184.

Farnoush, A., Gupta, A., Dolarsara, H.A., Paradice, D., Rao, S., 2021. Going beyond intent to adopt Blockchain: an analytics approach to understand board member and financial health characteristics. Ann. Oper. Res. https://doi.org/10.1007/s10479-021-04113-0.

Frow, P., McColl-Kennedy, J.R., Payne, A., 2016. Co-creation practices: their role in shaping a health care ecosystem. Ind. Market. Manag. 56 https://doi.org/10.1016/j.indmarman.2016.03.007.

Galvagno, M., Dalli, D., 2014. Theory of value co-creation: a systematic literature review. Manag. Serv. Qual. 24, 6. https://doi.org/10.1108/MSQ-09-2013-0187.

Giones, F., Brem, A., 2017. Technology innovation management review. available at:7. https://ssrn.com/abstract=2984542.

Gong, C., Ribiere, V., 2021. Developing a Unified Definition of Digital Transformation, 102. Technovation, Elsevier Ltd. https://doi.org/10.1016/j.technovation.2020.102217.

Grönroos, C., 2012. Conceptualising value co-creation: a journey to the 1970s and back to the future. J. Market. Manag. 28, 13–14. https://doi.org/10.1080/0267257X.2012.737357.

Grossi, G., Kallio, K.-M., Sargiacomo, M., Skoog, M., 2019. Accounting, performance management systems and accountability changes in knowledge-intensive public organizations. Account Audit. Account. J. 33 (1) https://doi.org/10.1108/AAAJ-02-2019-3869.

Gummesson, E., 2006. Qualitative research in management: addressing complexity, context and persona. Manag. Decis. 44 (2), 167–179.

Hinings, B., Gegenhuber, T., Greenwood, R., 2018. Digital Innovation and Transformation: an Institutional Perspective, 28. Information and Organization, p. 1. https://doi.org/10.1016/j.infoandorg.2018.02.004.

Hornuf, L., Kück, T., Schwienbacher, A., 2021. "Initial Coin Offerings, Information Disclosure, and Fraud", *Small Business Economics*. Springer. https://doi.org/10.1007/s11187-021-00471-y.

Hylock, R.H., Zeng, X., 2019. A blockchain framework for patient-centered health records and exchange (healthChain): evaluation and proof-of-concept study. J. Med. Internet Res. 21 (8) https://doi.org/10.2196/13592.

Iansiti, M., Lakhani, R.K., 2017. "The Truth about Blockchain", *Harvard Business Review*, pp. 1–17. No. January-February.

Iansiti, M., Lakhani, R.K., Lakhani, K.R., 2017. "The Truth about Blockchain", *Harvard Business Review*, pp. 1–17. No. January-February.

Janamian, T., Crossland, L., Jackson, C.L., 2016a. Embracing value co-creation in primary care services research: a framework for success. Med. J. Aust. 204 (S7) https://doi.org/10.5694/mja16.00112.

Janamian, T., Crossland, L., Wells, L., 2016b. On the road to value co-creation in health care: the role of consumers in defining the destination, planning the journey and sharing the drive. Med. J. Aust. 204 (S7) https://doi.org/10.5694/mja16.00123.

Joiner, K., Lusch, R., 2016. Evolving to a new service-dominant logic for health care. Innovat. Enterpren. Health. https://doi.org/10.2147/IEH.S93473.

Ken Lee, K.H., Matthew Austin, J., Pronovost, P.J., 2016. Developing a measure of value in health care. Value Health 19 (4). https://doi.org/10.1016/j.jval.2014.12.009.

Khodadad-Saryazdi, A., 2021. Exploring the Telemedicine Implementation Challenges through the Process Innovation Approach: A Case Study Research in the French Healthcare Sector, 107. Technovation, Elsevier Ltd. https://doi.org/10.1016/j.technovation.2021.102273.

Kirkpatrick, I., Jespersen, P.K., Dent, M., Neogy, I., 2009. Medicine and management in a comparative perspective: the case of Denmark and England. Sociol. Health Illness 31 (5). https://doi.org/10.1111/j.1467-9566.2009.01157.x.

Kraus, S., Schiavone, F., Pluzhnikova, A., Invernizzi, A.C., 2021. Digital transformation in healthcare: analyzing the current state-of-research. Journal of Business Research, Elsevier Inc. 123, 557–567.

Krippendorff, K., 2013. Content Analysis. An Introduction to its Methodology. Sage Publications, Thousand Oaks, CA.

Kuhlmann, E., Annandale, E., 2012. Researching transformations in healthcare services and policy in international perspective: an introduction. Curr. Sociol. 60, 4. https://doi.org/10.1177/0011392112438325.

Lee, K., Lim, K., Jung, S.Y., Ji, H., Hong, K., Hwang, H., Lee, H.Y., 2020, 22. Journal of Medical Internet Research, JMIR Publications Inc. https://doi.org/10.2196/18582, 11.

Lee, T.H., 2010. Putting the value framework to work. N. Engl. J. Med. 363 (26) https://doi.org/10.1056/NEJMp1013111.

Lewis, D., 2020. Why many countries failed at COVID contact-tracing — but some got it right. Nature 588 (7838). https://doi.org/10.1038/d41586-020-03518-4.

Lombardi, R., 2019. Knowledge transfer and organizational performance and business process: past, present and future researches. Bus. Process Manag. J. 25 (1) https://doi.org/10.1108/BPMJ-02-2019-368.

Lord, R., 2018,April13. Blockchain in Health Care: the Good, the Bad and the Ugly. Forbes.

Mačiulienė, M., Skaržauskienė, A., 2021. Conceptualizing blockchain-based value co-creation: a service science perspective. In: Systems Research and Behavioral Science, 38. John Wiley and Sons Ltd, pp. 330–341, 3.

Mackey, T.K., Kuo, T.-T., Gummadi, B., Clauson, K.A., Church, G., Grishin, D., Obbad, K., et al., 2019. 'Fit-for-purpose?' - challenges and opportunities for applications of blockchain technology in the future of healthcare. BMC Med. 17 (1) https://doi.org/10.1186/s12916-019-1296-7.

Massaro, M., 2021. Digital Transformation in the Healthcare Sector through Blockchain Technology. Insights from Academic Research and Business Developments. Technovation, Elsevier Ltd. https://doi.org/10.1016/j.technovation.2021.102386.

Massaro, M., Dal Mas, F., Chiappetta Jabbour, C.J., Bagnoli, C., 2020. Crypto-economy and New Sustainable Business Models: Reflections and Projections Using a Case Study Analysis. Corporate Social Responsibility and Environmental Management. https://doi.org/10.1002/csr.1954 in press.

McColl-Kennedy, J.R., Snyder, H., Elg, M., Witell, L., Helkkula, A., Hogan, S.J., Anderson, L., 2017. The changing role of the health care customer: review, synthesis and research agenda. J. Service Manag. 28 (1) https://doi.org/10.1108/JOSM-01-2016-0018.

McHugh, M., Harvey, J.B., Kang, R., Shi, Y., Scanlon, D.P., 2016. Community-level quality improvement and the patient experience for chronic illness care. Health Serv. Res. 51 (1) https://doi.org/10.1111/1475-6773.12315.

Meynhardt, T., 2009. Public value inside: what is public value creation? Int. J. Publ. Adm. 32, 3–4. https://doi.org/10.1080/01900690902732632.

Meynhardt, T., Jasinenko, A., 2020, 24. International Public Management Journal, Routledge, pp. 222–249, 2.

Meynhardt, T., Jasinenko, A., 2021. Measuring public value: scale development and construct validation. Int. Publ. Manag. J. 24 (2) https://doi.org/10.1080/10967494.2020.1829763.

Miles, M.B., Huberman, A.M., Saldana, J., 2013. Qualitative Data Analysis: A Methods Sourcebook, third ed. Sage Publications, Thousand Oaks, CA.

Moore, M.H., 2000. Managing for value: organizational strategy in for-profit, nonprofit, and governmental organizations. Nonprofit Voluntary Sect. Q. 29 (1_Suppl. l) https://doi.org/10.1177/0899764000291S009.

Nambisan, S., 2017. Digital entrepreneurship: toward a digital technology perspective of entrepreneurship. Enterpren. Theor. Pract. 41, 6. https://doi.org/10.1111/etap.12254.

Nguyen, L.T.Q., Hoang, T.G., Do, L.H., Ngo, X.T., Nguyen, P.H.T., Nguyen, G.D.L., Nguyen, G.N.T., 2021. "The Role of Blockchain Technology-Based Social Crowdfunding in Advancing Social Value Creation", *Technological Forecasting And Social Change*, 170. Elsevier Inc. https://doi.org/10.1016/j.techfore.2021.120898

OECD, 2020. Opportunities and Challenges of Blockchain Technologies in Health Care.

Oropallo, E., Secundo, G., Vecchio, P.D., Centobelli, P., Cerchione, R., 2021. Blockchain technology for bridging trust, traceability and transparency in circular supply chain. Inf. Manag. https://doi.org/10.1016/j.im.2021.103508.

Petersen, M., Hackius, N., von See, B., 2021, 60. IT - Information Technology, De Gruyter Oldenbourg, pp. 263–271, 5.

Pólvora, A., Nascimento, S., 2021. Foresight and Design Fictions Meet at a Policy Lab: an Experimentation Approach in Public Sector Innovation, 128. Elsevier Ltd, Futures. https://doi.org/10.1016/j.futures.2021.102709.

Porter, M.E., 2010, 363. New England Journal of Medicine, Massachusetts Medical Society, pp. 2477–2481, 26.

Ramaswamy, V., Ozcan, K., 2018. What is co-creation? An interactional creation framework and its implications for value creation. J. Bus. Res. 84, 196–205.

Rippa, P., Secundo, G., 2019. Digital academic entrepreneurship: the potential of digital technologies on academic entrepreneurship. Technol. Forecast. Soc. Change 146. https://doi.org/10.1016/j.techfore.2018.07.013.

Russo Spena, T., Mele, C., 2019. Practising innovation in the healthcare ecosystem: the agency of third-party actors. J. Bus. Ind. Market. 35, 3. https://doi.org/10.1108/JBIM-01-2019-0048.

Schlecht, L., Schneider, S., Buchwald, A., 2021. The Prospective Value Creation Potential of Blockchain in Business Models: A Delphi Study, 166. Technological Forecasting and Social Change, Elsevier Inc. https://doi.org/10.1016/j.techfore.2021.120601

Sebastian, I.M., Moloney, K.G., Ross, J.W., Fonstad, N.O., Beath, C., Mocker, M., 2017. How big old companies navigate digital transformation. MIS Q. Exec. 16 (3), 197–213.

Secundo, G., Riad Shams, S.M., Nucci, F., 2021. Digital technologies and collective intelligence for healthcare ecosystem: optimizing Internet of Things adoption for pandemic management. J. Bus. Res. 131, 563–572.

Secundo, G., Toma, A., Schiuma, G., Passiante, G., 2019a. Knowledge transfer in open innovation: a classification framework for healthcare ecosystems. Bus. Process Manag. J. 25 (1), 144–163.

Secundo, G., del Vecchio, P., Simeone, L., Schiuma, G., 2019b. Creativity and stakeholders' engagement in open innovation: design for knowledge translation in technology-intensive enterprises. April 2018. In: Journal of Business Research. Elsevier, 0–1.

Simpson, E.L., 2002. Involving users in the delivery and evaluation of mental health services: systematic review. BMJ 325, 7375. https://doi.org/10.1136/bmj.325.7375.1265.

Spanò, R., di Paola, N., Bova, M., Barbarino, A., 2018, 18. BMC Health Services Research, BioMed Central Ltd. https://doi.org/10.1186/s12913-018-3389-y, 1.

Spicer, Z., Goodman, N., Olmstead, N., 2021. The frontier of digital opportunity: smart city implementation in small, rural and remote communities in Canada. Urban Stud. 58 (3) https://doi.org/10.1177/0042098019863666.

Tait, L., Lester, H., 2005. Encouraging user involvement in mental health services. Adv. Psychiatr. Treat. 11 (3), 168–175.

Tandon, A., Dhir, A., Islam, N., Mäntymäki, M., 2020a. Blockchain in Healthcare: A Systematic Literature Review, Synthesizing Framework and Future Research Agenda, 122. Computers in Industry, Elsevier B.V. https://doi.org/10.1016/j.compind.2020.103290

Tandon, A., Dhir, A., Islam, N., Mäntymäki, M., 2020b. Blockchain in Healthcare: A Systematic Literature Review, Synthesizing Framework and Future Research Agenda, 122. Computers in Industry, Elsevier B.V. https://doi.org/10.1016/j.compind.2020.103290

Tanwar, S., Parekh, K., Evans, R., 2020. Blockchain-based electronic healthcare record system for healthcare 4.0 applications. J. Information Security Appl. 50 https://doi.org/10.1016/j.jisa.2019.102407.

Vakkuri, J., Johanson, J.-E., 2020. Hybrid Governance, Organisations and Society, Routledge, 1 Edition, 2020. Routledge, New York. https://doi.org/10.4324/9780429286247.

Vatin, F., 2013. Valuation as evaluating and valorizing. Valuat. Stud. 1 (1) https://doi.org/10.3384/vs.2001-5992.131131.

de Waele, L., Polzer, T., van Witteloostuijn, A., Berghman, L., 2021. 'A little bit of everything?' Conceptualising performance measurement in hybrid public sector organisations through a literature review. J. Public Budg. Account. Financ. Manag. 33, 3. https://doi.org/10.1108/JPBAFM-05-2020-0075.

Wegner, S.E., 2016. Measuring value in health care: the times, they are A changin'. N. C. Med. J. 77, 4. https://doi.org/10.18043/ncm.77.4.276.

van Woezik, A.F.G., Braakman-Jansen, L.M.A., Kulyk, O., Siemons, L., van Gemert-Pijnen, J.E.W.C., 2016. Tackling wicked problems in infection prevention and

control: a guideline for co-creation with stakeholders. Antimicrob. Resist. Infect. Control 5 (1). https://doi.org/10.1186/s13756-016-0119-2.
Yang, H.L., Hsiao, S.L., 2009. Mechanisms of developing innovative IT-enabled services: a case study of Taiwanese healthcare service. Technovation 29 (5), 327–337.
Yoo, Y., Henfridsson, O., Lyytinen, K., 2010. The new organizing logic of digital innovation: an agenda for information systems research. Inf. Syst. Res. 21 (4), 724–735.
Zhang, L., Tong, H., Demirel, H.O., Duffy, V.G., Yih, Y., Bidassie, B., 2015. A practical model of value Co-creation in healthcare service. Procedia Manuf. 3 https://doi.org/10.1016/j.promfg.2015.07.129.

Rosanna Spanò, Ph.D. is Assistant Professor of Accounting at the Federico II University of Naples where she teaches Management Accounting and Enterprise Risk Management. Her main research interest is for the behavioral aspects of accounting and management in complex settings, and is devoted to depict conflicts and resistance surrounding the difficult dialectic between economic and quality logics, in a picture of growing accountability demands. This research contends that more integration between contrasting issues is highly needed and arguments it from many perspectives and focusing on different settings and circumstances. This research already resulted in many publications on refereed journals, book series, and monographs. Rosanna has also a long settled interest in the healthcare field which resulted cooperation with colleagues in the medical fields and also in the participation to the EIT Health Network since 2018 and in related projects. She has also been project manager and participant to European funded projects under the Erasmus + scheme, focusing on entrepreneurship and technology. Finally, her research has developed through manifold collaborations and international experiences in worldwide recognized Higher Education Institutions. Relevant Recent Publications. *Technology*. Spanò Rosanna and Ginesti Gianluca (ahead-of-print) *Fostering performance management in healthcare: insights into the role of Big Data*, in Meditari Accountancy Research. Ferri Luca, Ginesti Gianluca, Spanò Rosanna and Theodosopoulos Grigorios (ahead-of-print) *Ascertaining auditors' intentions to use blockchain technology: evidence from the Big 4 accountancy firms in Italy*, in Meditari Accountancy Research. Ferri Luca, Spanò Rosanna, Fiondella Clelia and Maffei Marco (2021) *How risk perception influences CEOs' technological decisions: Extending the technology acceptance model to small and medium-sized enterprises' technology decision makers*, in European Journal of Innovation Management vol. 24, no.3. *Healthcare*. Spanò Rosanna, Caldarelli Adele, Ferri Luca and Maffei Marco (2020) *Context, culture and control: a case study on accounting change in an Italian regional health service*. Journal of Management and Governance, vol. 24.Spanò Rosanna, Di paola nadia, Bova Maria and Barbarino Alessandro (2018) *Value Co-Creation in Healthcare: Evidence from Innovative Therapeutic Alternatives for Hereditary Angioedema*, in BMC Health Services research, vol. 18, no.1. Fiondella Clelia, Macchioni Riccardo, Maffei Marco, Spanò Rosanna (2016) *Successful Changes in Management Accounting Systems: a Case Study on Healthcare*, in Accounting Forum vol. 40, no. 3.

Maurizio Massaro, Ph. D., is Associate Professor at Ca' Foscari University of Venice. Maurizio is the coordinator of the curricula in digital management provided by Ca' Foscari University where he teaches introduction to digital management, planning and management control systems and financial statement analysis. Before joining academia, he was founder and CEO of multiple consultancy firms. He has also served as a research center Vice President in the field of metal analysis for a subsidiary of the Metal Services group. He has been a visiting Professor at Florida Gulf Coast University and Leicester University. He enjoys several contacts and research partnerships with universities in the USA, continental Europe, UK, Asia and Australia. His research interests include strategy business model innovation, intellectual capital, and research methods. His research has been applied in multiple research contexts. Relevant recent publications: Health and COVID related publications: Cobianchi, Lorenzo; Dal Mas, Francesca; Peloso, Andrea; Pugliese, Luigi; Massaro, Maurizio; Bagnoli, Carlo; Angelos, Peter Planning the Full Recovery Phase: An Antifragile Perspective on Surgery after COVID-19 in ANNALS OF SURGERY, vol. Publish Ahead of Print (ISSN 0003-4932) Romani, Gabriele; Dal Mas, Francesca; Massaro, Maurizio; Cobianchi, Lorenzo; Modenese, Mirko; Barcellini, Amelia; Ricciardi, Walter; Barach, Paul; Lucà, Rossella; Ferrara, Maria Population Health Strategies to Support Hospital and Intensive Care Unit Resiliency During the COVID-19 Pandemic: The Italian Experience in POPULATION HEALTH MANAGEMENT, vol. ahead-of-print (ISSN, 1942-7891) Francesca Dal Mas; Helena Biancuzzi; Maurizio Massaro; Luca Miceli Adopting a knowledge translation approach in healthcare co-production. A case study. in MANAGEMENT DECISION, vol. ahead-of-print Strategy and technology related publications Massaro M.; Secinaro S.; Dal Mas F.; Brescia V.; Calandra D. Industry 4.0 and circular economy: An exploratory analysis of academic and practitioners' perspectives in BUSINESS STRATEGY AND THE ENVIRONMENT, vol. 30, pp. 1213-1231 Massaro M.; Dal Mas F.; Chiappetta Jabbour C.J.; Bagnoli C. Crypto-economy and new sustainable business models: Reflections and projections using a case study analysis in CORPORATE SOCIAL RESPONSIBILITY & ENVIRONMENTAL MANAGEMENT, vol. ahead-of-print (ISSN 1535-3958) Vaska S.; Massaro M.; Bagarotto E.M.; Dal Mas F. The Digital Transformation of Business Model Innovation: A Structured Literature Review in FRONTIERS IN PSYCHOLOGY, vol. 11, pp. 539363

Silvia Iacuzzi is an Assistant Professor at Udine University. After completing a honours degree in Politics, Philosophy and Economics at the University of Oxford (England), she obtained her PhD from the University of Tübingen (Germany). She has spent the last 25 years working as a researcher, management and strategy consultant in Europe, the Middle East, Asia and Africa. Her research focuses on public sector accounting and management, looking at value creation, stakeholder engagement, performance measurement and management in particular for local government and healthcare organizations. She currently teaches Strategic Business Innovation and Healthcare Management at the University of Udine and guest lectures at various universities in Italy. She has also taught at the University of Oxford and at the University of Applied Sciences in Nurnberg (Germany). Relevant recent publications: Health and COVID related publications: Iacuzzi S.; Fedele P.; Garlatti A. (2020) Using accreditation to leverage innovation in healthcare: Evidence from an oncological centre, in INTERNATIONAL JOURNAL OF PUBLIC ADMINISTRATION, online DOI: 10.1080/01900692.2020.1795671 Lombrano A.; Iacuzzi S. (2020) Comparing health system performance: the contribution of management studies, ECONOMIA AZIENDALE ONLINE, vol. 11 n. 2, pp. 175-189, DOI: 10.13132/2038-5498/11.2.175-189 Strategy, stakeholder engagement, and technology related publications: Massarutto A.; Garlatti A.; Miani S.; Cassetta E.; Iacuzzi S. (2021) Evaluating the performance of local SoEs as output-maximizing entities: the case of Friuli Venezia Giulia, in ANNALS OF PUBLIC AND COOPERATIVE ECONOMICS, vol. 92, pp. 307-332, https://doi.org/10.1111/apce.12286. Mason M.C.; Iacuzzi S.; Fedele P.; Garlatti A. (2020) Stakeholder engagement: which arrangements for value co-creation?, in MICRO & MACRO MARKETING, vol. 1, pp. 19-43, DOI: 10.1431/96397. Iacuzzi S.; Garlatti A.; (2020) Digitalization at local government level: Managing smart data or a bulky compliance effort?, in Schiuma G. (Ed.) IFKAD: KNOWLEDGE IN DIGITAL AGE, ISNB: 978-88-96687-13-0, pp.315-327. Brusati L.; Fedele P.; Ianniello M. (2018) Outcome-based performance management in the public sector: What role for inter-organizational ICT networks?, in Borgonovi E.; Anessi-Pessina E.; Bianchi, C. (Eds.) OUTCOME-BASED PERFORMANCE MANAGEMENT IN THE PUBLIC SECTOR: SYSTEM DYNAMICS FOR PERFORMANCE MANAGEMENT, vol. 2, Springer, 2018, pp. 161-177, DOI 10.1007/978-3-319-57018-1_9