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Identifying institutional barriers when implementing new technologies in the healthcare industry

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Abstract

Virtual and augmented reality solutions in healthcare are generally applied in communication, training, simulation, and therapy. However, like most new digital developments, these technologies face a large number of institutional barriers that are inherent to the healthcare sector. Following Richard Scott's view on institutions and organizations, we use a multiple case study to analyze regulatory, normative, and cultural-cognitive institutional pillars in the focal industry. The results of the study demonstrate that (1) the regulatory pillar inhibits the advancement of new technologies in the approach to treatment, regulation of patient data, educational processes for medical staff, and information and financial flows; (2) the number of barriers increases based on the solution's level of disruption and the number of variable conventional procedures; (3) trust between participants in the healthcare industry plays an important role in introducing new technologies; (4) new participants need to address certain pillars depending on the area of application. We discuss top-down and bottom-up approaches for overcoming institutional barriers when implementing augmented and virtual reality solutions for companies focusing on the healthcare market.

Keywords

Institutional barriers, virtual reality, augmented reality, medical industry

1. Introduction

Digital innovations modify how people perform their work activities (Agostini and Filippini, 2019; Denicolai and Previtali, 2020; Kulkov, 2021). At the same time, introducing such innovations can be obstructed by established regulations, industrial norms, ways of working, and even mindsets, all of which can be considered institutions (Scott, 2013). Thus, digital innovations both affect and are affected by institutional structures rooted in regulation, industrial organization, and individuals' cognitive perceptions. When entrepreneurs introduce digital innovations in highly institutionalized industries, they face various institutional barriers that stem from the inherent structures of organizing and governing those industries' activities. To successfully implement and realize the expected benefits of these solutions, it is critical to be aware of these barriers and their premises (Schiavone and Sprenger, 2017). This paper explores the implementation of augmented reality (AR) and virtual reality (VR) solutions in the healthcare industry and identifies how these innovations are affected by institutions prevalent in the healthcare sector. AR/VR technologies are becoming more and more essential in health care, providing opportunities and benefits for numerous actors in the industry, as well as holding substantial market potential (see Cacho-Elizondo *et al.*, 2017). Furthermore, the Covid-19 pandemic has boosted the implementation of AR/VR technologies in medical care and, thus, further strengthened the shift toward Healthcare 4.0 (Tortorella *et al.*, 2020).

Sherman and Craig (2018) define VR as a digital technology that creates new surroundings for the user. AR, in turn, is an interactive system where additional features are superimposed on the existing world. If VR isolates the user from reality, then AR complements the real world in various types of application (Bimber and Raskar, 2005). These technologies can also be applied in health care (Sehgal and Gupta, 2019). Researchers specifically distinguish AR/VR solutions for communication, training, simulation, and therapy (Kim *et al.,* 2017; Iserson, 2018). However, new healthcare technologies are challenging not only due to the costs of integration and usage errors but also because the healthcare infrastructure is so important for society (Guha and Kumar, 2018;

Baudier *et al.,* 2021). Large multinational corporations may have the power to overcome these challenges, but small companies and entrepreneurs, which are usually at the forefront of innovations, may stumble upon these and other types of institutional barriers.

From a theoretical point of view, there are several recent studies on the role of new technologies (Ng and Wakenshaw, 2017; Stiglitz, 2019; Verhoef and Bijmolt, 2019). Researchers directly argue that it is necessary to study more deeply the processes of forming new companies, their business models, and possible obstacles to establishing a successful business. The issues of value creation in applying VR/AR in healthcare are raised in several papers (for example, Parekh *et al.*, 2020; Kulkov, Berggren *et al.*, 2021). In turn, the limitations and recommendations for further research in these articles are "factors that influence the adaptation and use of new VR/AR services" (Kulkov, Berggren *et al.*, 2021). From a practical point of view, in all these industries, new entrants to the market suffer from a lack of resources to conquer a market niche, and the high probability of failure largely stops the desire to do business.

Institutions place external constraints on entrepreneurial actions and influence cognition through shared norms, which are internalized by actors (Bjørnskov and Foss, 2016). For example, the mechanisms of technology transfer may be one of the many institutional factors or elements (Carlsson, 2002) impacting the implementation of AR/VR technologies developed by entrepreneurs. Among other institutional factors affecting entrepreneurship are cognitive, normative, and regulative pillars outlined by Scott (2013) (for more information about the pillars, see section 2.3.). For example, certain regulatory regimes and systems may support particular entrepreneurial activities or restrict others (Sine and David, 2010). Previous entrepreneurship literature focused mainly on the impact of institutions on economic growth (Bjørnskov and Foss, 2016; Urbano *et al.*, 2019), with most work focused on the "'hard' economic constraints implied by institutions" rather than the "soft" shared values and cognitions aspect (Bjørnskov and Foss, 2016, pp. 293). Furthermore, studies on implementing Healthcare 4.0 and related innovations focus mostly on the technical sides of its implementation, disregarding the socio-cultural factors

(Tortorella *et al.*, 2020). Thus, our study responds to the call for more literature on institutions and innovations proposing a detailed pillar/carrier analysis of an institutional field. **The research question is as follows: What are the institutional constraints inherent in the healthcare industry that restrain the use of AR/VR solutions, and how do entrepreneurs seek to overcome these barriers?** To reach our aim, we conduct several qualitative interviews with entrepreneurs involved in the creation of AR/VR solutions for the healthcare industry. Our findings show how various institutional carriers (Scott, 2013) play a role in AR/VR technology and how entrepreneurs cope with challenges that arise from the implementation of digital innovations in seemingly traditional industries. **Therefore, the core contribution of the study is that is adds to the literature on institutional theory in entrepreneurship (Bjørnskov and Foss, 2016; Carlsson, 2002), particularly by distinguishing between regulative, normative, and cultural-cognitive barriers to implementation of AR/VR in the healthcare industry. Moreover, our empirical findings contribute to the understanding of how the digital transformation of highly institutionalized industries affect entrepreneurial activities and how entrepreneurs shape the institutional environment of the healthcare industry.**

2. Conceptual Background

2.1. Application and challenges of AR/VR technologies in health care

Information and communication technologies are increasingly used in all spheres of social activity, transforming them to the roots, and the healthcare industry is no exception (Aceto *et al.*, 2020). The recent practices of eHealth and mHealth, which concern the digitization of communication and processes and the use of mobile devices in health care, respectively, are succeeded by Healthcare 4.0, which is inspired by the transition of manufacturing to Industry 4.0. Healthcare 4.0 builds on the integration of cyber-physical systems (Internet of Things), with big data and cloud computing (Li and Carayon, 2021) to achieve smart and connected health care, where

predictive health care, precision medicine, and telemedicine become possible (Chen *et al.*, 2020). Digitalization, however, is not a goal per se, but rather a means of achieving desired outcomes (Kulkov, Hellström, et al., 2021). In this respect, the healthcare industry appears to be moving toward care outside hospitals, decentralized decision-making (Tortorella *et al.*, 2019), and a more predictive, preventive, personalized, and participatory mode, also called 4P Medicine (Flores *et al.*, 2013). While innovations directly related to Healthcare 4.0, such as big data analytics and artificial intelligence, play a crucial role in, e.g., predictive and preventive healthcare, other implemented innovations, such as smartphones, are a solid element in the transition by serving as data collection sensors and as user interfaces.

Similarly, VR has been used in health care since the 1990s (see, e.g., Cremer *et al.*, 1996), mostly for medical training (e.g., Satava and Jones, 1997; Basdogan *et al.*, 2007) and rehabilitation (e.g., Burdea, 2003; Kulkov *et al.*, 2021). In particular, Loureiro *et al.* (2019) state that the medical education field was one of the first to successfully employ VR and related technologies. The use of VR/AR capabilities is actively proposed for the treatment of diseases. In psychiatry, the patient or physician becomes not only an observer of what is happening on the screen but an active participant in the process (Cherniack, 2011; Levac *et al.*, 2015; Zhou *et al.*, 2018). Patients exercise to prevent disease progression (Wilhoit *et al.*, 2017) or to recover (Merians *et al.*, 2002; Tashjian *et al.*, 2017). The number of VR/AR applications that target a specific phobia is large, for example, fears of flying, spiders, or public speaking (Czerniak *et al.*, 2016; Morina *et al.*, 2015; North *et al.*, 2015).

Another promising area of VR/AR application is the training of groups of people for certain skills. This may include, for example, children with autism. VR/AR applications assist in learning new social skills and rules of social behavior (Herrera *et al.*, 2008). Patients with lost limbs (Henderson *et al.*, 2007) or distorted body image (Mölbert *et al.*, 2018) can receive support and accept new circumstances better.

Embedded in Healthcare 4.0, AR/VR has the potential to change the healthcare system by making certain activities possible outside of hospitals by placing a bigger responsibility in the treatment process on patients and making treatments more personalized. Such changes, however, question the established institutions that underlie the healthcare industry. Thus, the potential of AR/VR to create value for the patients, healthcare professionals, and society at large depends on the ability of solution developers and other actors to overcome these barriers.

The focus on technical challenges is the most adopted view in most scientific articles on VR and AR in health care (e.g., Marescaux and Diana, 2015; Robison *et al.,* 2011). For instance, Wu, Lee, Chang, and Liang (2013) highlight the following technical challenges in implementing VR and AR in medical training: the risk of device failure when multiple devices are used, the "tradeoff in technology design between location dependency and independency," and the need for a well-designed and realistic interface. Marescaux and Diana (2015) highlight another example of a technical challenge: the need to reshape the operating theater design and organization to have space for VR technologies.

To the authors' knowledge, only a few articles highlight the non-technical challenges of VR and AR in the healthcare industry. For example, Füller *et al.* (2010) use the theory of planned behavior to understand what motivates managers to adopt virtual customer integration (VCI) (a form of VR) in the healthcare industry when developing new products. They show that a VCI-friendly attitude is extremely important in trying to encourage all the staff to use the new methods. In their other paper, Füller and Matzler (2007) also emphasize the importance of third-party actors that facilitate the virtual integration of customers. Termed "innomediaries," these actors "[specialize] in the virtual dialogue with communities" (Füller and Matzler, 2007, p. 386). Similarly, Glegg and Levac (2018) discuss the need for evidence-informed knowledge translation (KT) interventions when problematizing the barriers of virtual reality in the field of medical rehabilitation. KT implies the "process of moving evidence into practice" and having the potential to overcome resistance to change, "including a lack of knowledge and skills" (ibid., p. 3). The high cost of AR/VR solutions

is also highlighted as a barrier in a few academic articles (e.g., Srivastava *et al.,* 2014). Health Technology Assessment (HTA) has been proposed by a number of European countries to assess the added value compared to existing medical procedures. Examples of evaluating new solutions include medical equipment, technologies, methods of diagnosis, treatment and rehabilitation, devices, etc. HTA bodies are obliged to evaluate not only the effectiveness of a new solution but also (1) patient side effects, including the impact on quality of life and ease of management, (2) side effects of the healthcare system, including cost and the need to change the methods of treatment (Banta, 2003). Finally, Marescaux and Diana (2015) state that, in order to implement VR into medical surgery, the surgeons need to enhance their ability to use hybrid tools and techniques, which is also done through correct training and knowledge transfer.

Thus, several key technical and commercial barriers to implementing AR/VR technologies in health care are commonly mentioned in the literature: (1) purchasing motivation of top management (Berg and Vance, 2017; Srivastava *et al.*, 2014); (2) technical difficulties (Wu *et al.*, 2013); (3) ease of use (Fuller *et al.*, 2010); and (4) the need for additional staff or retraining (Fuller and Matzler, 2007; Marescaux and Diana, 2015). These appear to be common barriers to technological innovations. However, rooted in the institutions that underlie the healthcare industry is a set of barriers, which are often difficult to identify as they are inherently built into how healthcare is organized, the roles of different healthcare actors, and healthcare governance. In this study, we identify these barriers using the three-pillar institutional framework developed by Scott (2003), which is described in the next section.

2.2. Three pillars of institutions

Even if opportunities brought by these technologies are numerous as VR/AR innovations enter the healthcare sector, it appears that integration into the current industry structure may prove challenging. Innovative companies can often encounter obstacles while delivering their

innovations due to an established way of working, including systemic historical lock-ins in terms of technology or institutionalized practices (Arthur, 1989) and industry recipes that define how companies interact and organize their activities (Spender, 1989).

In this paper, we aim to explore institutions that can be defined as “multifaceted, durable social structures made up of symbolic elements, social activities, and material resources” (Scott, 2013, p. 57). Simply put, they are human-devised rules in a society that shapes human interactions or “rules of the game” (North, 1990); they include both formal structures like political and economic rules and contracts and informal structures such as taboos, customs, and traditions (Jepperson, 1991). Both formal and informal institutions assist in giving patterns to human behavior by enabling and constraining their activities. While acknowledging that the theory of institutions has seen a multitude of non-converging streams, Scott (2013) identifies three institutional pillars: regulative, normative, and cultural-cognitive. Each reinforces the others by providing stimulus, guidelines, and resources for acting, and while they prohibit and constrain actions, they rely on various mechanisms to legitimize them. These mechanisms vary from coercive (compliance with rules to avoid punishment) to normative (compliance with common norms and standards of behavior) to mimetic (taken-for-granted and shared logics of action), respectively.

Apart from distinguishing the three institutional pillars, Scott (2013) identifies four types of carriers, i.e., vehicles for conveying institutions in time and space: symbolic systems, relational systems, activities, and artifacts. Symbolic systems concern various rules, values and norms, classification, representations, frames, schemas, prototypes, and scripts that guide behavior. Relational systems rely on role systems that can be defined as patterned interactions connected to networks of social positions. Activities reinforce the rules and patterns set by symbolic and relational systems so that, for a certain behavior to be institutionalized, it needs to be repeated and routineized (Nelson and Winter, 1982). Examples of artifacts include technologies, social contracts, and standards that become carriers of repeated behavior.

Institutional structures can be analyzed using different pillars and carrier types, as demonstrated in Table I.

----- *Insert Table I here* ----

The introduction of technological innovations is often associated with certain institutional barriers that slow or obstruct the adoption of new technologies; these include existing regulations, standards, and cognitive models (Scott, 2013) that are not compliant with the logic of a new technology. For successful technology transfer, and for new practices to become standardized, cultural assimilation is necessary, and technological and cultural paradigms should be combined (Irrgang, 2007), thus making all three pillars relevant. This is especially relevant for AR and VR applications in health care since these technologies change how patients and doctors interact, how medical staff are educated, and how medical treatment is organized. The healthcare sector, in particular, can be seen as an established, institutionally bound industry (Denicolai and Previtali, 2020). Moreover, it is associated with many ethical and privacy concerns that are manifested in the regulative, normative, and cultural-cognitive pillars. These include, for example, expectations and rules about patient privacy, tight control of the quality of healthcare services, and certain beliefs about what constitutes good patient treatment.

2.3. Institutional entrepreneurship

Institutional constraints play an even more significant role when it comes to digital innovations introduced by entrepreneurs and small- and medium-sized enterprises. Institutions are essential in the conditions of entrepreneurship (Bruton *et al.,* 2010; Bjørnskov and Foss, 2016; Torkkeli et al., 2021); for example, normative actors and supportive regulatory regimes are crucial when it comes to entrepreneurial outcomes (Sine and David, 2010). While institutions undoubtedly influence entrepreneurship processes, ambitious entrepreneurs may act as a powerful entity for change in institutional choices and policy (Bjørnskov and Foss, 2016). Entrepreneurs that create

new institutions or transform existing ones have been labeled as “institutional entrepreneurs” (Sine and David, 2010). However, such actors are normally considered to have enough resources and power to drive such institutional change, but many entrepreneurs or start-ups do not, especially when entering new sectors, as in the case of AR/VR solutions entering the healthcare industry. In that sense, the concept of institutional work (Lawrence and Suddaby, 2006; Lawrence *et al.,* 2009) appears more coherent as it considers actors that do not possess specific power or resources but that are crucial in changing institutional structures.

It has been discussed, in particular, how work is done by institutional entrepreneurs or by anyone who tries to create or change institutions. For instance, Oliver (1991) proposed a typology of strategic responses to institutional constraints that varied in the degree to which they involved “active agency,” which includes acquiescence, compromise, avoidance, defiance, and manipulation. For entrepreneurs attempting to enter new industries with disruptive innovations, it is expected that they would focus on more “active” strategic responses and attempt to create or re-create institutions. Lawrence and Suddaby (2006) define nine forms of institutional work aimed at creating institutions that address barriers related to regulative, normative, and cultural-cognitive pillars (see Table II).

---- Insert Table II here ----

To successfully innovate and implement new technologies, companies cannot ignore the institutional character of social life. While digital transformation can be mostly bound by normative lock-ins visible in various industry norms, standards, and established roles (see, e.g., the case of Intel in Gawer and Philips, 2013), in health care, all three institutional pillars (Scott, 2013) appear to significantly impact such a transition. Based on differentiations among regulative, normative, and cultural-cognitive institutions, it is possible to devise adequate strategic responses and forms of required institutional work (Lawrence and Suddaby, 2006), thereby increasing the success rate of the latter. That is, different approaches are suitable for changing, for example, shared cognitive

models regarding health care or for attempting to overcome certain legal barriers. Scott's (2013) three-pillar framework provides a holistic yet structured approach to analyzing the different institutional barriers that can slow innovation adoption, in this case, AR/VR implementation in the healthcare industry.

3. Methodology

Due to the explorative nature of the study and the under-researched nature of the study question, a qualitative approach was deemed the most appropriate. This approach is particularly useful when it is necessary to provide more in-depth knowledge (Eisenhardt, 1989; Yin, 2018). The data were collected during 2019 through in-depth interviews with eight executives of AR/VR start-ups located in Finland and Sweden. The search for suitable participant companies was carried out using the Crunchbase portal (https://www.crunchbase.com), which is one of the world's leading and reliable IT company databases. Initially, we used the Crunchbase platform with filters: Industry "Information Technology," Specialization "Virtual and Augmented Reality," and Headquarters "Finland" and "Sweden" (Li, 2017; Salmi, 2018). These countries were chosen primarily for their availability for researchers to visit the studied companies for offline interviewing and product testing. At this stage, the sample size was 43 companies. After that, we examined the companies' websites to determine the specialization. The final sample of 12 companies included only those that identify the healthcare industry as a key or priority one. Then we sent out invitations for interviews to all 12 companies and received confirmation from 8 of them. The scheme of preparing and conducting interviews is presented in Figure 1.

--- Insert Figure 1 here---

To identify the companies participating in the study, we used abbreviations as a derivative of their specialization. For example, company 1 from Training received the Tr1 code, company 2 from Simulation received the S2 code, and so on. These codes were used in analyzing the collected data and presenting the results. On the one hand, the main criterion for choosing these companies was their focus on developing AR/VR solutions for the healthcare industry. On the other hand, the selected companies could already offer working solutions for customers in full or with limited functionality. We believe that companies at the conceptualization or prototyping phases could concentrate more on the technical side and have less insight into the challenges related to introducing solutions in the market. Table III presents the general information about the companies involved in the study.

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The interviews lasted about one hour each and were conducted in English. The questions in the interview were open-ended and focused on unique value propositions, existing opportunities, and barriers for company development, market trends, differences from competitors, features of cooperation with market participants, and future plans. The interviews were tape-recorded and further analyzed by content analysis. Content analysis involves either inductive category development or deductive category application (Mayring, 2004), as in our case. In conducting the analysis, we were guided by the categorization of institutional pillars developed by Scott (2013), which were presented in section 2.3. Such an approach to content analysis can be labeled as a directed approach that aims for the theory to be supported or extended (Hsieh and Shannon, 2005). In our case, however, we do not aim to support the theory of institutional pillars; rather, we extend its application to the field of innovative solutions in the medical industry.

Further analysis of the interview data was conducted in the following manner: First, as a basis for the analysis, a thematic approach was chosen, endowing individual quotes collected during the

interview with certain codes (Gavin, 2008). The codes followed the conceptual framework of the institutional pillars and carriers described in section 2, Table 1. During the analysis, two additional new codes were also generated, and some were combined for each of the pillars. The main limitations of the thematic approach, however, are handling large amounts of data and working with details. To overcome these limitations, we used a journaling method (Hayman *et al.*, 2012; Gavin, 2008). Specifically, in addition to the audio recording of the interviews, we took manual notes, i.e., we formed ideas during the interview process. This method allowed us to fix the path that led us to the corresponding topic. Moreover, such notes form reflections for the researcher due to a detailed approach to the collection of information (Basit, 2003). Second, the collected notes allowed us to form a group of descriptive codes related to each of the institutional pillars. Finally, we interpreted the results via theoretically informed reading, which involves "reflecting theoretically on specific topics of interest and writing interpretations without following any systematic method" (Weck and Ivanova, 2013, p. 213). Thus, we classified which pieces of collected data are considered as pertinent to one of the institutional pillars and to a specific institutional carrier as presented in Table 1.

However, we acknowledge that the journaling method may generate some bias in the findings' interpretation. To overcome this limitation, the thematic analysis was conducted by two of the three researchers involved in this study to enable investigator triangulation (see Denzin, 2017) and enhance the credibility of the findings. After individually going through all the data and analyzing it according to the steps presented above, the two researchers discussed and combined the findings, which are presented in the following section and are organized based on the institutional pillars and carriers. We have also considered secondary data such as reports on the state of health care in European countries (e.g., European Medicine Agency, Medicine for Europe), reports and transcripts of conferences for AR/VR developers (Virtual Reality Nordic, VRDC), and thematic news. The scheme of information analysis is presented in Figure 2.

--- Insert Figure 2 here---

4. Findings

4.1. Regulative pillar

The state is often the main participant in the formation of the regulative pillar in the healthcare industry, starting from the local level to the national one. Reliability and stability of medical services could be considered a priority for the confident functioning of critical infrastructure for society. Therefore, innovations introduced into this industry are also critically evaluated in terms of possible damage to the system.

Symbolic systems

Developed countries do not assess the patient's condition and prescribe medications during online counseling, with the exception of general recommendations. The physician or nurse must personally meet with the patient, talk with them, conduct the necessary procedures and tests, and make a diagnosis, as mentioned several times in the interviews with Th1 and Th2. In this case, the legislation lags far behind new technologies that could be potentially used in health care.

Over the last few decades, there have been active discussions about the safety of patient data (Abouelmehdi *et al.,* 2018; Fahr *et al.,* 2019). On the one hand, AR/VR companies from all areas of application declare the guaranteed safety of transmitted data, the impossibility of saving data, and protection of the final user's identity. On the other hand, physicians and patients often distrust new technologies that are not widely used in everyday life. Big data is governed on a higher level than just the healthcare industry because digitalization trends are relevant for many other industries. This requires a compatibility of AR/VR solutions with existing and future data management rules (e.g., GDPR). Compliance can considerably impact privacy, transparency,

informed consent, and control in data-driven businesses and can improve end-users' trust in the use of new solutions.

Surgery training on real patients is considered unethical and is prohibited by law in developed countries; therefore, legislation dictates that special surgery training centers be available for all hospitals. For this purpose, AR/VR solutions could contribute to physicians' training and continuing education. Healthcare institutions would not need to build additional facilities, but rather engage in medical assistance. Moreover, one of the main benefits of AR/VR solutions in medical training, which was highlighted by Tr2, is the significant reduction of waiting time that surgeons spend in order to gain access to training sessions.

The availability of AR/VR solutions and the extra rehabilitation time allow for the discovery of new niches, as highlighted during the interviews with companies offering AR/VR solutions in the therapy sub-field. For example, standard stroke rehabilitation is considered to be only slightly promising in Finland, and therefore, it is not applied in practice. However, new technologies may advance the rehabilitation process of a stroke patient. Nevertheless, there is no legislative basis to implement such practices. Public clinics have no chance of using new solutions since insurance companies are reluctant to pay compensation for novel treatment procedures. Therefore, the range of potential customers for AR/VR solution providers is limited to private clinics.

Relational system

Business development in the new niche, e.g., stroke rehabilitation, requires new ways of promotion. The current healthcare system has limitations for novel solutions. Before market acceptance, patients are forced to cover these expenses in a private clinic, even if they possess health insurance or are entitled to free public health care. Therefore, a service provider could offer a solution directly to the final users at the B2C market, excluding insurance companies. In the case of Th1, the provider was able to form a group consisting of a public fund that offered financial support for the project, a public insurance company, private investor, and a local university.

The healthcare market requires recommendations for the safety and success of new solutions. Most therapy companies, as well as Th1 and Th2, start from the local market with support from interested physicians and hospitals. Companies seek to collaborate with key metropolitan hospitals, as this has a better value for promotion locally and in neighboring countries.

Activities

Based on information provided by the respondents, we identified a number of activities that reinforce the symbolic and relational systems described above. These activities include monitoring, maintaining medical routines and procedures for safety, and enhancing the reliability of the healthcare sector. The accurate implementation of actions is the key to achieving the required level of medical procedures for existing market participants as well as for new companies. Only solutions based on legally prescribed outputs can be taken into consideration and use.

The transfer and storage of patient data during the communication sessions with a physician is an important issue associated with new technologies such as AR/VR. Some of the companies rent data transfer channels from large IT providers and offer solutions based on them. The reputation of IT giants increases the start-ups' credibility. Other developers create solutions from scratch and promote value in complete control over the solution, reducing the likelihood of data loss. There is no predisposition toward a certain way of transferring data, which would be defined based on the application area.

The interviewed companies also stated that, depending on the specialization and the country where the business is established and developed, companies may encounter various regulatory restrictions and sanctions. These limitations affect therapy to a certain extent and training and simulation to a lesser degree, and they have little effect on communication.

Artifacts

Emerging digital technologies are gradually replacing certain artifacts in health care. For example, establishing Electronic Medical Records has reduced the use of paper and has increased the value for patients through accessibility. AR/VR solutions assist in reducing the need for previously mandatory objects, such as constructing new training facilities in the Tr1 case, providing home-based therapy sessions with the support of relatives in the Th2 case, or having online communication between patients and physicians without the need for personal meetings as in cases C1 and C2. However, like most artifacts, much time is needed to be accepted by the industry and users, and old artifacts persist for a certain time, even if the benefits of their use decrease.

4.2. Normative pillar

Social interaction imposes obligations on participants in the healthcare industry. Responsibility for the well-being and life of the patient is identified as a key value. The societal expectations in obtaining this value are formed by certain procedures, positions, and companies that form the healthcare system; values form activities to support the system's performance and reliability.

Symbolic systems

Values and standards of the healthcare system come from a long history, considering the experience and responsibility of the industry participants. The lack of market recommendations causes limitations on the development and application of new practices. Focal market participants adhere to these rules and expect the same from others. With the emergence of new solutions, not all participants seek adaptation despite possible progress. Making innovative decisions in the critical infrastructure can impact the future of the project and the participants.

Experience in the digital industry has little positive impact on introducing a business idea to the healthcare industry. Hospitals express distrust toward previous experience in another industry,

for example, in construction or manufacturing. As an exception, recommendations for the C2 company from the military have had a slightly better effect. Simultaneously, standards and experience in other countries in the healthcare industry have also had little chance to support the promotion of an innovative solution, as mentioned during the interviews with Tr1, Tr2, and S1 companies. On the one hand, hospitals require recommendations from leading world or regional clinics, industrial opinion leaders, and publications in peer-reviewed journals, which therapy companies highlighted during the interviews. On the other hand, representatives of S1 and Tr2 mentioned that the new customers expect to receive recommendations from the local practice in order to adopt an innovative treatment.

Relational systems

S2 and Th2 companies expect that the emergence of innovative solutions from major IT companies can change customers' attitudes toward new technologies. According to interviewees, the release of Apple's AR hardware could be a paradigm shift in society and dissemination of technology (Manika *et al.,* 2017; Manika *et al.,* 2018). The reputation of Apple could change the attitudes of the final users and companies about the new technology and could establish a new business ecosystem for software companies.

Providing services to large non-healthcare companies could be a step forward for communication developers like C1 and C2. Collaboration with manufacturers that could introduce a solution in a new market may be a strategy for entering healthcare. Nascent entrepreneurs could choose collaboration with leading IT integrators in health care and large consulting companies that provide services for healthcare as a way of developing their businesses. This allows them to concentrate on product development and interaction with several key players rather than on a multitude of clinics.

Traditional interaction with physicians may undergo changes. The physician is still needed to prepare a treatment plan and monitor progress in rehabilitation, but the physician's role is

declining. Alternatively, a nurse or self-treatment could be offered at a convenient time and place with follow-up visits to the specialist, as highlighted during the interview with the CEO of Th2.

The public sector also imposes restrictions. Not all physicians are ready to cooperate with start-ups, have sufficient interest in new products, and trust in new technologies. On the one hand, developers are forced to expect a long time for feedback due to the workload of medical personnel. On the other hand, the entry of new companies may be difficult since establishing working relationships with healthcare establishments comes with its own issues. This was mentioned mainly during discussions with companies offering AR/VR-based training and simulation solutions.

To enable collaboration, factors such as cost savings and immediate benefits for non-critical infrastructure could be considered. For example, the value of AR/VR solutions in reducing the need to build training centers for surgeons is clear to all hospitals. In turn, assessment and understanding of the benefits of training in AR/VR is obvious after the test use.

Activities

Collaboration with physicians is also important in product development. Solutions are developed by IT specialists, who may have no medical training. However, medical expertise is highly necessary when developing such solutions. This type of collective action is also important for adaptation and updates to the needs of a particular patient or group or when accounting for regional specifics in all types of applications.

Organizational change is necessary for the successful application of new technologies. On the one hand, the advantages of technologies could be visible and understandable from the start of cooperation. On the other hand, participants may be forced to change their organizational mindset, routines, and habits. In most cases, the complexity of implementing a new procedure in terms of changing individuals' mindsets exceeds the complexity of technical difficulties related to the implementation. For example, rather than wait for a technician, making a video call to

customer support and maintaining the equipment in-house with C1 or C2 solutions may cause difficulties in the initial stage of implementation. For example, nurses can become responsible for inspecting equipment in the event of a breakdown, which can cause resistance from their side.

AR/VR changes the usual jobs of various healthcare specialists. Physicians could obtain and use data that were previously unavailable. First, simulation applications of S1 and S2 allow for better operation preparation than standard methods. Modern 3D images in VR provide more possibilities than classic MRI images. Second, physicians could receive real-time support and guidance from other specialists in AR mode with communication and simulation solutions.

The workload of the physician could be reduced by changing the procedure for interaction with the patient. For example, other medical personnel may be sent for home consultation when they could have received AR support in interacting with the patient, as offered by C1 and C2 companies. The need for narrow specialists that support the accessibility of health care could also be reduced.

Nevertheless, the leading opportunity to improve activities is the reduction or complete absence of limits on individual training, rehabilitation time, or communication opportunities. The patient and the specialist have a greater responsibility for the treatment result and for improving skills, respectively. The transition from the B2B to the B2C market could stimulate the creation of platforms for the treatment of phobias, new ways of training specialists, and forming databases of atypical cases.

Artifacts

New procedures should be combined with existing IT solutions, for example, ticketing systems, communication platforms, and ERP systems. Despite the disruptive capabilities of novel IT solutions, customers could be wary of them, as implementation of new systems could affect the health and lives of people.

Hospitals could also be partly considered an institutional artifact. Reduced need for the construction of new physical facilities and the reorientation of the functions of the constructed buildings will release resources for other core activities of hospitals. The training facilities could lose the industry demand, which will lead to the reallocation of the existing staff. However, the costs associated with the release or retraining of personnel could be considered insignificant in comparison with the new construction and equipping of healthcare centers.

In line with Marescaux and Diana (2015), we found that operating rooms are an important institutional artifact that affects how surgeons are trained. Their design and construction process are well-established, but the introduction of AR and VR solutions in surgeon training will either affect their organization to embed new solutions or eliminate the need for rooms altogether.

Nowadays, the cost of AR/VR hardware for the final user can be considered a barrier. This restriction reduces the rate of transition from the B2B to the B2C market. The cost of the device and solution is not critical, even for a small clinic; however, the purchase for the final user could be difficult.

4.3. Cultural-cognitive pillar

The healthcare industry most often aims at solving local problems within the country. The vast majority of international clinics operating in other countries also focus on local residents. Integration into the specifics of local culture is necessary in adapting to existing healthcare standards. Such adaptation is necessary to understand the cultural characteristics and surroundings of their customers, which is fully consistent with Scott's theory of the local effect of cultural-cognitive carriers (Scott, 2013). Healthcare changes at the local and regional levels are slow, which makes this pillar important in the reliability and stability of the system.

Symbolic systems

It could be an issue for non-specialists to understand the difference in reality typification (virtual, augmented, and mixed), which could lead to obstructive misconceptions and resistance to using new technologies in the daily routine. Resistance may be based on information obtained from unreliable sources or an unwillingness to adapt to new technologies.

If physicians could quickly understand the benefits of preparing for operations or improving skills, patients may still be distrustful of a new practice. In particular, certain patient categories (e.g., elderly patients) may be reluctant to have an online consultation with a doctor and may prefer to visit a doctor in traditional schemas. In turn, it is a question of whether the doctor should engage in promoting new opportunities for patients. Such a task is not typical for a physician, which may make it difficult to advance the technology.

Relational system

Trust between the patient and the physician may be compromised in case of a new digital intermediary. Personal communication for most patients is more comfortable than remote treatment. Human empathy is an important factor in restoring the patient's health. In turn, patients become more responsible for the treatment outcome. Physicians create an individual treatment plan, present a new method based on AR/VR capabilities, and track the progress. Simultaneously, the relatives' responsibility increases, as they receive more opportunities to monitor the patient's condition and progress. The identity of a physician or patient, and to a certain extent a relative, needs to undergo changes.

In contrast, specialists and students often have little difficulty applying new AR/VR capabilities in training. The key benefits are understandable and are positively perceived by students. Moreover, simulation solutions allow them to immediately put the received information into practice.

New opportunities uncover additional threats to the identity of existing staff. For example, physicians may feel less needed and relevant in applications for therapy. On the one hand, the

authority and qualification of medical personnel is not called into question. On the other hand, technologies automatically allow for the detection of deviations and advise about treatment methods in a simulation mode.

Activities

Patients may negatively perceive virtual meetings as a script for communication with medical personnel. They can feel the loss of control of security and data privacy. Loss of data can be a concern not only during the meetings but also later during the storage period.

Artifacts

During the planning of the study, we expected to face a number of artifacts carrying institutional power in the cultural-cognitive pillar. We assumed that it would be important for patients to visit a specialized healthcare institution, undergo standard procedures, and meet with medical personnel. However, during the interviews, company representatives paid little attention to this aspect. As an insignificant barrier, we should mention older people's desire to see a physician in a white coat. Otherwise, patients seem ready to contact a doctor online if the illness is not critical or if a physician does not aim to improve their skills in a particular training center. However, to discover other important artifacts related to the cultural-cognitive pillar, it is worth interviewing the patients in addition to the AR/VR providers.

Table IV represents a summary of the identified institutional barriers to the implementation of AR/VR solutions in the healthcare industry. The barriers that restrict such implementation are marked with a "-", whereas the enabling conditions are identified with a "+".

---- Insert Table IV here ----

5. Discussion. Strategies to overcome institutional barriers

We identified four instances of symbolic systems related to the regulative pillar that affect the introduction of AR/VR solutions in healthcare. The first is formed through regulations of how patient treatment should be organized. The second system concerns the regulation of how data are managed and protected in the healthcare sector and in general. The third relates to the educational system for training medical personnel. Finally, the fourth symbolic system is based on the current structure of financing medical support, including insurance schemes. These systems are based on regulations and give structure as to how conventional healthcare procedures work. They include actors and affect the relational systems, activities, and artifacts discussed in section 4.1. Thus, the adjustment of systems is rather difficult to achieve for a single company, and institutional work is required (Lawrence and Suddaby, 2006; Lawrence *et al.,* 2009; Lepore *et al.,* 2018). However, the amount of work differs depending on the application. The more disruptive the application of the novel technology and approach, the greater the barriers that technology must overcome. For example, a change in the communication channel toward using AR/VR does not require significant changes or training of specialists, so mimicry can be a suitable strategic response to institutional barriers faced by technology. However, creating a new niche in health care, meaning therapy using VR technology in our case, requires the involvement of additional participants in the industry, including insurance companies and universities, thereby calling for such strategic responses as vesting and changing normative associations (Lawrence and Suddaby, 2006).

Based on the analysis, the institutional barriers related to the normative level mainly stem from the friction between two industrial sectors—healthcare and digital—whose actors have different standards, norms, and ways of working. Some of the challenges include lack of trust, different criteria to assess the quality of an AR/VR solution, and the speed of decision-making. **HTA, discussed in 2.1 (Banta, 2003; Angelis et al., 2018), can help harmonize the ways to assess**

the implications of using AR/VR technologies in various healthcare applications. However, the interviewees did not mention this factor as significant for their business. The other solutions to overcoming these barriers would be the high prevalence and availability of hardware for everyday operations and the presence of large companies setting the trend in the market or active state support. This way, AR/VR equipment can become the institutional artifact that can provide "an occasion for structuration" of activities and higher-level symbolic and relational systems (Barley, 1986).

On an individual level, the apparent institutional barrier is the current division of roles between medical personnel and medical equipment. Generally, medical procedures like patient examination have been consistent for many years. The possibility for remote counseling is prone to changing the working routines for medical personnel, their time management, physical environment, etc. The need to adjust or even remove operating rooms is one illustrative example, as discussed in section 4.2.

Finally, the main institutional barriers related to the cultural-cognitive pillar include changes in the identities of physicians and patients as well as potentially wrong perceptions of AR/VR technologies. With the introduction of AR/VR solutions in the healthcare industry, patients might need to take greater responsibility for their health, e.g., by using the technology for self-therapy at home. Similarly, healthcare professionals can take more responsibility in developing their professional skills through self-training using AR/VR solutions. That is, to fully realize the expected benefits of AR/VR solutions in therapy or training, there is a need to change the mindsets of the people using it and educating them about the technologies. This can be achieved through framing activities, i.e., mediating the meaning such as the role of a physician, through the use of cognitive frames (Snow and Benford, 1992; Snow *et al.,* 1986). Cognitive frames, in turn, have been defined as "metaphors, symbols, and cognitive cues that cast issues in a particular light and suggest possible ways of responding to these issues" (Campbell, 2005, pp. 48–49). The question is which actor entrepreneurs need to cooperate with in order to perform such framing activities.

High institutionalization on the regulatory pillar is an expected result because the healthcare sector faces a significant number of concerns related to human health, safety, and privacy. By analyzing the institutional work of the focal companies, we discovered two strategies for overcoming barriers rooted in the regulative pillar. The first is a top-down approach where AR/VR solutions are promoted on a higher level first and are then offered to physicians as a new standard mechanism for use in practice. However, the more common and practical strategy is a bottom-up approach, which starts with developing a solution with healthcare individuals interested in collaborating and testing new solutions with companies. The next step in this approach is to promote the solution to a number of public or private hospitals or healthcare professionals to prove the effectiveness and safety of the solutions and try to further diffuse the innovation locally and internationally and attempt to change the regulative and legal barriers using a hands-on method. The latter approach allows actors to commit to a larger gradual transformation without significantly undermining the current working processes. In this case, institutional work starts with the individuals and their activities, e.g., through advocacy, constructing normative networks, or education (Lawrence and Suddaby, 2006).

6. Theoretical contribution

We analyzed the healthcare industry in terms of the application of AR/VR technologies. We found that all AR/VR healthcare companies stress the regulatory pillar due to the novelty of the used technologies. However, companies developing new methods for healthcare face more limitations. In our case, these are companies from the therapeutic area that form a new niche in health care. When traditional rules and procedures need to change, AR/VR companies appeal more to the normative pillar. To a greater extent, applications from communication, training, and simulation form this group. These applications change the traditional approach and rules based on new opportunities, improving speed and usability, or reducing costs. In general, the more disruptive

the solution offered to the market, the more it has to interact with the regulatory pillar. If the procedures inherent in the industry undergo change, then the developers are faced with an influence on the normative pillar. In turn, all companies appeal to the cultural-cognitive pillar to a greater extent because of the conservative nature of health care, the traditional importance, and the role of physicians in the industry (Barlow, 2016; Stanton, 2012).

The explication of these approaches follows the concept of institutional strategy introduced by Lawrence (1999), who defines it as "patterns of organizational action concerned with the formation and transformation of institutions, fields and the rules and standards that control those structures." We add to the discussion of strategic responses that vary in how much "active agency" is involved for organizations in their interactions with institutional structures (Oliver, 1991) and forms of institutional work summarized by Lawrence and Suddaby (2006). For this, we propose a process for "conscious" institutional work that starts with the analysis of institutional barriers according to the pillars and carriers (Scott, 2013) and devise appropriate strategic responses based on that information.

The digitalization of industries, including the healthcare industry, requires a systemic change (Sherman and Craig, 2018; Agostini and Filippini, 2019; Leone *et al.*, 2020). Due to the high complexity of such an effort, it is often difficult to identify where the change should be initiated and what strategy should be used to overcome the prevalent institutional barriers. At the same time, Beckert (1999, p. 779) notes that institutions "come under pressure from agents who recognize their constraining qualities for more efficient outcomes." Thus, the main theoretical contribution of this paper lies in proposing a detailed pillar/carrier analysis of an institutional field as a prerequisite for institutional work (Lawrence and Suddaby, 2006; Lawrence *et al.,* 2009). That is, distinguishing between the different institutional barriers helps entrepreneurs identify strategies that are suitable to overcome them. Consequently, our paper also contributes, to some extent, to the limited literature on the bidirectional relationship between entrepreneurship and institutions (Urbano *et al.,* 2019). While our paper mostly showcases how institutions affect entrepreneurial activities, it

also exemplifies how entrepreneurs are gradually shaping the institutional environment of the healthcare industry.

We identify two “dimensions” of such strategies: which institutional pillar it addresses (while we admit that there is a certain interplay among the pillars) and whether it follows top-down or bottom-up logic as described in section 5**.** We cannot indicate a particular approach as the priority since the strategy choice depends on the level of the innovation’s “disruptiveness” and the maturity of the entrepreneurial company. It is important to note, however, that since entrepreneurs often lack resources and power for institutional change, as the notion of institutional entrepreneurship implies (Lawrence and Suddaby, 2006), there are still strategies that allow them to overcome related institutional barriers through institutional work following more bottom-up strategies. This idea is visualized in Figure 3.

---- Insert Figure 3 here ----

The explanation of the applicability of each strategy and the implications of its use for overcoming the institutional barriers is an avenue for further exploration. Also, comparing the digitization process of other industries is beneficial in order to draw general conclusions regarding how institutional barriers pertinent to digitalization can be overcome by entrepreneurial firms.

7. Managerial and policy implications

The practical contribution of the paper includes implications for novice entrepreneurs who plan to develop AR/VR solutions for the healthcare industry. The summary in Table IV (end of section 4.3) can be practical for start-ups that aim to implement their AR/VR solutions in the healthcare industry, thus outlining the benefits of implementation and barriers that still need to be resolved.

Accurate positioning is important for understanding the process of entering the healthcare market. We demonstrate that, depending on the area and novelty of the solution, the company has to collaborate with different industry participants. Companies that face most barriers in relation to the normative pillar work with hospitals, physicians, and patients, whereas companies offering solutions in a new niche will be forced to work additionally with policymakers and insurance companies to create a demand for the product. **This means that policymakers need to support new technologies in healthcare implementation, for example, through being flexible in adjusting legislation to accommodate most promising and beneficial technologies.** We expected that cooperation with universities and opinion leaders would be important to successfully form and promote the digital solutions in focus (Kulkov *et al.*, 2020). However, this is not entirely true for all solutions. For example, such cooperation has proven mandatory for cases like therapy and training areas; there is a limited need inherent to simulation, and it has little impact on communication solutions. Attempts to combine solutions for different areas can be successful, for example, in training and simulation. However, integrating any area with therapy may require more resources than can be estimated from the start.

The framework presented in Figure 3 also has practical implications for entrepreneurs that attempt to introduce innovations in established sectors bound by institutions. First, the lack of institutional power affects the strategic responses available for such “newcomers” but does not eliminate the potential for institutional work. That is, entrepreneurs can choose more bottom-up strategies to enroll individual actors and change individual activities gradually to create or re-create institutional structures in the healthcare sector. Second, if changes at the level of symbolic or relational systems are required first, as in regulatory frameworks, then certain strategic cooperation and further outreach is necessary. Thus, detailed pillar-carrier analysis is a useful exercise for realizing the points where most efforts to achieve change will be required. **Policymakers can utilize the developed framework in order to identify, for example, regulative barriers that may obstruct innovation in healthcare.**

8. Limitations and future research

The study has a number of limitations. Firstly, the article is based on cases from Finland and Sweden. These regions imply various conditions in which companies operate, but they belong to Northern Europe and may not represent all European or global regions. The geographical and sociocultural context may be important in developing and adapting to new technologies in practice. Institutional barriers related to the introduction of new technologies in the healthcare sector may vary depending on the context and their "rigidity" in institutional work. In these countries, a networked and cooperative business culture, as well as a more developed technological infrastructure, may affect the fluidity of these barriers. Secondly, we were not able to collect and analyze personal information about the interviewees, such as age, gender, and experience, and we also had only general information about the number of employees and the turnover of the company. Such information can be valuable in overcoming institutional barriers. Thirdly, while our study focuses on the barriers to introducing AR/VR technologies, it would be interesting to evaluate the increase in efficiency after these new solutions have already been introduced to the healthcare sector. Finally, since our data consist of a limited number of interviews and because they have an exploratory nature, we call for further research on larger samples in order to claim the generalizability of study results. We therefore hope that our study will serve as inspiration for more studies on institutional barriers of implementing innovative solutions into relatively conservative industries.

We have chosen to focus on work related to creating institutions and have left out the work aimed at disrupting and maintaining them (Lawrence and Suddaby, 2006), as well as literature on market shaping through the introduction of new solutions (Biggemann *et al.,* 2013). As AR/VR technology providers are seen as newcomers to the healthcare industry, we assume the need to create institutional structures within the healthcare sector (or to base them on existing ones) that would legitimize the use of technology. However, it is possible that some existing institutions need to be

disrupted, which calls for another set of strategic responses by entrepreneurs. In particular, new solutions introduced by, e.g., entrepreneurs, are able to not only bring customers value but also affect other market actors and even shape the market (Biggemann *et al.,* 2013; Schiavone *et al.*, 2021). The created institutions should also be maintained through reenacting activities by many actors in order to persist. This is a promising topic for further research related to the introduction of new technologies in the established healthcare sector.

References

Abouelmehdi, K., Abderrahim and Khaloufi, H. (2018), "Big healthcare data: preserving security and privacy", *Journal of Big Data*, Vol. 5 No. 1, pp.1-18.

Aceto, G., Persico, V., and Pescapé, A. (2020), "Industry 4.0 and health: Internet of things, big data, and cloud computing for healthcare 4.0", *Journal of Industrial Information Integration*, Vol. 18, p.100129.

Agostini, L. and Filippini, R. (2019), "Organizational and managerial challenges in the path toward Industry 4.0", *European Journal of Innovation Management*, Vol. 22 No. 3, pp. 406-421.

Angelis, A., Lange, A., & Kanavos, P. (2018). Using health technology assessment to assess the value of new medicines: results of a systematic review and expert consultation across eight European countries. *The European Journal of Health Economics*, 19(1), 123-152.

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

Banta, D. (2003), "The development of health technology assessment", *Health Policy*, Vol. 63 No. 2, pp.121-132.

Barley, S. (1986), "Technology as an occasion for structuring: evidence from observations of CT scanners and the social order of radiology departments", *Administrative Science,* Vol. 31, No. 1, pp. 78-108

Basdogan, C., Sedef, M., and Wesarg, S. (2007), "VR-based simulators for training in minimally invasive surgery", *IEEE Computer Graphics and Applications*, Vol. 27 No. 2, pp.54-66.

Basit, T. (2003), "Manual or electronic? The role of coding in qualitative data analysis", *Educational Research,* Vol. 45 No. 2, pp.143-154.

Baudier, P., Kondrateva, G., Ammi, C., Chang, V., and Schiavone, F. (2021), "Patients' perceptions of teleconsultation during COVID-19: a cross-national study", *Technological Forecasting and Social Change*, Vol. 163, p.120510.

Beckert, J. (1999), "Agency, entrepreneurs, and institutional change. The role of strategic choice and institutionalized practices in organizations", *Organization Studies*, Vol. 20 No. 5, pp.777-799.

Biggemann, S., Kowalkowski, C., and Brege, S. (2013), "Development and implementation of customer solutions: a study of process dynamics and market shaping", *Industrial Marketing Management*, Vol. 42 No. 7, pp.1083-1092.

Bimber, O. and Raskar, R. (2005), *Spatial Augmented Reality: Merging Real and Virtual Worlds*. AK Peters/CRC Press.

Bjørnskov, C. and Foss, N. (2016), “Institutions, entrepreneurship, and economic growth: what do we know and what do we still need to know?” *Academy of Management Perspectives*, Vol. 30 No. 3, pp.292-315.
Bruton, G., Ahlstrom, D., and Li, H. (2010), “Institutional theory and entrepreneurship: where are we now and where do we need to move in the future?” *Entrepreneurship Theory and Practice*, Vol. 34 No. 3, pp.421-440.
Burdea, G. (2003), “Virtual rehabilitation – benefits and challenges”, *Methods of Information in Medicine*, Vol. 42 No. 05, pp. 519-523.
Cacho-Elizondo, S., Álvarez, J.D.L., and Garcia, V.E. (2017), “Assessing the opportunities for virtual, augmented, and diminished reality in the healthcare sector”, In *The Digitization of Healthcare*, Palgrave Macmillan, London, pp.323-344.
Campbell, J. (2005), “Where do we stand?” *Social Movements and Organization Theory*, pp.41-68.
Carlsson, B. (2002), “Institutions, entrepreneurship, and growth: biomedicine and polymers in Sweden and Ohio,” *Small Business Economics*, Vol. 19 No. 2, pp.105-121.
Chen, C., Loh, E.W., Kuo, K.N., and Tam, K.W. (2020), “The times they are a-changin’–Healthcare 4.0 is coming!” *Journal of Medical Systems*, Vol. 44 No. 2, pp.1-4.
Cherniack, E.P. (2011), “Not just fun and games: applications of virtual reality in the identification and rehabilitation of cognitive disorders of the elderly”, *Disability and Rehabilitation: Assistive Technology*, Vol. 6 No. 4, pp.283-289.
Cremer, J., Kearney, J., and Papelis, Y. (1996), “Driving simulation: challenges for VR technology”, *IEEE Computer Graphics and Applications*, Vol. 16 No. 5, pp.16-20.
Czerniak, E., Caspi, A., Litvin, M., Amiaz, R., Bahat, Y., Baransi, H., … and Plotnik, M. (2016), “A novel treatment of fear of flying using a large virtual reality system”, *Aerospace Medicine and Human Performance*, Vol. 87 No. 4, pp.411-416.
Denicolai, S. and Previtali, P. (2020), “Precision medicine: implications for value chains and business models in life sciences”, *Technological Forecasting & Social Change*, Vol. 151, pp.119767.
Denzin, N. (2017), *The Research Act: A Theoretical Introduction to Sociological Methods*. Routledge.
Eisenhardt, K. (1989), “Building theories from case study research”, *The Academy of Management Review,* Vol. 14 No. 4, pp.532-550.
Fahr, P., Buchanan, J., and Wordsworth, S. (2019), “A review of the challenges of using biomedical big data for economic evaluations of precision medicine”, *Applied Health Economics and Health Policy,* pp.1-10.
Flores, M., Glusman, G., Brogaard, K., Price, N.D., and Hood, L. (2013), “P4 medicine: how systems medicine will transform the healthcare sector and society”, *Personalized Medicine*, Vol. 10 No. 6, pp.565-576.
Füller, J. and Matzler, K. (2007), “Virtual product experience and customer participation — a chance for customer-centred, really new products”, *Technovation*, Vol. 27 No. 6-7, pp.378-387.
Füller, J., Faullant, R., and Matzler, K. (2010), “Triggers for virtual customer integration in the development of medical equipment — from a manufacturer and a user’s perspective”, *Industrial Marketing Management*, Vol. 39 No. 8, pp.1376-1383.

Gawer, A. and Phillips, N. (2013), “Institutional work as logics shift: the case of Intel’s transformation to platform leader”, *Organization Studies*, Vol. 34 No. 8, pp.1035-1071.
Gerardi, M., Rothbaum, B.O., Ressler, K., Heekin, M., and Rizzo, A. (2008), Virtual reality exposure therapy using a virtual Iraq: case report”, *Journal of Traumatic Stress: Official Publication of The International Society for Traumatic Stress Studies*, Vol. 21 No. 2, pp.209-213.
Glegg, S. and Levac, D. (2018), “Barriers, facilitators and interventions to support virtual reality implementation in rehabilitation: a scoping review”, *PM&R*, Vol. 10 No. 11, pp.1237-1251.e1.
Guha, S. and Kumar, S. (2018), “Emergence of big data research in operations management, information systems, and healthcare: past contributions and future roadmap”, *Production and Operations Management*, Vol. 27 No. 9, pp.1724-1735.
Guttentag, D. (2010), “Virtual reality: applications and implications for tourism”, *Tourism Management*, Vol. 31 No. 5, pp.637-651.
Hagel, J. and Singer, M. (1999), “Unbundling the corporation”, *Harvard Business Review*, Vol. 77 No. 2, pp.133-134.
Hayman, B. and Jackson, D. (2012), “Journaling: identification of challenges and reflection on strategies”, *Nurse Researcher,* Vol. 19 No. 3.
Henderson, A., Korner-Bitensky, N., and Levin, M. (2007), “Virtual reality in stroke rehabilitation: a systematic review of its effectiveness for upper limb motor recovery”, *Topics in Stroke Rehabilitation*, Vol. 14 No. 2, pp.52-61.
Herrera, G., Alcantud, F., Jordan, R., Blanquer, A., Labajo, G., and De Pablo, C. (2008), “Development of symbolic play through the use of virtual reality tools in children with autistic spectrum disorders: two case studies”, *Autism*, Vol. 12 No. 2, pp.143-157.
Hsieh, H. and Shannon, S. (2005), “Three approaches to qualitative content analysis”, *Qualitative Health Research*, Vol. 15 No. 9, pp.1277-1288.
Irrgang, B. (2007), “Technology transfer and modernization: what can philosophers of technology contribute?” *Ubiquity*, 2007(December):1.
Iserson, K. (2018), “Ethics of virtual reality in medical education and licensure”, *Cambridge Quarterly of Healthcare Ethics*, Vol. 27 No. 2, pp.326-332.
Jantarasami, L., Lawler, J., and Thomas, W., (2010), “Institutional barriers to climate change adaptation in US national parks and forests”, *Ecology and Society,* Vol. 15 No. 4.
Jepperson, R. (1991), “Institutions, institutional effects, and institutionalism”, *The New Institutionalism in Organizational Analysis,* pp.143-163.
Kim, Y., Kim, H., and Kim, Y. (2017), “Virtual reality and augmented reality in plastic surgery: a review”, *Archives of Plastic Surgery*, Vol. 44 No. 3, p.179.
Kraus, S., Schiavone, F., Pluzhnikova, A., and Invernizzi, A. (2021), “Digital transformation in healthcare: analyzing the current state-of-research”, *Journal of Business Research*, Vol. 123, pp.557-567.
Kulkov, I. (2021), “The role of artificial intelligence in business transformation: a case of pharmaceutical companies”, *Technology in Society*, Vol. 66, p.101629.
Kulkov, I., Barner-Rasmussen, W., Ivanova-Gongne, M., Tsvetkova, A., Hellström, M., and Wikström, K. (2020), “Innovations in veterinary markets: opinion leaders’ social capital”, *Journal of Business & Industrial Marketing*, Vol. 36 No. 13, pp.40-53.
Kulkov, I., Berggren, B., Hellström, M., and Wikström, K. (2021), “Navigating uncharted waters: designing business models for virtual and augmented reality companies in the medical industry”, *Journal of Engineering and Technology Management*, Vol. 59, p.101614.

Kulkov, I., Hellström, M., & Wikström, K. (2021). Struggling with conservatism: entrepreneurships' challenges in business model design. International Journal of Value Chain Management, 12(1), 45-61.
Langlois-Bertrand, S., Benhaddadi, M., and Pineau, P.O. (2015), "Political-institutional barriers to energy efficiency", *Energy Strategy Reviews*, Vol. 8, pp.30-38.
Lawrence, T. (1999), "Institutional strategy", *Journal of Management*, Vol. 25 No. 2, pp.161-187.
Lawrence, T. and Suddaby, R. (2006), "1.6 institutions and institutional work", In *The Sage Handbook of Organization Studies, p.*215.
Lawrence, T., Suddaby, R., and Leca, B. (2009), *Institutional Work: Actors and Agency in Institutional Studies of Organizations*. Cambridge University Press.
Lepore, L., Metallo, C., Schiavone, F., and Landriani, L. (2018), "Cultural orientations and information systems success in public and private hospitals: preliminary evidences from Italy", *BMC Health Services Research*, Vol. 18 No. 1, pp.1-13.
Leone, D., Schiavone, F., Appio, F., and Chiao, B. (2020), "How does artificial intelligence enable and enhance value co-creation in industrial markets? An exploratory case study in the healthcare ecosystem", *Journal of Business Research*, 129, 849-859.
Levac, D., Espy, D., Fox, E., Pradhan, S., and Deutsch, J.E. (2015), "'Kinect-ing' with clinicians: a knowledge translation resource to support decision making about video game use in rehabilitation", *Physical Therapy*, Vol. 95 No. 3, pp.426-440.
Li, J. and Carayon, P. (2021), "Health Care 4.0: a vision for smart and connected health care", *IISE Transactions on Healthcare Systems Engineering*, pp.1-10.
Li, L., Yu, F., and Jiang, Q. (2017), "Application of virtual reality technology in clinical medicine", *American Journal of Translational Research*, Vol. 9 No. 9, p.3867.
Loureiro, S., Guerreiro, J., Eloy, S., and Panchapakesan, P. (2019), "Understanding the use of Virtual Reality in marketing: a text mining-based review", *Journal of Business Research*, Vol. 100, pp.514-530.
Manika, D. and Antonetti, P. (2017), "Pride in technology-based health interventions: a double-edged sword", *Psychology & Marketing,* Vol. 34 No. 4, pp.410-427.
Manika, D., Gregory-Smith, D., and Papagiannidis, S. (2018), "The influence of prior knowledge structures on website attitudes and behavioral intentions", *Computers in Human Behavior*, Vol. 78, pp.44-58.
Maples-Keller, J.L., Bunnell, B.E., Kim, S.J., and Rothbaum, B.O. (2017), "The use of virtual reality technology in the treatment of anxiety and other psychiatric disorders", *Harvard Review of Psychiatry*, Vol. 25 No. 3, p.103.
Marescaux, J. and Diana, M. (2015), "Inventing the future of surgery", *World Journal of Surgery*, Vol. 39 No. 3, pp.615-622.
Mayring, P. (2004), "Qualitative content analysis", *A Companion to Qualitative Research*, Vol. 1, pp.159-176.
Merians, A.S., Jack, D., Boian, R., Tremaine, M., Burdea, G.C., Adamovich, S.V., … and Poizner, H. (2002), "Virtual reality–augmented rehabilitation for patients following stroke", *Physical Therapy*, Vol. 82 No. 9, pp.898-915.
Metcalf, M., Rossie, K., Stokes, K., Tallman, C., and Tanner, B. (2018), "Virtual Reality cue refusal video game for alcohol and cigarette recovery support: summative study", *JMIR Serious Games*, Vol. 6 No. 2, p.e7.

Morina, N., Ijntema, H., Meyerbröker, K., and Emmelkamp, P.M. (2015), “Can virtual reality exposure therapy gains be generalized to real-life? A meta-analysis of studies applying behavioral assessments”, *Behaviour Research and Therapy*, Vol. 74, pp.18-24.
Mölbert, S.C., Thaler, A., Mohler, B.J., Streuber, S., Romero, J., Black, M.J., … and Giel, K.E. (2018), “Assessing body image in anorexia nervosa using biometric self-avatars in virtual reality: attitudinal components rather than visual body size estimation are distorted”, *Psychological Medicine*, Vol. 48 No. 4, pp.642-653.
Nelson, R. and Winter, S. (1982), *An Evolutionary Theory of Economic Change*, Belknap, Cambridge, MA.
Ng, Irene C. and Wakenshaw, Susan Y. (2017), “The Internet-of-Things: review and research directions”, *International Journal of Research in Marketing*, Vol. 34 No. 1, pp.3-21.
North, D. (1990), *Institutions, Institutional Change and Economic Performance*. Cambridge: UK.
North, M.M., North, S.M., and Coble, J.R. (2015), “Virtual reality therapy: an effective treatment for the fear of public speaking”, *International Journal of Virtual Reality (IJVR)*, Vol. 3 No. 3, pp.1-6.
Oliver, C. (1991), “Strategic responses to institutional processes”, *Academy of Management Review*, Vol. 16 No. 1, pp.145-179.
Parekh, P., Patel, S., Patel, N., and Shah, M. (2020), “Systematic review and meta-analysis of augmented reality in medicine, retail, and games”, *Visual Computing for Industry, Biomedicine, and Art*, Vol. 3 No. 1, pp.1-20.
Pensieri, C. and Pennacchini, M. (2014), “Overview: virtual reality in medicine”, *Journal For Virtual Worlds Research*, Vol. 7 No. 1.
Porter, M. (1980), “Techniques for analyzing industries and competitors”, *Competitive Strategy*. New York.
Reay, T. and Hinings, C. (2005), “The recomposition of an organizational field: health care in Alberta”, *Organization Studies*, Vol. 26 No. 3, pp.351-384.
Riva, G. (2005), “Virtual reality in psychotherapy”, *Cyberpsychology & Behavior*, Vol. 8 No. 3, pp.220-230.
Robison, R., Liu, C., and Apuzzo, M. (2011), “Man, mind, and machine: the past and future of virtual reality simulation in neurologic surgery”, *World Neurosurgery*, Vol. 76 No. 5, pp.419-430.
Salmi, S. (2018), “What virtual reality technologies could provide to specialized healthcare in Finland?”
Satava, R. and Jones, S. (1997), “Virtual environments for medical training and education”, *Presence: Teleoperators & Virtual Environments*, Vol. 6 No. 2, pp.139-146.
Schiavone, F., Mancini, D., Leone, D., and Lavorato, D. (2021), “Digital business models and ridesharing for value co-creation in healthcare: a multi-stakeholder ecosystem analysis”, *Technological Forecasting and Social Change*, Vol. 166, p.120647.
Schiavone, F. and Sprenger, S. (2017), “Operations management and digital technologies”, *Production Planning & Control*, Vol. 28 No. 16, pp. 1281-1283
Scott, W.R. (2013), *Institutions and Organizations: Ideas, Interests, and Identities*. Sage.
Sheffer, D., Levitt, R., and Taylor, J. (2013), “Innovation of unique, complex products”, working paper no. 80, Global Projects Center, Stanford University.
Sehgal, S. and Gupta, G. (2019), “Converging resources and co-producing for innovation: evidence from healthcare services”, *European Journal of Innovation Management,* Vol. 23 No. 3, pp. 429-453.
Serrano, B., Baños, R.M., and Botella, C. (2016), “Virtual reality and stimulation of touch and

smell for inducing relaxation: a randomized controlled trial", *Computers in Human Behavior*, Vol. 55, pp.1-8.
Sheffer, D. (2011), "Innovation in modular industries: implementing energy-efficient innovations in US buildings"
Sherman, W. and Craig, A. (2018), *Understanding Virtual Reality: Interface, Application, and Design, 2nd ed*. Morgan Kaufmann.
Sine, W.D. and David, R.J. (2010), "Institutions and entrepreneurship", Sine, W.D. and David, R.J. (Ed.) Institutions and Entrepreneurship (Research in the Sociology of Work, Vol. 21), Emerald Group Publishing Limited, Bingley, pp. 1-26.
Skog, D., Wimelius, H., and Sandberg, J. (2018), "Digital disruption", *Business & Information Systems Engineering,* Vol. 60 No. 5, pp.431-437.
Snow, D. and Benford, R. (1992), "Master frames and cycles of protest", *Frontiers in Social Movement Theory,* Vol. 133, p.155.
Snow, D., Rochford E.B., and Benford, R. (1986), "Frame alignment processes, micromobilization, and movement participation", *American Sociological Review*, pp.464-481.
Spender, J. (1989), *Industry Recipes*. Oxford [u.a.], Blackwell.
Srivastava, K., Das, R., and Chaudhury, S. (2014), "Virtual reality applications in mental health: challenges and perspectives", *Industrial Psychiatry Journal*, Vol. 23 No. 2, p.83.
Stiglitz, J. (2019), *People, Power, and Profits: Progressive Capitalism for an Age of Discontent.* Penguin UK.
Tashjian, V.C., Mosadeghi, S., Howard, A.R., Lopez, M., Dupuy, T., Reid, M., … and Rosen, B. (2017), "Virtual reality for management of pain in hospitalized patients: results of a controlled trial", *JMIR Mental Health*, Vol. 4 No. 1, p.e9.
Torkkeli, L., Ivanova-Gongne, M., Vuorio, A., & Kulkov, I. (2021). Always Trusts, Always Hopes, Always Perseveres? Comparative Discourse Analysis of the Perception of International Entrepreneurship During Pandemic. In Empirical International Entrepreneurship (pp. 199-215). Springer, Cham.
Tortorella, G.L., Fogliatto, F.S., Mac Cawley Vergara, A., Vassolo, R., and Sawhney, R. (2020), "Healthcare 4.0: trends, challenges and research directions", *Production Planning & Control*, Vol. 31 No. 15, pp.1245-1260.
Urbano, D., Aparicio, S., and Audretsch, D. (2019), "Twenty-five years of research on institutions, entrepreneurship, and economic growth: what has been learned?" *Small Business Economics*, Vol. 53 No. 1, pp.21-49.
Verhoef, Peter C. and Bijmolt, Tammo H.A. (2019), "Marketing perspectives on digital business models: a framework and overview of the special issue", *International Journal of Research in Marketing*, Vol. 36 No. 3, pp.341-349.
Wang, Y. (2018), "An integrated big data analytics-enabled transformation model", *Information & Management*, Vol. 55 No. 1, pp.64-79.
Weck, M. and Ivanova, M. (2013), "The importance of cultural adaptation for the trust development within business relationships", *Journal of Business & Industrial Marketing*, Vol. 28 No. 3, pp.210-220.
Wilhoit, L.F., Scott, D.A., and Simecka, B.A. (2017), "Fetal alcohol spectrum disorders: characteristics, complications, and treatment", *Community Mental Health Journal*, Vol. 53 No. 6, pp.711-718.
Wu, H., Lee, S., Chang, H., and Liang, J. (2013), "Current status, opportunities and challenges of augmented reality in education", *Computers & Education*, Vol. 62, pp.41-49.

Yaqoot, M., Diwan, P., and Kandpal, T. (2016), “Review of barriers to the dissemination of decentralized renewable energy systems”, *Renewable and Sustainable Energy Reviews,* Vol. 58, pp.477-490.
Yin, R. (2018), *Case Study Research and Applications*. Sage: Los Angeles; London; New Delhi; Singapore; Washington DC; Melbourne.
Zhou, M., Leenders, M.A., and Cong, L.M. (2018), “Ownership in the virtual world and the implications for long-term user innovation success”, *Technovation*, 78, pp.56-65.