The Emergence of Multi-Sided Platforms:

A Value-Based Perspective in Digital Health

ABSTRACT

The present paper aims at understanding *the emergence process of a multi-sided digital platform* by applying the value-based perspective of (digital) health. While new emerging multi-sided platforms (MSPs) play a critical role in the shift towards digital health, with the prevailing interest in the established and mature platforms, the platform emergence phenomenon is almost neglected. Existing research on MSPs has mainly focused on the value and growth of established platforms enabled by network effects and the aggressive attraction of more new users. Exploring the case of the Safe Steps healthcare MSP, the present paper revealed the fine-grained process of the MSP emergence that consists of the three phases, namely, 1) *platform activation*, 2) *platform scale-up*, and 3) *shared values merger*. Moreover, we found that shared between the platform actors' values are the drivers of the platform emergence, platform actors' attraction, and value creation. The present research contributes to the digital platforms literature, specifically, platforms emergence. Moreover, the paper put the break into an understanding of the nature of value creation of an MSP health platform.

Keywords:

Multi-Sided Platform, Emergence, Value Creation, Shared Value, Digital Health

INTRODUCTION

Digital transformation has enabled exciting opportunities for transformation within the healthcare sector (Bardhan *et al.*, 2020; Nambisan, 2017). In particular, digital health platforms—conceived as intermediaries that connect multiple fragmented participants, from patients to healthcare providers, scientists, or NHS as a whole (Chamakiotis et al., 2021)—play a critical role in the shift towards digital health (Hermes et al., 2020; Zenooz and Fox, 2019). In this context, two and more users groups can connect their resources in a smarter and value-adding manner through multi-sided platforms (MSPs) (Abdelkafi et al., 2019; Boudreau and Jeppesen, 2015; De Reuver et al., 2018; Evans and Schmalensee, 2016; Gawer, 2014).

Existing research on MSPs has mainly focused on the impact of mature established platforms exploring the successfully operating platforms on the market (de Reuveur et al., 2017; McIntyre and Srinivasan, 2017); exemplarily, the economic and industry impact of multi-sided mature platforms (e.g., Constantinides et al., 2018; Gleiss et al., 2021; Parker et al., 2016b) or platforms growth (e.g., Gregory et al., 2020; Parker et al., 2016a). Also, studies have examined the mechanism behind mature platforms' growth focusing on network effects thanks to building a business model around consumers' needs and aggressive attraction of more new users (Ceccagnioli et al., 2012; Gawer & Cusumano, 2014). The more people use the platform, the more valuable it becomes to users (Gregory et al., 2020). This led to the concerns that tech-giants established platforms are more a pathway to big earnings in the healthcare sector generated by a large number of platform users rather than a solution to concrete medical needs (Pearl, 2019). Indeed, this does not correlate with the fundamental value-based healthcare delivery principle in (digital) healthcare (Porter, 2008) that suggests the (medical) value is the main goal in any healthcare initiative "no matter who pays" (Porter, 2008).

Due to the prevailing interest in established tech-giants platforms, the platform emergence phenomenon with some exceptions (e.g., Hein et al., 2019) is almost neglected (de Reuver et al., 2018; Gawer et al., 2014; Hein et al., 2019; McIntyre and Srinivasan, 2017; Murthy & Madhok, 2021). Indeed, existing established MSPs cases allow only *ex-post* studies of the emergence phenomenon, unlike new emerging platforms. Moreover, although value created through network effects is the main driving the mature platforms element, it is not clear what drives value creation during the platform emergence in the healthcare context.

The present paper aims at answering the question of *what is the fine-grained emergence process of a multi-sided digital platform* by applying the value-based perspective of (digital) health. We explore the case of the Safe Steps digital health platform emergence and evolution cycle. We focus on the digital health platform that successfully operates in the aging well sector.

THEORETICAL BACKGROUND

Multi-Sided Digital Platforms

MSPs are commonly conceived as platforms that facilitate digital exchanges, coordination, and interaction between two or more different, yet affiliated users groups (Fürstenau et al., 2019; Hagiu, 2014). As a specific type of platform, they are considered a distinct organizational form in the digital era (Gawer, 2021; Hagiu & Wright, 2015). The fundamental characteristics are direct interactions between different platform sides and their affiliation with a platform (Hagiu & Wright, 2015). On the one hand, direct interaction presupposes that various platform sides have control over main interaction processes, with no or very limited role of intermediaries. The research highlighted affiliation enables the meaningful connection of users of a platform (Hagiu, 2014) and deliberate platform investments to directly interact (Hagiu & Wright, 2015). Recently, studies have shown how collaborations and interactions can be improved especially in healthcare as they can

involve diverse intersectoral and interprofessional groups, including patients (Fürstenau et al., 2021; Zenooz and Fox, 2019). Indeed, in this context, MSPs play the role of intermediaries that connect multiple fragmented participants, from patients to healthcare providers, care delivers, nurses, scientists, pharmaceutical firms, NHS, and many others (Chamakiotis et al., 2021).

Existing studies on MSPs have primarily investigated the growth dynamics of established large platforms (Abdelkafi et al., 2019). Only recently, the research interest shifted toward a better understanding of platform emergence (Murthy & Madhok, 2021; Hein et al., 2019). The latter become salient thanks to the emergence of new technological advancements that serve as enablers of MSPs (Gawer, 2021). Emerging technologies have been seen to allow collecting and using a large amount of data, facilitating interactions, and leveraging interactions data (Gawer, 2021; Nambisan et al., 2017). These studies mainly provide insights on MSPs' emergence as a digital age phenomenon (Gawer, 2021; Hein et al., 2019).

In addition, scholars have pointed out the determinants of successful emergence. For instance, the platform needs to attract participants and users (Ceccagnoli et al., 2012; McIntyre & Srinivasan, 2017; Murthy & Madhok, 2021; Mukhopadhyay & Whalley, 2021). For this, an emerging platform needs to compete with established platforms and overcome the lack or absence of key advantages, such as established technology infrastructure (Constantinides et al., 2018; Tiwana et al., 2010) and timing of entry (McIntyre & Subramaniam, 2009; Abdelkafi et al., 2019).

Finally, MSPs are considered to emerge when they can create and capture value for all sides of the platform (Gawer, 2021). The recent work of Murthy and Madhok (2021) focused on MSPs emergence and value creation and found that the right choice of a new platform's scope can lead to the attraction of committed participants to an emerging and yet unknown platform (Adner, 2017; Autio & Thomas, 2020; Dattée et al., 2018). The authors highlighted that in emerging platforms is

crucial to firstly focus on value proposition (or "what problem is solved") and then on actors, since the value proposition of an emerging platform evolves as new actors join the platform.

Emerging MSPs in Healthcare: Value-Based Healthcare Principle

MSPs health platforms are considered crucial in guiding the shift towards digital health and show a growing number of health platforms (Chamakiotis et al., 2021; Hermes et al., 2020; Zenooz and Fox, 2019). Despite promises, the majority of existing established health platforms are considered more a pathway to big earnings in the healthcare sector, therefore providing any real value for platforms' users is an unavoidable measure (Pearl, 2019). While, in healthcare, consumer preferences are not equal to medical or patients' needs. Thus, the logic of established MSPs to cover consumers' needs, have more users, and produce a strong network effect does not necessarily mean covering medical needs (Gleiss et al., 2021). For this reason, doubts that large established platforms will "struggle to disrupt healthcare" (Pearl, 2019) highlight the need to focus on value creation (e.g., Gawer, 2021).

More specifically, studies on established MSPs discuss value creation and value proposition mainly investigating indirect network effects (Gregory et al., 2021; Hangiu, 2014; Hagiu & Wright, 2015). In other words, enabling value creation to one side of a platform by increasing the number of users on the other side (Hangiu, 2014); the more users of one side use an MSP, the more valuable it becomes to each user of another side (Gregory et al., 2021; Hagiu & Wright, 2015). However, value creation through network effects composes an essential drawback when examining the emergence of platforms. Network effects are key drivers of platform scaling and growth (Hagiu & Wright, 2015; Fürstenau et al., 2019), however, they are not sufficient *per se* to create MSPs.

For this reason, this study adopts the value-based healthcare principle (VBHC) formulated by Porter (2008). The fundamental assumption of VBHC suggests that only working together all actors could reach healthcare delivery at its highest potential. Working on delivering one common value, all actors should win (Porter, 2008). The core concept in VBHC is dedicated to the patient value—a multidimensional construct that firstly relates to medical and patient outcomes, and secondly to healthcare efficiency issues (e.g., cost savings) (Fürstenau et al., 2021). This principle is in line with Gawer's (2021) essay that manifested a reformulation of value creation principles in digital platforms, and where human needs are the core of digital platforms.

In particular, VHBC is focused on delivering *medical outcomes* in terms of improved patients' well-being through evidence-based medicine and care, and action-oriented data (Fürstenau et al., 2019). In the MSPs realm, this can be addressed through patients' data generation and sharing and, thus, more informed healthcare and enhanced expertise (Gleiss et al., 2021). In its turn, p*atients' outcomes* are considered in terms of quality of life (Fürstenau et al., 2021). Thus, MSPs can enable data and direct interactions for personalized and contextualized healthcare (Gleiss et al., 2021). In VBHC cost savings cannot be the main goal (Porter, 2008). Providing any health service without considering (patients) value will lead to either an additional cost to other players or will be postponed due to the unaddressed value in a long run. Emerging digital health MSPs need to be able to generate patients' and other stakeholders' value in the long run but also be sustainable in terms of value creation (Fürstenau et al., 2021). Finally, existing research on MSPs provides pieces of evidence that the VBHC principle employed to build MSPs could improve patient value creation by managing the quality of care and patient and medical outcomes, and patient involvement (Fürstenau et al., 2021).

METHODS

Setting

The setting of our research is based on the Safe Steps native digital health multi-sided platform developed by a private UK-based technology company. The platform aims to improve the quality of life for an aging society by generating large patients' data sets and sharing them with care homes, hospitals, NHS, General Practitioners, nurses, etc., The Safe Steps platform grew from a targeted specific digital solution to an MSP that addresses various issues and problems of the aging population and helps to track and prevent the problems inside care home, in four years (Figure 1).

Figure 1 about here

The story of the Safe Steps platform started in 2018, initiated by a group of specialists operating within the digital health sector and developing products for healthcare in the UK. Specialists were aware that healthcare needs digitalization tools and, specifically, platforms. The initial idea of Safe Steps was to develop a platform that would be positioned inside the silver economy context. The platform would play the role of aggregator of the patients' data (aging people), helping e.g. hospitals and care homes to grasp necessary information about their patients to improve decision-making and operations, eliminating paperwork, and enabling data flow between main stakeholders. However, Safe Steps faced two major issues. Firstly, the silver economy is vast in terms of issues that need to be addressed and the number of actors and stakeholders involved in one small issue tackling. Thus, it was unclear who exactly needs to be part of the platform and who will get the value. Second, Safe Steps understood that the classic startup approach to find and address the unique pain point or need of a platform user would not work in the sphere of health.

The first issue was addressed by performing several co-creation sessions with care homes workers trying to understand what are real pressing issues, what are regulations, and, most importantly, values that care homes and caregivers seek to receive. This helped to launch the platform in 2018. Specifically, all the research and co-creation sessions were narrowed to the focused issue that care homes experience – falls of the aging population is a major issue in the UK. Tracking the health state of an aging population, especially those people who stay home or are alone is one of the most important measures to prevent hospitalization, consequences of falls, or even death. The tracking system functioning in the UK was based on the paper questionnaires that although tracking very important patients' information was easily lost, disorganized, and not always delivered to care homes, hospitals, and Clinical Commissioning Groups (CCGs).

The second issue was not easy to handle, as care homes, hospitals, and other players of the healthcare system were not willing to work applying economics rationale. Specifically, first, Safe Steps discovered that issue of the frequent falls of aging people result in dramatically increased bed-time in hospitals and care homes, in general, affecting the healthcare system for millions of pounds. However, surprisingly, the logic of saving costs or reducing bed-time was not of primary importance for healthcare participants. Safe Steps decided to explore more, which values the platform should deliver.

Research Methods

As the present research aims to empirically explore the emergence and evolution of the digital health platform in its complexity in a real context and develop generalizable connections based on rich empirical observation, we chose to adopt a participatory observation as the primary method (Van de Ven & Poole 1995; Street & Meister, 2004; Bryman, 2012). Participatory observations allow us to get insights on the drivers of the platform emergence and observe the platform

emergence in real-time during a long period. Moreover, as the research explores the phenomenon in a real business setting, it presupposes the involvement of various stakeholders from MSP developers and managers to the platform stakeholders, users, value recipients. With this respect, the participatory approach is recognized as an efficient method to understand complex situations and relationships and to achieve more significant and less hierarchical research practice (Clark et al., 2009). We drew on the three steps participatory research process developed by Street and Meister (2004). We built a comprehensive *ad-hoc* three stages framework of reliable data generation via participatory observation within the technology innovation context. Three steps approach is especially helpful when there is a need to move from case observations to generalizable to a certain level of findings (Street & Meister, 2004). Moreover, we implemented two iterative rounds of the participatory observation research, where the second round starts with the new gained from the previous round of knowledge while being focused on grasping new knowledge too. Each of the two rounds was composed of three steps. Table 1 presents the research design and summarizes the methods and approaches we used in the research.

Table 1 about here

As typically, the first step of the participatory observation research aims at building a robust evidence base on MSP emergence. In step 1, we used the triangulation principle of data collection and analysis (Yin, 2013) to provide a comprehensive view of the emergence of the platform. Specifically, we triangulated participatory observations' notes with other data sources to enable reliable evidence base and facts production. Thus, we collected and qualitatively analyzed the content of the online visual collaboration platform (Miro) that was used as the place to share ideas, run co-creation sessions, and ideate new MSP features. Moreover, we collected main strategic internal documents that officially report results of the brainstorming, co-creation sessions,

changes, and other important events of the platform emergence process as well as external documents that were used to inform decisions (white papers, regulations, etc.). This was particularly helpful to follow the overall flow of the project from its start to its end, to understand main events, changes, drivers, values, and stakeholders. In step 2, we reflected and specified what we learned during step 1 into three main phases of the MSP emergence, stakeholders' composition and shared values change. During step 3, we moved to the abstraction and conceptualized findings into three phases of the MSP emergence driven by three big shared values.

We repeated the research process using gained knowledge to grasp new aspects of the MSP emergence during the second round of the research. Thus, at step 1A, we came back to participatory observations notes to get data on various combinations of values during three emergence phases of the platform and derived a new evidence base by triangulating observations data with content from Miro dashboards and internal documents analysis. This was particularly important to get more insights into the role of shared values in platform emergence. During step 2A, we specified main shared values and additional values that MSP different groups of stakeholders were receiving. We also derived the main features of shared and additional values. Finally, in step 3A, we conceptualized findings on the MSP emergence phases and values into the "Three Phases of the Multi-Sided Digital Health Platform Emergence Process" framework.

The three stages framework enabled us to gradually move from participatory observations and learning from the case to conceptualizing findings. Although the steps of the research occurred subsequently, the boundaries were blurred, as the researchers were repeatedly going back to observations, documents analysis, and conceptualization. This reflective and iterative research approach was important not to lose crucial aspects and deal with the vast amount of the data collected.

Data Collection and Analysis

In steps 1 and 1A, a big amount of primary data based on participatory observations was collected. The researchers took part and followed one specific case of the MSP emergence from the initial phase until the platform emerged. Further, as a supportive knowledge source, the researchers got access to the Miro dashboard that was used for the Safe Steps platform ideation, brainstorming on design and technical features, potential stakeholders' analysis, and different values research. Specifically, as the Safe Steps team worked remotely, ideation and changes to the platform were done remotely too. The Miro dashboard has various digital boards to collect, share ideas, and store data (i.e., "Safe Steps Business Plan Development", "Smart Design Sprint", or "AI in Health and Care Award", and other boards). We also collected internal (strategic plans, commercialization plans, reports, evaluations, and appraisals) and external documents (directives, long-term NHS plans, white papers) that were guiding decisions on the MSP (see all data sources specified in Appendix A).

Data collection started in April 2018 and ended in August 2021 with the direct involvement of one of the authors in the ideation and development of the Safe Steps platform. The author gathered ethnographic data over 3 years. The author participated in the ideation of the first version of the platform (April 2018), the second version (April 2020), and the third final version (June 2021). Moreover, the participatory observations were run in the field by taking part (online) in the workshops with the platform's users and staff to develop the platform further. The author was attending online calls and real-life meetings (Liverpool office) during which the author documented the agenda of the discussion, strategic decisions, external and internal events that triggered changes in the MSP launch and development. As the project's team was international and worked remotely mainly, all meetings were run online.

To make a vast amount of collected heterogeneous data homogeneous, we developed an *ad-hoc* data analysis protocol based on the general inductive approach for qualitative data analysis (Thomas, 2006). The approach is especially suitable for condensing various raw contents into a summary (Thomas, 2006). The protocol aimed at helping, firstly, to unify in a single format fact and knowledge gained through participatory observations and texts, secondly, to ease follow-up analysis of the vast amount of various data, thirdly, to derive key facts that are related to MSP emergence and values. Specifically, all researchers were rigorously and systematically reading all contents familiarizing with the context and some hidden aspects. Then, following the protocol format, we systematized contents from meetings, calls, Miro dashboards, and documents focusing on MSP phases (step 1) and shared and additional values (step 1A). Final items were screened to triangulate data sources and group pieces of evidence in logic and concise blocks related to the specific issue or event. The reflective practice and participatory observations coupled with the expertise of one of the authors in ideation and advancements of MSP allowed us to derive key phases and drivers of MSP emergence and build a large empirical knowledge base on the shared values of the platform stakeholders.

RESULTS

We found that the platform emergence went through the three phases, namely, 1) *platform activation*, 2) *platform scale-up*, and 3) *shared values merger*, being driven by specific strong shared values (See fig.2). We conceive shared value as the value that all participants accept to be uppermost crucial for a value recipient; second, if delivered for the value recipient, shared value enables additional values for network actors. The peculiarity of such a shared value is that it is concerned with the final recipient who is not the user of the platform, namely, the aging population.

We further explain the mechanism of the shared values driving the emergence and shaping the configuration of the platform.

Platform Activation Phase

The rationale behind the platform activation. For the 11.6 million older people living in the U.K., falls represent a major problem, with six people falling every single minute. 40% of people who suffer from a fall are left with a moderate or extensive injury. With 40% of hospital admissions from care homes occurring due to a fall, falls prevention represents a huge challenge for care homes across the U.K.

  The shared value. Preventing falls of the aging population was considered a crucial issue by at least four large groups of actors. The platform owners' found that each of the four groups, first of all, pointed out the importance of reducing the number of falls and only at the second moment discussed additional benefits that the delivered value (a prevented fall) could bring personally to them (see Table 2). The value proposition, therefore, was built accordingly.

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Table 2 about here

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The shared value of preventing falls was supported by additional values for each actor. While those values were unique and crucial for each actor, there were not enough *per se* to launch the health platform and play a beneficial role.

  The solution. A digital falls risk assessment tool was designed to reduce the number of falls in care homes. Based on NICE guidelines, Safe Steps allowed care homes to proactively implement a review process whereby vulnerable residents can be identified, receive appropriate care, and thus reduce their risk of falling. The platform was activated.

Platform Scale-Up Phase

The rationale behind platform scale up. The big problem of the fast-spreading of the COVID-19 virus inside care homes was pressing. The world pandemic urged a quick response from the health system. Specifically, the existing falls prevention solution, its architecture, actors' network, and existing data algorithms focused on the preventive actions could become a good base for reuse for the COVID emergency in care homes.

The shared value. Although the COVID-19 emergency prompted the spontaneous scale-up solution for the platform, we found that the basic principle was the same as for the platform activation. Thus, preventing virus spreading in care homes was the value that was shared and considered crucial between at least six large groups of actors. Among them, the four groups were already existing actors, and the two others were the new groups (G.P.s and regional leaders). In the analogy with the previous phase, the delivered shared value would trigger the emergence of the additional unique values for all six large groups of actors (see Table 3).

Table 3 about here

The scale-up of the platform was observed not only at the level of the platform's configuration (the new platform COVID-19 tracker emerged) or at the level of the platform's actors (the new groups of actors entered the platform in addition to the existing ones). There were now the two strong shared values and related unique additional values that were delivered simultaneously.

The solution. Covid-19 tracker was designed to monitor symptoms and prevent the spread of Covid-19 in care homes by care homes staff inputting information about a residents' COVID-19 related symptoms into a tracker and directly sharing data with the residents G.P. and others. This information is used by professional health teams to help prioritize the response and resources where they are needed the most. Although the newly emerged shared value might give the

impression of a new platform emergence, we found that it was indeed the scale-up of the previously activated platform. The backend had the same infrastructure and algorithms with the different levels of data accessibility - some accounts had access only to the falls prevention side of the platform, other accounts had access only to the COVID-19 tracker.

Platform's Shared Values Merger Phase

The rationale behind platform shared values merge. The platform was growing its data sets that could be leveraged by new actors too. The decision was to unite the two solutions in one and create a "digital home for the ageing population" with new data sources and users, more advanced data analytics, and visualization features.

The shared value. The value focus shifted towards enabling a better quality of life for the aging society in care homes. Moreover, the new strong and concrete shared value was able to naturally merge with the two already existing shared values but keep them independent. Thus, all the existing actors shared the new value while still focusing on their initial shared value. New groups of powerful actors entered the platform, namely, regional NHS and families of aging patients. Thus, the ultimate composition of the platform is composed of eight large groups of actors that share one strong value but also other strong shared values and get additional unique values (see Table 4).

While the stronger shared value enabled the merger of the two shared values, it is not equal to the sum of the merged shared and related additional values that actors can get. Instead, it works as the maximizing values function. The multi-sided platform emerged.

Table 4 about here

DISCUSSION AND CONTRIBUTIONS

Our research sheds light on the process of the MSPs emergence using the value-based health perspective. Specifically, we observed that at each phase a new strong shared value is added, and ultimately all of them merge while still being separate *per se*. This process can be better explained using the analogy of building blocks. When several blocks unite or merge, they do not become one inseparable object, instead, they share the common wall to minimize surface area and maximize overall strength, while remaining separate bodies of blocks. Figure 2 presents the conceptualized emergence process.

Figure 2 about here

Furthermore, every new added shared value is similar (is positioned in close proximity) with a prior shared value. In this way, they can merge, maximize the overall strength of the value delivered, and become the next building block for an emerging platform.

We argue that proximity is the important condition for the successful merge of shared values. Thus, we observed that the proximity had four specific features: 1) the shared final value recipient (aging population, in our case); 2) the shared context (care homes); 3) the shared platform infrastructure (all three phases use the same platform but add new features); 4) partially shared actors across shared values (care homes, care providers, CCGs share all three values). In this case, although a digital health platform can successfully function with only one shared value (activation phase) or the sum of several shared values (scale-up phase), shared values are maximized only when merged.

In this way, the contribution of the present research to MSPs literature is three-fold. Firstly, we provide a fine-grained view on the emergence process of MSPs that was neglected so far (Abdelkafi et al., 2019; de Reuver et al., 2018; Gawer et al., 2014; Hein et al., 2019; McIntyre and

Srinivasan, 2017). Unlike prior research that provides a large view on MSPs phenomenon emergence by exploring the role of technology evolution (Hein et al., 2019; Tiwana et al., 2010, Gawer & Cusumano, 2014) or challenges of emerging platforms on the world of established platforms (Ceccagnoli et al., 2012; McIntyre and Srinivasan, 2017; Mukhopadhyay & Whalley, 2021), we conceptualized the emergence process into three fine-grained phases. We found that MSPs' emergence process goes through platform activation, scale-up, and SHs merger phases.

Second, we contributed to the existing view that MSPs has emerged when it can create value (Gawer, 2021). In line with the recent studies (Murthy & Madhok, 2021) we found that in emerging MSPs platforms, it is crucial to focus on what value is delivered. Thus, we found that each of the MSPs' emergence phases is driven by the presence of strong and specific shared values between stakeholders. Moreover, following three phases of the MSPs emergence, we found that value propositions of an emerging platform evolve, as shared values are merged.

Third, we put the break into an understanding of the nature of value creation of a digital health platform. Adding to growing debates that established and emerging healthcare platforms are heterogeneous in their value creation nature (Gleiss et al., 2021; Jia and Kenney, 2021; Hermes et al., 2020; Boudreau and Jeppesen, 2015; Pearl 2019), we contributed to the VBHC perspective (Porter, 2008). We argue that the driver of the value creation in emerging MSPs healthcare platforms is SV. We argue SV for healthcare MSPs emerging platforms plays the role of patient value (Fürstenau et al., 2021). Moreover, SV enables additional values for platform users if delivered to the value receiver.

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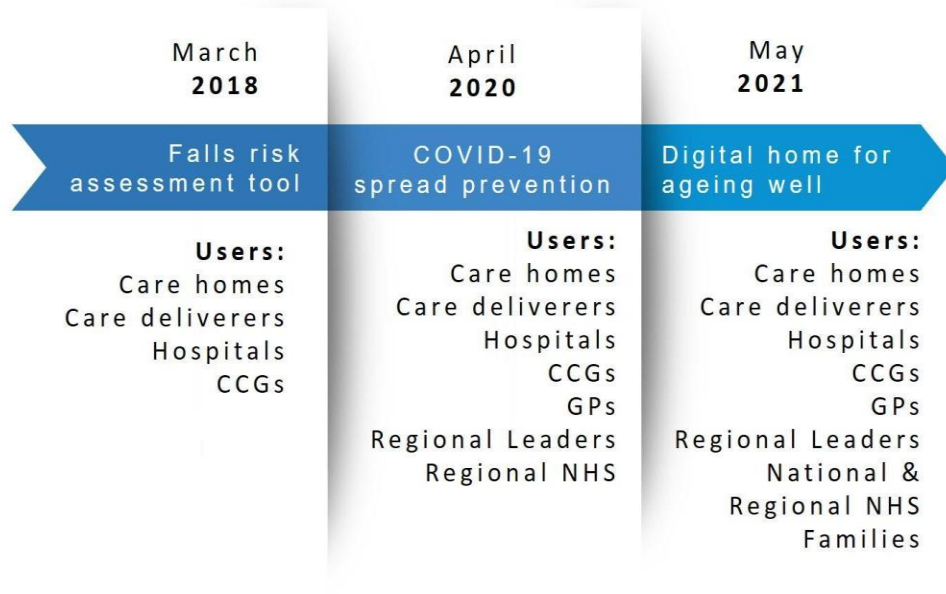
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FIGURE 1

Safe Steps Platform Emergence Timeline

March 2018	April 2020	May 2021
Falls risk assessment tool	COVID-19 spread prevention	Digital home for ageing well
Users: Care homes Care deliverers Hospitals CCGs	**Users:** Care homes Care deliverers Hospitals CCGs GPs Regional Leaders Regional NHS	**Users:** Care homes Care deliverers Hospitals CCGs GPs Regional Leaders National & Regional NHS Families

FIGURE 2

Three Phases of the Multi-Sided Digital Health Platform Emergence Process

1. Platform Activation   2. Platform Scale Up   3. Shared Values Merger   Multi-sided Platform Emergence
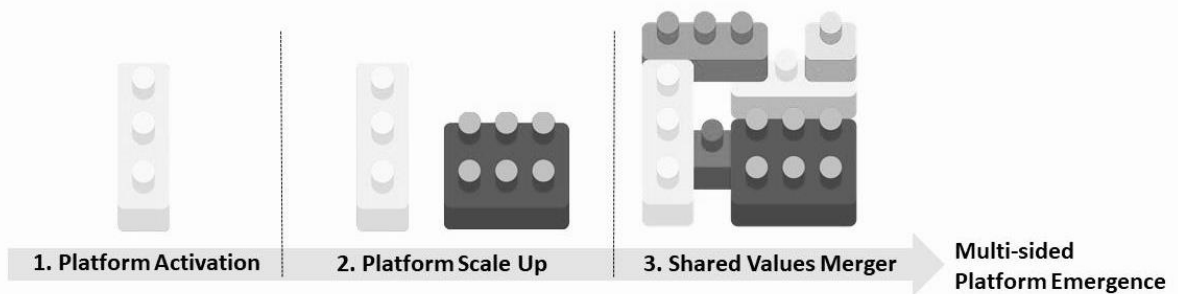
TABLE 1

Research Steps and Methodological Tools

The first round of the research	Step 1: Observing Safe Steps platform emergence		The second round of the research	Step 1: Observing Safe Steps platform emergence	
	Methodological tool	Description		Methodological tool	Description
	Main: Participatory observation	- Deriving the key points of the platform emergence, changes, issues in real-time; - Enabled to follow official milestones and spot natural reactions and key topics discussed on the formalized meetings.		**Main:** Participatory observation filed notes analysis	- Deriving new insights on various combinations of values during three emergence phases.
	Supportive: Miro digital dashboard content analysis	- An extension of the participatory observation; - Enabled observation of ideation phases of the platform.		**Supportive:** Miro digital dashboard content analysis	- An extension of the participatory observation; - Enabled getting more insights on the role of shared values in the platform emergence.
	Supportive: Internal and external official documents analysis	- Analysis of unstructured data following the general inductive approach to analyze qualitative data; - Enabled key topics deriving from formalized documents.		**Supportive:** Internal and external official documents analysis	- Analysis of unstructured data following the general inductive approach to analyze qualitative data; - Enabled key topics deriving from formalized documents.
	Step 2: Specifying findings of the Safe Steps platform emergence process			**Step 2A: Specifying main shared values and additional values**	
	Description			Description	
	Specification of the safe Steps platform emergence phases, stakeholders' composition, and shared values.			- Specification of main shared values and additional values that that Safe Steps platform sides were receiving; - Deriving main features of shared and additional values.	
	Step 3: Conceptualizing three phases of the MSP emergence			**Step 3A: Conceptualizing the MSP emergence framework**	
	Description			Description	
	Conceptualization findings into three phases of an MSP emergence driven by three big shared values.			Conceptualization of findings on the MSP emergence phases and values into the "Three Phases of the Multi-Sided Digital Health Platform Emergence Process" framework.	

TABLE 2

Shared and Additional Values at the Platform Activation phase

Shared value 1: preventing falls of elderly people in care homes	
Actor	**Additional value delivered**
Care homes	Fiscal savings on treatment
Hospitals	Reduced bed-time and money spent on treatment
Care delivers	Dramatic reduction of paperwork and no loss of patients' data
Clinical Commissioning Groups	Ability to allocate resources in a better way

TABLE 3

Shared and Additional Values at the Platform Scale Up Phase

Shared value2: preventing the spread of COVID-19 in care homes	
Actor	**Additional values delivered**
Care homes	Preventing contamination of other care home residents and fiscal savings
Hospitals	Possibility to plan bed-time and intensive therapy places if needed
Care providers	Dramatic reduction of paperwork and no loss of patients' data
CCGs	Ability to allocate resources in a better way during the emergency
G.P.s	Possibility to exclude weekly physical visits to care homes
Regional leaders	Data to track COVID-19 spread in the region to better allocate recourse

TABLE 4

Shared and Additional Values at the Three Steps of the Platform Emergence

Actors	SHARED VALUE: FALLS PREVENTION		SHARED VALUE: COVID-19 SPREAD PREVENTION		SHARED VALUE: IMPROVING QUALITY OF LIFE FOR AGEING SOCIETY IN CARE HOMES	
	Value shared	*Additional value*	*Value shared*	*Additional value*	*Value shared*	*Additional value*
Care Homes	✓	Fiscal savings on treatment	✓	Preventing contamination of other care home residents and fiscal savings	✓	A constant flow of patients' information
Hospitals	✓	Reduced bed-time and money spent on treatment	✓	Possibility to plan bed-time and intensive therapy places if needed	✓	Reduced pressure on hospitals system
Care delivers	✓	Swift and professional risk assessment	✓	Swift and professional COVID-19 symptoms track	✓	Dramatic reduction of paperwork and no patients' data loss
Clinical Commissioning Groups	✓	Ability to allocate resources in a better way to prevent falls	✓	Ability to allocate resources in a better way during the emergency	✓	Possibility to get insights in dynamics and real-time across health and care services for aging people.
General Practitioners			✓	Possibility to exclude physical visits to care homes	✓	Time savings on physical visits in care homes
Regional Leaders			✓	Data to track COVID-19 spread in the region to better allocate recourse	✓	A constant flow of rich and reliable patients' information
Regional NHS					✓	A constant flow of rich and reliable patients' information
Families					✓	Prevent diseases due to swift and professional risk assessment

APPENDIX A

Summary of Data Sources

Method	Data source	Source details	Quantity
Participatory observation	**Online standup calls**	During the calls, Safe Steps designers, managers, and CEO discussed the flow, timing of the project, challenges, platform design, and development, plans for the next week, and results of the previous week.	38 calls
	Co-creation sessions: 1. At the activation phase 2. At the scale-up phase 3. At the merger phase	1. Co-creation sessions with care homes workers in offline mode. 2. Co-creation sessions with care homes and hospitals workers, and regional leaders in online mode only (COVID-19 emergency). 3. Co-creation sessions with regional NHS representatives and families members. Blended mode.	1. 3 sessions 2. 3 sessions 3. 2 sessions
	Safe Steps platform design and development	The researcher was observing: 1. The design and development process of the platform at three phases 2. The process of testing the platform 3. Changes implemented	
Qualitative content analysis	**Internal documents:** 1. NHS whit papers and directives 2. Goals and scope 3. Project management documents 4. Commercialization plans	1. Various official documents launched by regional and national NHS regulations, directives, and white papers with strategies and goals for the next 5 years were guiding the ideation and design, participants of the Safe Steps platform. 2. The document with clear goals and the scope for each of the three phases of the platform. 3. Managerial guidelines for the platform designers, developers, managers: milestones, phases, deadlines, KPIs, responsible persons. 4. Commercialization plan that was developed before any new phase of the platform. Included market analysis, competitive analysis, business models proposition, exact platform functionalities, and features, platforms' stakeholders' groups.	1. Overall 200 pages
	Miro dashboard various boards	1. Safe Steps Business Plan Development board 2. SWOT analysis board; 3. Vanguards analysis board (national UK healthcare programs, which Safe Steps was analyzing to understand the UK healthcare trends development); 4. Platform participants, contributors, and mentors boards (all stakeholders of the final version of the platform, including those who were playing a mentoring role); 5. Smart Design Sprint boards (co-creation sessions boards with regional NHS, caregivers, families); 6. AI in Health and Care Award (brainstorming to apply for AI in healthcare award).	11 boards