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The Role of Digital Technology in Scaling Social Innovations

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ABSTRACT

Objective: social innovation plays a crucial role in addressing social challenges, but innovation initiatives can be remote and short-term. Scalability is essential for expanding the impact of these solutions, thus making it critical to investigate the factors that may contribute to this process. A promising approach to enhancing the scalability of social innovations lies in the use of digital technology. The objective of this study was to understand how digital technologies contribute to scale social innovations. **Methods:** we conducted a qualitative multiple case study that analyzed three social innovation initiatives. **Results:** our key contributions include: (1) identifying different types of digital technology that can be applied in the social context; (2) providing evidence that scaling out, scaling up, and scaling deep can occur simultaneously and reinforce one another; (3) understanding the role of technology in scaling social innovations by facilitating operationalization, strengthening trust, and building relationships and network engagement. **Conclusions:** it is expected that the results and contributions will foster reflections on the importance of establishing a digital infrastructure that favors initiatives aimed at solving societal challenges.

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INTRODUCTION

In a world marked by complex challenges, such as poverty, social inequalities, environmental problems, and climate change, social innovation emerges as a promising approach that has gained the attention of scholars, businesses, institutions, and society in general. It has the potential to respond to unmet needs and the ability to cause significant social transformations (Bufali et al., 2023; Moulaert et al., 2013) through the development of new ideas, processes, technologies, and social structures that are driven by various actors, all aimed at satisfying social needs (Hämäläinen & Heiskala, 2007; Howaldt & Schwarz, 2010; Mulgan, 2006).

As the importance of social innovation grows, critical challenges arise concerning its ability to survive and its scalability (Pirotti et al., 2021), especially in contexts with limited resources, a precarious infrastructure, and socioeconomic complexities, such as those encountered in emerging countries like Brazil. Initiatives are often confined to short-term projects, which limits their impact and ability to provoke social change (Facco, 2022). Despite the relevance of this debate, few studies have been dedicated to understanding the scalability of social innovations and the factors that may contribute to this process (Bauwens et al., 2020; Dallara et al., 2023; Silva et al., 2016).

A possible alternative for boosting the scalability of social innovations is the use of digital technology, which has the potential to improve process efficiency, generate new products and services, and create new forms of interaction among the actors involved (Batko, 2023; Dionisio et al., 2024). Despite this potential, however, there is very little debate on how digital technologies can be effectively leveraged to support the scalability of these initiatives, especially in emerging countries where the digital technology infrastructure is limited (Parthiban et al., 2020; Soni et al., 2021).

To address this issue, we propose the following research question: How do digital technologies contribute to the scalability of social innovations? To answer this question, this study aims to understand how digital technologies contribute to the scalability of Brazilian social innovation initiatives.

To achieve the paper's objective, the study employs an exploratory qualitative method through multiple case studies that involve three social innovation initiatives whose activities were scaled by digital technologies that have had an impact on their outcomes. These initiatives focus on finding solutions for different social needs, two of which address food waste and one that is centered on solid waste management.

This study aims to contribute to the social innovation discussion, therefore, by providing important knowledge and insights that demonstrate how social innovators can harness digital tools to scale their impact. This study makes three main contributions: (1) it identifies the different types of digital technologies that can be applied in the social context; (2) it offers empirical evidence that the three scalability processes (scaling out, scaling up, and scaling deep) can occur simultaneously, and even reinforce each other; and (3) it provides an understanding of the role of technology in the scalability of social innovation by facilitating the operationalization of initiatives, strengthening trust, and building relationships and network engagement.

LITERATURE REVIEW

Social innovation

Although social innovation (SI) is not a recent phenomenon, it has attracted significant attention in recent years from a wide range of actors, including policymakers, the scientific community, NGOs, businesses, and civil society. This growing interest is driven by the recognition that SI can serve as a means of meeting social needs that are not addressed by public authorities or market solutions (Murray et al., 2010).

Despite the widespread recognition of the importance of social innovation, as a concept it remains ambiguous and measuring it is challenging (Moulaert et al., 2013). In a broad context, SI can be seen as offering new ways of carrying out activities (Taylor et al., 2002), or as improved forms of action that contribute to the well-being and prosperity of the community, offering the potential for a more sustainable and equitable future (Martins et al., 2023). Various definitions of SI have been presented by scholars depending on its use and field of application. In this study, we understand social innovation as the development of new ideas, processes, technologies, and social structures, which are driven by different actors with the deliberate aim of meeting social needs (Hämäläinen & Heiskala, 2007; Howaldt & Schwarz, 2010; Mulgan, 2006).

Despite these different conceptualizations, however, some elements are central to any discussion of SI. The first element refers to the specificity of the context. The specific characteristics of the locations where initiatives occur may facilitate or constrain their development. Therefore, economic, social, environmental, and institutional elements must be considered when formulating and developing any initiative (Martins et al., 2023; Vercher et al., 2022).

The second element concerns the mobilization of actors, because social innovation requires collaboration between the different actors involved (individuals and organizations) (Howaldt et al., 2019). Collaboration facilitates the reconfiguration of social relationships and enhancement of the knowledge and skills of the actors involved in an initiative (Vercher et al., 2022). As these relationships deepen, the actors involved acquire a greater capacity to promote new practices and acquire the resources needed, thus increasing their ability to facilitate SI (Howaldt et al., 2019; Phillips et al., 2019).

The objectives that motivate people to take part in social innovation initiatives are also a central point discussed in the literature; they engage in initiatives because they are attracted by compelling narratives (Vercher et al., 2022). Reaching consensus on the objectives and direction of social innovation is, therefore, essential (Harrisson et al., 2012; Kohler & Chesbrough, 2020). Although the literature references the construction of a common goal in the pursuit of social innovation initiatives (Saji & Ellingstad, 2016), some studies point out that this goal is not necessarily unique (Agostini et al., 2020; Santos, 2012). It makes more sense, therefore, to think of complementary objectives that can be shared rather than a single objective that integrates the different interests involved in SI initiatives. Moreover, it is important to consider that these objectives evolve over time during the development of social innovation initiatives, and are characterized by a process of construction and shared learning among the different social actors.

Social impact has often been stressed in SI studies, and more specifically the expected outcomes of social initiatives that generate a social impact or cause a transformation. Research on the topic, therefore, investigates changes in reality or in the state of vulnerability that is promoted by these initiatives. This means investigating the results and the extent of these results, whether in the social, cultural, environmental, political, and/or economic spheres, or in terms of improvements in living conditions, well-being, and the social development of communities (Silva & Bitencourt, 2019). Therefore, it is important to stimulate the longevity and scalability of initiatives, and maximize their impact. Short-term and isolated projects tend to have a limited impact and fail to transform the social reality. For this reason, the notion of expansion or scalability assumes an important role in any discussions of social innovation.

Scaling social innovation and the role of digital technologies

To tackle deeply rooted societal problems, social innovation initiatives need to be fostered to expand their respective impacts. Scalability enables the amplification and exploitation of the social impacts generated by innovation (Bolzan et al., 2019). Webb et al. (2010) suggest that the scalability of social innovations occurs when an initiative achieves a satisfactory level of performance. From that point on, the possibility of implementing it on a larger scale arises, the goal being to increase the creation of social value. Initially, social innovations tend to focus on offering localized, short-term solutions, but if that is their vocation or intention over time, they develop replication strategies, build collaborative networks, accumulate knowledge, and gain experience and reputation, thus driving systemic change, i.e., they expand to achieve greater scale (Westley et al., 2014).

According to the literature, the scalability process of a social innovation can be manifest in various ways (Bolzan et al., 2019). Riddell and Moore (2015) identify three forms of scalability for social innovation: scaling out, scaling up, and scaling deep.

Scaling out occurs when the aim of the strategy is to extend social innovations to include different geographic regions, thereby reaching an increasing number of beneficiaries of the initiative (Taylor et al., 2002). Conquering new regions or markets is necessary for broadening the impact of a social innovation, but this requires overcoming barriers and adapting to the new context (Heuts & Versele, 2016; Westley & Antadze, 2010).

Scaling up is related to influencing public policies and legislation since social problems often transcend geographic boundaries and require innovative approaches that are reflected in laws, policies, and institutions (Bloom & Skloot, 2010; Riddell & Moore, 2015).

Finally, scaling deep involves changing beliefs and culture during the expansion of social innovation, and promoting transformation at the personal and community levels (Riddell & Moore, 2015; Silva et al., 2016). This approach can be achieved by expanding the options available to the population to meet specific needs, or by improving the services provided (Riddell & Moore, 2015).

Given the importance of scaling social innovations to broaden the reach and impact of the solutions, it is crucial to investigate the factors that can contribute to this process, and the literature points to some examples of SI initiatives that seek to scale social impact. An experiment conducted in Bangladesh indicates that more and more people that were previously excluded from society are willing to use digital technology and, as a result, they have the opportunity to transform their futures (Lira, 2018). Bieling et al. (2016) argue that digital technologies are tools for activism and can act as opportunity systems for social inclusion.

Recent studies have observed an increase in the digitization of social innovation initiatives (Dionisio et al., 2024; Foroudi et al., 2021; Leal et al., 2024; Morrar et al., 2017). These studies investigate the relationship of the initiatives that involve the use of technologies, such as Industry 4.0, internet of things, cloud computing, big data, blockchain, social networks, online platforms, websites, blogs, and other digital communication services, and how these technologies impact the activities and processes of these organizations (Ancillai et al., 2023; Cardoso et al., 2019).

New digital tools can help address societal challenges in several ways, and can support or enable social innovations, making them more efficient, and expanding their reach. Social innovations supported by digital technologies are those in which technology significantly enhances the existing initiative, while innovations enabled by digital tech-

nologies are those that would not exist without technology (Buck et al., 2023).

The term 'digital technology' refers to the transformation of analog information into a language understood by computers, allowing the processing of digital content through storage, transmission, and processing technologies (Ancillai et al., 2023). Nambisan (2017) describes three elements of digital technologies: digital artifacts, digital platforms, and digital infrastructure. Digital artifacts are digital components such as applications or media content that integrate new products or services, and provide the end-user with specific functionalities or value. Digital platforms refer to a shared and common set of services and architecture that host complementary offerings such as digital artifacts. Digital infrastructure encompasses tools and systems that are characterized by communication, collaboration, and computing capabilities and that support innovation processes (Nambisan, 2017).

Dionisio et al. (2024) point out that digital technologies contribute to a 'new way of doing things,' offering a significant evolution in many different sectors, such as health, smart cities, agriculture, and the fight against poverty and inequality. Digitalization can reduce the barriers to cost, communication, reach, and access (Certomà & Corsini, 2021; Millard & Carpenter, 2014), in addition to enabling the involvement of various actors (Morrar et al., 2017; Nambisan, 2017).

Digital technologies offer significant potential to support and enable these innovations, thus contributing to their scalability (Maiolini et al., 2016; Parthiban et al., 2020; Silva et al., 2016), but more research is needed to understand how these technologies can be designed and implemented to maximize their potential for solving social problems. Given these considerations, the analysis and characterization of digital technologies that support or enable social innovations are crucial for advancing research and practice in this area (Batko, 2023; Dionisio et al., 2024).

METHODOLOGY

This study aims to understand how digital technologies contribute to the scalability of social innovations in three different contexts. We adopted a qualitative research approach that involved multiple case studies to collect and analyze empirical data. The choice of a qualitative method was driven by the scarcity of studies in this specific field, which requires the use of more in-depth methods aimed at exploring the 'how' of a particular phenomenon.

Multiple case studies are ideal for investigating how digital technologies contribute to the scalability of social innovation initiatives, as they allow for deep immersion in the details and specific contexts of the phenomenon, thus capturing important nuances and understanding how digital technologies are being applied and their contributions to the scalability of social initiatives (Bryman et al., 1988; Eisenhardt, 1989; Yin, 2004). Exploring multiple cases also allows for comparisons to be made between contexts and experiences, and for the various ways that technologies are being adopted and adapted in different social innovation contexts to be identified.

The selection of multiple cases of social innovation initiatives was based on the following criteria: (a) initiatives that focused on solving social problems; (b) initiatives that had already started their scalability process; and (c) initiatives that used digital technologies for scalability. Initiatives were also selected based on the principle of data accessibility (Eisenhardt, 1989). Before data was collected, we made preliminary contact with potential SI initiatives, and chose cases that maintained good communication and where there was a willingness to provide a significant amount of primary data.

Based on these criteria, three Brazilian social innovation initiatives operating in different sectors were selected. Two of them focus on combating food waste, while the third focuses on solid waste management. The selected initiatives, located in the state of Rio Grande do Sul (Trashin) and São Paulo (Cheap Food and Food to Save), were chosen due to the relevance of their approaches to the research question, as all of them used digital technology to expand their operations.

Data were collected by way of semi-structured and in-depth interviews, document analysis, and non-participant observation of one of the initiatives. Twenty participants were interviewed (four from Food to Save, seven from Cheap Food, and nine from Trashin), including the founders and employees from various areas of the initiatives, who were selected for their ability to adequately respond to our proposed questions. The snowball technique was used to select participants (Bell et al., 2018), with the founders of the initiatives being the first to be interviewed. Theoretical saturation was the strategy adopted to determine the number of interviewees.

We prepared an interview script based on the theoretical framework for conducting the interviews. The script included questions covering the categories of social innovation and scalability based on studies, such as those by Bolzan et al. (2019), Riddell and Moore (2015), Heuts and Versele (2016), Howaldt et al. (2019), as well as questions related to digital technologies that were based on studies by Millard and Carpenter (2014), Soni et al. (2021), Bonina et al. (2021), Certomà and Corsini (2021), and Lira (2018). Participants were asked to respond to questions such as: (1) How did the initiative emerge, and what is its history? (2) Who has been and continues to be part of this initiative? (3) How have the initiative and its impact evolved over the years? (4) What digital technologies are used by the initiative, and how are they used? (5) How has tech-

nology contributed and continues to contribute to scaling the initiative? Data from the interviews were collected both in-person (Trashin) and virtually via Microsoft Teams (Cheap Food and Food to Save) between 2021 and 2022. The interviews lasted between 50 and 60 minutes, on average. They were recorded, transcribed, and subsequently analyzed.

Non-participant observation was conducted in one of the cases because of restrictions imposed by the COVID-19 pandemic. The purpose of this observation was to understand the social context in which the initiative developed and to capture the social relationships between the actors. A field diary was used to record perceptions of the activities we observed on site. The research was complemented with secondary data related to each initiative, including annual reports, marketing materials, and other documents available online, such as podcasts and media articles.

A detailed presentation of the qualitative method used, the research setting, the case selection criteria, and evaluation of the different sources of evidence enabled data triangulation, thus ensuring the transparency, validity, and reliability of the study (Aguinis & Solarino, 2019; Baxter & Jack, 2008).

We coded the collected data in a spreadsheet and analyzed it using content analysis techniques, as described by Bardin (2009). Interviewees were coded as E1 to E20, and documents as D1 to D18, as shown in Table 1.

Table 1. Codes for interviewees and documents.

Interviewee code	Case	Role	Online/In-person
(E1)	Food to Save	CEO 1	Online
(E2)	Food to Save	CEO 2	Online
(E3)	Food to Save	CTO	Online
(E4)	Food to Save	CMO	Online
(E5)	Cheap Food	CEO 1	Online
(E6)	Cheap Food	CTO	Online
(E7)	Cheap Food	Marketing specialist	Online
(E8)	Cheap Food	Developer	Online
(E9)	Cheap Food	Developer	Online
(E10)	Cheap Food	Commercial	Online
(E11)	Cheap Food	Marketing	Online
(E12)	Trashin	CEO 1	In-person
(E13)	Trashin	CEO 2	In-person
(E14)	Trashin	CTO	In-person
(E15)	Trashin	Manager	In-person
(E16)	Trashin	Production	In-person
(E17)	Trashin	Operations	In-person
(E18)	Trashin	Commercial	In-person
(E19)	Trashin	Commercial	In-person
(E20)	Trashin	Commercial	In-person
Document codes	**Case**	**Types of document**	**Link**
D1	Food to Save	Podcast	https://inovasocial.com.br/podcast/96-food-to-save/
D2	Food to Save	News	https://www.projetodraft.com/milhoes-de-pessoas-no-pais-nao-sabem-o-que-vao-comer-hoje-conheca-empreendedores-que-lutam-para-mudar-essa-realidade/
D3	Food to Save	News	https://startups.com.br/noticias/com-pre-seed-de-r-13-mi-food-to-save-quer-escalar-suas-sacolas-surpresas/
D4	Food to Save	News	https://www.gazetadopovo.com.br/bomgourmet/negocios-e-franquias/food-to-save-restaurantes-alimentos-excedentes/
D5	Food to Save	News	https://forbes.com.br/forbesagro/2022/05/foodtech-quer-captar-r-13-milhao-para-investir-no-combate-ao-desperdicio-de-alimentos/
D6	Food to Save	News	https://www.foodtosave.com.br/
D7	Trashin	Company website	https://trashin.com.br/servicos/

(continue)

Table 1 (continued)

Interviewee code	Case	Role	Online/In-person
Document codes	**Case**	**Types of document**	**Link**
D8	Trashin	News	http://www.poa.ifrs.edu.br/index.php?option=com_content&view=article&id=3333:estacao-de-lancamento-do-campus-porto-alegre-e-oportunidade-de-empreendedores-acelerarem-seus-projetos-inscricoes-vao-ate-12-07&catid=17&Itemid=121
D9	Trashin	News	https://captable.com.br/projects/5
D10	Trashin	News	https://www.amcham.com.br/noticias/inovacao/trashin-e-eleita-a-melhor-startup-do-brasil-no-amcham-arena
D11	Trashin	Company website	https://trashin.com.br/cooperativas-de-reciclagem-gerando-impactos-socioambientais-positivos/
D12	Trashin	Company website	https://trashin.com.br/17-05-dia-internacional-da-reciclagem/
D13	Trashin	Company website	https://trashin.com.br/creditos-de-reciclagem-conscientizacao-atraves-de-ferramenta-economica/
D14	Trashin	Internal report	Trashin — indicators
D15	Cheap Food	Company website	https://www.cheapfoodapp.com.br/quem-somos
D16	Cheap Food	News	https://olheparaafome.com.br
D17	Cheap Food	News	https://g1.globo.com/sp/santos-regiao/noticia/2022/03/15/amigos-criam-aplicativo-que-promete-acabar-com-o-desperdicio-de-comida-em-sp.ghtml
D18	Cheap Food	Internal report	Cheap Food report

Note. Developed by the authors.

The case descriptions were organized based on the context of the initiatives, followed by the main results, and grouped into the following categories and subcategories: (1) social innovation (context, objectives, actor mobilization, and impact); (2) scalability (scaling out, scaling up, and scaling deep); and (3) digital technologies.

CASE ANALYSIS

In the following section we present the research context (Aguinis & Solarino, 2019) and highlight the characteristics of the cases and the environment in which they operate, thus providing important information for understanding the peculiarities of the context and the social innovation (SI) initiatives we investigated.

Case: Food to Save

Food to Save is an initiative that focuses on reducing food waste by promoting conscious consumption in a sustainable manner. It is a foodtec (an innovative company in the food sector) that works to prevent food waste in Brazil. The initiative connects establishments that have surplus production with engaged consumers who are concerned about conscious consumption. It also provides low-income individuals with access to low-cost food. The initiative has an app that offers surplus food that is still fit for consumption from commercial establishments, but that would be discarded for various reasons. These products are sold at a 70% discount.

According to E1: "We're a marketplace that connects food businesses, which can be bakeries, greengrocers, pastry shops, coffee shops, convenience stores, etc., with products that weren't consumed during the day but are still good to eat. We help reduce inequality in the country by providing access to food, because today almost 80% of the minimum wage is spent on a basic food basket. It's absurd. And it's literally a basic basket" (E1).

Consumers use this app to select only the type of food they wish to receive (savory, sweet, or mixed) and choose from three bag sizes/prices. The businesses, in turn, increase their income by avoiding the disposal of surplus food.

Inspired by an international model established in Europe, the initiative was created in Campinas in 2020 with funding from four partners. But it was only in 2021 that the initiative's operations began when it received an angel investment. In its first year of operation, the initiative generated over BRL 1.8 million and provided over BRL 1 million in incremental revenue to partner establishments. In 2022, the startup raised BRL 1.3 million in just 24 hours to combat food waste. The funds were raised via CapTable (a Brazilian startup investment platform), and attracted 211 investors.

The initiative operates in a context that is marked by high levels of food waste, which is a significant social challenge. According to a report by the United Nations, 17% (931 million tons) of all food available for consumption in Brazil is wasted (United Nations, 2021).

The context is also characterized by low awareness of food waste, and while the initiative initially targeted only those individuals who were already aware of the social cause, a broader effort to raise awareness is now

underway with the public and other stakeholders that are necessary for the initiative's long-term success.

Case: Cheap Food

Cheap Food was founded in March 2020 with the goal of reducing food waste in Brazil using a delivery app. The initiative sells the daily surplus from businesses or products nearing their expiration date (D15). In other words, instead of restaurants discarding unsold food, they package these items into bags and sell them at a discount of as much as 70%.

Cheap Food, the partner business, can sell both its daily surplus and near-expiration products, as well as their regular products at a 'cheap' price. The startup operates with the 'Cheap Box,' a surprise bag that offers a unique experience for customers from start to finish. Cheap Food's partners avoid waste by offloading their surplus, while people have the opportunity to buy quality products at a low price. As E7 explains: "People who buy save money, and it's a very good solution for those who need to consume more affordably. We're talking about people eating better, and that's better for their health."

Cheap Food was also inspired by an international initiative: "I discovered a startup in Europe ... and saw that they were reducing waste. ... helping the environment and giving discounts. What company offers this kind of innovation that truly helps everyone? I did a lot of research and saw that it was possible" (E6).

As in the previous case, Cheap Food operates in a context marked by high levels of food waste: "Brazil is the third country in the world in terms of the amount of food wasted and this is a problem. So, I thought, 'Man, we really need to focus on this to help,' and we started shaping everything to fit the market because it's truly a taboo" (E5).

In addition to food waste, the rise of food insecurity in the country is significant. A study by the Brazilian Network for Research on Food and Nutrition Security (Rede Penssan) showed that 33.1 million people in Brazil are facing hunger (D16). Therefore, the food waste market is still underexplored in the country, and there are few initiatives that combine technology and social innovation to reduce food waste.

Case: Trashin

Trashin was officially created in Porto Alegre in 2018 with the aim of simplifying the recycling process through waste management, from collection to transformation. The idea was conceived during a hackathon to develop technology-driven sustainability initiatives (E12). The focus is on educating, collecting, tracking waste, extracting consumption data, and proposing recycling alternatives for waste from condominiums, schools, and businesses.

The initiative operates in waste management and reverse logistics. Waste is managed by way of employee training, clear signage, organized collections, and appropriate waste disposal (E16). Regarding reverse logistics, it designs customized containers for different types of waste, which would otherwise be sent to landfills, and returns them to the production chain, thus enabling a circular economy.

Trashin's methodology includes four main pillars: education, collection, disposal, and certification. The first pillar involves education through information material, lectures and training on sustainability, online content, and visual communication to facilitate an understanding of how and why to correctly separate waste. The initiative seeks to educate not only employees, managers, and customers but also the operating and cleaning teams of waste generators (D7).

The second pillar relates to collection, which is carried out with a predefined frequency that is adjusted to meet the customer's needs. The third pillar focuses on the suitable disposal of solid waste by partnering with the associations and cooperatives that handle the proper separation of materials and return the waste to the transformation industry. Finally, the fourth pillar concerns certification. The initiative provides a certificate called the Selo T (T Seal), which guarantees the correct disposal of collected waste. Companies can use this certification label in their communication material, thus demonstrating their concern regarding the impact of the waste they generate (D7).

Trashin operates with solid waste. The need for waste management aimed at recycling is a global issue, and it is especially important in Brazil where solid waste production is estimated at 825 million tons per year, with only 3% of it being recycled (D11). Discussion of this topic, however, remains marginalized, particularly in business environments, and does not receive the necessary attention, resulting in waste being improperly disposed of without adequate reuse. E16 points out: "Trashin disrupted the market by showing the value of waste ... we even try to reframe the term 'trash' by showing that it's a resource — mineral resources, new raw materials."

This is, therefore, a promising context as an emerging social problem, and society is increasingly concerned with sustainability aspects. "Looking more at the market, sustainability is in high demand, and we were looking at this for those who are innovating and using technology" (E16).

RESULTS

The study identified a set of possibilities in terms of how the initiatives have utilized digital technologies to improve processes and scale their impact. The following section is organized as follows: the first subsection provides an overview of the characteristics of the initiatives from the perspective of social innovation. The second subsection contains aspects that demonstrate the scalability of these initiatives. Finally, the last section presents the digital technologies used by these initiatives.

Social innovation

The initiatives were analyzed through the lens of social innovation literature to understand the context in which they operate, the social objectives they seek to address, and the actors mobilized to carry them out. As pointed out in the theoretical framework, these elements are central to social innovation. We conducted an initial in-depth analysis of the context in which the initiatives were embedded. Investigation of social innovation revealed that the underlying motivation for the creation of these initiatives was rooted in the search for solutions to the social problems observed in the environment in which they were developed. Food to Save and Cheap Food emerged in response to food waste, while Trashin's aim was to improve the effective management of solid waste, which is a global issue. The context of these initiatives is marked by different challenges that impact societal well-being and require creative solutions.

The motivation behind creating the initiatives, which were inspired by successful international examples, arose with the goal of addressing the social challenges that were identified in the context of waste. The main social objective of Food to Save and Cheap Food is to prevent food waste. Hunger and food waste are serious social problems that require innovative alternatives for their mitigation, particularly in the Brazilian context. In the case of Trashin, the increasing production of solid waste by the population and the inadequate disposal of it, which has a negative impact on society and the environment, motivated the setting up of the initiative. This situation led to the development of a solution capable of providing an appropriate and profitable destination for these waste materials.

Another noteworthy point in social innovation is the mobilization and diversity of the actors involved. In all three cases, a key actor, represented by the initiative's founder, was identified as playing a central role in the conception and planning of the initiative: "I always had the dream of creating something with a purpose. I've never been driven by money; I've always thought money would be a consequence. I looked at the food waste scenario, the social and economic scenario of the country, and the opportunity to merge technology with a purpose" (E1).

After identifying a social problem, these key actors involved other individuals, often friends and family, who helped drive the initiatives forward. As E1 explained: "The main actors at the beginning were friends, friends of friends, and friends of family members from São Paulo who validated the idea, and gave feedback to help us reach the solution we have today. Those were the main actors."

Universities, research institutes, and the infrastructure provided by their technology parks and accelerators were important when it came to refining the ideas. Only after testing the business model did the founders start involving a broader range of actors. For example, in the case of Trashin a technology business incubator played a significant role, as D8 explained: "The whole pre-incubation process prepared us for carrying out our idea and succeeding in the acceleration processes we participated in" (D8). This maturation of the idea enabled the initiative to move into the fundraising phase. In 2021, the startup raised BRL 11 million through CapTable and attracted 426 investors (D9).

These initiatives have started having a positive impact in society and on the environment. In addition to reducing food waste, Food to Save and Cheap Food have the following impacts: they reduce carbon dioxide (CO^2) emissions related to food waste, and food insecurity (by enabling low-income individuals to purchase food at a 70% discount), they raise public awareness, and they form partnerships with NGOs. These social innovations also generate financial benefits for other stakeholders, such as supermarkets and restaurants.

In the case of Trashin, the results and impact are linked to its management of solid waste, including clear signage, the organized collection of waste, and its proper disposal. This contributes to the circular economy, helps with reverse logistics and social education on waste, and provides customers and recycling cooperatives with income and other benefits, all of which ensures the initiative remains active.

Scaling social innovation

Although the three social innovation cases we studied were recently set up, they demonstrate a notable scaling-out process within the Brazilian context. They only have one physical location each and utilize partners and digital technologies for their scalability. The scaling-out of the Food to Save and Cheap Food initia-

tives becomes evident when these innovations reach a significant number of users, despite their relatively recent existence in the social innovation landscape. Signs of this scalability are evident in D17's statement, which mentions: "The project was first tested in São Paulo, where it was successful. In the first month they sold 400 bags and earned enough to expand the business" (D17). Currently the initiative operates in São Paulo and the regions of Santos, Praia Grande, and Salvador.

Many social innovations are often disruptive and demand changes in laws and public policies to become viable and absorbed by the market. Regarding the scaling-up process, in the first two cases we studied (Food to Save and Cheap Food), no changes in the law were necessary for these initiatives to operate. However, amendment of Law no. 14,016 (2020), which regulates food donations by establishments, facilitated and expanded the market reach of these initiatives. In the case of Trashin, a very recent social innovation, constant dialogue was necessary with state departments with the aim of achieving more flexible local laws: "We're always in contact with government officials by WhatsApp" (E13).

In terms of the scaling-deep process (which involves changes in beliefs, culture, and transformations at the personal and community levels), we observed that in the cases of Food to Save and Cheap Food there are still no objective indicators to provide measurable evidence of any changes in beliefs and culture. But the absence of cultural or behavioral changes does not necessarily imply that new values have not emerged in local society. Generally, the people who are involved in these initiatives are already aware of the problem of food waste. Food to Save and Cheap Food are working on a reeducation process, although this is a challenge for these initiatives. In the case of Trashin, the company actively seeks to raise awareness and reeducate those involved and its customers, because the success or failure of the business depends on changing attitudes and ensuring engagement. This awareness and engagement occur via various digital technologies, such as the internet, social networks, WhatsApp, Google Ads, YouTube for advertising, LinkedIn, and others.

In summary, regarding the three scalability processes of social innovation, we observed that for a social innovation initiative to reach a large number of beneficiaries and expand to include other regions (scaling out), it is often necessary to bring about a transformation in the values, beliefs, culture, and awareness of the beneficiaries (scaling deep). In the case of the social innovations we studied, it is also crucial that laws and public policies are changed (scaling up) to enable the initiatives to expand and the scalability process to take place.

Similarly, the findings suggest that scaling-up and scaling-deep processes act as facilitators of the scaling-out process in the context of social innovation. This indicates that in order to reach a larger number of beneficiaries, the cultural changes and changes in public policies and laws that enable social innovation need to be promoted; scaling-up and scaling-deep processes drive the scaling-out process.

Digital technologies and the scalability of social innovations

Based on the investigations we carried out, it became evident that digital technologies play a fundamental role in the development and scalability of social initiatives. Our analysis reveals that digital technologies are a major ally of scalability on different levels (reaching new users/beneficiaries, transforming culture, raising awareness, and influencing public policies and laws). In the case of scaling out, they help reach new people, while in scaling up they facilitate access to people and information about the laws and public policies that can directly influence the success of any social innovation. Finally, in scaling deep, digital technologies help mainly with communication and raising public awareness of the social problem the initiative is seeking to address. Facilitated by technologies, such communication aims to bring about changes in beliefs and culture among individuals.

Table 2 following highlights the role of digital technologies in the three different types of social innovation scalability:

Social innovation initiatives, as we have shown, can employ various widely recognized technologies to increase their impact. In the cases we investigated, we identified the use of digital artifacts, digital platforms, and digital infrastructure (Nambisan, 2017). Regarding digital artifacts, the use of apps was found to be fundamental for the operationalization and scalability of the initiatives. For example, Cheap Food, which initially sold via WhatsApp, fits into the digital artifacts category. Apps are software components that are part of the service offered by the initiative, and provide specific functionalities to end-users.

Table 2. Digital technologies used in the scalability of initiatives.

Scalability	Contribution of digital technologies	Types of digital technologies used
Scaling out	Access to new people, increasing the number of users.	Internet; Google Ads; social networks (Instagram, Facebook, LinkedIn); WhatsApp; website; YouTube; others.
Scaling up	Access to people; access to information on laws and public policies.	Internet; search engines; social networks (Instagram, Facebook, LinkedIn); WhatsApp; YouTube; others.
Scaling deep	Tools to change beliefs, behaviors, and culture.	Internet; Google Ads; website; social networks (Instagram, Facebook, LinkedIn); WhatsApp; YouTube; others.

Note. Developed by the authors.

These initiatives also use digital platforms, such as mobile apps and websites, which enable interaction and transactions with users. These platforms host the digital artifacts of social innovations and offer opportunities to develop complementary products, such as expanding Food to Save's services.

In terms of digital infrastructure, internet access is essential for the operation of these social innovation initiatives. In the cases we investigated, the internet is a digital technology tool that provides communication and collaboration resources, which enable connection with beneficiaries, the dissemination of initiatives, and the coordination of operations.

The technologies used by the initiatives for enabling their activities and expanding their impact encompass digital artifacts, digital platforms, and digital infrastructure. These digital technologies simplify the operationalization of initiatives and strengthen the connection between the various actors involved. Our findings showed, however, that these social innovations involve specific technical knowledge related to technology, and the direct participation of other actors in their creation and execution can be challenging (E9; E12).

Although external actors, including founders, partners, and users, did not play a direct role in the conception of the idea in the initiatives we investigated, the knowledge derived from these individuals was crucial when it came to adapting the technology to be used (E12; E13). Therefore, these findings highlight the importance of interaction with various actors, especially users and beneficiaries, for legitimizing the idea and incorporating different perspectives and knowledge.

In all three cases, engagement and the knowledge transfer between different actors occur both in-person and virtually. The three initiatives also use formal and informal engagement mechanisms, such as social networks, websites, reports, and feedback loops, among others. It also became clear from the interviews that technology plays an important role in reducing the technical errors that are often associated with human labor, which makes the initiative more credible because it reduces effort and increases efficiency (E16). In this context, technology helps validate and analyze data more clearly and correctly (E12), thus facilitating the dissemination and transparency of the activities performed and the impact of the initiative.

Digital technologies enabled greater access to people and services, encompassing beneficiaries, new markets, partners, and collaborators (E5), and facilitated partnerships between the different actors involved. In general terms, digital technologies helped: (a) communicate social business initiatives; (b) capture and screen information; (c) establish trust and credibility; (d) accelerate scalability; (e) automate processes; and (f) maintain a lean structure and exponential growth.

The use of digital technologies in social innovations does, however, present its challenges. Although technology facilitates the scalability of an initiative, it can distance its purpose from its primary beneficiaries, as noted in the case of Cheap Food. When they analyzed the results of the initiative as they expanded their operations, they found that they were not reaching the audience they had initially intended targeting, which led to adjustments to ensure access for a more diverse public. As E6 noted: "So, we're starting to rethink a little and adjust these standards a little more to give access to these people; this is really our intention. We did it to reach audience C, and we're reaching audience A. And then we ask ourselves, are we really complying with all of this or not? Can we make any improvements?" (E6).

Another limiting factor in the reach of the social innovation initiatives that use digital technologies to scale these initiatives is related to the population's limited access to and knowledge of digital technologies. Interviewees reported that in many regions, especially marginalized ones, a lack of access to the internet or appropriate technological devices, as well as digital illiteracy, can prevent the population from fully benefiting from these innovations (E6; E12; E13). The digital divide can create a barrier to inclusion and the active participation of those actors who could benefit, thereby limiting the potential impact and the ability of these initiatives to reach and benefit a broader range of people. Social innovation initiatives, therefore, must evaluate different contexts and use technologies that are accessible and appropriate to each reality. This alignment is illustrated by the case of Trashin (E12), which initially tried to implement blockchain technology in its opera-

tions but later realized that it did not make sense at that time, which led to it discontinuing implementation: "We first looked for ways to interact with the blockchain. But since our actors were all internal, we realized that it didn't make much sense, unless I could actually implement proof in the cooperative, and then in a purchasing company at the end. But if I don't have all these agents talking, having this blockchain just to say that my collection is traceable is really just for show. So, we really took a step back and put using the blockchain on hold" (E12).

The interviews highlight the importance of considering the context and the accessibility of technologies to ensure the success and scalability of social innovations. This includes issues such as the availability of digital infrastructure, the digital knowledge level of users, and other relevant skills that influence the adoption of technologies. In the cases we analyzed, it became evident that the lack of digital infrastructure or limited user or beneficiary knowledge could hinder the full use of technology in their operations, sometimes requiring adjustments in the technology they used.

DISCUSSION

This article focused on the use of digital technologies in social innovation initiatives as a means of contributing to their scalability. A key aspect of the social innovations discussed is their origin in urgent societal needs, such as food waste, food insecurity, and the difficulties encountered in managing solid waste. In the Brazilian context, these challenges take on significant proportions, and stand out not only because of the urgency of the social causes, but also because of the opportunity to align diverse interests in favor of innovative solutions. This convergence of interests has been a determining factor in the success of social initiatives in the country (Pirotti et al., 2021), and the initiatives we investigated in this study reflect this aspect.

The incorporation of digital technologies can strengthen social innovation, and represents a dynamic and promising field that can address complex social challenges. Recent research highlights two main categories of integration between digital technologies and social innovations: those in which technology significantly enhances existing initiatives, and those in which technology enables initiatives that would not be viable without it (Buck et al., 2023). This study underlines the fact that new digital tools used in a social context contribute both as the supporters and enablers of positive change in different social contexts. These technologies result in greater fluidity and permeability, and reduce barriers to cost, communication, reach, and access (Certomà & Corsini, 2021; Millard & Carpenter, 2014). Scalability that is based on the use of digital technology also plays a role in increasing speed and efficiency, which makes social initiatives more sustainable in the long term, while promoting connections between different actors that are essential for the success of social innovation.

Despite the specificities involved in digital technologies, which are not easily understood, mobilizing different actors is a fundamental aspect of the success of social innovation. Previous studies have highlighted the importance of strong partnerships and collaborative networks for promoting the scalability and impact of initiatives (Dallara et al., 2023; Phillips et al., 2019; Pirotti et al., 2021). Engaged actors and their personal motivations not only strengthens the implementation of initiatives, but also broadens their reach and influence (Dong & Götz, 2021; Martins et al., 2023).

In addition to the underlying personal and social motivations, it is important to recognize that many social innovation initiatives have an economic orientation, including a commercial perspective. An analysis of social innovations that incorporate information technology, or is enabled by it, also highlighted elements of identity orientation, both of a utilitarian (commercial) and collectivist nature. The study by Bonina et al. (2021) found that, due to the focus on products and technology, these initiatives display a strong commercial orientation, which is particularly notable in for-profit startups that are seeking economic sustainability.

Our findings also show that social innovation initiatives are often inspired by benchmarking and the adaptation of best practices from other initiatives (Facco, 2022). In this regard, digital technologies facilitate the replication of initiatives that are developed in contexts other than the local context. It is important to consider, however, the importance of adopting a contextualized and adaptive approach to ensure that social innovations meet the specific needs of each community (Martins et al., 2023; Vercher et al., 2022).

While digital technologies offer opportunities to scale the impact of social innovations, they also present significant challenges related to infrastructure and access. In emerging countries, as indicated by previous studies (Parthiban et al., 2020; Soni et al., 2021), the lack of a digital infrastructure and undeveloped levels of technological literacy can limit the potential of some initiatives. Overcoming these disparities is essential to ensure that digital technologies are accessible and effective in different contexts.

Finally, the issue of scalability should not be addressed without considering the potential ethical and practical challenges that arise when social initiatives expand. Continuous monitoring of social impact, facili-

tated by digital technologies, is essential to mitigate the risk of distancing initiatives from their original purpose. This capacity for ongoing evaluation and adaptation allows initiatives to adjust their approach as needed, thus ensuring that they continue to effectively serve the communities they aim to benefit.

In conclusion, social innovations supported by digital technologies represent a promising frontier for addressing global social challenges. In the cases investigated, we observe patterns and best practices that not only promote the scalability of initiatives, but also strengthen their capacity to create a sustainable and positive social impact.

CONCLUSIONS AND IMPLICATIONS

This research aimed to understand how digital technologies contribute to scale social innovation initiatives. To achieve this objective, we conducted a multiple case study, which analyzed how these initiatives scale social initiatives at the three levels proposed by Riddell and Moore (2015): scaling up, scaling out, and scaling deep. This study offers valuable theoretical and practical contributions to the field of social innovation.

First, we identified and described the digital technologies that play a fundamental role in social innovation, including the use of apps, online platforms, and internet access. This mapping helped us understand how digital technologies are employed to address social challenges and facilitate the scalability of initiatives. We categorized these technologies based on Nambisan's (2017) framework, and highlighted their classification as digital artifacts, digital platforms, and digital infrastructure. This conceptual framework provides a solid foundation for understanding the role of technology in social innovation.

Second, we emphasized the importance of adapting technologies to fit the context in which they are applied, considering factors such as digital infrastructure and the level of knowledge of their users. This underscores the need for a context-sensitive approach when utilizing digital technologies in social innovation. The influence of context also extends to the implementation of initiatives. Our findings provide empirical insights demonstrating that two elements stand out among the initiatives we investigated: 'legislative structure' and the 'awareness and re-education of actors.' This study reinforces the need to establish a legislative framework that facilitates and supports the development of social innovation. This indicates that to change the negative practices that exacerbate social problems, government involvement for creating a conducive environment is crucial.

There must also be an awareness and re-education process for actors to achieve an attitude shift and become engaged in the initiatives. Access to knowledge proved to be particularly important. The impact of awareness and education campaigns promoted by the initiatives can encourage favorable social behaviors that minimize food waste and/or promote the proper disposal of waste.

The third contribution of this study is its empirical analysis of the types of scalability. The study examines the scalability processes of social innovations, and highlights the challenges and opportunities associated with expanding these initiatives. This deepens our understanding of how digital technologies play a fundamental role in scalability. We found that scaling up and scaling deep often drive the scaling out of initiatives, since cultural change and public policies play a crucial role in expanding to reach a broader audience. Our findings also suggest that the three types of scalability can occur simultaneously or reinforce one another.

The fourth contribution of the study highlights the fundamental role technology plays in the scalability of social innovation. This contribution is based on three aspects: (1) technologies facilitate the operationalization of initiatives. By minimizing human errors, automating processes, reducing effort, and increasing effectiveness, technologies enable initiatives to expand their reach while maintaining the same structure, thus ensuring quality and speed; (2) digital technologies strengthen trust in the initiative by enabling the monitoring of the entire operational process, thereby facilitating transparency and the dissemination of the activities performed and the impact generated; (3) digital technologies facilitate the building of relationships and engagement among actors, such as partners, collaborators, and users. Different digital technologies, especially social networks, enable social innovation initiatives not only to communicate their purpose, but also to establish the strategies required for engaging and educating society on the consequences of, for example, food waste or improper solid waste management, as observed in the cases we studied. Thus, internet access and digital technology, in general, have proven to be relevant factors for the success of digitally-oriented social innovations. This highlights the potential of digital democratization for expanding the market and having a significant impact on addressing social challenges.

In short, this study provides a comprehensive view of the role played by digital technologies in social innovation. It does so by highlighting how these technologies are applied, classified, and adapted to address social challenges and promote the scalability of initiatives. These contributions have the potential to benefit

researchers, social innovators, and policymakers who are interested in promoting social innovation through the use of digital technologies.

It is important to note that this research also has some limitations. Among the main limitations is the difficulty of access caused by the COVID-19 pandemic. Travel restrictions hindered on-site observation in two of the initiatives we investigated, and limited interviews to online access. Future research in this field of study could:

(a) conduct studies that address the perspective of the partners and beneficiaries of social innovations. This could provide valuable insights into how digital technologies impact their interactions and experiences with the initiatives;

(b) investigate in more depth the connections between scalability processes (scaling up, scaling out, and scaling deep). Our specific recommendation would be to understand how these processes interact and influence each other, and how they can be optimized to achieve more effective results;

(c) study the creativity of developers in designing these scalable social innovations;

(d) analyze in more detail the digital technologies used by various social innovations and their specific functions and contributions to the scalability process. This could help identify the most effective technologies for specific objectives;

(e) understand how social innovations enabled by digital technologies balance social and commercial objectives. This would provide insights into how these initiatives can be financially sustainable without compromising their social goals;

(f) conduct longitudinal studies showing how the long-term operation of these initiatives promotes cultural change and deeper social transformation;

(g) investigate the ecosystem in which these initiatives are embedded and how this contributes to their scalability, thus seeking to identify the roles of different actors, such as government, civil society organizations, and the private sector, in promoting scalability;

(h) explore the challenges and impacts of digital democratization in the context of social innovation by analyzing how internet access and digital technologies affect the market and the objectives of these organizations.

In terms of practice and management, the following are our recommendations: (a) map out the digital technologies that could help scale a specific social innovation and apply them; (b) seek government support, which is essential for social innovation; (c) establish a legislative framework with public authorities that facilitates and supports the development of social innovation; (d) explore how to use new digital technologies, such as artificial intelligence and others, for optimizing processes in companies that provide social innovations.

This study expands our knowledge on how digital technology contributes to the scalability of social innovations. It is hoped that its results, contributions, and limitations will inspire reflection on the importance of establishing a digital infrastructure that supports initiatives with the aim of providing innovative and scalable solutions for the challenges facing society

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