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TESE

IMPROVING INNOVATION PERFORMANCE IN AGTECH: UNDERSTANDING THE ROLE OF SOCIAL MEDIA AND DYNAMIC CAPABILITIES

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“Todas as vitórias ocultam uma abdicação”.

(Simone de Beauvoir)

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RESUMO

O desenvolvimento de capacidades dinâmicas é crucial para a sobrevivência das empresas que atuam no ambiente organizacional contemporâneo, que vem sendo caracterizado como turbulento (dinâmico). Nesse ambiente, onde cada vez mais as relações sociais vêm ocorrendo de forma digital, muitas organizações vêm usando mídias sociais em suas mais diversas rotinas. Diante da difusão da internet e do uso dessas ferramentas digitais, o objetivo desse estudo foi propor e testar um modelo teórico para mensurar a importância das mídias sociais e das capacidades dinâmicas para melhorar o desempenho de inovação. Esse modelo analisou três capacidades dinâmicas: capacidade de colaboração interna, capacidade absortiva e agilidade organizacional. Essas capacidades foram definidas por meio de uma revisão de literatura, que foi a etapa inicial dessa pesquisa. O foco do estudo foi em *startups*, empresas inovadoras e com potencial de escalabilidade. As *startups* analisadas são brasileiras e atuam no setor do agronegócio, sendo conhecidas como AgTech. O foco por esse tipo de organização se deu por serem empresas que atuam em ambientes com alto nível de incerteza ambiental, onde baixos níveis de desempenho de inovação podem afetar de forma negativa a desenvolvimento de vantagem competitiva e em casos mais críticos, levar à falência. A região escolhida para a realização do estudo foi o Brasil, devido a importância do agronegócio na economia desse país e dada a relevância brasileira na produção e exportação de alimentos. O estudo é de natureza quantitativa sendo que os dados foram coletados por meio de questionários enviados *online*. Os respondentes dos questionários são pessoas que ocupam cargos de gestão nas AgTech, incluindo CEOs, diretores e gestores em geral. Cada AgTech analisada foi representada por um único respondente, sendo analisadas 237 respostas. Medidas de estatística descritiva foram utilizadas para mensurar a caracterização da amostra. Dentre os resultados, as mídias sociais mais utilizadas são WhatsApp, Instagram, LinkedIn e Google Meeting. Para testar o modelo teórico proposto, foi utilizada a modelagem de equações estruturais com estimação por mínimos quadrados parciais (PLS-SEM). O modelo desenvolvido e analisado constitui-se de seis hipóteses e compreende quatro construtos de primeira ordem: mídias sociais, capacidade absortiva, agilidade organizacional e desempenho de inovação. O modelo também apresenta um construto de segunda ordem, denominado de capacidade de colaboração interna, que é formado por três construtos: comunicação, confiança e engajamento. Com o arcabouço teórico empregado foi possível testar as hipóteses desenvolvidas, sendo que todas não foram rejeitadas. De forma geral, identificou-se que o uso de mídias sociais afeta de forma positiva o desempenho de inovação e contribui para a capacidade interna de colaboração. Essa capacidade dinâmica, por sua vez, influência de forma positiva a capacidade absortiva e agilidade organizacional das AgTech. Por fim, essas duas capacidades dinâmicas impactam de forma positiva o desempenho de inovação. Como análises adicionais, também se verificou a existência de mediações seriais na relação mídia social e desempenho de inovação. Os resultados mostram que a capacidade interna de colaboração e a capacidade absortiva, e a capacidade interna de colaboração e a agilidade organizacional, medeiam parcialmente essa relação. Os resultados também indicam que o poder explicação (R^2) do desempenho de inovação é maior no modelo teórico proposto, comparando com o efeito direito do uso de mídias sociais. O modelo desenvolvido e validado permite uma compreensão analítica de como melhorar o desempenho de inovação, indicando também, que existem capacidades dinâmicas (capacidade de colaboração interna) que antecedem outras capacidades dinâmicas (capacidade absortiva e agilidade organizacional). Esse e os demais achados da pesquisa permitem que os pesquisadores e gestores entendam a sequência e os mecanismos por trás do desempenho de inovação, e compreendam a relevância do uso das mídias sociais como ferramentas organizacionais, bem como a importância das capacidades dinâmicas. Em relação as capacidades dinâmicas, destaca-se a sua importância

tanto para fomentar novas capacidades, quanto como *drivers* do desempenho de inovação nas AgTech.

Palavras-chave: AgTech. Agritech. Criação de conhecimento. Inovação. Mediação serial. Vantagem competitiva.

ABSTRACT

The development of dynamic capabilities is crucial for the survival of companies that operate in the contemporary organizational environment, which has been characterized as turbulent (dynamic). In this environment, where more and more social relations are taking place digitally, many organizations have been using social media in their most diverse routines. Given the diffusion of the internet and the use of these digital tools, this study aims to propound and test a theoretical model that measures the importance of social media and dynamic capabilities to improve innovation performance. This model analyzed three dynamic capabilities: internal collaboration capacity, absorptive capacity, and organizational agility. These capabilities were defined through a literature review. The study focused on startups, that is, innovative companies with scalability potential. The startups analyzed are Brazilian and operate in the agribusiness sector. Therefore, this study analyzed AgTech. The focus on this type of organization was because they are companies that operate in environments with a high level of environmental uncertainty, where low levels of innovation performance can negatively affect the development of competitive advantage and, in more critical cases, lead to bankruptcy. The region chosen for the study was Brazil due to the importance of agribusiness in that country's economy and given the Brazilian relevance in the production and export of food. The study is quantitative in nature, and data were collected through questionnaires sent online. Respondents are people who occupy management positions in AgTech, including CEOs, directors, and managers in general. Each AgTech analyzed was represented by a single respondent. Given this, the sample of this study refers to 237 AgTech. Descriptive statistics measures were used to measure the characterization of the sample. Among the results, the most used social media are WhatsApp, Instagram, LinkedIn, and Google Meetings. To test the proposed theoretical model, structural equation modeling with partial least squares estimation (PLS-SEM) was used. The model developed and analyzed consists of six hypotheses and comprises four first-order constructs: social media, absorptive capacity, organizational agility, and innovation performance. The model also presents a second-order construct, named internal collaboration capacity, which is formed by three constructs: communication, trust, and commitment. The six hypotheses are tested and all of which were not rejected. In general, it was identified that the use of social media positively affects innovation performance and contributes to the internal collaboration capability. This dynamic capacity, in turn, positively influences the absorptive capacity and organizational agility of AgTech. Finally, these two dynamic capabilities positively impact innovation performance. As additional analyses, the existence of serial mediations in the relationship between social media and innovation performance was also verified. The results show that the internal collaboration capability and absorptive capacity, and the internal collaboration capability and organizational agility, partially mediate this relationship. The results also indicate that the explanatory power (R^2) of innovation performance is higher in the proposed theoretical model compared to the direct effect of using social media. The developed and validated model allows an analytical understanding of how to improve innovation performance, indicating that there are dynamic capabilities (internal collaboration capability) that precede other dynamic capabilities (absorptive capacity and organizational agility). This and other research findings allow researchers and managers to understand the sequence and mechanisms behind innovation performance, the relevance of using social media as organizational tools, and the importance of dynamic capabilities. About dynamic capabilities, we highlight their importance both for fostering new capabilities and as drivers of innovation performance in AgTech.

Keywords: AgTech. Agritech. Knowledge creation. Innovation. Serial mediation. Competitive advantage.

FIGURES LIST

TABLE LIST

SUMMARY

1. INTRODUCTION

Social media refers to internet-based technological tools that are open-source of data, information, and knowledge. LinkedIn, Yammer, YouTube, WeChat, QQ, Second Life, WhatsApp, Facebook, Twitter, and online communities, are examples of social media. Although these technological tools were initially used mainly for people's leisure activities (ZACH; LISSITSA, 2016), in the last few years, social media have been widely implemented in business organizations (KAPLAN; HAENLEIN, 2010; CAO et al., 2016; SCHLAGWEIN; HU, 2017; TAJUDEEN; JAAFAR; AININ, 2018; CAO; ALI, 2018; ALI et al., 2020; PEKKALA; VAN ZOONEN, 2021). In this regard, Ratliff and Kunz (2014) indicate that about 90 percent of the Fortune 500's companies use LinkedIn. They also argue that more than 60 percent of these companies use at least three social media.

Social media are pivotal for organizational collaboration, presenting nearly limitless opportunities for companies to build relationships with internal members and external parties, such as customers, vendors, and the public at large (KAPLAN; HAENLEIN, 2010; CAO et al., 2016; CAO; ALI, 2018). Some studies indicate that social media enables knowledge creation and innovation, which is pivotal to business growth and competitiveness (BHIMANI; MENTION; BARLATIER, 2019; MUNINGER; HAMMEDI; MAHR, 2019; ALI et al., 2020). Therefore, social media can be understood as an important '*ba*,' that is, a place that enables knowledge creation (NONAKA; TOYAMA; KONNO, 2000; NONAKA et al., 2014), becoming indispensables tools to contemporaneous companies (PEKKALA; VAN ZOONEN, 2021). In this regard, Papa et al., (2018) argue that social media facilitate knowledge creation in organizations. Mäntymäky and Riemer (2014) also indicate that the effective use of social media can improve employee productivity by about 20 to 25 percent.

Due to the importance of social media, a body of reviews studies (BHIMANI; MENTION; BARLATIER, 2019; OLANREWAJU et al., 2020) and empirical papers (CAO et al., 2016; CAO; ALI, 2018; MUNINGER; HAMMEDI; MAHR, 2019; ALI et al., 2020; PEKKALA; VAN ZOONEN, 2021) have been analyzing the role of these technological tools in business organizations. Among these efforts, recent literature has been analyzing the use of social media in the context of dynamic capabilities (for some examples, see MUNINGER; HAMMEDI; MAHR, 2019; HASSANI; MASCONI, 2022; ALI et al., 2020; TORTORA et al., 2021; DWIVEDI et al., 2022; YE et al., 2022). In general, these studies describe the role of using social media in the context of rapid organizational change and the importance of dynamic

capabilities to firm performance and decision-making effectiveness (DWIVEDI et al., 2022; YE et al., 2022).

Dynamic capabilities comprise a useful perspective for examining innovation management practices at the organizational level. Dynamic capabilities refer to a set of adaptive capabilities of the firm in the face of the dynamism of the environment (TEECE; PISANO; SHUEN, 1997; TEECE; PISANO, 2003; MEIRELLES; CAMARGO, 2014). Therefore, in the context of rapid technological development, ever-increasing globalization, ever-changing customer demand, and constant threats of new competitors (MUNINGER; HAMMEDI; MAHR, 2019; DWIVEDI et al., 2022; YE et al., 2022), understanding the role of dynamic capabilities is important. Given the organizational importance of digital relationships and the diffusion of social media usage at work (ALI et al., 2020), analyzing how these capabilities influence innovation performance is pivotal to enabling the organization to adapt quickly to the current turbulent environment.

Dynamic capabilities influence organizational routines and refer to the company's ability to constantly adapt and reconfigure its resources in turbulent (dynamic) environments (TEECE; PISANO; SHUEN, 1997). Collaboration capability, absorptive capacity, and organizational agility are examples of dynamic capabilities that have been analyzed in the context of digital relationships and innovation. Absorptive capacity refers to the organizational ability to learn (COHEN; LEVINTHAL, 1990; ZAHRA; GEORGE, 2002) and is frequently theorized as a collection of capabilities for the acquisition, assimilation, transformation, and exploitation of external knowledge (ZAHRA; GEORGE, 2002). Ali et al., (2020) show that absorptive capacity is important in the relation between social media use at work and knowledge creation. Organizational agility refers to firms' ability to rapidly adapt to seize potential opportunities in turbulent environments (ECKSTEIN et al., 2014; HARRAF et al., 2015; DWIVEDI et al., 2022; YE et al., 2022). Collaboration capability[1] refers to the organizational ability to develop and maintain trust, commitment, and communication (BLOMQVIST; LEVY, 2006). Collaboration capability supports members' relationships even if they work not geographically proximal (BATARSEH; USHER; DASPIT, 2017a), that is, even if they work through using social media. This capability refers to interorganizational relationships and or intraorganizational collaboration (BLOMQVIST; LEVY, 2006).

[1] As we use this capability to analyze internal organizational arrangements, in many parts of this thesis we cite this capability as "internal collaboration capability."

Despite the boost of research on social media[2]in the last few years, there is little quantitative empirical evidence on the role of social media in improving innovation (a notable exception is Ali et al., 2020). In this regard, we argue that social media usage is key to companies achieving innovative performance (BHIMANI; MENTION; BARLATIER, 2019; ALI et al., 2020). However, these studies do not analyze the importance of internal collaboration capability as an antecedent of other dynamic capabilities (such as absorptive capacity and organizational agility). We argue, thus, that intraorganizational collaboration is critical to the development of other dynamic capabilities. This assumption is in line with Cohen and Levinthal (1990) on the importance of internal communication to absorb external knowledge. Studies such as Harraf et al., (2015) and Rafique et al., (2018) also describe the role of internal communication and commitment (elements of collaboration capability) as drivers of agility. More generally, internal collaboration has been described as a new approach to understanding dynamic capability building (LOPEZ HERNANDEZ; FERNANDEZ-MESA; EDWARDS-SCHACHTER, 2018). In this thesis, we also argue that dynamic capabilities, particularly absorptive capacity and organizational agility have insightful implications for innovation performance (COHEN; LEVINTHAL, 1990; SOLHEIM et al., 2023). In this study, innovation performance refers to the firm capability to create innovations and new operating methods (e.g., creating new products or services, and new organizational methods and processes) (Inkinen et al., 2015).

Analyzing these dynamic capabilities (absorptive capacity, internal collaboration capability, and organizational agility) enables understanding the organizational settings related to members' relationship management and organizational responses to external demands. Therefore, the analysis of social media usage and dynamic capabilities is relevant to measure the organizational's ability to manage internal resources and use the knowledge acquired from external sources to improve innovation performance. Given this backdrop, we provide the following research questions (RQ): **How do social media usage and dynamic capabilities support innovation performance in turbulent environments?**

Given this research question, in this thesis, we defend that social media usage and dynamic capabilities are critical for startups. In light of the foregoing, we argue that understanding startups characteristics (such as its dynamic capabilities) is pivotal for analyzing the context of companies that works under high levels of uncertainty (LEATHERBEE; KATILA, 2021; OLIVEIRA-DIAS et al., 2022; NOBARI; DEHKORDI, 2023). Startups are

[2] Social media term has more than 61,000 hits on Scopus (November 2022) in social sciences and business management fields. Sixty percent of these occurrences have been published since 2018.

knowledge-intensive companies operating in an environment of high uncertainty that exhibit the capacity to grow rapidly through the implementation of promising ideas (POMEROL, 2018; TROISE et al., 2021). Analyzing the role of social media and dynamic capabilities for innovation performance in these organizations is important for at least four reasons, including i) there are few studies of social media on small and medium-sized companies (CHEN; JI; MEN, 2021); ii) the necessity to develop internal collaboration in startups (see, LOPEZ HERNANDEZ; FERNANDEZ-MESA; EDWARDS-SCHACHTER, 2018) as a first step to building blocks for supporting other dynamic capabilities; iii) as startups frequently work with scarce resources (HITCHEN et al., 2017; COX; NGUYEN, 2017), understanding how these companies can improve their innovation performance is necessary because innovation is vital for startups to survive and can attract financial investments; and iv) as startups working in an environment of high uncertainty, dynamic capabilities are indispensable.

There are several sectors that startups have operating, including education, health, and agribusiness. Particularly, we analyze agribusiness technology companies. (AgTech[3]), seeking to improve their innovation performance. We chose to analyze AgTech because agribusiness is a relevant sector for several economies and startups from this sector having creating important solutions for improving food productivity and agricultural sustainability, coping with climate change issues (PHAM; STACK, 2018; RADAR AGTECH, 2021; RAMOS; PEDROSO, 2021; RIALTI et al., 2022). Furthermore, over the last decades, the agribusiness sector has been facing challenges concerning population growth, limited farming land and scarcity of natural resources, which affects food security (FOOD AND AGRICULTURE ORGANIZATION - FAO, 2019). The solutions promoted by AgTech are pivotal in this regard. More details on the agribusiness sector and AgTech are in sections 1.2 and 2.4

In this thesis, we defend that while social media is pivotal to innovation performance, and it also supports internal collaboration capability. We also defend that this capability is an antecedent of capabilities that have a direct effect on innovation performance: absorptive capacity and organizational agility. This research integrates social media and dynamic capabilities to develop a research model supported by hypotheses to answer these questions. To test our hypotheses, we analyze empirical data of managers from AgTech[4]. In this study, AgTech refers to a type of startup model that move quickly with the possibility of scalability

[3] Although the term AgTech is broad, referring to agricultural innovations, as will be seen later, in this thesis it also refers to startups from the agribusiness chain.

[4] The literature provides a set of terminologies of startups from agribusiness sectors, including AgTech, agritech, agricultural startups and agrotech. To avoid some confusion, the term adopted throughout all the thesis is AgTech.

and seek innovative solutions in the agribusiness sector, through new technologies applied in this field. AgTech offer products and services such as drones, autonomous systems, biotechnology, farm and livestock management, tracking, robots, and sensors, among others (see RADAR AGTECH, 2021). Particularly, we analyze startups in medium and high stages of life cycle development[5], such as organization and traction, growth and scale, and consolidation and transition stages, because startups at these stages are characterized by a structured organizational behavior, having formal work routines (see, COUTO et al., 2021). In other words, in the medium and high life cycle stages of development, the startups have better organizational arrangements and are more managerial maturity and established routines, than startups in the conception and development stage (also known as pre-seed or seed stage) (see, SALAMZADEH; KESIN, 2015; PASCHEN, 2017; COUTO et al., 2021).

As we analyze AgTech, regarding collaboration capability, we focused on internal collaboration because internal collaboration is pivotal to organization move quickly and make better decisions, which is relevant to enhancing growth (BATARSEH; USHER; DASPIT, 2017a; LOPEZ HERNANDEZ; FERNANDEZ-MESA; EDWARDS-SCHACHTER, 2018; KAFAJI, 2020). Furthermore, recent studies have provided relevant evidence on the role of internal collaboration in improving organizational performance and other capabilities (BATARSEH; USHER; DASPIT, 2017a; LOPEZ HERNANDEZ; FERNANDEZ-MESA; EDWARDS-SCHACHTER, 2018). Particularly in startups, internal communication is crucial for organizational success (WOLF et al., 2022). In this regard, communication is considered among the most challenging of management (WIESENBERG et al., 2020). Commitment and trust among the startup's members are also critical to these organizations' competitiveness (WANG; WU, 2012; LOPEZ HERNANDEZ; FERNANDEZ-MESA; EDWARDS-SCHACHTER, 2018). As startups are innovative businesses with the possibility of scalability, trust between the members is necessary to share problems and create new ideas in favor of innovation. High trust among the startup's members is essential for high relational capital, which is relevant to competitiveness (BLATT, 2009).

1.1 Objectives of the research

The overall objective of this thesis is to propound and empirically test a research model that analyzes the role of social media and dynamic capabilities (internal collaboration

[5] Couto et al., (2021) provide four stages of startups' life cycle: conception and development, organization and traction, growth and scale, and consolidation and transition.

capability, absorptive capacity, and organizational agility) to improve innovation performance in AgTech.

The specific objectives were to:

i) Characterize the Brazilian AgTech surveyed;
ii) Analyze the influence of social media usage on innovation performance and internal collaboration capability;
iii) Analyze the influence of internal collaboration capability on absorptive capacity and organizational agility; and
iv) Analyze the influence of absorptive capacity and organizational agility on innovation performance.

1.2 Relevance of the research

The thesis provides theoretical and empirical contributions. The theoretical contribution refers to developing and testing a new research model. This model is important to clarify the relevance of social media as an relevant technological tool for business relationships, contrasting the assumption on the negative effects of these tools (for more details, see BACCARELLA et al., 2018; SUN et al., 2021).

While there are a plethora of valuable quantitative research models in the literature showing the influence of social media in diverse business sectors (for more details see, CAO et al., 2016; CAO; ALI, 2018; PAPA et al., 2018; AL-OMOUSH; SIMÓN-MOYA; SENDRA-GARCÍA, 2020; ALI et al., 2020; PEKKALA; VAN ZOONEN, 2021; DWIVEDI et al., 2022, YE et al., 2022), to the best of our knowledge, there is no study that analyzes the role of social media on dynamic capabilities (absorptive capacity, collaboration capability, and organizational agility) for AgTech innovation performance. Furthermore, no effort analyze the role of internal collaboration capability as an antecedent for absorptive capacity and organizational agility in the field of startups. In this regard, our study also examines the role of a particular dynamic capability (internal collaboration capability) as key to the organization developing others' capabilities. Given the pandemic outbreak and the increase in competition growth, based on previous studies (*e.g.*, BLOMQVIST; LEVY, 2006; CAO; ALI, 2018; ALI et al., 2020; DWIVEDI et al., 2022; YE et al., 2022), we argue that organizations that do not manage this triad of dynamic capabilities are doomed to lose competitiveness. Therefore, the

proposed research model may help understand the role of social media and dynamic capabilities in startups' innovation performance in the context of dynamic environments.

Startups are an interesting phenomenon to study[6] because they are new ventures which seek to create disruptive businesses and grow as quickly as possible. Therefore, they have gained recognition as important companies for the economy of emerging and developed regions. Startups contribute to job creation and entrepreneurship and are considered driving forces for innovation and economic growth (DI PIETRO; PRENCIPE; MAJCHRZAK, 2018; ZUBIELQUI; JONES, 2020; CHOI; SUNG; PARK, 2021). There has been a boost in the number of startups created, representing innovation hubs in many regions in the last few years. However, the literature on social media and dynamic capabilities in startups remains scant, as well as in small and medium enterprises in general; a notable exception is Zubielqui and Jones's (2020) study.

Social media are key for startups. As startup founders often work with scarce resources (HITCHEN et al., 2017), social media can enable the acquisition of external knowledge available on the internet or interaction with stakeholders at low costs. Digital spaces, such as online communities, comprise various opinions and attract innovative customers (FÜLLER; JAWECKI; MÜHLBACHER, 2007; FARAJ; JARVENPAA; MAJCHRZAK, 2011; CEPEDA-CARRION et al., 2022). The members of startups can absorb this knowledge and improve their innovative performance. Social media also contributes to crowdfunding. Due to the lack of financial resources and operating history, startups frequently have difficulties conveying the value of their proposed venture to investors (PASCHEN, 2017). In this regard, the efficient use of social media (*e.g.*, the amount and quality of content shared) can support crowdfunding success (COX; NGUYEN, 2017), which is relevant to develop new products or services. Furthermore, social media is pivotal to internal communication in startups, contributing to strengthening ties of trust among the organizational members. As startups face intense time pressure, operating in a turbulent and uncertain environment (TOMY; PERDADE, 2018), it is well-known the high rate of failure of these organizations (ARRUDA et al., 2015; KALYANASUNDARAM, 2018). Social media may help improve dynamic capabilities in startups, enabling internal collaboration, which can foster the assimilation of external knowledge, such as new market trends and consumer behavior characteristics, supporting the startups' response to market demands and innovation.

[6] It is important to highlight the recent call for papers on technological tools in startup contexts in relevant academic journals, such as Technological Forecasting and Social Change. More details in: https://www.sciencedirect.com/journal/technological-forecasting-and-social-change/about/call-for-papers

Given this backdrop, this study focused on Brazilian AgTech. We chose this region and this type of startup for four main reasons. First, Brazil is a "giant" in the agribusiness sector, being one of the world's largest food producers and exporters. Data from the Food and Agriculture Organization (FAO, 2022) indicates that Brazil was the largest producer of soybean and orange and the third largest producer of maize. Furthermore, according to *Empresa Brasileira de Pesquisa Agropecuária* (EMBRAPA, 2022), Brazil provides more than a third of the world's sugar production and is the largest exporter of cattle. Given its importance in the production and export of food, agribusiness is the main economic sector in Brazil. Data from the *Centro de Estudos Avançados em Economia Aplicada* (CEPEA, 2022) show that historically, agribusiness has been responsible for more than 20 percent of the Brazilian Gross Domestic Product (GDP), and in 2021 the sector contributed with 27.6 percent (Figure 1). The relevance of agribusiness calls for constant production and management innovations so that the country continues to be a protagonist in the production and export of food. Thus, studying AgTech (and its innovation performance) is necessary.

Figure 1 - Participation of agribusiness in Brazil's GDP

Source: CEPEA (2022)

Second, the number of Brazilian startups increased from 4,100 to almost 14,000 from 2015 to 2019 (*ASSOCIAÇÃO BRASILEIRA DE STARTUPS* - ABSTARTUPS, 2020). Considering only AgTech, currently, there are more than 500 in the ABStartups database. Furthermore, the Radar AgTech (an extensive report that mapped AgTech throughout Brazil)

listed more than 1,500 Brazilian AgTech between 2020 and 2021 (RADAR AGTECH, 2021). These results indicate that the Brazilian agricultural innovation ecosystem is amongst the most dynamic in the world (RADAR AGTECH, 2021). The boost in startup diffusion and the expressive amount of AgTech leads to the creation of private hubs for innovation for these new companies (*e.g.*, AgTech Garage, Animals Hub, and CoCriagro), stimulating the connection between the AgTech and several investors, public and private universities, consumers, farmers, and other stakeholders of the agribusiness chain. These hubs also support the development of technological solutions that increase the sustainability and competitiveness of agribusiness. In this regard, understanding the role of social media and dynamic capabilities in Brazilian AgTech may contribute to developing public incentives and other private efforts to improve innovation by this type of startup.

Third, the adoption of technologies, such as drones, sensors, agricultural data processing, performing GPS (Global Positioning System) monitoring, automation, and applications for decision-making was relevant for Brazilian agribusiness to achieve high levels of competitive, improving food productivity, increasing the knowledge level of cultivated areas, and reducing cost (PIVOTO et al., 2019; SILVEIRA; FARINA; SANTOS, 2022). The offering of these technologies is, in part, carried out by AgTech (RAMOS; PEDROSO, 2021). Therefore, AgTech are seen as key companies for innovation in the agribusiness chain and are rapidly transforming parts of the worldwide agriculture industry. In this regard, measuring what influences the innovation performance in AgTech may support them to innovate more efficiently and continue contributing to the performance of the agribusiness sector (PHAM; STACK, 2018; RAMOS; PEDROSO, 2021).

Fourth, the failure rate of Brazilian startups (including AgTech) is a relevant concern. The study of Fundação Dom Cabral (FDC) shows that 25 percent of startups ‘die’ in the first year of operating, and at least 50 percent fail within four years of existence (ARRUDA et al., 2015). The inability to adapt to market changes represents one of the main factors for startup failure (ARRUDA et al., 2015). Although the thesis focuses on AgTech, the results of this academic effort may provide insights to support management practices to reduce the startups’ failure rate and improve their competitive advantage and the chances of scalability.

2. THEORETICAL FOUNDATIONS AND EMPIRICAL BACKDROP

This section comprises the theoretical backdrop of this thesis. First, we define social media as digital spaces for social interactions. We also provide examples of social media types and general characteristics of recent studies in this section. Second, using the dynamic capability approach (TEECE; PISANO; SHUEN, 1997; EISENHARDT; MARTIN, 2000), we explore the literature on collaboration capability (BLOMQVIST; LEVY, 2006), absorptive capacity (COHEN; LEVINTHAL, 1990; ZAHRA; GEORGE, 2002), and organizational agility (DWIVEDI et al., 2022; YE et al., 2022). Finally, we provide general definitions of agribusiness and startups focusing in AgTech, the type of startup analyzed on this thesis (the empirical backdrop of this study).

2.1 Social media as digital spaces for social interactions and innovation

Given the emergence and diffusion of information technology, firms can easily move beyond physical spaces for social interactions. In this regard, in the last few years, virtual spaces have become popular. Also known as cyber *ba*[7] or virtual *ba*, the virtual space enables people to interact in a virtual world instead of real space and time (NONAKA; KONNO, 1998). The use of social media is a good example of information technology that contributes to the use of virtual bas, which is relevant to the creation of new knowledge (VACCARO; VELOSO; BRUSONI, 2009; FARAJ; JARVENPAA; MAJCHRZAK, 2011), which supports the organizations stay ahead of their competitors (GUPTA et al., 2018; MENTION; BARLATIER; JOSSERAND, 2019). Furthermore, social media enables members' communication across various departments, improving online collaboration (JIA et al., 2021) and intra-organizational commitment (LUO et al., 2018).

"Organizational usage of social media is changing organizational communication and public relations" (TAJUDEEN; JAAFAR; AININ, 2018, p. 308). In this regard, Cao et al., (2016) argue that social media have revolutionized organizational communication and knowledge work. Similarly, some authors argue that social media have radically changed the way companies and their internal members interact (WANG; KIM, 2017; TAJUDEEN; JAAFAR; AININ, 2018; MENTION; BARLATIER; JOSSERAND, 2019; MUNINGER;

[7] *Ba* means space, place, or context, where social interactions amongst individuals occur, rather than an individual operating alone. This concept was proposed in the early 1990s by the Japanese philosopher Nishida and, years later, developed by Shimizu (NONAKA; KONNO, 1998).

HAMMEDI; MAHR, 2019). Therefore, social media have been considered an important digital place for social interactions.

Social media is a broad concept. According to Ali et al., (2020, p. 1), "social media includes a set of technological tools that enables smooth communication and interaction among organizational members and serves as an open-source knowledge repository." Hitchen et al., (2017) define social media as an internet-based platform that enables the creation and sharing of user-generated content. These authors cite LinkedIn, Twitter, Facebook, and Pinterest as examples of social media. To avoid mistakes, in this study, social media refers to "a group of internet-based applications that build on the ideological and technological foundations of Web 2.0[8], and that allow the creation and exchange of User Generated Content" (KAPLAN; HAENLEIN, 2010, p. 61). Given this, social media is on the agenda of many business decision-makers and consultants (KAPLAN; HAENLEIN, 2010). Furthermore, due to its importance, social media has attracted the attention of diverse academic areas, including information systems, management (OLANREWAJU et al., 2020), health (MWAURA; CARTER; KUBHEKA, 2020), education (CHUGH; RUHI, 2018), and agricultural extension (MAMGAIN; JOSHI; CHAUHAN, 2020).

Social media refers to technological tools that allow communication and interactions among organizational members through the internet, serving as a source of knowledge repository (KAPLAN; HAENLEIN, 2010; CAO et al., 2016; BHIMANI; MENTION; BARLATIER, 2019; MUNINGER; HAMMEDI; MAHR, 2019; ALI et al., 2020). Therefore, social media supports knowledge management and organizational collaboration (CAO; ALI, 2018) because it increases the connectivity of people inside and outside the organization. While intranet is a good example of internal social media (social media hosted inside the organization and accessible only by team members), Telegram, Facebook, LinkedIn, Twitter, WeChat, QQ, Second Life, Yammer, WhatsApp, and online communities[9] are some examples of external (public) social media, *i.e.,* social media hosted outside of the organization (FÜLLER et al., 2007; SCHLAGWEIN; HU, 2017; CAO; HITCHEN et al., 2017; ALI, 2018; SONG et al., 2019; ALI et al., 2020; ZHOU et al., 2021). Table 1 presents an overview of some types of social media.

[8] Concept based on developing an information network where each user can access the available information and contribute to knowledge sharing and creation. Given the definition provided by Kaplan and Haenlein (2010), we also consider social media other nomenclatures, including enterprise social media (see DWIVEDI et al., 2022).
[9]Companies' online forums also are examples of social media, allowing customers to discuss products and services (PAPA et al., 2018).

Table 1 - Overview of some types of social media found in literature

Types of social media	**General characteristics**	**Examples**
Blogs and microblogs	Blogs are like 'online journals' where first the most recent post appears, and they provide information on the life and opinions of the authors. Microblogs are used to share short messages (*e.g.*, Twitter enables sharing messages of up to 140 characters) with other people.	WordPress and Twitter
Content communities	Digital places that provide information through text, voice, image or video.	Online communities, YouTube, and Flicker
Networking ties based on user messages	Web-based places with a clean interface that allows instant messages through text, voice, video chat, or sharing files.	Microsoft Teams, Telegram, WhatsApp, and WeChat
Networking ties based on user profile	Web-based places that support the individual in creating a profile within a bounded system. Enterprise social networking (*e.g.*, Yammer) also allows connection across departments and physical boundaries.	Facebook, Instagram, LinkedIn, and Yammer
Online communities	Digital places focused on commonly shared hobbies, where users actively provide ideas and opinions on a particular issue. Generally, information is shared through public text, visible to all users.	GitHub and Harley-Owners-Group
Wikis	Support collaborative editing of Web pages, share files, and manage projects.	Brainkeepper and PBworks

Source: based on Füller et al., (2007), Kaplan and Haenlein (2010), Razmerita, Kirchner and Nabeth (2014), Sutikno et al., (2016), Wong et al., (2020); Muninger, Hammedi and Mahr (2022)

Qualitative and conceptual studies have been analyzing how social media influences organizations routines. Through qualitative techniques designed on physicians who were active social media users, Panahi, Watson, and Partridge (2015) concluded that information encountered on social media support tacit knowledge creation. Among other factors, the qualitative research of Schlagwein and Hu (2017) shows that social media is pivotal to maintaining organizational support, formalizing knowledge, and storing business information. The seminal conceptual study[10] of Kaplan and Haenlein (2010) points out that social media is important for all types of organizations, from small and medium enterprises (SMEs) to multinationals and even nonprofit and governmental enterprises.

[10]Differently of widely cited theoretical studies based in the development of organizational approaches, *e.g.*, Cohen and Levinthal (1990), Teece, Pisano, and Shuen (1997), Nonaka, Toyama, and Konno (2000), the Kaplan and Haenlein's (2010) paper describes the concept of social media. They provide pieces of advice to organizations that aim to use social media. To date (November 2022), this study has 28382 citations in Google Scholar.

The influence of social media in organizations has also drawn the attention of quantitative researchers. These studies have been using multivariate techniques, such as structural equation models (for example, see DWIVEDI et al., 2022; YE et al., 2022), to analyze the influence of social media on several organizational factors (Table 2), including absorptive capacity, decision-making effectiveness, new product development, trust, shared vision, open innovation, among others. The findings generally show the importance of social media usage, contributing to the development of important organizational capabilities.

Table 2 - Overview of recent quantitative studies that analyze the role of social media in organizations

Authors	**Country analyzed**	**Sample characteristics (number of respondents)**	**Variables analyzed in research models[1]**
Cepeda-Carrion et al., (2022)	Spain	Small firms in the service sector (n=113)	Open innovation and absorptive capacity
Dwivedi et al., (2022)	Bangladesh	The employee of public and private emergency and disaster management organizations during Covid-19 (n=198)	Organizational agility, social media infrastructure, knowledge sharing, and decision-making effectiveness
Ye et al., (2022)	China	Staff from the firms responsible for customer relationships and social media management (n=249)	Agility and adaptability
Rakshit et al., (2021)	India	Product managers/marketers of small and medium enterprises (n=217)	New product development
Ali et al., (2020)	China	Sixty-one teams from the software industry (n=309)	Potential absorptive capacity, realized absorptive capacity, and transactive memory system
Zubielqui and Jones (2020)	Australia	Employees from startups (n=1769)	Managerial learning network and innovation
Cao and Ali (2018)	China	Sixty-eight teams (n=334). The authors do not specify the organizational business sector analyzed	Absorptive capacity, transactive memory system, and knowledge creation capability
Zubielqui, Fryges and Jones (2019)	Australia	The authors do not specify the organizational business sector analyzed (n=1024)	Firm innovativeness
Cao et al., (2016)	China	Working professionals who were part-time postgraduate students (n=379)	Shared vision, network ties, and trust

[1] Only the variables hypothesized as influenced by social media.
Source: the author

Cepeda-Carrion et al., (2022) point out that social media is important for firms' interactions with their stakeholders (customers, suppliers, partners) as they are an important source of information, which supports the development of innovation. The authors show the role of absorptive capacity in the relationship between social media and innovation in family firms. They also conclude that social media has totally transformed the way organizations acquire external knowledge. Cao and Ali (2018) and Ali et al. (2020) also show the positive influence of social media on the organization acquiring external knowledge. These two studies analyze organizational teams and describe the importance of social media as tools for communication and coordination systems, knowledge repositories, and platforms to access and search for knowledge, which in turn is relevant for improving organizational knowledge management. Ali et al., (2020) also indicate the role of social media in improving the transactive memory system, that is, a cognitive system that helps team members to carry out effective knowledge management.

Zubielqui and Jones (2020) argue that social media is pivotal in facilitating the interaction and knowledge between organizations and users. They analyze startups and provide valuable findings on the role of social media in this kind of organization. Among the results, the authors describe that social media underlie idea exchange and network interaction, which is pivotal for collaboration. Furthermore, social media is seen as an effective channel of communication for organizations to access knowledge and information to improve innovation and work performance (CAO et al., 2016; ZUBIELQUI; FRYGES; JONES, 2019; ZUBIELQUI; JONES, 2020; DWIVEDI et al., 2022). Similarly, Rakshit et al., (2021) and Dwivedi et al., (2022) point out the role of social media as an effective and powerful way for organizations innovate and for decision-making effectiveness during crisis time, such as the Covid-19 pandemic.

Given this backdrop, organizations are using social media to achieve a range of objectives. However, the adoption and use of social media do not guarantee the organization's success in favor of innovation and efficiency. The consolidation of a global market and the development and diffusion of digital technologies transformed the organizational environment into more complex and dynamic. This environment is constantly changing and forces the creation of new ways to create and deliver value for society (FUKAWA; ZHANG; EREVELLES, 2021). To cope with such context, organizations must explore and adapt to their business environment in the current fast-changing world. In this regard, through the use of social media, organizations need to identify and develop certain capabilities that support them for collaborative actions and innovation to achieve and maintain competitiveness and economic

growth. The theoretical lens of dynamic capability is particularly pivotal in this context (TEECE; PISANO; SHUEN, 1997; TEECE; PISANO, 2003; MEIRELLES; CAMARGO, 2014; WANG; KIM, 2017; DWIVEDI et al., 2022; HASSANI; MOSCONI, 2022; YE et al., 2022).

2.2 Dynamic capabilities

The dynamic capabilities approach has attracted attention in recent years (NIELSEN, 2006; BARRETO, 2010; YE et al., 2022). This approach is a relevant field for organizations facing an unstable environment. In these environments, the manipulation of knowledge resources is critical (NIELSEN, 2006). Studies on dynamic capabilities gained a boost since the contributions of David Teece, Gary Pisano, and Amy Shuen (see TEECE; PISANO; SHUEN, 1997; TEECE; PISANO, 2003). Particularly, their study published in the Strategic Management Journal in 1997 has been widely used to support business management and strategy research, among other academic fields[11]. This approach is intrinsically related to market (environment) dynamism and suggests that organizations with higher levels of dynamic capabilities can better adapt to the environment in which they are inserted. Therefore, in an unstable environment, organizations need dynamic capabilities, *i.e.*, capabilities that help them adapt to an ever-changing environment.

The word 'dynamic' refers to several changes that can affect the organization, including new technologies, new market settings, and the emergence of new regulations. 'Capability' refers to intangible resources, such as efficiency, skills, and competencies (TEECE; PISANO; SHUEN, 1997; WANG; AHMED, 2007; BARRETO, 2010; MEIRELLES; CAMARGO, 2014). In the seminal work of Eisenhardt and Martin (2000), dynamic capabilities are described as a set of specific processes, including strategic decision-making, product development, and the creation of organizational alliances. They also argue that dynamic capabilities refer to a firm's organizational and strategic routines[12] by which the firms achieve new resource configurations. Dynamic capabilities are also defined as an organization behavioral orientation to constantly integrate, recreate, renew, reconfigure upgrade its capabilities in response to the

[11] While this thesis analyzes the dynamic capabilities in the innovation context, this approach constitutes a field of great interest to researchers in several academic fields, such as entrepreneurship, marketing, strategic management, and operations management, among others (MEIRELLES; CAMARGO, 2014).

[12] Routines are 'actions' carried out by 'actors. Put simply, routines are what actors do. Winter (2003) also argues that routines refer to behavior that is learned, highly patterned, repetitious, or quasi-repetitious, founded in part in tacit knowledge.

changing environment (WANG; AHMED, 2007), seeking to sustain organizational competitive advantage[13] (AMBROSINI; BOWMAN, 2009; CHIEN; TSAI, 2012; MEIRELLES; CAMARGO, 2014). According to Barreto (2010, p. 271), "a dynamic capability is the firm's potential to systematically solve problems, formed by its propensity to sense opportunities and threats, to make timely and market-oriented decisions, and to change its resource base." Zollo and Winter (2002) describe the concept of dynamic capabilities as a learned and stable pattern of collective activity through which the organization modifies its operating routines to achieve effectiveness. Furthermore, in the classical definition of Teece, Pisano, and Shuen (1997, p. 516), dynamic capabilities comprise the organization's ability "to integrate, build and reconfigure internal and external competencies to address the rapidly to change environments[14]."

While it may appear that the definition proposed by Teece, Pisano and Shuen (1997) links an organization's reaction to improvisation, *i.e.*, the organizations are only responding to environmental changes, recombining their resources (RIALTI et al., 2019). Actually, dynamic capabilities also have been analyzed as a critical factor for improving knowledge management (NIELSEN, 2006; ZHENG et al., 2011; CHIEN; TSAI, 2012) and innovation (CHENG; CHEN; HUANG, 2014; PIENING, 2013; ALI et al., 2020). In this regard, dynamic capabilities play a pivotal role in transforming organizational knowledge resources to respond the market needs (FALASCA et al., 2017).

Given the increase of digitalization and diffusion of social media, a body of recent studies is concerned with understanding how social media influence dynamic capabilities in organizations. Among these efforts, researchers have measured the role of collaboration capability (BATARSEH; USHER; DASPIT, 2017a; BATARSEH; DASPIT; USHER, 2018), absorptive capacity (BATARSEH; USHER; DASPIT, 2017b; SCHLAGWEIN; HU, 2017; CAO; ALI, 2018; ALI et al., 2020), and organizational agility (DWIVEDI et al., 2022; YE et al., 2022). These three dynamic capabilities have been analyzed because they support organizations to adapt to an ever-changing environment. We argue that these three dynamic capabilities support innovation performance in organizations, and they are closely related.

[13] Traditionally, dynamic capabilities are analyzed as a proxy of competitive advantage/firm performance. However, in the last few years, a body of studies has used this theoretical approach to analyze organizational innovation (for some examples, see ZHENG et al., 2011; CHENG; CHEN; HUANG, 2014; ALI et al., 2020; ALI et al., 2021)

[14] It is important to note that dynamic capabilities is a broad concept, so it is not surprising that it encompasses a range of capabilities. In other words, Wang and Ahmed (2007) argue that researchers refer to dynamic capabilities as a wide range of capabilities.

Absorptive capacity depends on individuals' relationships and relational embeddedness with colleagues inside the organization (EBERS; MAURER, 2014; MENNENS et al., 2018). Furthermore, organizational agility is influenced by intra-organizational collaboration. The following subsections provide details on these three dynamic capabilities.

2.2.1 Collaboration capability

Collaboration capability is considered a dynamic capability (BLOMQVIST; LEVY, 2006). Collaboration is pivotal in situations of "high market or technological uncertainty and technological or organizational complexity and the need for information and knowledge creation" (BLOMQVIST; LEVY, 2006, p. 42). Furthermore, collaboration capability is important because it allows organizations to adapt quickly to a changing economic environment (BLOMQVIST; LEVY, 2006; CASTILHO; QUANDT, 2017; QUANDT; CASTILHO, 2017). This responsiveness is based on the competence of collaborating actors to quickly adapt and apply the knowledge to solve a particular problem of a product or service (BLOMQVIST; LEVY, 2006). Besides, collaboration is the capability that "relies on "ingredients" of social interaction that have a strong impact on the innovative result" (CASTILHO, QUANDT, 2017, p. 34). Collaboration capability derives from the quality and quantity of social ties (QUANDT; CASTILHO, 2017) and helps managers improve organizational performance for innovation (BLOMQVIST; LEVY, 2006; BATARESH; DASPIT; USHER, 2018). In this regard, some studies describe this type of firm capability as 'collaborative innovation capability' (WANG; HU, 2019).

Several studies analyze the concept of collaboration capability, including assessing firm competitive superiority (TUOMINEN; ANTTILA, 2006), sharing information with stakeholders (PING et al., 2018), and analyzing how collaboration improves organizational performance (ALLRED et al., 2011). However, these studies have not as the main focus the knowledge creation or innovation. Furthermore, some studies that use this concept do not describe its meaning (see SHIH; SUN; LI, 2005; TUOMINEN; ANTTILA, 2006). To meet this point, the paper "Collaboration capability – a focal concept in knowledge creation and collaborative innovation in networks" by Blomqvist and Levy (2006) clarifies several aspects, describing which means the capacity to collaborate. According to them, the key dimensions of collaboration capability are trust, commitment, and communication. For Ulbrich et al., (2011), these three components are closely interrelated and dependent on the members' subjective perception of collaboration success. Trust, commitment, and communication are evidenced in

organizational activities, including information processing, negotiation skills, and knowledge absorption (BLOMQVIST; LEVY, 2006; VAN HOOF; THIELL, 2014), and are relevant to achieve internal collaboration.

Trust has been reached as a key condition for social interactions and is often referred to as positive future expectations. Trust is a physiological state in which a party is willing to be valuable to another party based on the belief that others will perform a particular action important to the trustor in the absence of the trustor's control and monitoring (MAYER; DAVIS; SCHOORMAN, 1995). This definition conceptualizes trust as a dyadic relation between a part to be trusted (trustee) and a trusting party (trustor) (BREUER et al., 2020). In simple words, trust refers to the willingness to take risks, and the level of trust serves as an indication of the amount of risk one is willing to take. Therefore, more trust in a relationship among parties leads to more risk-taking behaviors on the part of the trust.

Commitment is the second dimension of collaborative capability. For Thompson and Heron (2005, p. 385), "the importance of commitment to knowledge creation has been recognized by practitioners." Organizational commitment is derived from social psychology and sociology and affects common values, goals, and relationships (ULBRICH et al., 2011). Among several definitions (see O'REILLY; CHATMAN, 1986; MEYER; BOBOCEL; ALLEN, 1991; BLOMQVIST; LEVY, 2006), typically this relational factor has been analyzed in studies on knowledge management and innovation as affective commitment, *i.e.*, as the sense of community and sense of belonging (WASKO; FARAJ, 2005; BATARSEH; USHER; DASPIT, 2017a). Affective commitment refers to how the individuals identify and are involved with the organization's mission, values and goals (MEYER; BOBOCEL; ALLEN, 1991; ULBRICH et al., 2011).

Communication is the third dimension of collaboration capability. Communication is fundamental to any form of organization and is not necessarily verbal. Contracts and e-mails are examples of explicit communication among the parties. Communication is the third component of collaboration capability and is the 'vehicle' for social interactions. Communication research provides important findings analyzing intra- and inter-organizational interactions. Outside the firm, informal communication obtained through visits to fairs and events has been examined as useful for generating knowledge (BALESTRIN; VARGAS; FAYARD, 2008). Given this, Sawy et al., (2001) describe that the best ideas emerged in informal communication compared with formal meetings.

The development of collaboration in intra-organizational boundaries, *i.e.*, between leaders and employees and among team members, has been analyzed as pivotal to supporting

the organization's learning capacity (SCHLAGWEIN; HU, 2017). The learning capacity, also known as absorptive capacity (COHEN; LEVINTHAL, 1990), is described in the following subsection.

2.2.2 Absorptive capacity

Before the 1990s, the concept of absorptive capacity was mainly related to life sciences, including nutrition diet (for example, see ARRAMBIDE et al., 1989). In general, studies like these analyze nutrients' role in the human organism and how they are absorbed. However, since the seminal work of Cohen and Levinthal (1990), the field of management and strategy has been widely using the concept of absorptive capacity as the organizational ability to recognize the value of new external knowledge, assimilate it and explore it to improve commercial gains and competitive advantage (COHEN; LEVINTHAL, 1990; ZAHRA; GEORGE, 2002; CHEN; LIN; CHANG, 2009; CAMISÓN; FORÉS, 2010; SCHLAGWEIN; HU, 2017). While absorbed nutrients are important for human life, the organizational absorptive capacity supports the 'organizational health,' contributing to the development of innovation[15] and maintaining the competitive advantage.

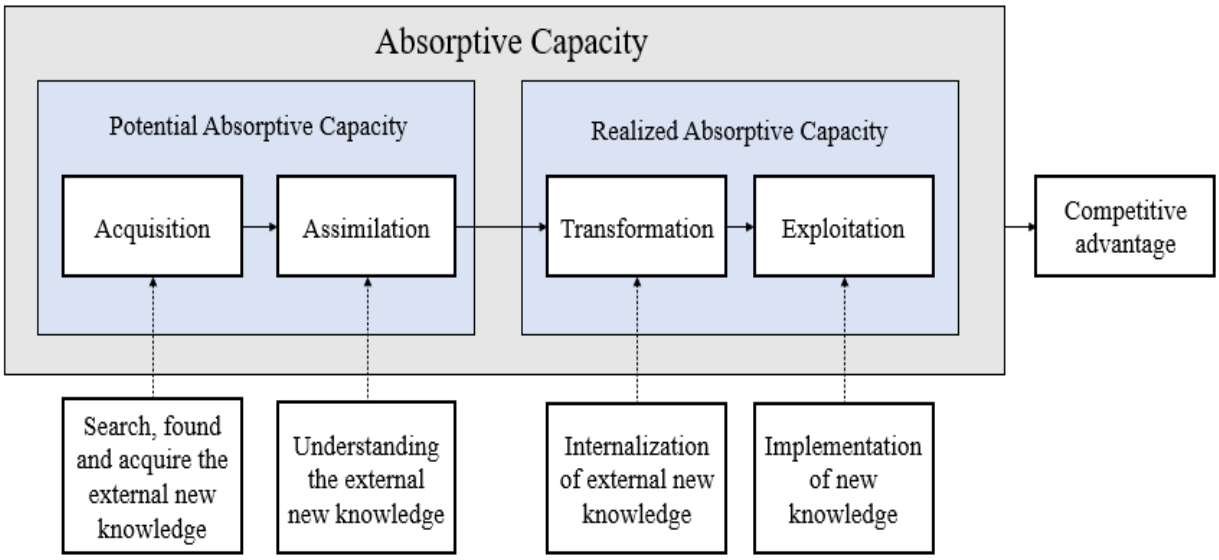
Absorptive capacity is the ability to acquire knowledge and learn, and involves a collection of routines for knowledge management (COHEN; LEVINTHAL, 1990; ZAHRA; GEORGE, 2002; CHEN; LIN; CHANG, 2009; CAMISÓN; FORÉS, 2010; JIMÉNEZ-BARRIONUEVO; GARCÍA-MORALES; MOLINA, 2011). Globalization and growing business competition are making the organizational environment increasingly dynamic. In this regard, the process of absorbing external knowledge becomes a relevant issue for organizational innovation (CAMISÓN; FORÉS, 2010; SCHLAGWEIN; HU, 2017). This capability is not, however, simply the sum of employees' absorptive capacity of external sources (*e.g.*, customers, suppliers, competitors, among other stakeholders) but also their ability to transform and exploit new knowledge (COHEN; LEVINTHAL, 1990; ZAHRA; GEORGE, 2002). Therefore, an organization with a high absorptive capacity is likely to harness new knowledge obtained from external sources and apply it to identify opportunities (ZAHRA; GEORGE, 2002; LIU et al., 2013; SCHLAGWEIN; HU, 2017).

Inspired by Cohen and Levinthal (1990) and Zahra and George (2002), the literature has been using four components to analyze absorptive capacity: acquisition, assimilation,

[15] Therefore, several studies analyze absorptive capacity as an antecedent of innovation in firms (for a few examples, see CHEN; LIN; CHANG, 2009; KOSTOPOULOS et al., 20211; ALI et al., 2020).

transformation, and exploitation of knowledge (CHEN; LIN; CHANG, 2009; CAMISÓN; FORÉS, 2010; LIU et al., 2013). These four dimensions are divided into two 'blocks' of capacities: potential and realized absorptive capacity (ZAHRA; GEORGE, 2002), according to Figure 2. In this respect, potential and absorptive capacity are complementary because organizations cannot apply external knowledge without acquiring it (CAMISÓN; FORÉS, 2010).

Figure 2 - Dimensions of absorptive capacity



Source: based on Zahra and George (2002)

Potential absorptive capacity involves the acquisition and assimilation of knowledge. Acquisition refers to the organization's capacity to search, identify, and acquire new knowledge from external sources. The intensity and speed of an organization's effort to search, find and gather new external knowledge can determine the firm's quality of acquisition (ZAHRA; GEORGE, 2002). An organization that acquires new knowledge about customer preferences and technical information can build a sense of environmental uncertainties and market tendencies, which would be pivotal to improving profitability performance (LIU et al., 2013). However, obtaining external knowledge alone may not impact organizational performance, but it is only an initial step of absorptive capacity (*i.e.*, it is the first step). Therefore, after acquiring knowledge, it is necessary to assimilate it (JIMÉNEZ-BARRIONUEVO; GARCÍA-MORALES; MOLINA, 2011).

When new knowledge is acquired, it is allocated to experts on this topic that can act as a gatekeeper to verify the relevance of the knowledge, and it is expected that assimilation of knowledge occurs (ALI et al., 2020). Therefore, assimilation refers to an organizational process of internalizing the external knowledge acquired (ZAHRA; GEORGE, 2002). In other words, assimilation refers to the ability to absorb and understand new knowledge (LIU et al., 2013). To assimilate the new knowledge, the organization's members must comprehend this knowledge in order to learn (JIMÉNEZ-BARRIONUEVO; GARCÍA-MORALES; MOLINA, 2011). Despite the importance of potential absorptive capacity, the organizations may suffer from the costs of knowledge acquisition (JANSEN; VAN DER BOSCH; VOLBERDA, 2005). The development of realized absorptive capacity is critical to meet this point by transforming and using new knowledge.

Realized absorptive capacity involves transformation and exploitation. Transformation follows the assimilation component and is related to the reconfiguration of entrepreneurial opportunities (JIMÉNEZ-BARRIONUEVO; GARCÍA-MORALES; MOLINA, 2011). Transformation is the capability to internalize knowledge by combining internal knowledge (*e.g.,* employee knowledge) with the newly acquired and assimilated (ZAHRA; GEORGE, 2002; TODOROVA; DURISIN, 2007; CAMISÓN; FORÉS, 2010). According to Schlagwein and Hu (2017), internal knowledge management supports the transformation. This dimension of absorptive capacity may be achieved by interpreting or combining existing knowledge in a different way (CAMISÓN; FORÉS, 2010). Transformation "is accomplished by adding or deleting knowledge or simply by interpreting the same knowledge in a different manner" (ZAHRA; GEORGE, 2002, p. 190). Therefore, transformation capability is related to employee creativity (*i.e.,* the capacity to produce novel and useful ideas concerning services, practices, procedures, or products) to understanding the acquired knowledge, and seeking its implementation in the organization (COHEN; LEVINTHAL, 1990; ZAHRA; GEORGE, 2002; CAMISÓN; FORÉS, 2010; JIMÉNEZ-BARRIONUEVO; GARCÍA-MORALES; MOLINA, 2011).

Knowledge implementation refers to the exploitation component of absorptive capacity. Exploitation is the final learning process (ZAHRA; GEORGE, 2002; SCHLAGWEIN; HU, 2017). "Exploitation as an organizational capability is based on routines that allow firms to refine, extend, and leverage existing competencies or create new ones by incorporating acquired and transformed knowledge into its operations" (ZHARA; GEORGE, 2002, p. 190), contributing to achieving competitive advantage. The exploitation of new knowledge requires efficient organizational coordination and considerable amounts of capital resources. However,

the degree of knowledge absorbed by the organization can influence its agility in dynamic environments (LIU et al., 2013; CEGARRA-NAVARRO; SOTO-ACOSTA; WENSLEY, 2016).

2.2.3 Organizational agility

Nowadays, companies face several changes that require them to reconfigure their strategies and actions quickly. Thus, one of the features necessary today is agility. The term agility is almost synonymous of flexibility (TEECE; PETERAF; LEIH, 2016) and enables quick and accurate responses, supporting organizational success in a turbulent environment. In this regard, organizational agility is fundamentally important in order to firms adapt their strategies in this dynamic environment (CEGARRA-NAVARRO; SOTO-ACOSTA; WENSLEY, 2016; RAVICHANDRAN, 2018[16], CIAMPI et al., 2022). Organizational agility is a capability that facilitates the use of knowledge to develop new products, services and react to the market competition (CEGARRA-NAVARRO; SOTO-ACOSTA; WENSLEY, 2016; RAVICHANDRAN, 2018; AHLBÄCH et al., 2017; DWIVEDI et al., 2022).

Tallon and Pinsonneault (2011, p. 464) indicate that organizational agility refers to a "firm's ability to detect and respond to opportunities[17] and threats in the environment with ease, speed, and dexterity." In a survey, Ahlbäck et al., (2017) found that organizational agility was identified as one of the top priorities for strategic development. Ravichandran (2018) argue that organizational agility is the ability of the company to adjust its actions to enhance performance. In other words, to respond to market demands and environmental uncertainties and generate higher revenues and profits, organizations need to develop and sustain agility (RAVICHANDRAN, 2018; RAFI et al., 2021; DWIVEDI et al., 2022; RABAL-CONESA; JIMÉNEZ-JIMÉNEZ; MARTÍNEZ-COSTA, 2022; YE et al., 2022). This dynamic capability is related to reacting to the emergence of new competitors and enabling businesses to move quickly regarding creating new market solutions (CEGARRA-NAVARRO; SOTO-ACOSTA; WENSLEY, 2016). Similarly, Ye et al., (2022) argue that organizational agility refers to the organization's ability to sense, capture, and respond to market demands.

[16] Ravichandran (2018) argues that the current business environment is very dynamic and hyper-competitive.
[17] Zara, one of the most famous companies in the fashion sector, is a good example of an agility organization that detects market opportunities. Zara introduces new products rapidly to guarantee a quick response to customers, and this company delivers new products twice each. This adds more than 10,000 new designers every year (PETRO, 2012).

According to Oliva and Kotabe (2019), the agile organization reacts quickly to change its structure, its services or products tm meet the dynamic changes. Teece, Peteraf and Leih (2016, p. 17) also define organizational agility as "the capacity of an organization to efficiently and effectively redeploy/redirect its resources to value creating and value protecting (and capturing) higher-yield activities as internal and external circumstances warrant". In light of the foregoing, recent studies have analyzed organizational agility as a dynamic capability (TEECE; PETERAF; LEIH, 2016; ECKSTEIN et al., 2014; WALTER, 2021; CIAMPI et al., 2022; DWIVEDI et al., 2022; RABAL-CONESA; JIMÉNEZ-JIMÉNEZ; MARTÍNEZ-COSTA, 2022; YE et al., 2022).

A body of empirical studies has explored a range of factors that support organizational agility. Eisele et al., (2022) point out that organizational agility constitutes a driver to companies' success in today's dynamic context. Among other factors, they describe the role of human factors, including the knowledge, experiences, skills and abilities of companies' employees, as pivotal to achieving organizational agility. Cegarra-Navarro, Soto-Acosta and Wensley (2016) describe the knowledge application process *(*the process that ensures the use of knowledge properly) as influencing organizational agility, which in turn mediates the relationship between knowledge application and firm performance. Irfan, Wang and Akhtar (2019) show a positive influence of information technology (IT) capabilities (IT infrastructure and IT assimilation) on organizational agility through supply chain capabilities (information integration and operational coordination). This study points out the importance of IT capabilities to organizations quickly respond to environmental changes. Similarly, Liu et al., (2013) indicate that IT capabilities (IT assimilation and infrastructure) support supply chain agility. These authors argue that IT capabilities make data, information, and knowledge available in the organization, facilitating collaboration and the development of supply chain agility. The findings of this study also reveal the positive influence of supply chain agility on firm economic performance.

Also, analyzing the IT context, Ravichandran (2018) indicates that digital platforms, combined with a range of enterprise software platforms, positively influence organizational agility. Thus, this study highlights the importance of investing in IT tools to improve the firm's agility. Given this backdrop, "firms that have created these digital platforms have the capacity to both sense market trends and customer needs and the ability to react quickly" (RAVICHANDRAN, 2018, p. 5).

The literature described above (in subsections 2.2.1, 2.2.2, and 2.2.3) provides important findings on the role of dynamic capabilities in improving an organization's competitive

advantage and innovation performance. However, little effort on this subject was made to analyze startup innovation performance. A notable exception is the study of Antonio et al., (2021), but this paper has another scope, it examines the leadership role and proposes a team ambidexterity as a mediator variable to improve the impact of leadership to improve innovation in startups. Given this, we argue that understanding the nature of innovation performance in startups, *i.e.*, which are the enablers or drives for innovation performance, can support its competitive advantage, scalability and reduce its rate of failure. Based on the importance of agribusiness and AgTech (see section 1.2), understanding what affects the innovation performance of these startups is relevant.

2.4. General overview of agribusiness and AgTech

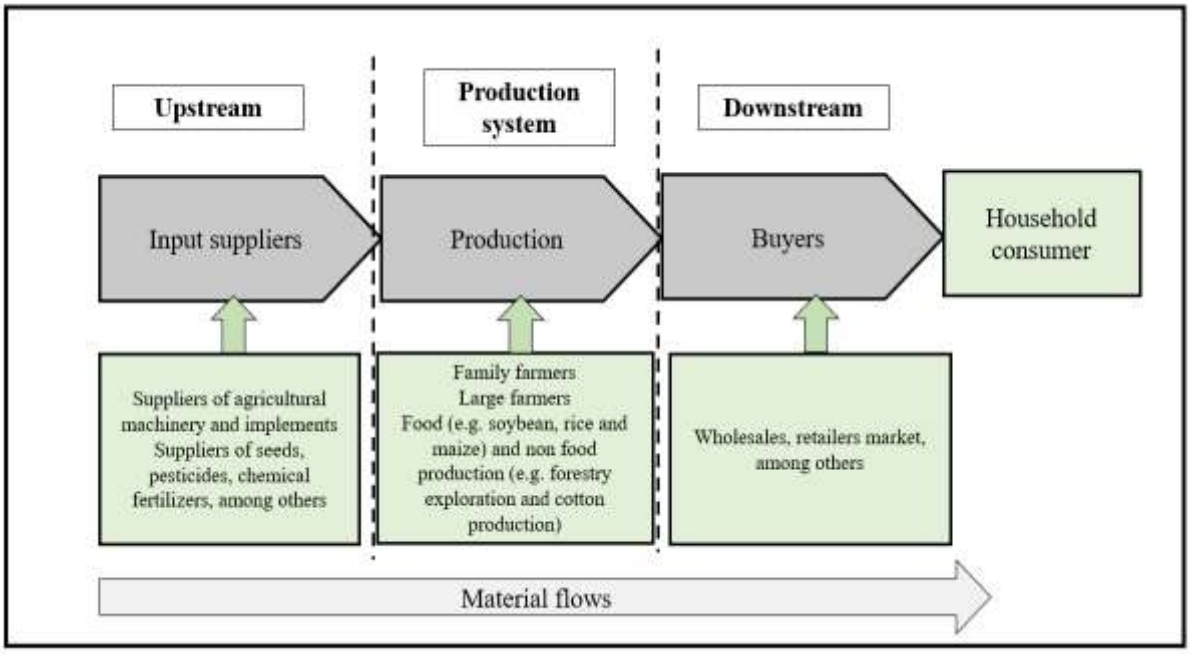
The emergence and diffusion of the Green Revolution[18] were important to increase food production worldwide. This revolution made a range of dramatic changes in the relations between the agricultural sector and other organizations responsible for providing agricultural raw materials and food processing. In this regard, the agricultural sector (also known as agricultural production system) could no longer be analyzed in isolation from other actors (BATALHA; LAGO DA SILVA, 2014; ZYLBERSZTAJN, 2017). The concept of agribusiness thus emerged to explain the relationship that exists between the agricultural sector (the farm) and upstream, also named 'before the farm' (*e.g.*, suppliers of agricultural machinery) and downstream actors, that is, 'after the farm' (*e.g.*, wholesale and retails).

The agribusiness concept was developed by the professors of the Graduate School of Business Administration at Harvard, Ray Goldberg and John Davis, in 1957 and comprises "the sum of all operations involved in the manufacture and distribution of agricultural supplies, production operations on the farm, and the storage, processing, and distribution of farm commodities" (DAVIS; GOLDBERG, 1957, p. 85). Years later, Goldberg (1968) improved the agribusiness concept as a chain that encompasses all those involved in the production, processing, and distribution of a product, from the supply of inputs to the agricultural system to the household consumer. Therefore, Davis and Goldberg (1957) and Goldberg (1968) describe that the agricultural production system is part of an extensive chain, and this chain

[18] The Green Revolution started in the late 1950s in developed countries. It referred to agricultural modernization on a global scale through the adoption and diffusion of a set of innovations, such as high-yielding seeds, pesticides and chemical fertilizers, and agricultural machinery. Based on this, the production of various foods increased significantly, including agricultural commodities such as soy and corn. Interesting details on the Green Revolution are in Evenson and Gollin (2003) and Conway (2019).

comprises a range of organizations, including suppliers and buyers (Figure 3[19]). That is, the agricultural production system (including small and large farmers) became part of an interdependent supply that operates in interconnected industries (BATALHA; LAGO DA SILVA, 2014; ZYLBERSZTAJN, 2017).

Figure 3 - Synthetic illustration of an agribusiness chain



Source: based on Batalha and Lago da Silva (2014)

Based on the contributions of Davis and Goldberg, the academic agribusiness field gained a boost. Given the importance of analyzing the agribusiness chain characteristics from several regions worldwide, scientific journals specializing in this context emerged, including the Agribusiness (Wiley), International Food and Agribusiness Management Review (Wageningen Academy), Journal of International Food & Agribusiness Marketing (Taylor & Francis), and Journal of Agribusiness in Developing and Emerging Countries (Emerald). Furthermore, research on agribusiness has attracted the attention of several academic fields, such as corporate social responsibility (BIRÓ; SZALMÁNÉ; 2021), transportation (CARLUCCI et al., 2021), supply chain coordination (NEMATOLLAHI; TAJBAKHSH;

[19] It is important to highlight that Figure 3 presents a general model of an agribusiness chain. However, there are several types of chains. In some, after the production system, the product (food or non-food) is industrialized and then sold wholesale or retail (e.g., soybean oil). In others, the product is sold directly by the farmer to the consumer household, not requiring a middleman (retail or wholesale). In these cases, there is what is known as a short food supply chain (for more details, see RENTING; MARSDEN; BANKS, 2003).

SEDGHY, 2021), bioeconomy and biotechnology (TITTOR, 2021), and innovation (PIVOTO et al., 2019; RAMOS; PEDROSO, 2021). Among the innovation research, in the last few years studies on startups have attracted the attention of researchers (for some examples, see, LOWRY; AVELLAN; GILBERTSON, 2019; RAMOS; PEDROSO, 2021; CHAUDHARY; SURI, 2022; LACHMAN; LÓPEZ, 2022; SILVEIRA; FARINA; SANTOS, 2022).

Startups are nascent business organizations whose main objective is to develop or improve a business model, preferably scalable (GIARDINO et al., 2014; OLIVA; KOTABE, 2019; COUTO et al., 2021). These organizations are known as new ventures and can be referred to as a group of companies conceived to create new services or products, including disruptive ideas, more quickly. Brazilian Law number 182, chapter two, defines startups as nascent organizations or in a recent operation whose performance is characterized by innovation applied to the business model or products or services offered (BRASIL, 2021). Recently, these organizations have gained notoriety. The global startup economy generated nearly 3 trillion dollars in economic value from 2017 to 2019 (STARTUP GENOME, 2020). In this regard, there is a global interest in encouraging startups to stimulate growth, creativety and innovative capacity (GIARDINO et al., 2014; OLIVA; KOTABE, 2019; MATOS; RADAELLI, 2020; COUTO et al., 2021).

Recent studies, such as Couto et al., (2021), describe that startup's life cycle comprises four phases (Table 3). The first phase is the "conception and development," where the entrepreneur(s) comes up with an idea for a new product or service. This phase is important to test and validate the idea and business model.

The second phase is "organization and traction." In this stage, the startup presents better-defined organizational routines than the previous phase and the level of formality increases. "Growth and scale" is the third lifecycle stage. At this point, the startup has achieved traction, and revenue growth is accelerating (COUTO et al., 2021). In this stage, the focus is on scaling the business, building the team, and expanding into new markets. The last stage is named "consolidation and transition." In this phase, the startup has achieved maturity, and the revenue growth has stabilized. The objective is to maintain customer satisfaction of its well-established customer base.

Table 3 - Phases and characteristics of startup's lifecycle

Lifecycle	Definition
Conception and development	In this very early stage (also known as the seed phase), the entrepreneur(s) use(s) initiate several activities to turn an idea into a business. In this stage, there are few (if any) organizational routines in the startup.
Organization and traction	Organization and traction is the second lifecycle stage and is characterized by the beginning of developing a more managerial behavior by the entrepreneur. In this phase, establishing organizational routines is important to improve the value proposition and increase sales.
Growth and scale	Growth and scale refer to the phase where there is a considerable increase in sales and the startup routines aim to achieve scale. In this stage, the startup. At this stage, the startup begins to attract the attention of a larger contingent of investors.
Consolidation and transition	This is the last lifecycle stage, where the startup begins the transition process to a (traditional) company. This stage presents greater maturity in several organizational aspects compared with the earlier stages.

Source: based on Salamzadeh and Kesin (2015); Paschen (2017); Couto et al., (2021); Marcon and Ribeiro (2021)

Along all lifecycle stages, startups are recognized as agile organizations (GIARDINO et al., 2014; OLIVA; KOTABE, 2019) and have some inherent characteristics[20], including quickly reacting to market changes (GIARDINO et al., 2014; MATOS; OLIVA; KOTABE, 2019; RADAELLI, 2020). When compared with established organizations, startups are highly reactive, that is, these companies have the capacity to quickly react to market changes. A disruptive business model, high uncertainty, and rapid scalability are also relevant characteristics of startups retrieved from previous works, which better differentiate them from established companies (GIARDINO et al., 2014; OLIVA; KOTABE, 2019; MATOS; RADAELLI, 2020; FRARE et al., 2022). That is, although investing in startups can result in relevant economic returns, the risk of failure is high. Startups from the agribusiness sector are known as AgTech and are present throughout the agribusiness chain (for more details, see RADAR AGTECH, 2021), that is, downstream, in the production system, and upstream (see Figure 3).

AgTech[21] are organizations that provide technological advancements in management, biological, chemical, and mechanical processes in the agribusiness chain. These advancements are pivotal to coping with the negative impacts of agriculture (including soil degradation, irrigations problems, land use change, mission-cutting production mechanisms, natural

[20] Giardino et al., (2014) provide a detailed paper on startups' inherent characteristics.

[21] A relevant portion of startups in Brazil, one of the most important countries in the agribusiness sector, are AgTech. The Radar AgTech (2021) report estimated the existence of more than 1,500 AgTech (200, 657, and 717 AgTech in the upstream, production system, and downstream, respectively).

resources optimizing systems, and deforestation) and improving agricultural productivity (RADAR AGTECH, 2021; RAMOS; PEDROSO, 2021; WILSON; VETSCH; BULLOCK, 2021; ISSA; JABBOURI; PALMER, 2022). On the other hand, AgTech can be useful in optimizing the quantity of chemical waste produced and optimizing agricultural logistics. Therefore, the purpose of AgTech is to modify the agribusiness sector, improving its sustainability. Furthermore, AgTech has one alternative that can contribute to improving food production for a growing global population (RADAR AGTECH, 2021; WILSON; VETSCH; BULLOCK, 2021). Given its relevance, a body of recent literature has analyzed the AgTech context.

Some studies revise the role of AgTech in the agribusiness chain. Lowry, Avellan and Gilbertson (2019) provide a general background on the opportunities and challenges for nanotechnology in the AgTech revolution, *i.e.*, driven by nanotechnology, AgTech has the potential to improve the sustainability in the agricultural production system. The review of Ramos and Pedroso (2021) presents some AgTech characterization based on a range of factors, such as the sector of AgTech (*e.g.*, genetics and health, chemicals, animal management, marketplace, and robotics) and where in the agribusiness chain the AgTech operates (in the upstream, production system, or downstream). Empirical efforts, such as Lachman and López (2022), measure the enabling factors that foster the development of AgTech. They analyze how incubators, accelerators, and venture capitals, among others, support the consolidation and internationalization of these organizations.

Empirical studies also have been published, showing the factors that influence the adoption of mobile platforms for farm management (FOX et al., 2021), the role of artificial intelligence in decision-making (GANESHKUMAR; DAVID; JEBASINGH, 2022), advancing the knowledge of AgTech life cycle (RAMOS; PEDROSO, 2022), and provide important insights on AgTech entrepreneurship including the Covid 19 impact (CHAUDHARY; SURI, 2022). Furthermore, recently, Frare and Beuren (2022) proposed and tested a theretical model to analyze the context of environmental performance, analyzing 81 Brazilian AgTech.

While the above studies provide relevant results, some gaps in the AgTech context remain, including the lack of research analyzing the role of social media and dynamic capabilities for improving AgTech innovation performance. As AgTech are important for economic development, and in a world where a large part of social relations occurs through social media, understanding the impact of these virtual ba and whether certain dynamic capabilities are important to improve innovation capacity is necessary. This thesis aims to

overcome this lacune. In this regard, the next section presents the hypotheses to be tested and the proposed framework.

3. RESEARCH HYPOTHESES AND MODEL PROPOSED

Building on the dynamic capabilities approach, this section provides the research hypotheses and the model proposed to analyze the role of social media and dynamic capabilities for improving innovation performance in AgTech. The research model integrates five latent constructs: social media, absorptive capacity, collaboration capability (a second-order construct formed by trust, commitment, and communication), organizational agility, and innovation performance. In this regard, we provide six hypotheses related to the direct relations among these constructs. The hypotheses refer to the specific objectives of the thesis. Finally, at the end of this section, we provide the visual representation of the research model developed to be empirically tested using empirical data.

3.1 Influence of social media on innovation performance and internal collaboration capability

Social media are highly interactive platforms that enable users to discuss, share and co-create digital content through text, voice, image, or video. While in the past, the main focus of social media usage was linked to personal life, given the importance of these tools to organizational communication, supporting decision-making, searching and finding relevant knowledge, companies are widely adopting social media (RATLIFF; KUNZ, 2014; RAZMERITA; KIRCHNER; NABETH, 2014). Social media have transformed how companies interact and collaborate (ZUBIELQUI; JONES, 2020). In this regard, "organizations are relying increasingly on social media to utilize knowledge resources beyond geographic boards and time limits" (ALI et al., 2020, p. 10).

Some studies show that companies such as IBM, Microsoft, and Google are spending considerable resources on internal social media to facilitate organizational members' communication, with the expectation of enhancing collaboration and job performance (LEE; HWANG; LEE, 2006; LU et al., 2015), because social media contributes to managing (internal and external) knowledge flows in the organization (CAO; ALI, 2018; ALI et al., 2020). In this regard, compared with face-to-face communication, social media are more actively used for connecting larger and more diverse individuals (OOMS; BELL; KOK, 2015). Furthermore, most scholars believe that social media use at work is important to organizational performance, including increasing sales and co-create products and services (OOMS; BELL; KOK, 2015; PAPA et al., 2018). In this regard, the "My Starbucks Idea" platform has produced about 300

ideas from the online community that has been implemented by Starbucks subsequently (MUNINGER; HAMMEDI; MAHR, 2019). In this 'digital space,' customers can discuss and share ideas useful for the strategic management of the company. Another example is the "Nike by you[22],"an online community that enables Nike to understand customers' preferences regarding product designs. Social media, thus, might be developed as a crowdsourcing platform to gather ideas from a large sample of people. Therefore, in the last past decades, research interest has increasing towards analyze the importance of social media to innovation (WEHNER; RITTER; LEIST, 2017; ZUBIELQUI; FRYGES; JONES, 2017; BHIMANI; MENTION; BARLATIER, 2018).

Social media refers to bundles of information and communication tools, providing multiple communication channels (KAPLAN; HAENLEIN, 2010; CAO et al., 2016; SCHLAGWEIN; HU, 2017). Social media use at work has become popular due to its convenience (SCHLAGWEIN; HU, 2017; ZHOU et al., 2021), providing a digital space for creating, editing, and exchanging web-based content (KAPLAN; HAENLEIN, 2010), fostering innovation. In this regard, Gibbs et al., (2015) argue that social media drives innovation by promoting cross-boundary communication where the users' collaboration support access to new knowledge. Therefore, as social media usage enables access to knowledge from external actors, firms are increasingly adopting these tools as drives for innovation (ZUBIELQUI; FRYGES; JONES, 2017). In the same line, Zubielqui and Jones (2020) show that social media is pivotal for companies because it facilitates innovation.

Social media also have been described as a relevant organizational socialization tool (RAZMERITA; KIRCHNER; NABETH, 2014; OOMS; BELL; KOK, 2015; CAO et al., 2016; ZUBIELQUI; FRYGES; JONES, 2017; CAO; ALI, 2018; PAPA et al., 2018; ALI et al., 2020; ZHOU et al., 2021) and is pivotal to internal collaboration in organizations. In this regard, social media provide an efficient virtual space for communication, supporting organizational members to work together on shared projects, *i.e.*, through collaborative actions (ZEILLER; SCHAUER, 2011) facilitating members interactions (RAZMERITA; KIRCHNER; NABETH, 2014). According to Zeiller and Schauer (2011, p. 1), "social media provide an efficient and accessible means of encouraging and supporting team members working together on shared objects, *i.e.*, performing collaborative tasks within these teams." Furthermore, reviewing the literature, Wehner, Ritter and Leist (2017) shed light on the relevance of social media to improve collaboration among employees and to foster organizational knowledge management. They

[22] See, https://www.nike.com/us/en_us/c/nikeid

argue that companies adopt social media tools for a range of reasons, including improving innovation management and providing social collaboration.

Social media is pivotal to improving organizational members' commitment, which in turn supports internal collaboration (EWING; MEN; O'NEIL, 2019). Van Zoonen et al., (2016) found that social media usage for work is positively related to engagement through enhanced members' communication, contributing to vertical and horizontal and knowledge sharing in the organization. Similarly, Sievert and Scholz (2017) argue that social media usage drives employees' commitment by improving organizational communication, which facilitates collaborative actions. Furthermore, Cao et al., (2016) argue that social media usage is a key to increasing trust among organizational employees. Given this backdrop, we propose the following hypotheses:

H1: Social media usage is positively related to innovation performance.
H2: Social media usage is positively related to internal collaboration capability.

3.2 Influence of internal collaboration capability on absorptive capacity and organizational agility

While recent studies analyze the (direct) influence of social media on absorptive capacity (CAO; ALI, 2018; ALI et al., 2020) and organizational agility (DWIVEDI et al., 2022; YE et al., 2022), there is a lack of efforts to explain how internal collaboration capability affects these two dynamic capabilities. This section aims to meet this point, analyzing the components of collaboration capability (trust, commitment, and communication) as drives for absorptive capacity and organizational agility.

Social interactions within the organization are relevant to the firm's ability to adapt and coordinate its routines. Internal collaboration among organizational members contributes to the development of intra-firm social bonds, contributing to the creation of '*l'espritd'e'quipe*' (team spirit). Trust is critical to team spirit and members' wellbeing. It also is key to improve agility organizations. According to Salanova et al., (2021), employee trust in managers supports organizational productivity, which can be useful for exploring opportunities in a turbulent environment and introducing novel products or services to the market. Similarly, Vokić, Bilušić and Najjar, (2021) describe that trust among the organizational members is pivotal to fostering innovations, which can help to cope with new competitors. Furthermore, trust among organizational members contributes to making strategic and quick decisions, enhancing the

likelihood of using novel knowledge in their knowledge background, which is important for the organization to be agile and improve its competitive advantage (BIEŃKOWSKA et al., 2018). Similarly, employee commitment supports organizations in achieving higher levels of agility and achieving their goals because organizational members feel connected to the firm are more dedicated, which enables quick and accurate responses to market changes. In this regard, "employees with high commitment perform better as they are satisfied with their jobs and organization" (RAFIQUE; HAMEED; AGHA, 2018, p. 3).

Some studies also analyze the importance of internal communication as a driver of organizational agility. Internal communication refers to communication among members who are employed in an organization. It is important to achieve business goals. Adequate internal communication is the basis for good relations within any organization (STEVANOVIĆ; GMITROVIĆ, 2015). Robson and Tourish (2005, p. 213) point out that "internal communications help to improve the likelihood of an organization being successful." According to Harraf et al., (2015, p. 681), "internal communication responds to the avenues by which information is circulated throughout an organization." They also argue that agile organizations are able to manage the flows of internal communication, including top-down, horizontal, and bottom-up channels. Koch and Denner (2022) also argue that internal communication usually focuses on strategic issues with or among organizational members and supports them in carrying out their jobs more effectively. Consequently, a higher level of organizational effectiveness results in greater organizational agility.

Through internal collaboration, the members of the organization also build a bridge from his/her background knowledge. As the process of knowledge assimilation is not static, it requires organizational members' coordination and collaboration for the successful application (BATARSEH; DASPIT; USHER, 2018). Enhanced collaboration in the organization is helpful for the team members to assess, assimilate, and apply new knowledge[23] (BATARSEH; DASPIT; USHER, 2018) because internal collaboration improves the trust and communication within the organization, facilitating the knowledge flows within the organization, improving the organizational learning capacity *i.e.,* absorptive capacity (see, SCHLAGWEIN; HU, 2017; BATARSEH; DASPIT; USHER, 2018; MENNENS et al., 2018). Furthermore, Rafique, Hameed and Agha (2018) point out the influence of organizational commitment, that is, employee commitment, to improve knowledge acquisition and assimilation. Therefore, "employees with high commitment may perform better and exploit the cognitive proximity and

[23] For example, higher levels of internal collaboration drive the amount of external knowledge collected about costumers' problems (KELLEY, 1993).

in turn enhance absorptive capacity process effectively" (RAFIQUE; HAMEED; AGHA, 2018, p. 6).

Given this backdrop and following Flor, Cooper and Oltra (2018), we argue that absorptive capacity is dependent on the internal process of the firm (such as internal collaboration capability). We also claim that internal collaboration capability drives organizational agility. Thus, we provide the following hypotheses:

H3: Internal collaboration capability is positively related to organizational agility.
H4: Internal collaboration capability is positively related to absorptive capacity.

3.3 Influence of absorptive capacity and organizational agility on innovation performance

In dynamic ever-changing environments, a focus on closed innovation, *i.e.,* a focus only on internal knowledge, is often dangerous because it may delay access to new knowledge and technologies (WUYTS; DUTTA, 2014). Organizational agility and absorptive capacity are thus, pivotal.

Organizational agility "is often treated as an immutable quality, implying that firms need to be in a constant state of transformation" (TEECE; PETERAF; LEIH, 2016, p. 12). This dynamic capability is important to achieving operational performance by improving sales growth rate, market share, and customer satisfaction (YE et al., 2022). An agile organization has flexibility and explores opportunities in a turbulent environment and introduces novel products or services to the market (O'REILLY; TUSHMAN, 2008; PURIWAT; HOONSOPON, 2022). Agility is a cost to develop and maintain. However, in many cases even more costly if agility is nonexistent because it supports organizations to efficiently and effectively redirect its efforts to value creation (TEECE; PETERAF; LEIH, 2016).

Given its importance recent studies have shown the importance of organizational agility in the innovation context. Rabal-Conesa, Jiménez-Jiménez and Martínez-Costa (2021) indicated a positive relationship between organizational agility and environmental knowledge, an antecedent factor for eco-innovation. Shahzad et al., (2020) showed a positive effect between organizational agility and green innovation. Furthermore, Puriwat and Hoonsopon (2022) indicate that organizational agility helps firms improve their performance in radical innovations under uncertain environments. Analyzing service innovation, the results of Tsou and Cheng (2018) show that firms with a higher degree of organizational agility have better incremental

and radical innovation. Given these studies, it is possible to note that highly agile organizations might be more innovative compared to the lower ones.

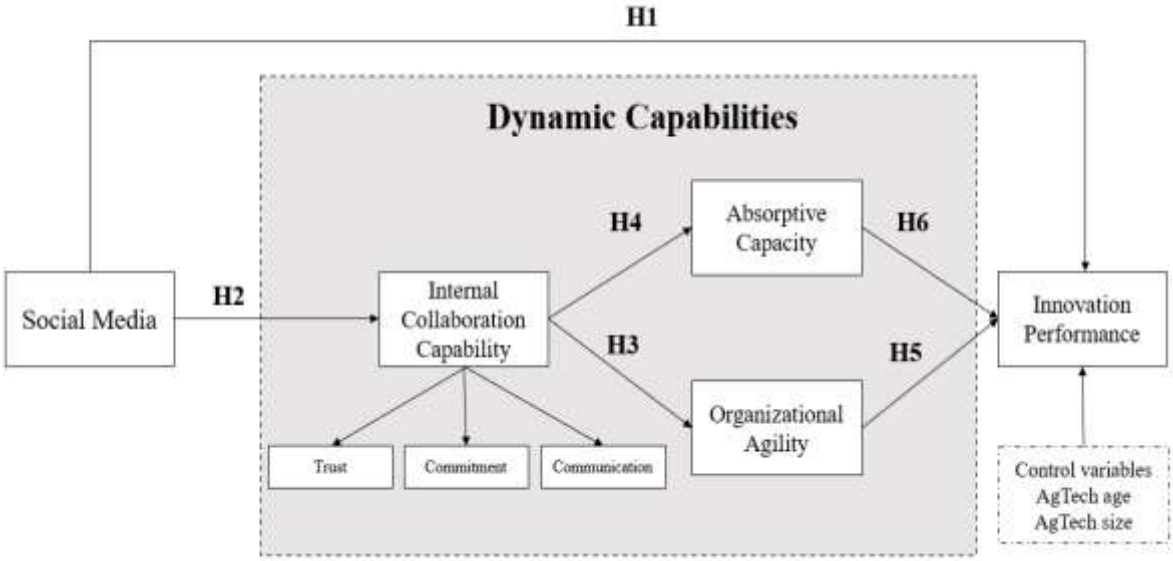
According to organizational learning theory, organizational innovation is linked to the recognition of external knowledge (COHEN; LEVINTHAL, 1990; ZAHRA; GEORGE, 2002). Therefore, a body of researchers also has described the importance of absorptive capacity in innovation (CHEN; LIN; CHANG; 2009; LAU; LO, 2015; ALI et al., 2020). They have found important results on the role of this dynamic capability for organizational innovation. Cheng, Lin and Chang (2009) and Xie, Zou and Qi (2018) show the importance of absorptive capacity to innovation performance. Similarly, Ali et al., (2020) posit that high levels of realized and potential absorptive capacity leads to high innovation performance.

Schilling (1998) asserted that absorptive capacity supports firms in expanding their knowledge base, which in turn facilitates the assimilation of new knowledge, such as external knowledge. Absorptive capacity helps companies identify and exploit relevant external knowledge (*e.g.*, from government, universities, and spillovers from competitors), which facilitates changes in the organizational structure and fosters innovation (COHEN; LEVINTHAL, 1990; LAU; LO, 2015). For instance, almost 45 percent of Procter & Gamble's innovation projects in 2006 have fostered by elements outside this company (external sources), throughout a global network of individuals and institutions (HUSTON; SAKKAB, 2006). Therefore, when organizations have a greater level of absorptive capacity, it would increase their innovation capacity. In light of the foregoing, we hypothesized that:

H5: Organizational agility is positively related to organizational innovation performance.
H6: Absorptive capacity is positively related to organizational innovation performance.

Given these six hypotheses, we present the research model of this thesis. The theoretical-analytical advancement effort represented in this model (Figure 4) is part of the understanding of how social media affects innovation performance and internal collaboration capability, and the impact of this construct on absorptive capacity and organizational agility. Finally, this model analyzes the role of these two dynamic capabilities on innovation performance. Despite the importance of understanding how organizations innovate using social media and how dynamic capabilities impact innovation, there is little conceptual and empirical research in this context (*e.g.*, ALI et al., 2022; DWIVEDI et al., 2022) and there are no studies on this subject analyzing AgTech, an important startup segment, focused on agribusiness chain. This model aims fill this gap.

Figure 4 - Proposed research model



Source: the author

In the next section, which presents the methodology of the thesis, is described in detail how the model proposed was operationalized and applied, including the use of two control variables (AgTech age and size) that are not explicated in this section.

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4. METHODOLOGY

This section provides the methodological elements used to carry out this thesis. Section 4.1 provides information on the epistemological view of this study. Section 4.2 describe the nature and the phases of this thesis. In section 4.3, we described how the questionnaire used in this study was made and details about the sample size. Furthermore, the statistical analysis used in this research is in section 4.4. Particularly, we describe the descriptive statistics and how we analyze the model proposed, using the structural model.

4.1 Epistemology of the study

In the present work, a positivist view was adopted. This epistemology is widely used in management studies (OLIVEIRA et al., 2018) and favors empiricism and replication. In this thesis, the positivist view supports the understanding of the object (AgTech) and the phenomenon (innovation performance). According to Collis and Hussey (2009), positivist research in social sciences has as background the natural sciences (such as biology, physics, and chemistry), where the researchers observe a particular reality. In this regard, positivist studies follow the paradigm that reality can be completely apprehended and understood from the study of the relationships between a set of variables or constructs through statistical measurements. Therefore, the adoption of statistical analysis supports the test of causal relationships among the variables or constructs (DEMO, 2009). In other words, positivist studies are concerned with explaining and predicting events in the social world, seeking found causalities.

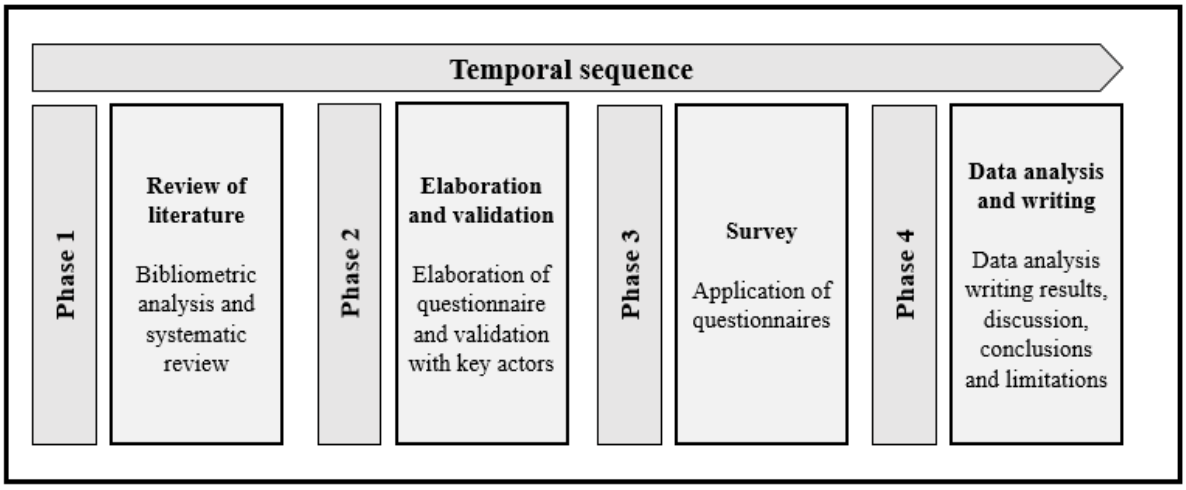
This thesis also is deductive, which is a logical approach related to the positivist paradigm. Deductive research uses a general (broad) theoretical background to analyze specific situations and predicts that the observed facts are based on hypotheses that can be rejected or non-rejected (LEÃO; MELLO; VIEIRA, 2009). In this thesis, using the concept of virtual ba and the dynamic capabilities approach, we developed some hypotheses to be tested through statistical analyzes using empirical data.

4.2 Nature and phases of the study

The nature of this thesis is exploratory and descriptive. Exploratory study enables maximizing the understanding of a particular phenomenon or research topic, providing greater

familiarity to the researcher. Descriptive research aims to identify and analyze the characteristics, factors or variables that relate to the phenomenon or process. Descriptive studies are important to provide a range of information on the object analyzed. The phases of the study are in Figure 5.

Figure 5 - Sequence (phases) of the study



Source: the author

The first phase comprised a review of the state of the art of scientific studies on social media and dynamic capabilities. We performed a bibliometric analysis and systematic review to identify the nature of the papers and research gaps. In Appendix 1, the general results of this phase are presented. We perform the search using two of the most largely and relevant scientific database: Scopus and Web of Science. To find relevant research, we use the following keywords: “social media” AND “dynamic capabilit*.” We choose to analyze only peer-reviewed studies, limiting our sample to “articles and “reviews. Given this, we found 125 studies.

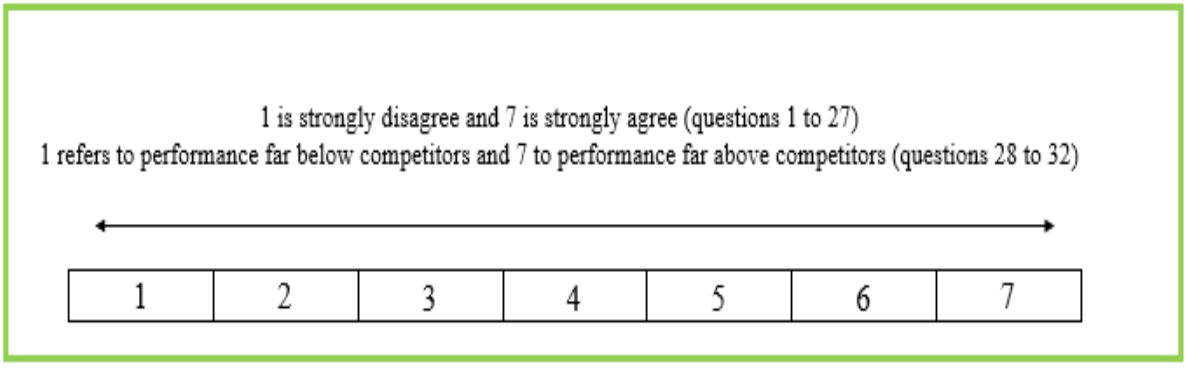
Among the results of phase 1, we found studies that analyze collaboration, absorptive capacity, and organizational agility as dynamic capabilities. Given the relevance of these capabilities to improve innovation performance and the absence of studies that analyze these three capabilities in the context of social media, we elaborate six hypotheses and a model (see Figure 4) to analyze the role of social media and dynamic capabilities (absorptive capacity, internal collaboration capability, and organizational agility) for improving innovation performance in AgTech. To meet this point, we elaborated a questionnaire that served as a data collection instrument in this research. The completed questionnaires were analyzed and

described. The next sections present greater detail on how the questionnaire was made and how it was applied.

4.3 Questionnaire and data collection of the study

This topic presents the phases two and three. The second phase represents the ‘empirical base' of this thesis because we collected empirical data to test the model of this study. We applied a structured questionnaire to meet the objectives of this research. The questionnaire comprises two steps. First, general information on AgTech is presented. These questions refer to sociodemographic characteristics and will be responded to using continuous and dummy variables. The number of people working at AgTech and the Brazilian state where Agtech is located are examples of questions. Second, we provide a set of statements measured through a seven-point Likert scale to analyze the respondents' perception of social media, dynamic capabilities (absorptive capacity, collaboration capability, and organizational agility), and innovation performance. We chose a scale using a seven point-scale because we followed recent studies on social media in organizations, such as Ali et al., (2020), Dwivedi et al., (2022), and Ye et al., (2022). For items 1 to 27, the seven point-scale refers to 1 is strongly disagree and 7 is strongly agree. These questions refer to the constructs of social media, internal collaboration capability (trust, commitment and communication), absorptive capacity, and organizational agility. Items 28 to 32 comprise the innovation performance construct. The scales of this construct are 1 to performance far below competitors and 7 to performance far above competitors (Figure 6).

Figure 6 - The seven-point Likert scale used in the thesis



Source: the author

The questionnaire aimed to operationalize the proposed theoretical research model (Figure 4). Social media usage's construct is measured through three items adapted from Cao et al., (2016) (items 1 to 3, see questionnaire). As collaboration capability involves three components (trust, commitment, and communication), we used the adapted items by Bataresh, Usher and Daspit (2017a) that analyzed the role of internal collaboration in virtual teams. We analyzed four, four, and six items for trust, commitment, and communication[24], respectively (items 4 to 17). Therefore, we follow Bataresh, Usher and Daspit (2017a) to reflective-formative second-order constructs for measuring collaboration capability. Six items for measuring absorptive capacity are adopted from Cao and Ali (2018) to measure absorptive capacity (items 18 to 23). These items provide statements that comprise all those absorptive capacity dimensions (Figure 2). To measure organizational agility, we used four items adapted from Zhen, Xie and Dong (2021) (items 24 to 27)[25]. To measure innovation performance, we used five items adapted from Inkinen, Kianto and Vanhala (2015) on innovation performance (items 28 to 32 of the questionnaire). These scales were chosen because they present satisfactory results in empirical research, having been used in recent research published in important journals. A visual representation of the model proposed with the items is in Appendix 2.

Finally, some variables are potentially relevant to AgTech innovation performance and can affect the results of the proposed model, *i.e.*, there are other factors that can influence innovation performance in AgTech. Following Frare et al., (2022), we include firm age, and firm size (ALI et al., 2020) as control variable, because previous studies suggest that organizations' demographic characteristics have significant influence with innovation performance (ALI et al., 2020).

Before the questionnaire application, it was sent in the Portuguese version for experts' validation. The questionnaires were sent to five startup managers and seven researchers (Ph.D. students or professors in the field of management and innovation). As the questionnaire is based on English items, this step was important to better translate some terms. Appendix 3 and 4 present the questionnaires in Portuguese and English, respectively. After this validation, the questionnaire was sent for a pre-test, with nine AgTech, in order to assess understanding of the

[24] Item number 13, "Startup members are afraid to express their concerns openly," was inversely analyzed in the structural model of this thesis.

[25] After the organizational agility statements, to verify that respondents were paying attention, the following statement was included in the Google Forms questionnaire: "if you are paying attention, mark the number 4 on the scale. Respondents who did not correctly mark these statements were not considered in this research. Given this footnote, we excluded this statement from the questionnaire appendixes.

content. Through this pre-test, we concluded that the questionnaire could be applied due to the clarity of the items. The pre-test responses were not used in the analysis of the thesis results.

Before starting the questionnaire application, it was sent for consideration and approved by the Ethics Committee (C*ertificado de Apresentação de Apreciação Ética* - CAEE number: 62882322.9.0000.5344). The questionnaire file and general research information were sent through the Brazil platform (*Plataforma Brasil*). The questionnaire was approved and then, we created a Google Forms (*Google Formulários*) to send it to potential respondents through e-mails. Considering that this research has no funding, a survey via e-mails is a suitable way to obtain answers quickly and with low operational costs (NULTY, 2008). Following Malhotra (2006), online surveys have lower costs and are adequate to reach specific samples. Furthermore, from the respondent's point of view, it is possible to respond in whichever is most convenient, at your own time and place (MALHOTRA, 2006).

The phenomenon studied in the thesis is Brazilian small and medium companies of the agribusiness sector, also known as AgTech. Collecting AgTech data is a challenging task. While there are some online databases that provide AgTech information (*e.g.,* ABStartup and Startup Base), sometimes they are not updated, such as e-mail or phone number information. Even so, the research was carried out using the websites of ABStartup and Startup Base. Between August and September 2022, these two websites were searched, and an Excel list with the name, phone numbers, and e-mails of all AgTech found was created. We also used the Radar AgTech (2021) report to find AgTech names web sites to find their contact information. The AgTech found in the Radar Agtech report was thus included in the Excel list. Using these databases, in total, we listed 1450 different Brazilian AgTech. It is important to highlight that Radar AgTech, ABStartup, and Startup Base are among the main important and reliable sources of information about Brazilian startups.

Since no document presents the total AgTech in Brazil, the sum of all AgTech listed was considered the total population. Furthermore, it is worth remembering that this number does not only refer to AgTech in the organization and traction, growth and scale, and consolidation and transition startup life cycle (the life cycle analyzed in the thesis)[26]. Even so, to determine the sample size to be analyzed, through a probabilistic analysis, it was taken into account that the population of Brazilian AgTech is 1450. For the sample calculation, we consider the Slovin Formula. This formula is suitable for situations where there are no known characteristics of the population's behavior. Considering a sampling error of 6 percent was used,

[26] To the best of our knowledge, there are no national data on the lifecycle stage of AgTech.

with a population of 1450 AgTech estimated, according to equations 1 and 2 (SLOVIN, 1960), where N1 refers to the minimum sample size. Therefore, the minimum sample size was 234 respondents.

$$N° = \frac{1}{error^2} = \frac{1}{(0{,}06)^2} = 277{,}77 \cong 278, \quad (1)$$

$$N1 = \frac{(N°*N)}{(N°+N)} = \frac{(278*1450)}{(278+1450)} = 233{,}75 \cong 234, \quad (2)$$

Using AgTech e-mails, questionnaires were sent between October 2022 and January 2023. Before starting to fill in the questionnaires, the Free and Informed Consent Form (in Portuguese, *Termo de Consentimento Livre e Esclarecido* - TCLE) was made available to clarify the research to the respondents. After expressing their agreement to participate in the research, the questionnaire directed respondents to the questions of interest for the study. Respondents of interest to the survey were people who hold management positions, such as owners, CEOs and directors of AgTech, where each response refers to one AgTech. Several reinforcement messages were sent to increase the number of participants between December 2022 and January 2023. In total, 237[27,28] valid responses were obtained. Therefore, our sample comprise responses of 237 AgTech.

4.4 Data analysis and writing

This section comprises details on descriptive statistics (subsection 4.4.1) used to analyze the first part of questionnaire. Furthermore, in the subsection 4.4.2, we describe information on the structural model used to measure the thesis' hypotheses.

[27] There are other criteria for checking the minimum sample size. For example, in many non-probabilistic surveys, at least five responses are sought for each variable (HAIR et al., 2009). In this case, at least 170 responses would be required for this thesis. Recently, some studies also used the G Power software. Following the recommendations of Cohen (1998) and Hair et al. (2014), by including in the software a power of 0.80, median $f^2 = 0.15$ and error of 0.05, we found 92 responses as minimum sample (with four predictors).

[28] It is important to highlight that the Brazilian Law number 182 determines that startups has up to 10 years. In our sample, nine AgTech have more than 10 years old. We decided to keep them since they are part of the lists used (Radar AgTech, ABStartup and Startup Base). We performed the same statistical tests excluding these AgTech and the result of the hypotheses remained the same, with some little variations in the beta (β).

4.4.1 Descriptive statistics

In this topic, we described the analyzes made using the 236 valid responses. The first step in carrying out the analyzis was to download the data. Then, the data were tabulated in Excel spreadsheets. Tabulation is important for coding several variables to carry out statistical analyses. The first part of the questionnaire, that is, the question on general AgTech information, was analyzed using the Statistical Package for Social Sciences (SPSS), version 26. The analysis of the first part provides information on the sample characteristics, including the mean, standard deviation (SD), and frequencies. Understanding the characteristics of the sample allows an overview of the demographic and social aspects of the respondents.

We also use descriptive statistics to analyze all items measured through the seven-point Likert scale. In this regard, we provide a range of information, including mean, median, SD, and frequencies of all items that comprise all constructs of this research, *i.e.*, social media, internal collaboration capability (trust, commitment, and communication), absorptive capacity, organizational agility, and innovation performance.

4.4.2 Structural equation model

Using the items of the second part of the questionnaire, we test the model of this study (Figure 4), *i.e.,* we test all hypotheses. As mentioned earlier, the hypotheses refer to the specific objective of the thesis. To achieve these objectives, we perform a structural equation model. While in regression models, X can affect Y; in structural equation models, X can affect Y, and Y can influence Z. Particularly, we perform a partial least square structural equation model (PLS-SEM[29]). Before running the PLS-SEM model, univariate and multivariate normality were checked. To run PLS-SEM, we use the software SmartPLS version 3.0. The items presented in the questionnaire are used as reflective indicators[30] of the respective constructs. In reflective models, the observable items (*i.e.,* each item of the questionnaire) are caused by the construct, *i.e.,* are affected by latent variables (social media, internal collaboration capability, absorptive capacity, organizational agility, and innovation performance).

We use PLS-SEM for several reasons. First, this technique has been used in recent studies on innovation performance (ALI et al., 2020), analyzing AgTech (FRARE; BEUREN,

[29] Hair et al., (2014) argue that PLS-SEM has received considerable attention in several scientific areas in the last few years, including in management.
[30] For more details on reflexive and formative structural models, see Brei and Liberali Neto (2006).

2022), and in the context of dynamic capabilities (YE et al., 2022). Second, PLS-SEM is a pivotal analysis for testing new theoretical relationships, while the covariance-based structural equation model (CB-SEM) is more appropriate for testing a theory (HAIR; RINGLE; SARSTEDT, 2011). Third, compared to CB-SEM, PLS-SEM is less sensitive in relation to the sample size and alleviates the need for data normality (HAIR et al., 2014). In this regard, using SPSS, we perform the Kolmogorov-Smirnov and Shapiro-Wilk tests, and both indicate that the data of the thesis does not present normality ($p < 0.001$). Fourth, the use of PLS-SEM is robust and appropriate to analyze complex models, that is, models that include many constructs, indicators and/ or model relationships (HAIR et al., 2014; 2019). Fifth, PLS-SEM is relevant to exploring theoretical extensions of established theories (exploratory research for theory development) (HAIR et al., 2019). Therefore, PLS-SEM[31] is an appropriate analysis to estimate cause and effect relationship models theoretically justified, such as the model of this research.

Before running PLS-SEM, we also analyze the common method bias (CMB). This analysis is critical because the data of the exogenous and endogenous variables have been obtained from the same respondents, with the same form of collection, and in the same period. Values lower than 50 percent are considered adequate. Using SPSS, we perform the Harmon one-factor test to analyze this issue, one of the most widely used techniques to examine the existence of common method bias (PODSAKOFF et al., 2003). This technique analyzes all items simultaneously of a particular dataset (in this case, items 1 to 32) in factor analysis without rotation. The result of this test showed that most covariance explained by one factor was 32.03 percent. Therefore, CMB is not expected to be a problem in this research.

When applying PLS-SEM, it is necessary to follow some procedures, including the model specification, outer model evaluation (measurement model), and inner model evaluation (structural model). The first step in using PLS-SEM involves creating a path model, such as Figure 4, that connects constructs in a logical way (*e.g.*, social media à internal collaboration capability). In this regard, the theory presents the initial point to analyze the structural equation models, providing information on a range of relationships involving several items and constructs hypothesized. Given this backdrop, the PLS-SEM fits very well in situations where the theory that sustains the causal relationships does not yet have great "sedimentation" and can be used in a more "exploratory" way (BIDO; SILVA, 2019).

The PLS-SEM interpretation process involves examining the measurement model and the structural model. The first step in reflective measurement models (such as the model of this

[31] It is important highlights that, like other multivariate methods, PLS-SEM is not capable of turning poor samples (e.g., non-representative samples) into a proper way that results in valid estimations (HAIR et al., 2019).

thesis) refers to analyzing the indicator loading (or factor loading). Loadings above 0.5 are recommended (see DORCE et al., 2021). It is also necessary to verify the variance inflation factor (VIF), which is frequently used to measure the multicollinearity among the items. Ideally, the VIF values should be lower than three (HAIR et al., 2019).

In the measurement model, we also assess the internal consistency reliability. In this regard, the composite reliability and Cronbach's alpha are analyzed. For composite reliability, values between 0.60 and 0.70 are "acceptable," and values between 0.70 and 0.90 range from "satisfactory to good." Values higher than 0.95 are "problematic," indicating that the items of the construct are redundant (HAIR et al., 2019). According to Hair et al., (2019, p. 8), "reliability values of 0.95 and above also suggest the possibility of undesirable response patterns (*e.g.*, straight-lining), thereby triggering inflated correlations among the indicators' error terms."

Cronbach's alpha is a method that measures the internal consistency of the constructs. This coefficient is widely used by researchers that perform surveys where at least two items comprise the constructs. Despite its importance, "Cronbach's alpha is a less precise measure of reliability, as the items are unweighted. In contrast with composite reliability, the items are weighted based on the construct indicators' individual loadings" (HAIR et al., 2019, p. 8). Cronbach's alpha greater than 0.6 are considered appropriate (STEENKAMP; VAN TRIJP,1991).

Following Hair et al., (2019), the next step in the measurement model refers to examining the convergent validity of each construct. "Convergent validity refers to the extent to which the construct converges to explain the variance of its items" (HAIR et al., 2019, p. 8), *i.e.,* examining if the items of each construct converge to explain the construct. To verify the convergent validity, the average variance extracted (AVE) was analyzed. AVE values equal to or higher than 0.5 are adequate, indicating that the construct has a "good" power of variance explication. In other words, values equal to or higher than 0.5 show that the construct explains at least 50 percent of the variance of their items (HAIR; HOWARD; NITZL, 2020). Following Fornell and Larcker (1981), the variance shared by the constructs must not be greater than the original AVE of the construct under consideration.

The analysis of the discriminant validity is also necessary for the measurement model. Discriminant validity is useful for measuring the distinctiveness of a construct (HAIR; HOWARD; NITZL, 2020). Discriminant validity is presented by two analyzed criteria. The Fornell-Lacker criteria are the first. This criterion postulates that the square root of AVE should be superior to the construct correlations. The second criterion is the heterotrait-monotrait ratio

of correlations (HTMT). “The HTMT is defined as the mean value of the item correlations across constructs relative to the (geometric) mean of the average correlations for the items measuring the same construct” (HAIR et al., 2019). An HTMT value equal to or smaller than 0.9 provides sufficient evidence of the discriminant validity (HENSELER; RINGLE; SARSTEDT, 2015; HAIR; HOWARD; NITZL, 2020). Table 4 presents a summary of all methods used to perform the measurement model.

Table 4 - Analysis used to perform the measurement model

Analysis	**Methods**	**Reference values**	**Sources**
Indicator reliability	Factor loading	≥ 0.50	Dorce et al., (2021)
Multicollinearity measurement (outer model)	VIF	< 3.0	Hair et al., (2014)
Composite reliability	Composite reliability	≥ 0.60 and < 0.95	Hair et al., (2019)
Composite reliability	Cronbach’s alpha	> 0.60	Steenkamp and Van Trijp (1991)
Convergent validity	AVE	≥ 0.50	Hair et al., (2019)
Discriminant validity	Fornell-Lacker criterion	Compare the square roots of the values of the AVEs of each construct with the correlation between the constructs. To the square roots of the AVEs must be greater than the correlations of the constructs (FORNELL; LACKER, 1981)	
Discriminant validity	HTMT	< 0.90	Henseler, Ringle and Sarstedt (2015); Hair, Howard and Nitzl (2020)

Source: based on the cited references from column “source”

After a suitable measurement model was obtained, we estimated the structural model. In the structural model, the independent (exogenous) and dependent (endogenous) variables are related to measure and test the hypotheses. Similar to the measurement model, in the structural model, it is necessary to measure a range of indicators. Among them, it is important to verify the inner VIF values, which are used to measure the multicollinearity among constructs. VIF values should be lower than three (HAIR et al., 2019).

If there are no problems with multicollinearity, we analyze the size and significance of the path coefficients (HAIR; HOWARD; NITZL, 2020). Generally, these values range from -1 to 1. This analysis is pivotal to examine the hypothesized relationships created (in this case, to test the six hypotheses). Values closer to 0 (zero) indicate a weak relationship between exogenous and endogenous constructs. On the other hand, “the closer the values are to the

absolute value of 1, the stronger they are in predicting dependent constructs" (HAIR; HOWARD; NITZL, 2020, p. 106).

After analyzing the path coefficients, the determination coefficient (R^2) of constructs is examined. R^2 values range from zero to one, where values closer to one indicate a greater predictive power (*i.e.,* indicating that power that an endogenous construct predicts an exogenous construct). In social and behavioral sciences, R^2 values higher or equal to two, 13, and 26 percent are, respectively, low, medium, and greater effects (COHEN, 1988). According to Falk and Miller (1992), $R^2 > 0.1$ is a critical point for assessing power prediction. Cohen (1988) also introduced the effect size f^2. This index measures how much each construct is "useful" for the adjustment of the model (HAIR et al., 2019). "The effect size is also considered an in sample predictive metric" (HAIR; HOWARD; NITZL, 2020, p. 107).

The Q^2 analysis also is performed. This analysis refers to the predictive validity or the Stone-Geisser indicator. This index examines how close the model approximates what was expected of it (HAIR; HOWARD; NITZL, 2020). Values higher than 0 (zero) are suitable and significant (HAIR et al., 2014; RINGLE; SILVA; BIDO, 2014). In other words, $Q^2 > 0$ indicates that the model has predictive relevance, while $Q^2 < 0$ suggests lacking of predictive relevance. Table 5 presents a summary of all methods used to perform the structural model.

Table 5- Analysis used to perform the structural model

Steps	**Methods**	**Reference values**	**Sources**
Multicollinearity measurement (inner model)	VIF	< 3.0	Hair et al., (2014)
Path coefficient analysis	Verify the Beta (β) value	|1| = strong; 0 = weak	Hair et al., (2019)
Determination coefficient	R^2	≥0.02 = small; >0.13 = medium; >0.26 = high	Cohen (1988)
Effect size	f^2 of Cohen	>0.02 <0.15 = low; ≥0.15 <0.35 = medium; ≥0.35 = high	Cohen (1988)
Predictive relevance	Q^2	$Q^2 > 0$	Hair et al., (2014)

Source: based on the cited references from column "source"

The analysis described in this section and summarized in Tables 4 and 5 are used following recent empirical studies that, through PLS-SEM, examined the measurement model and structural model (*e.g.*, CAO et al., 2016; MIKALEF; PATELI, 2017; DORCE et al., 2021; YE et al., 2022).

As an additional analysis, we also analyzed mediation effects. We test if social media usage and innovation performance are mediated by internal collaboration capability and absorptive capacity, and internal collaboration capability and organizational agility. Thus, we examine if the dynamic capabilities sequentially mediate this relation. To test these two serial mediations, the recommendations of the Preacher and Hayes (2008) were followed.

All direct (hypotheses tests) and indirect (serial mediation) analyses were made through bootstrapping with samples of 5000 at 95 percent confidence level.

5. RESULTS AND DISCUSSION

In this section, we present the results and discussion of the thesis. Section 5.1 provides the sample characteristics, including information on the respondents and Agtech characteristics. Descriptive statistics of all Likert scale items are presented in section 5.2. Therefore, in sections 5.1 and 5.2, we aim to meet the first specific objective. In section 5.3, we analyze the proposed model, testing the hypotheses presented in the thesis. This section comprises information on the measurement model and structural model and a discussion of the results, considering the specific answering the three research questions presented in the introduction. The results and discussion of section 5.3 refer to the second, third, and fourth specific objectives. Finally, in section 5.4, we provide the results of the additional analyzes, *i.e.*, the serial mediation analyses.

5.1 Sample characteristics

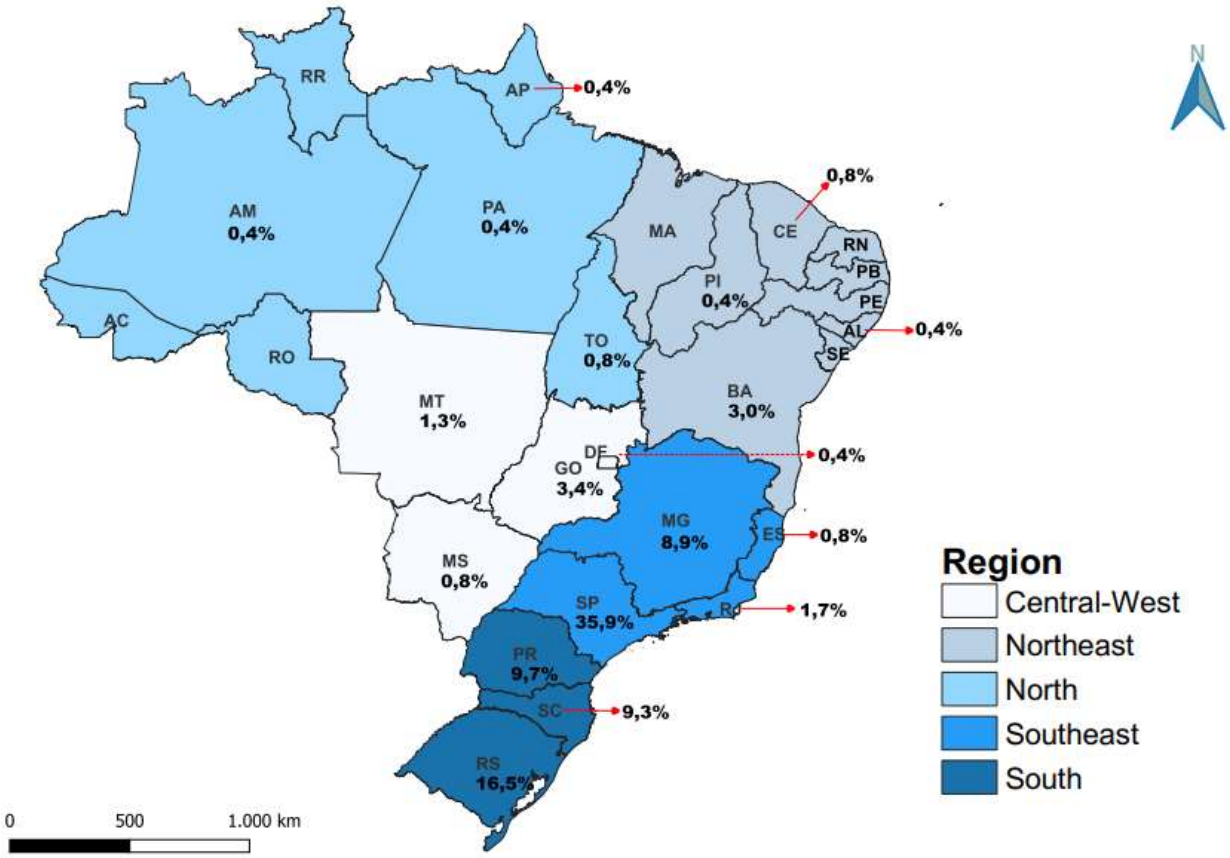
Through the questionnaire applications, we collected 237 valid responses from 237 AgTech. Most respondents are male (n=179), representing 75.5 percent of all responses. Respondents are generally CEOs (39.9 percent) or managers (39.1 percent) of several sectors, such as innovation, finance, and marketing. The remaining respondents declared themselves to be owners of AgTech (nine percent) or directors (12 percent). For formal education, 16 respondents (7.6 percent) have incomplete higher education. More than half of respondents (n=123, 51.9 percent) have completed at least a higher education course, and 41 (17.3 percent) have a doctor's degree. Of these, 16 respondents (6.8 percent) had completed a post-doctorate[32]. It can be considered that the level of formal education of most respondents is consistent with what is desired for the exercise of functions at organizational management levels. The average age of respondents is 37.93 years, with the SD of 10.72. The youngest respondent has 20 years, while the oldest has 74 years. About 10 percent of the sample is up to 25 years old and almost 60 percent of respondents are up to 40 years old.

Given that the study was not regional and the questionnaire was sent to AgTech throughout Brazil, the sample comprises startups from 19 states from all Brazilian regions, as shown in Figure 7. While four questionnaires did not have this question answered (1.7 percent), more than 80 respondents indicated the São Paulo state (SP) as the main location of AgTech. SP is the state with the largest economy in Brazil and has a range of innovation hubs, including

[32] Startup investors should consider founders' education as pivotal to making investments (HYYTINEN; PAJARINEN; ROUVINEN, 2015).

those focused on agribusiness startups (the AgTech Garage is a good example, located in Piracicaba). According to Bambini and Bonacelli (2019), this state is an important AgTech ecosystem, including São Paulo city, Piracicaba, and Ribeirão Preto.

Figure 7 - Location of AgTech surveyed



Source: the author

The second state with the highest amount of AgTech is Rio Grande do Sul (RS), followed by Paraná (PR) and Santa Catarina (SC). These three states are part of the southern region of Brazil and are important producers of various agri-food products, such as soy, wheat, cattle, and dairy. Some cities in these states are also developing important ecosystems and attracting AgTech, such as the metropolitan region of Porto Alegre, the capital of RS, which has some of the best Brazilian universities[33], and important incubators and technological parks (THOMAS; FACCIN; AHSEIM (2021). Other states, such as Minas Gerais also had a considerable number of respondents (8.9 percent). Belo Horizonte is an important startup

[33] More details on the relevance of the Porto Alegre ecosystem are presented in Thomas, Faccin and Asheim (2021).

ecosystem from this state, being the second largest city in number of startups in the country, behind only the São Paulo city (ABSTARTUP, 2022).

Some general characteristics of Agtech are in Table 6. The average number of people working in these startups is more than 20 people (20.65). Furthermore, nearly 70 percent of AgTech surveyed (n=166) have up to 15 employees. On the other hand, 11 AgTech (4.6 percent) have more than 100 employees. The average number of people who work in the same department/project/team as the survey respondent is 11.10, with a range of 94 (ranging from 1 to 95). Regarding the time that AgTech has been operating in the market, the average is just over 50 months, that is, just over four years. While there are AgTech that have been operating for over ten years (n=9), approximately 27.5 percent (n=65) have been in the market for less than two years.

Table 6 - Descriptive statistics on general AgTech characteristics

	Descriptive statistics			
Variables	**Mean**	**SD**	**Min**	**Max**
Number of people working at the AgTech	20.65	29.44	5	200
Number of people working in your department/project/team at the AgTech	6.45	11.10	1	95
Months that the AgTech are on the market	50.89	33.76	7	150

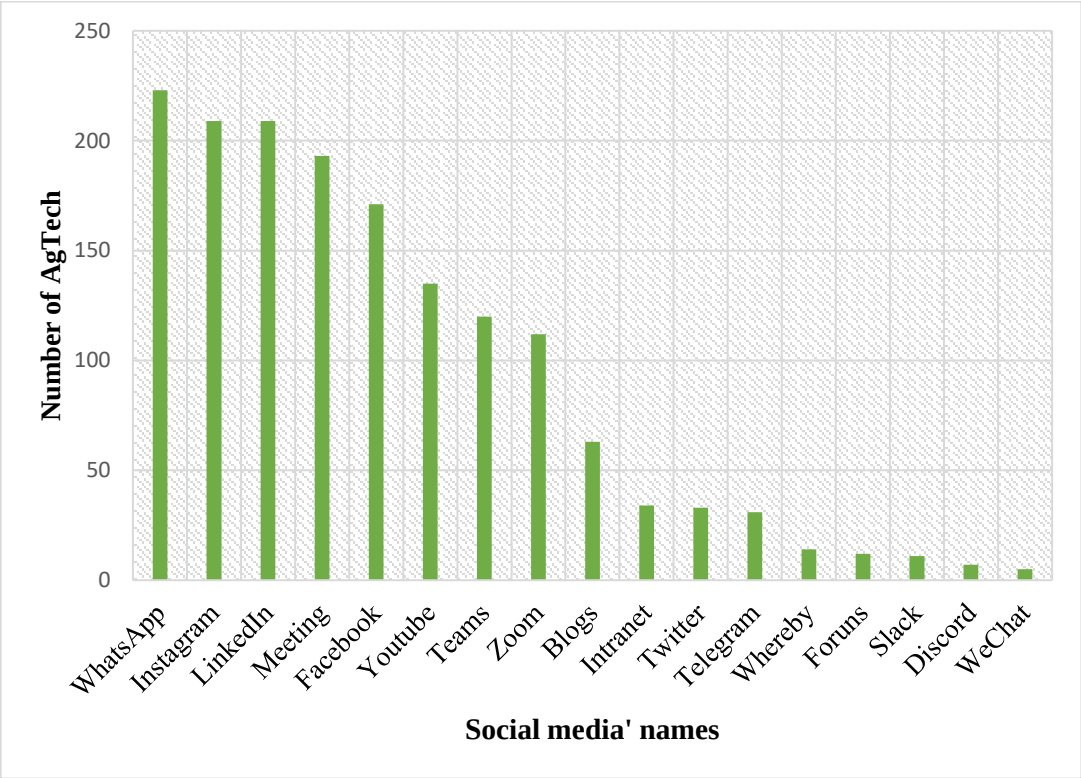
Source: the author

As mentioned in the introduction and method section, this thesis focused on Agtech in medium and high stages of development, such as organization and traction, growth and scale, and consolidation and transition stages. Agtech in these stages have formal routines and are more managerial maturity (see SALAMZADEH; KESIN 2015; COUTO et al., 2021). In this regard, dynamic capabilities are critical to influencing firms' routines, which can enhance competitive advantage (TEECE; PISANO; SHUEN, 1997) and improve innovation. More than half of the sample (n=125) is in the organization and traction phase, representing 52.7 percent of the AgTech surveyed. Startups that are in the growth and scale, and consolidation and transition phases, represent respectively, 22.8 and 24.5 percent.

Questions about the use of social media were also part of the questionnaire. Among them, respondents indicated the number of social media used at AgTech. On average, the AgTech members use more than six social media (mean=6.66, SD=2.09). While five startups (2.1 percent) use only one social media and 18 (5.5 percent) use a maximum of three, almost 40 percent of the sample have used at least nine social media. The most used social media are

presented in Figure 8. According to respondents, WhatsApp is the most used social media (n=223), representing 94.04 percent of the sample surveyed. A possible explanation for the broadness of WhatsApp is that in recent years, this tool does not only allow the sending of instant text messages but also allows calls and video calls.

Figure 8 - Social media used by AgTech



Source: the author

Instagram and LinkedIn are the second most used social media. Both social media are used by 88.19 percent of the sample (n=209). While Instagram (and Facebook, the fourth social media most used by the sample) mainly focus on sharing personal information, LinkedIn is an important place to connect professionals, share knowledge and organizational experiences and recruit new employees (CAERS; CASTELYNS, 2011). Social media, such as Google Meeting (n=193), Microsoft Teams (n=120), and Zoom (n=112) that allow voice and video meetings, private chats, and recording of content are also being adopted by AgTech. In facing the lockdown (and social distancing) caused by Covid-19, social media like these are widely adopted as intermediate tools for organizational work and communication (KENNEY; ZYSMAN, 2020). While these social media are hosted outside the startups (as well as WhatsApp, YouTube, and Twitter, among others), internal social media was also analyzed

(intranet). Intranet is used by 14.35 percent of the sample (n=34). On the one hand, the intranet serves as a digital repository of organizational information, including companies' manuals and policies. On the other hand, it allows interaction among internal members through chat rooms, shared editable documents, and new feeds (BENNET, 2014).

The question about the type of social media used also had the option "other," which aimed to identify social media not mentioned in the questionnaire. This question enabled the identification of two social media, Slack and Discord, being used, respectively, by 11 (4.64 percent) and 7 (2.95 percent) AgTech. Slack is a professional tool that allows sending messages, contributing to team communication and collaboration. Similarly, Discord, which was initially established for gaming, is a messaging social tool through voice calls, video calls, and text messaging, among others. On the other hand, Yammer (a collaboration enterprise social network), a social media analyzed in recent studies (*e.g.*, ALI et al., 2020), is not used by any AgTech surveyed.

The social media analyzed (Figure 8), in general, have been used frequently in AgTech. Nearly 70 percent of respondents use social media daily (n=161). Respondents who claim to use social media two to three times a week represent 19.8 percent (n=47). On the other hand, some respondents stated that they do not use social media so often. In this regard, respectively, three (n=7) and seven percent (n=11) use some social media fortnightly or once a month only. According to Mujahid and Mubarik (2021), social media usage is pivotal to improving communication and sharing information in startups. In this regard, the usage frequency is crucial to improve networking ties with customers, other organizations, as well as among the internal members of AgTech.

Characterizing the sample allows the understanding of the AgTech and respondents' profiles. This initial and descriptive analysis is necessary to analyze the general characteristics of the sample, contributing to analyzing how AgTech have been using social media. Given this understanding, section 5.2 presents descriptive statistics and frequencies of all Likert scale statements.

5.2 Sample responses on social media usage, dynamic capabilities, and innovation performance

The questionnaire used in the thesis presents two types of questions: questions that aim to identify the characteristics of the sample, described in section 5.1, and items that form the

social media, dynamic capabilities, and innovation performance constructs. In this section, we analyzed these items (from 1 to 32, according to the questionnaire).

The social media construct was based on three items from Cao et al., (2016), and Cronbach's alpha is 0.831. Table 7 shows the frequency of responses for each of the social media items. For all items, more than 80 percent of responses were marked with the numbers five, six, or seven. For the three social media items, the median is six. The mean for items 1, 2, and 3 are, respectively, 5.85 (SD=1.36), 5.83 (SD=1.4), and 5.94 (SD=1.33). In line with Mujahid and Mubarik (2021), this result demonstrates the relevance of social media for AgTech. According to Ali et al., (2020), social media usage is important for internal collaboration (team collaboration) and communication, contributing to information flows. These authors also describe that social media is key to finding knowledge outside the organization. Similarly, Cao et al., (2016) argue on the role of social media in improving organizational trust among employees. They also describe the importance of social media to maintaining employees' networks and working together, which strongest internal collaboration.

Table 7 - Frequency of Likert scale responses of social media items

	Likert scale						
Items	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	Percentual (%)						
1. I often use social media to obtain relevant information and knowledge related to my work	0.84	2.95	1.69	10.97	15.19	24.89	43.46
2. I use social media to maintain and strengthen communication in my work	1.69	2.53	2.11	9.70	15.61	25.32	43.04
3. I use social media regularly in my work	0.42	2.53	2.95	11.39	12.24	20.68	49.79

Source: the author

Table 8 presents the frequency of responses for each of the internal collaboration capability (trust, commitment, and collaboration) statements. These items are adapted from Bataresh, Usher and Daspit (2017a). Trust construct comprises four statements (from 4 to 7), and Cronbach's alpha is 0.820. The mean of trust statements is, respectively, 6.36 (SD=0.93), 6.54 (SD=0.77), 6.50 (SD=0.77), and 6.19 (SD=0.99). The median for all these four statements is seven. These results indicate a high level of trust among AgTech members. Some items, such as "the people working at the startup are reliable" and "startup members consider the feelings of others," have no responses for numbers 1 and 2 on the Likert scale. Similarly, the item "the people working at the startup are friendly" has no responses for numbers 1, 2, and 3. Trust among the organizational members positively influences relational capital (trust is a central

element of relational capital), which is beneficial for organizational success. The results suggest that lack of trust in AgTech surveyed is not a problem.

Table 8 - Frequency of Likert scale responses of internal collaboration capability items

	Likert scale						
Items	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	Percentual (%)						
4. My colleagues in AgTech can count on each other	0.00	0.42	0.42	5.91	7.17	27.85	58.23
5. The people working at the startup are reliable	0.00	0.00	0.84	2.11	5.91	24.89	66.24
6. The people working at the startup are friendly	0.00	0.00	0.00	2.95	8.44	24.47	64.14
7. Startup members consider the feelings of others	0.00	0.00	0.84	7.17	14.77	26.58	50.63
8. Startup members like to belong to the AgTech	0.00	0.00	1.27	2.11	8.86	32.91	54.85
9. Startup members feel as if this organization's problems are their own	0.42	0.84	1.69	8.86	21.10	33.33	33.76
10. Startup members feel emotionally attached to it	0.00	1.69	2.95	8.44	18.14	29.11	39.66
11. Startup members feel part of the family throughout work routines	1.27	1.69	2.95	10.13	18.57	30.80	34.60
12. If we have a decision to make, everyone contributes to the decision-making process	1.69	2.11	5.49	10.97	22.78	27.85	29.11
13. Startup members are afraid to express their concerns openly	41.77	33.76	14.35	5.06	4.22	0.84	0.00
14. We tell each other how we're feeling	2.11	4.64	10.13	18.99	19.83	24.89	19.41
15. At startup, everyone's opinion is heard	0.00	0.84	2.11	8.44	18.99	21.94	47.68
16. People say what they really mean in the startup	0.00	0.84	4.22	12.66	21.10	35.44	25.74
17. Startup members are encouraged to voice their concerns openly	0.42	0.42	2.53	7.59	13.92	30.80	43.88

Source: the author

Commitment's construct presents Cronbach's alpha of 0.892 and comprises four items (from 8 to 11). The mean of items 8, 9, 10, and 11 is 6.38 (SD=0.83), 5.84 (SD=1.13), 5.89 (SD=1.20), and 5.72 (SD=1.33), respectively. The median is seven for "startup members like to belong to the AgTech" and six for the other items. These results indicated an appropriate level of commitment among AgTech members. Commitment reflects one's liking of the attachment to the company, *i.e.,* commitment reflects the sense of belonging to the

organization. The results reveal a higher level of internal commitment among AgTech members.

The third component of internal collaboration capability is communication. The value of Cronbach's alpha is 0.829. The mean of items 12, 13, 14, 15, 16, and 17 is 5.51 (SD=1.41), 2.02 (SD=1.17), 5.02 (SD=1.54), 6.02 (SD=1.16), 5.63 (SD=1.17), and 6.02 (SD=1.15), respectively. The mean of item 13, "startup members are afraid to express their concerns openly," is low (compared with the other items), showing that internal communication is not a problem in the sample. Excluding items 13 and 14 (median two and five, respectively), the median for the other items is six. These results indicate an appropriate level of communication among AgTech members. In this regard, agile internal communication is a critical issue to startups' sense and seize opportunities (GONZÁLEZ-CRUZ; BOTELLA-CARRUBI; MARTÍNEZ-FUENTES, 2020).

As mentioned earlier, internal collaboration capability is hypothesized as a driver for organizational agility and absorptive capacity. Firms with higher absorptive capacity make easier the search for the knowledge necessary to solve problems and develop innovation. We use six items to measure this dynamic capability (CAO; ALI, 2018). Absorptive capacity is crucial to AgTech because they are companies that are "exploring new business opportunities, working to solve a problem where the solution is not well known, and the market is highly volatile" (GIARDINO, 2014, p. 28). Table 9 provides the frequencies of the absorptive capacity items.

Table 9 - Frequency of Likert scale responses of absorptive capacity items

	Likert scale						
Items	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	Percentual (%)						
18. Startup members are able to identify and acquire internal and external knowledge to the organization	0.42	0.84	0.84	4.64	16.46	27.85	48.95
19. In the startup there are effective routines to identify, value and import new information and internal and external knowledge	1.27	0.84	5.91	17.30	23.21	23.63	27.85
20. In the startup there are adequate routines to assimilate new information and knowledge	0.84	1.69	4.22	13.92	29.54	26.16	23.63
21. In startup it is possible to successfully integrate existing knowledge with new information and knowledge acquired from external sources	0.42	0.84	2.53	12.24	23.63	33.76	26.58
22. Startup members are effective at turning existing information into new knowledge	0.00	0.42	2.11	7.17	23.21	35.86	31.22
23. People working in the startup can successfully exploit internal and external information and knowledge into concrete applications	0.00	0.00	2.53	6.33	21.10	37.97	32.07

Source: the author

The Cronbach's alpha of absorptive capacity's construct is 0.878. The mean of items 18, 19, 20, 21, 22, and 23 are respectively 6.15 (SD=1.07), 5.43 (SD=1.37), 5.43 (SD=1.28), 5.65 (SD=1.16), 5.86 (SD=1.04) and 5.91 (SD=0.99). For all items, the median is six. For items 18, "startup members are able to identify and acquire internal and external knowledge to the organization," and 23, "people working in the startup can successfully exploit internal and external information and knowledge into concrete applications," more than 70 percent of respondents marked the number six or seven in the scale. Therefore, these results indicate a high level of absorptive capacity in the sample. This finding suggests a high level of knowledge acquisition, assimilation, transformation, and exploitation among the AgTech surveyed.

While studies such as Ali et al., (2020) argue on the importance of absorptive capacity to help companies survive in dynamic environments, others describe the role of organizational agility (see PURIWAT; HOONSOPON, 2022). Organizational agility supports the search and retrieval of important knowledge (CEGARRA-NAVARRO; SOTO-ACOSTA; WENSLEY, 2016). Table 10 presents the frequencies of the organizational agility statements. This table comprises four statements adapted from Zhen, Xie and Dong (2021). The value of Cronbach's alpha is 0.853. The mean of items 24, 25, 26, and 27 is 5.57 (SD=1.31), 5.28 (SD=1.41), 5.62 (SD=1.3), and 6.14 (SD=1.08). Item 25, "we can rapidly increase/decrease our product/service levels in the face of fluctuations in market demand," has a median equal to five. For the other

items, the median is six. Furthermore, almost 80 percent of respondents marked six or seven for item 27 “we look for ways to reinvent/re-engineer the startup to serve the market better. These results indicate that AgTech have an appropriate level of organizational agility, which is an important capability to improve innovation performance.

Table 10 - Frequency of Likert scale responses of organizational agility statements

	Likert scale						
Statements	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	Percentual (%)						
24. We respond to new market demands quickly, when such demands arise	0.84	1.69	5.06	10.97	22.78	30.38	28.27
25. We can rapidly increase/decrease our product/service levels in the face of fluctuations in market demand	1.69	2.53	6.75	15.19	24.47	27.43	21.94
26. We are quick to make decisions in the face of market changes	0.84	1.27	4.22	13.50	18.99	31.65	29.54
27. We look for ways to reinvent/reengineer the startup to better serve the market	0.42	0.42	1.69	6.75	11.39	31.65	47.68

Source: the author

The frequency results of innovation performance statements are in Table 11. Using the scale proposed by Inkinen, Kianto and Vanhala (2015), we analyze five items to measure the innovation performance in AgTech. The Cronbach’s alpha is 0.748, demonstrating the existence of internal reliability. The mean for items 28, 29, 30, 31, and 32 is 5.88 (SD=1.29), 5.31 (SD=1.57), 4.98 (SD=1.53), 4.71 (SD=1.66) and 5.60 (SD=1.29), respectively. The median is five for items 30, “has the startup created new management practices among its employees?” and 31, “did the startup develop new marketing and relationship practices with its customers?." For the remaining items the median is six.

Table 11 - Frequency of Likert scale responses of innovation performance statements

	Likert scale						
Items	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	Percentual (%)						
28. Has the startup created new products or services for its customers?	0.84	1.69	2.53	8.86	18.57	24.89	42.62
29. Has the startup developed new organizational methods and processes?	2.95	5.06	4.64	11.39	24.47	24.47	27.00
30. Has the startup created new management practices among its employees?	2.95	3.38	9.70	20.68	21.52	23.63	18.14
31. Did the startup develop new marketing and relationship practices with its customers?	5.06	6.33	10.12	20.25	23.63	18.14	16.46
32. Did the startup make improvements to the it business plan(s)?	1.27	1.27	2.95	12.24	24.47	28.27	29.54

Source: the author

The information presented in this section provides some important evidence. First, the constructs used in the questionnaire have suitable internal reliability values, *i.e.*, Cronbach's alpha is greater than 0.6. This result demonstrates that the items used were adequate to form the constructs. Second, social media is widely used by AgTech members. Furthermore, there is no preference for a specific social media. Despite more than 94 percent using WhatsApp, other tools are also widely used, including LinkedIn, Instagram, Meeting, and Facebook. The most used social media have in common the agility to exchange messages between people and the practicality to search for external information. Furthermore, they have free versions of usage, which can be relevant for all AgTech with a lack of financial resources. Third, to survive, startups must build dynamic capabilities seeking to adapt to frequent environmental changes (PIGOLA et al., 2022). In general, the results show that AgTech have high levels of dynamic capabilities (internal collaboration capability, absorptive capacity, and organizational agility). Along the same line, the results show a high level of innovation performance, which also is vital to startups' survival (PIGOLA et al., 2022).While the results presented in this section allow an overview of the descriptive statistics of each construct, they are analyzed separately. To measure the general and specific objectives of the thesis, testing the proposed model and hypotheses, the next section presents the results of the PLS-SEM.

5.3 Partial least square structural model (direct analysis)

To analyze and test the hypotheses of the study, we use PLS-SEM. While PLS-SEM allows testing complex models with first- and second-order constructs, this method also allows

simultaneous evaluations of the items and constructs in the model. As mentioned in the method section, the PLS-SEM involves examining the measurement of the structural model.

The evaluation of the measurement model resulted in some changes in the items analyzed, *i.e.*, resulted in some respecification. Item 13, "startup members are afraid to express their concerns openly," was removed from the model because it has a loading lower than 0.5. Items 10 "startup members feel emotionally attached to it," 11 "startup members feel part of the family throughout work routines," 14, "we tell each other how we are feeling," and 15, "at startup, everyone's opinion is heard" were remove because of their high VIF (VIF >3). The internal consistency (composite reliability) and convergent validity of the measurement model are presented in Table 12. While the AVE of innovation performance is lower, we decided to maintain all items of this construct because the value is close to 0.5.

Table 12 - Internal consistence and convergent validity

Panel A	**Main Model constructs**			
Constructs	**Loadings**	**CA[1]**	**CR[2]**	**AVE[3]**
Social media	[0.773; 0.873]	0.831	0.899	0.748
Internal collaboration capability	[0.663; 0.799]	0.889	0.908	0.531
Absorptive capacity	[0.689; 0.831]	0.878	0.910	0.628
Organizational agility	[0.788; 0.889]	0.853	0.901	0.695
Innovation performance	[0.548; 0.778]	0.748	0.830	0.498
Panel B	**First order constructs**			
Constructs	**Loadings**	**CA[1]**	**CR[2]**	**AVE[3]**
Trust	[0.773; 0.873]	0.828	0.886	0.660
Commitment	[0.862; 0.888]	0.694	0.867	0.765
Communication	[0.803; 0.870]	0.777	0.871	0.692

[1] Cronbach's Alpha; [2] Composite reliability;[3]Average variance extracted
Source: the author

The results of Table 12 indicate that the internal consistency and convergent validity present suitable assumptions. In Table 13, we provide the results of discriminant validity of the main model. The square root of AVE (values in bold) and HTMT values are presented.

Table 13 - Discriminant validity (Fornell-Lacker and HTMT criterions)

Fornell-Lacker					
Constructs	AC	ICC	IP	OA	SM
AC	**0.793**				
ICC	0.576	**0.729**			
IP	0.401	0.300	**0.705**		
OA	0.618	0.446	0.410	**0.834**	
SM	0.323	0.324	0.241	0.201	**0.865**
HTMT					
Constructos	AC	ICC	IP	OA	
ICC	0.645				
IP	0.492	0.259			
OA	0.708	0.508	0.511		
SM	0.315	0.255	0.282	0.227	

Note: AC = absorptive capacity; ICC = internal innovation collaboration; IP = innovation performance; OA = organizational agility; SM = social media
Source: the author

The results of Table 13 also present suitable values. There are no problems in the discriminant validity following the Fornell-Lacker criterion and all HTMT values are lower than 0.9. These results allow proceeding with the statistical analysis, measuring the structural model. No construct had a VIF value greater than three. Therefore, there was no exclusion of latent variables.

The findings presented in Table 14 show that all hypotheses related to the direct effect are supported. Our results indicate that all path coefficients are significant and in the expected (positive) direction, *i.e.,* the findings confirmed all the relationships proposed in the model. The results provide an adequate level of variance (R^2) explained by the dependent variables, showing medium and high predictive power. Social media explains 13.4% ($R^2 = 0.134$) of the variance of internal collaboration capability. Internal collaboration capability explains 32.9% ($R^2 =0.329$) and 19.9% ($R^2 = 0.199$) of the variance of absorptive capacity and organizational agility, respectively. Together, absorptive capacity and organizational agility explain 29.8% ($R^2 = 0.298$) of the variance of innovation performance. Furthermore, for all constructs, Q^2 is greater than zero. Table 14 also shows that the influence of control variables (AgTech age and size) is significant.

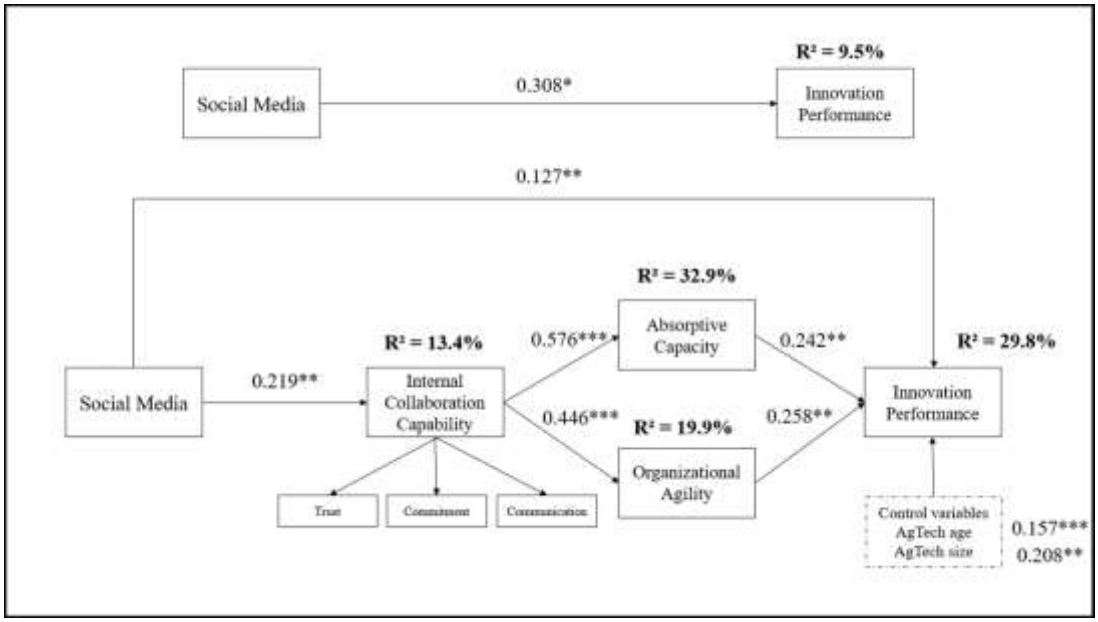
Table 14 - Results of the structural model

Hypotheses	Std. β	|t-value|	f^2	Conclusion	Construct	R^2	R^2 adj.
H1: SM→ IP	0.127	2.15*	0.021	Supported	ICC	0.134	0.130
H2: SM → ICC	0.219	2.84**	0.155	Supported	AC	0.329	0.327
H3: ICC → OA	0.446	6.89***	0.249	Supported	OA	0.199	0.196
H4: ICC → AC	0.576	12.40***	0.424	Supported	IP	0.298	0.282
H5: OA → IP	0.258	3.18**	0.057	Supported			
H6: AC → IP	0.242	3.15**	0.041	Supported			
AgTech age	0.157	5.592***	0.034				
AgTech size	0.208	3.024**	0.059				

Note: AC = absorptive capacity; ICC = internal innovation collaboration; CMT = commitment; COM = communication; IP = innovation performance; OA = organizational agility; SM = social media; TR = trust
Source: the author
* p < 0.05; ** p < 0.01; *** p < 0.001
Source: the author

Figure 9 shows the model proposed with the results of standard β and R^2 of the constructs analyzed. This figure also shows that our models explain more variance in innovation performance than the direct effect of social media. Therefore, while social media affects innovation performance in AgTech, social media usage and the development of dynamic capabilities increase the level of variance of innovation performance.

Figure 9 - Visual representation of structural model results



* p < 0.05; ** p < 0.01; *** p < 0.001
Source: the author

After verifying that all hypotheses were not rejected (see the column named of conclusion in Table 14), we proceed to discuss these results, concerning in the the second, third, and fourth specific objectives.

5.3.1 Analyzing the influence of social media usage on innovation performance and internal collaboration capability

There is a range of evidence that social media has negative consequences for people and companies. The improper use of these digital applications promotes fake news, raises privacy concerns among company members, development of personal conflicts, blurs the boundary between work and life, reduction of work productivity (*e.g.*, the excessive use of social media such as Instagram and Facebook may results in distractions and addictive-like behavior among individuals). Given these implications, social media have a "dark side[34]" (for more details, see the reviews of BACCARELLA et al., 2018 and SUN et al., 2021). However, social media have also introduced a range of digital applications that have improved the organizational routines in the workplace. While some studies describe that firms have used social media mainly for marketing purposes (ZUBIELQUE; FRYGES; JONES, 2019), including branding promotion (PAKURA; RUDELOFF, 2020), our results indicate that these tools are important to innovation performance in AgTech ($\beta = 0.127$, $p < 0.05$). Our results are in line with Bhimani, Mention and Barlatier (2019) and Zubielqui and Jones (2020), that describe social media as an enabler or driver of innovation.

AgTech can foster innovation by using social media because these tools are privileged vehicles to search external knowledge and create rich market data. The openness of these tools allows entrepreneurs overcome initial adversities in the earlier stages of new business (KUHN; GALLOWAY; COLLINS-WILLIAMS, 2016), including the lack of financial resources to search relevant information and knowledge. Furthermore, many AgTech provide a small number of employees (GIARDINO et al., 2014) and sometimes they have few (if any) skills to innovate. As social media comprise a tremendous source of data, AgTech members can use these tools to monitoring competitors' and consumers' trends aiming develop new market solutions. Through social media, the AgTech can engaging in customer discussion and co-create ideas[35] and concepts with users, since social media support interactions with participants from

[34] In a search in Scopus using "social media" and "dark side" as keywords, we found 195 documents (March 2023).
[35] In this regard, social media efficiently aligns the firm's and customers' needs, which supports the creation of an embedded, compelling customer experience (HULT, 2023).

different backgrounds whit different expertise. This is critical to many AgTech, given their small number of employees when comparing with traditional companies. Furthermore, social media can allow AgTech to connect and establishes relationships with potential investors, including crowdfunding (see, OLANREWAJU et al., 2020) which is pivotal to the development of innovations. Therefore, social media enables interactions and collaborations between the startup and its network partners (KAPLAN; HAENLEIN MUNINGER; HAMMEDI; MAHR, 2019; ZUBIELQUI; JONES, 2020), which helping to increases organizational creativity. Furthermore, social media usage is an important low-cost way (several tools are free to use, including WhatsApp and Telegram). This is pivotal to many AgTech, as several of them operates with scant financial resources to innovate.

Social media usage is also key to improving the AgTech internal collaboration capability. Although face-to-face interactions remain uncontested for social relationships and a range of factors influence intra-collaboration in firms, our results indicated that social media usage presents a positive effect on internal collaboration capability in AgTech ($\beta = 0.219$, $p < 0.01$). This result is in line with Ali et al., (2020) when they argue on the insightful implications of social media for intra-collaboration or team collaboration. Similarly, our results are in line with Cao et al., (2016), which show the importance of social media usage to improve employees' trust and network ties within the organization. Therefore, as internal collaboration is vital for companies to move quickly and make better decisions, our findings indicate the relevance of social media usage in this regard. This result contributes to the body of research that describes social media's "bright side."

Recognized as places that support sharing ideas, creating solutions, or just giving their opinions about something through text, image, audio, or video, social media enriches intra-organizational interactions, which is key to internal collaboration capability. Social media enables informal communication, allowing employees and teams to interact with one another (KWAYU; ABUBAKRE; LAL, 2021), which is relevant to AgTech because it fosters creativity. Informal communication can improve social ties among team members, such as trust and commitment, leading to collaborative actions. The creation of groups in WhatsApp and Telegram is an example in this regard. In groups like this, informal communication (including text messaging, images, video, and voice recording) supports a range of social interactions among startup members. These groups are often created to keep employees from the same department or project in touch and are useful in both simple task coordination and complex work collaboration. Furthermore, communication via social media is typically less hierarchical

and enables the AgTech members not only to solve defined problems but also to make unexpected, serendipitous discoveries (for more details, see SCHLAGWEIN; HU, 2017).

The use of social media, such as those applications that send instant messages (*e.g.,* WhatsApp and Telegram), contributes to easy and quick communication among organizational members, even when they are geographically distant, which can foster collaborative actions. Thus, non-geographical proximities are not a challenge for enabling collaboration, which is pivotal for startups, because as many of these companies operate with the scarce resource (see HITCHEN et al., 2017; COX; NGUYEN, 2017), many employees work through the home office. The use of Microsoft Teams, Zoom, and Google Meeting, among others, are also useful in this regard. Given this backdrop, as social media provides an accessible and efficient means for employees to work together, performing collaborative tasks within the company, the terms "collaborative media" (THOMAS; AKDERE, 2013) and "electronic collaboration" (ZEILLER; SCHAUER, 2011) were coined.

These results indicate that social media is a relevant *ba* for AgTech. While this concept is important to analyze and understandind the organizational knowledge creation (NONAKA; KONNO, 1998; NONAKA; TOYAMA; KONNO, 2000; NONAKA et al., 2014), our findings also show the role of the digital spaces for improve innovation performance (an output of knowledge creation) and internal collaboration capability.

5.3.2 Analyzing the influence of internal collaboration capability on absorptive capacity and organizational agility

Collaboration capability is a construct measured by trust, commitment, and communication (BLOMQVIST; LEVY, 2006). This dynamic capability is relevant to measuring the level of social interactions in organizations. In startups, this capability "lies in the management and team members, through interaction and integration among the rest of the team members" (LOPEZ HERNANDEZ; FERNANDEZ-MESA; EDWARDS-SCHACHTER, 2018, p. 19). Through these social interactions, we argue that internal collaboration capability can support the developing other dynamic capabilities in AgTech. That is, the collaboration of AgTech members is a first step towards developing other dynamic capabilities. Our results support this assumption showing that internal collaboration capability positively influences organizational agility ($\beta = 0.446$, $p < 0.001$), supporting the H3 of the thesis.

Increased organizational agility increases the ability to respond to the market proactively, and this dynamic capability has been characterized as an essential business success

element (TEECE; PETERAF; LEIH, 2016). Given this, recent studies on organizational agility have gained interest (DWIVEDI et al., 2022; YE et al., 2022). Managers and owners of startups, mainly those who are young, typically have to respond to a range of new situations requiring immediate actions and decisions (DEBRULLE; MAES; SELS, 2013). According to our findings, sustaining internal collaboration capabilities is key in this regard because this capability allows AgTech to detect and react to environmental changes. This is particularly true for startups operating in high-uncertainty environments, where agility is key to sustaining their market share. In this regard, the strength of social ties, such as communication, trust, and commitment among AgTech members, may improve organizational coordination, productivity, and decision-making (BIEŃKOWSKA et al., 2018; SALANOVA et al., 2021), which has positive implications for organizations to be agile and adapt to new situations. In other words, when organizational members understand one another, increase social ties, and become more familiar, they likely cope efficiently with unpredictable changes in the workplace (PITAFI et al., 2020).

High levels of internal collaboration capability in AgTech also can support collective knowledge creation, a relevant driver for organizational agility (see ARSAWAN et al.,2022). In this regard, increased levels of knowledge in AgTech team members can foster quick decision-making in favor of improving insight into changes in the market, resulting in rapid adjustment to these changes. Our results also indicate that internal collaboration capability positively influences absorptive capacity ($\beta = 0.576$, $p < 0.001$), supporting the H4 of the thesis. Absorptive capacity is particularly critical for startups because many of these companies are new in the market, without a business history. In this regard, these companies typically have lower levels of knowledge base. In other words, these organizations face and carry risks associated with the lack of knowledge. In AgTech, internal collaboration capability is relevant to the acquisition, assimilation, transformation, and exploitation of external knowledge, *i.e.,* the promotion of a "team spirit" culture in AgTech is key to improving their knowledge base through absorptive capacity.

Our findings are in line with Debrulle, Maes and Sels (2013) on the importance of internal resources for new ventures to improve their absorptive capacity. Our results also are in the same direction as the study of Schlagwein and Hu (2017), which argues for the importance of internal collaboration to absorptive capacity. They also describe the role of internal communication to "connect" multiple departments to the interpretation and exploitation of knowledge. Cohen and Levinthal (1990) also point out the relevance of internal communication to knowledge flows within the organization. Given this backdrop, without adequate internal

communication, knowledge transfer cannot be designed and implemented. In this regard, proper and frequent communication is a vital conduit where knowledge is exchanged. Proper communication also contributes to team trust. When team members trust each other, they are more likely to collaborate in favor of accessing and exploiting external knowledge. Our results are also in line with Rafique, Hameed and Agha (2018) on the importance of commitment as a driver for knowledge acquisition and assimilation. That is, a higher level of employee commitment is key to acquiring and exploiting external knowledge.

Given that H3 and H4 are supported, this study sheds light on at least two points. First, internal collaboration capability has a stronger effect on absorptive capacity than organizational agility. A plausible explication for this finding is that compared to traditional companies, small businesses such as AgTech face challenges such as lack of experience and limited access to information (GIARDINO et al., 2014). Therefore, the ability to absorb new knowledge may be more critical. This situation can be even more critical for startups with fewer employees or newer ones on the market because external learning increase with startup size (ALMEIDA; DOKKO; ROSENKOPF, 2003). Given this, internal collaboration capability may be more relevant because helping to create a culture of learning within AgTech.

Second, these findings provide valuable insights on the role of human resources inside organizations in creating a collaborative environment. While a plethora of studies analyzes inter-organizational collaboration (*e.g.,* university-industry collaboration and creation of organizational alliances with government and other stakeholders) and the relevance of networking capabilities, *i.e.,* capacities to improve inter-organizational relationships (WEGNER; FOGUESATTO; ZULIANI, 2023), the importance of internal collaboration capabilities remains scant. Analyzing AgTech, this situation is intrigant because team members are the heart of startups (OECHSLEIN; TUMASJAN, 2012; LOPEZ HERNANDEZ; FERNANDEZ-MESA; EDWARDS-SCHACHTER, 2018). Although the relevance of inter-organizational relationships remains uncontested for startups due to several factors, such as the lack of resources and in many cases, the low knowledge base, we highlight the role of internal collaboration capability. In view of this, it is suggested that before seeking external partnerships, AgTech need develops its internal collaboration capacity because this capability is key to supporting other dynamic capabilities. That is, building internal collaboration capability is the first step to developing other dynamic capabilities, such as organizational agility and absorptive capacity, both relevant to improve innovation performance.

5.3.3 Analyzing the influence of absorptive capacity and organizational agility on innovation performance

Our findings suggest that organizational agility positively impacts innovation performance ((β =0.258, p < 0.001). Therefore, AgTech with a higher level of agility has more likelihood to innovate. Overall, higher levels of agility allow organizations to be more responsive to market demands. In this regard, Scheinrock and Richter-Sand (2013) argue the importance of "fail fast and often." The authors argue that as startups generally develop innovative businesses, often the product or service provided by them is not well accepted in the market or the market demand has changed. In these cases, it is important to be agile so that, when failing, quickly seek to correct errors. The quest to correct errors quickly fosters creativity and can support innovation performance, suggesting that given higher levels of agility "fail faster, succeed sooner" (SCHEINROCK; RICHTER-SAND, 2013).

Organizational agility is also important in dealing with the growing number of competitors. According to the Radar AgTech (2021), in the last few years, AgTech have a boost in Brazil. For instance, currently, only in the rural management category, there are 154 AgTech. Organizational agility is also important in dealing with the growing number of competitors. Therefore, startups need to be agile and frequently innovate to provide differentials for their customers, including new financial indicators and new graphical ways of presenting financial results, among others. Furthermore, in rural management, AgTech also faces competition from agribusiness multinationals. "Giants" of the agribusiness field, such as BASF, Bayer, and John Deere[36] have been developing technological solutions for rural management that compete with the products and services provided by AgTech. This strong competition may be a factor that explains why organizational agility has a greater impact on innovation performance than absorptive capacity (see Table 14 and Figure 9).

The seminal work of Cohen and Levinthal (1990) described the importance of external knowledge to organizations. In this article, they explain the role of absorptive capacity in innovation performance. In front of this trial opened by Cohen and Levinthal (1990), a body of research has been analyzing how this dynamic capability affects innovation (LAU; LO, 2015; XIE; ZOU; QI, 2018; ALI et al., 2020). Analyzing data from a survey of the software industry context, Ali et al., (2020) found that potential and realized absorptive capacity leads to innovation performance. The results of Lau and Lo (2015) indicate that absorptive capacity is positively related to innovation performance in the manufacturing sector (from electronics,

[36] The digital solutions provide by these companies are available in the Play Store and Apple Store.

machinery, and toy, among others). Our results are in line with these studies (β =0.242, $p < 0.001$), supporting the H6. Therefore, absorptive capacity presents a positive effect on innovation performance in AgTech.

While absorptive capacity studies are widely analyzed in large companies, little is known in the context of startups (CAJUELA; GALINA, 2020). Processing knowledge is relevant for all companies, but absorptive capacity is of special importance for startups (DEBRULLE; MAES; SELS, 2013) because startups create disruptive ideas more quickly. However, in many cases, startups are dependent on the owner's knowledge and have limited spending on R&D. Furthermore, startups cannot easily access external knowledge, because sometimes these companies are not equipped with the necessary skills to assimilate and exploit external knowledge (DEBRULLE; MAES; SELS, 2013). On the other hand, if AgTech are not in a thriving ecosystem, perhaps there is little knowledge to absorb.

In a relevant innovation ecosystem[37] here is a range of stakeholders and places where startups can search and absorb external knowledge. For instance, the relationship with mature companies and reputable universities can provide access to intangible and tangible resources, including equipment, skilled individuals, and knowledge (TOOLE; CZARNITZKI; RAMMER, 2015; TRIPATHI; OIVO, 2020). Regarding mature companies, some large companies started to see startups as important actors, as an option to constantly generate innovations (CAJUELA; GALINA, 2020). As a two-way street, AgTech can assimilate and exploit external knowledge, presenting a greater probability of increasing its innovation performance. Furthermore, external mentors, such as successful entrepreneurs, can serve as advisers, providing knowledge about the market, future projections and improving innovativeness. Places such as incubators and innovation hubs (*e.g.*, the Harven Agribusiness School[38] and AgTech Garage) can servers as relevant sources of external and useful knowledge for AgTech absorb in favor or improve their innovation performance.

5.4 Partial least square structural model (indirect analysis)

While recent quantitative studies have analyzed the role of social media and dynamic capabilities (ALI et al., 2020; DWIVEDI et al., 2022; YE et al., 2022) in organizations, this study is the first that develop and test an integrative model, examining three dynamic

[37] In this regard, several Brazilian cities are among the 1000 best cities for startups, according to the Startup Blink (2022), including São Paulo (16th), Curitiba (141st), Rio de Janeiro (180th), and Belo Horizonte (215th).
[38] A new higher education institution focused on agribusiness, located in Ribeirão Preto (SP).

capabilities (internal collaboration capability, absorptive capacity, and organizational agility). The results show the importance of social media and dynamic capabilities to innovation performance. While dynamic capabilities are a widely adopted approach to analyzing how organizations survive in turbulent environments (TEECE, PISANO, SHUEN, 1997; MEIRELLES; CAMARGO, 2014), many times is not clear how capabilities are relevant in this regard. Our model is an attempt to show that the three capabilities analyzed are important, showing the complexity behind the mechanism to improve innovation performance in AgTech.

We also made additional analysis, testing (potential) indirect effects. We measure two serial mediation to verify whether: i) internal collaboration capability and organizational agility sequentially mediate the relationship between social media and innovation performance; and if ii) internal collaboration capability and absorptive capacity sequentially mediate the relationship between social media and innovation performance. The findings of this analysis are in Table 15.

Table 15 - Results of the indirect mediation analysis

Relationship	**Direct effect**	**Indirect effect**	**Confidence interval (95%)**		**Interpretation**
			2.5%	**97.5%**	
SM → ICC → OA → IP	0.127**	0.025*	0.006	0.055	Partial mediation effect
SM → ICC → AC → IP	0.127**	0.029*	0.009	0.064	Partial mediation effect

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$
Source: the author

These results suggest that the relationship between social media usage and innovation performance is serially mediated by internal collaboration capability and organizational agility (and absorptive capacity) ($p < 0.05$). Therefore, social media usage improves internal collaboration capability, which in turn leads to a higher level of organizational agility (and absorptive capacity), ultimately positively impacting AgTech innovation performance.

These findings are relevant for two main reasons. First, in general, the studies on social media usage and innovation performance do not provide details on serial mediations, despite some indirect effects provided by Ali et al., (2020) and Cao et al., (2016). Our result brings out the importance of developing certain "internal" dynamic capabilities as support for capabilities

related to the external environment. These results reinforce the importance of startup managers fostering conditions to promote a collaborative environment that improves the creation of trust, commitment, and communication to develop other capabilities further. In this regard, spaces designed to increase levels of social relationships can be created in AgTech, similar to those described by Auernhammer and Hall (2014). They describe these spaces as *Freiraum* [39] (spaces that encourage free communication among organizational members). While spaces like this (physical or virtual) are usual in large innovative companies, such as Google and 3M (AUERNHAMMER; HALL, 2014) it could be useful for small ones as a driver for impacting new capabilities.

Second, very few studies have tested complex relationships, such as serial mediators in the field of innovation management. Exceptions are Arsali, Arici and Kole (2020) and Do, Budhwar and Patel (2018). Understanding the role of serial mediations allows a deep analysis of the factors (in this case, the dynamic capabilities) that are key to achieving innovation. In view of this, it is noteworthy that while the use of social media is important to improve innovation performance in AgTech, dynamic capabilities strengthen this relationship. These results provide new insights in the field and reinforce the findings of previous studies on the importance of dynamic capabilities to achieve innovation performance.

Overall, the thesis provides a richer and deeper understanding of the role of social media and dynamic capabilities in improving innovation performance in AgTech.

[39] The Linguee online dictionary defines the German term *kreativer Freiraum* as creative freedom (https://www.linguee.com.br/).

6. CONCLUSIONS, LIMITATIONS AND AVENUES FOR FURTHER RESEARCH

In the last few years, the use of social media in organizations has become increasingly because many managers have recognized the importance of these digital spaces, such as LinkedIn, Google Meeting, Instagram, and Twitter, among others, as pivotal for organizational routines. In this regard, in turbulent environments, also known as dynamics, social media usage can support innovation performance and dynamic capabilities. Given this backdrop, the objective of this study was to propose and test a theoretical model that analyzes the importance of social media and dynamic capabilities to improve innovation performance in startups. Particullary, we focus on AgTech from Brazil, given the importance of the Brazilian agribusiness sector. Furthermore, understanding AgTech is critical because they are innovative companies operating in environments with a high level of uncertainty, where to stay competitive, a high level of innovation performance is key.

The thesis analyzed a sample of 237 respondents (237 AgTech) and tested six hypotheses related to the theoretical model proposed. We considered that this thesis objective was reached, through the theoretical deepening of the subject and the empirical application, analyzed by quantitative techniques, such as descriptive statistics and the structural equation model.

Among the conclusions, we found that although social media usage may have negative implications (BACCARELLA et al., 2018; SUN et al., 2021), these tools are relevant to improve innovation performance and internal collaboration capability (an important dynamic capability related to inter trust, commitment, and communication). In this regard, while face-to-face interactions remain uncontested for social relationships, geographical proximity is not more an issue for intraorganization communication, commitment, and the creation of trust among employees. Therefore, it is not a surprise that the increasing number of organizations where employees work from locations other than the office, such as virtual teams (BATARSEH, USHER DASPIT, 2017a). This conclusion highlights the importance of social media to maintain internal collaboration in companies that, since the Covid pandemic, have adopted a hybrid way of working. Therefore, it is expected that most office workers will work from home in the next years (APPEL-MEULENBROEK et al., 2022) and the use of social media as organizational tools continues to expand.

Although there are studies that use structural equation models to analyze the role of dynamic capabilities in organizations, they are still incipient in showing whether a given capability serves of enabler/driver of others capabilities. In this study, we conclude that internal

collaboration capability influences both absorptive capacity and organizational agility. These results allow we concluding on the importance of a collaborative and engaged team, as a relevant organizational asset to seek external knowledge and be agile in dynamic environments. Thus, before seeking to create capabilities to find and assimilate external knowledge, for example, it is necessary to improve internal capabilities, such as commitment, communication and trust. On the other hand, we can presume that problems regarding internal collaboration capability can negative influence the development of other dynamic capabilities.

Although some studies use structural equation models to analyze the role of dynamic capabilities in organizations, they are still incipient in showing whether a given capability serves as an enabler/driver of others' capabilities. This study concludes that internal collaboration capability influences both absorptive capacity and organizational agility. These results allow we concluding on the importance of a collaborative and engaged team as a relevant organizational asset to seek external knowledge and be agile in dynamic environments. Thus, before seeking to create capabilities to find and assimilate external knowledge, for example, it is necessary to improve internal capabilities, such as commitment, communication, and trust. On the other hand, we can presume that problems regarding internal collaboration capability can negatively influence the development of other dynamic capabilities.

Following previous studies, we concluded that absorptive capacity and organizational agility are important to improve innovation performance. In this context, since its introduction, absorptive capacity has been related as relevant to innovation (COHEN; LEVINTHAL, 1990). Furthermore, organizational agility has been described as relevant to firm performance (YE et al., 2022). However, this is the first empirical effort that uses these capabilities in the field of Brazilian AgTech, in a national study. Thus, we can conclude that these dynamic capabilities are important for firms that have few financial resources, a small number of employees, and often with few human resources to innovate. This conclusion suggests to AgTech managers that they constantly seek external knowledge and monitor environmental changes.

Despite the results found, there are limitations that need to be described. These limitations could serves as inspiration for further academic works. First, our findings are derived from an online survey. Online questionnaires are important due to the agility and low cost of application. However, the absence of the researcher at the time of the responses may result in some kind of bias, due to the respondents' lack of attention, even so that our questionnaire contained a question to test the level of attention (for more details, see the 25th footnote). Second, other items could be used to measure the constructs (social media, internal collaboration capability, absorptive capacity, organizational agility, and innovation

performance) used in the questionnaire. In this regard, a large number of items could be used, allowing each construct to be analyzed in more detail. For example, Xie, Zou and Qi (2018) analyzed the four dimensions of absorptive capacity, through thirteen items. Ye et al., (2022) measured organizational agility using sixteen items divided this construct into dynamic sensing, flexibility and speed. However, an extensive number of items may be of limited utility for respondents who wish to quickly answer the questionnaire.

Third, although the set of items analyzed in the study explained a substantial amount of respondents' variance, our cross-sectional design limits our ability to make inferences in the regard of causality. To meet this point, experimental and longitudinal studies are required to clarify the nature of the direct effects found. These studies can be carried out in innovation hubs, incubators, and universities, with the aim of generating more depth on the role of social media and dynamic capabilities for innovation performance. Further studies also can analyze a range of responses in the same startup, such as the startup's team, similar to Ali et al., (2020).

Fourth, in this thesis, the term social media refers to several digital technologies, such as WhatsApp, Telegram, Instagram, Twitter, LinkedIn, and Facebook, among others. Thus, it was not analyzed whether any specific social media have higher influence in innovation performance and internal collaboration capability. For example, social media that enables more informal communication (*e.g.,* WhatsApp) have greater impact on internal collaboration than more formal ones? Other question also emerges, such as: Does the frequency of social media use in organizations affect internal collaboration and innovation performance? and can social media use influence other dynamic capabilities? Future studies may seek to answer these questions, contributing to the understanding of the role of social media in organizations.

Fifth, while our study in a relevant sample size, several Brazilian AgTech does not participate of our study. Despite the research being probabilistic and having an adequate level of significance (95 percent), future studies may try to increase the number of respondents and reduce the margin of error. Finally, our sample refers to a specific type of startups from a single country. Further efforts could analyze others startups (*e.g.,* FinTech, HealthTech, and EdTech) from other regions to compare and test our findings.

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APPENDIX 1 – General results from bibliometry and systematic review on social media and dynamic capabilities studies

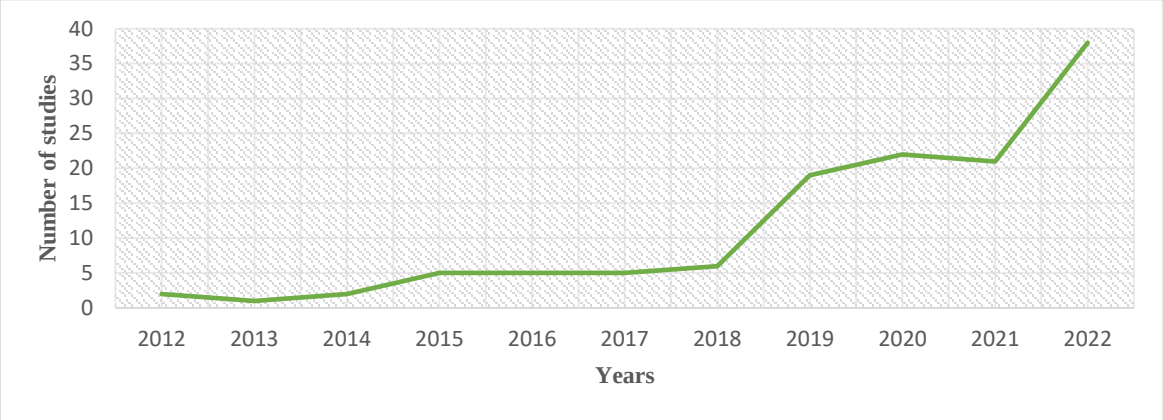
We performed searches in scientific databases to analyze state of the art and identify research gaps in social media and dynamic capabilities studies. We choose Web of Science (WoS) and Scopus to perform a search to develop the exploratory review of this project. Both databases are widely recognized as important places for searching relevant scientific peer-reviewed studies. Furthermore, Scopus and Web of Science present many studies from several knowledge fields. Particularly, Scopus is the largest database of abstracts and citations of peer-reviewed literature[40].

As WoS and Scopus require internet proxy usage to perform advanced searches, we use the Unisinos proxy. To find relevant research, we use the following keywords: "social media" AND "dynamic capabilit*." We choose to analyze only peer-reviewed studies, limiting our sample to "articles and "reviews" because peer-reviewed studies contribute to improving the reliability of scientific communication (KELLY et al., 2014). We searched both databases in August 2022. Given the interest in revised studies of innovation and management fields, we will select some research areas, such as business, management and accounting, social sciences, decision sciences, computer sciences, and economics, econometrics and finance. Using these procedures, we found 135 in WoS and 59 in Scopus. Excluding replications, we found 125 studies and analyzed them using bibliometric analysis.

The bibliometric analysis uses quantitative techniques to measure the general characteristics of a particular research field. Most cited papers, journals, authors, and publishers are examples of outputs from the bibliometric analysis. To perform these analyses, we use the bibliometrix (ARIA; CUCCURULLO, 2017), an R-tool package (R CORE TEAM, 2022). Among the results, Figure 1 presents the annual scientific production of studies on social media and dynamic capabilities. While no period restriction was made, the first studies on this subject were published in 2012. A possible explanation for this result is that the adoption of social media, as well as digitization in general, is recent. The results also indicate an improvement in publications in the last three years (2020, 2021, and 2022). In this regard, almost 65 percent of all publications (81 studies) where from these periods. Thus, it can be concluded that there is a growing interest in this field of study.

[40] See, https://www.elsevier.com/pt-br/solutions/scopus

Figure 1 – Annual scientific production



Source: the author

The articles found were published in 95 different journals. Table 1 presents some characteristics of the main relevant sources of publication, that is, the journals that publish the most on the subject. This table comprises seven journals that represent 32 percent of all published articles. It can be seen that the journals that publish the most have relevant metrics in relation to their scientific impact, given that they have values considered high in metrics such as Journal Citation Report (JCR) and Scimago Journal & Country Rank (SJR). These results indicate that studies on social media and dynamic capabilities are accepted in high-impact journals. These findings also suggest that the topic studied in this thesis has been published in journals related to marketing management (*e.g.*, Industrial Marketing Management and European Journal of Marketing), but also in management more broadly (*e.g.*, Journal of Business Research and Technological Forecasting and Social Change).

Table 1 – The main journals (with at least three publications)

Journal	**Number of publications**	**JCR**	**SJR**	**H-index (SJR)**
Industrial Marketing Management	10	8.8	2.21	147
Journal of Business Research	10	10.9	2.32	217
Information & Management	4	10.3	2.56	170
Journal of Business & Industrial Marketing	4	3.31	0.78	73
European Journal of Marketing	3	5.1	1.48	110
Journal of Knowledge Management	3	8.6	1.74	124
Technological Forecasting and Social Change	3	10.8	2.34	134

Source: the author

Table 2 provides information on the main authors. The results show that there is no concentration of authors who publish on the subject. The information in Table 2 also indicates

that studies on social media and dynamic capabilities are studies by researchers from several universities in several countries.

Table 2 – The main authors (with at least three publications)

Author name	University (country)	Number of studies
Víctor García-Morales	University of Granada (Spain)	4
Sérgio Begnini	Federal University of Fronteira Sul (Brazil)	3
Carlos Eduardo Carvalho	University of Oeste de Santa Catarina (Brazil)	3
Sheshadri Chatterjee	Indian Institute of Technology (Inidia)	3
Munmun De Choudhury	School of Interactive Computing (USA)	3
Yogesh Dwivedi	Swansea University	3
Aurora Garrido-Moreno	University of Malaga (Spain)	3
Paul Harrigan	The University of Western (Australia)	3
Rodrigo Martín-Rojas	University of Granada (Spain)	3
Demetris Vontris	University of Nicrosia (Cyprus)	3

Source: the author

Using Google Academic citations, Table 3 presents the most cited studies on social media and dynamic capabilities. To save space and in order not to make the table tiresome, the ten articles with the most citations are presented. Although the studies are relatively recent, they have relevant considerations, and the most cited has more than 1000 citations. Some of them are closely related to marketing relationships, such as Trainor et al., (2014) and Wang and Kim (2017). Organizational innovation also was analyzed among the most cited research (PALACIO-MARQUÉS et al., 2015; MUNINGER; HAMMEDI; MAHR, 2019). Furthermore, while some studies provide information on a range of social media (*e.g.*, Facebook, Instagram, Pinterest, and YouTube), others focus on only one, such as Chae (2015), that analyzed Twitter.

Table 3 – The (ten) most cited studies

Authors (year)	Title	Citations
Trainor et al., (2014)	Social media technology usage and customer relationship performance: A capabilities-based examination of social CRM	1070
Wang and Kim (2017)	Can Social Media Marketing Improve Customer Relationship Capabilities and Firm Performance? Dynamic Capability Perspective	683
Chae (2015)	Insights from hashtag #supplychain and Twitter Analytics: Considering Twitter and Twitter data for supply chain practice and research	477
Aarikka-Stenroos and Ritala (2017)	Network management in the era of ecosystems: Systematic review and management framework	374

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Matarazzo et al., (2021)	Digital transformation and customer value creation in Made in Italy SMEs: A dynamic capabilities perspective	303
Nguyen et al., (2015)	Brand innovation and social media: Knowledge acquisition from social media, market orientation, and the moderating role of social media strategic capability	283
Dong and Wu (2015)	Business value of social media technologies: Evidence from online user innovation communities	223
Muninger; Hammedi; Mahr (2019)	The value of social media for innovation: A capability perspective	194
Bocconcelli et al., (2018)	SMEs and Marketing: A Systematic Literature Review	185
Palacios-Marqués et al., (2015)	Online social networks as an enabler of innovation in organizations	179

Source: the author

To identify research gaps, we also performed a systematic review. To meet this, we read all titles and abstracts to identify studies closed related to social media and dynamic capabilities. Our focus was on studies that analyzed organizations in the field of social media and dynamic capabilities. Thus, all studies without this indication in the title and abstract were excluded. Given this procedure, we selected 45 studies to be read in full. In general, all these studies described the concept of dynamic capabilities using the classical studies of David Teece and colleagues and Kathleen Eisenhardt and Jeffrey Martin to describe the importance of these capabilities to organizations achieve innovation performance and vantage competitive in turbulent environments. While dynamic capability is a broad concept, we noted that some studies had described these capabilities as organizational agility, absorptive capacity, and collaboration (Table 4).

The studies in Table 4 provide relevant insights through conceptual works and qualitative and quantitative approaches. Quantitative studies have used multivariate techniques, including cluster analysis, regressions, and structural equation models. While some studies test empirical models using panel data (DONG; WU, 2015), most quantitative papers conducted surveys. Among the gaps found, our findings show that limited research has been conducted on the role of social media for improving dynamic capabilities (exceptions are Dwivedi et al., 2022 and Ye et al., 2022). Despite a set of studies used structural equation models (*e.g.*, Chatterjee et al., 2022; Ortega-Gutiérrez; Cepeda-Carrión; Alves, 2022), there is little effort to analyze the role of dynamic capabilities as mediators between social media and organizational innovation. Furthermore, despite the importance of social media in improving dynamic capabilities (ALI et

al., 2020; DWIVEDI et al., 2022), there is no study that analyze organizational agility, absorptive capacity, and collaboration is a unified model to analyze social media.

Table 4 –Characteristics of some studies found that describe dynamic capabilities as agility, absorptive capacity and collaboration

Authors (year)	Title	Some evidence on what means DC (where the evidence was found)	DC can be defined as…[1]	Type of research[2]	Data analyzed
Cartwright and Davies (2022)	The development of B2B social networking capabilities	DC refers to capabilities which support firms to reconfigure processes, actors, resources and activities to do the right things at the right time (p. 141)	OA	Quali	12 case studies, 47 interviews with employees from marketing, sales, and digital divisions
Chatterjee et al., (2022)	The Impact of Dynamic Capability on Business Sustainability of Organizations	DC is a firm competence to reconfigure its capabilities to address external changes (abstract)	OA	Quanti	302 respondents form several firms
Dwivedi et al., (2022)	Examining the effects of enterprise social media on operational and social performance during environmental disruption	Organizational agility is a DC that ensure organizations to detect and react to environmental changes (p. 3)	OA	Quanti	198 employees of emergency and disaster management organization
Horng et al., (2022)	Role of big data capabilities in enhancing competitive advantage and performance in the hospitality sector: Knowledge-based dynamic capabilities view	From a DC perspective, working with customers allows companies to gain the external knowledge needed (p. 26)	AC	Quanti/Quali	257 hotel marketing managers
Lardon-López; Martín-Rojas; García-Morales (2022)	"Social media technologies: a waste of time or a good way to learn and improve technological competences?"	DC as capability to achieve collaboration with other department, and capability to absorb key knowledge from social media (Table 3)	AC and CO	Quanti	197 technology firms
Ortega-Gutiérrez; Cepeda-Carrión; Alves (2022)	The role of absorptive capacity and organizational unlearning in the link between social media and service dominant orientation	Absorptive capacity and unlearning processes are DC necessary to transform the knowledge acquired in social media and to become service-dominant oriented (abstract)	AC	Quanti	101 respondents from service sector firms
Ye et al., (2022)	Investigating the effect of social media application on firm capabilities and performance: The perspective of dynamic capability view	The authors provide a framework where DC is described as agility (sensing, flexibility, speed) and adaptability (structural sensing and innovation)	OA	Quanti	249 firms (R&D and non R&D)
Adamides and Karacapilidis (2020)	Information technology for supporting the development and maintenance of open innovation capabilities	Among other factors, the author analyzes collaboration and absorptive capacity as relevant capabilities for implementation of open innovation (this is described along the paper)	AC and CO	Conceptual	The paper provides a discussion on the role of information technology for open innovation
Garrido-Moreno et al., (2020)	Social Media use and value creation in the digital landscape: a dynamic capabilities perspective	DC as external information technologies that are useful to capture and respond to external knowledge (p. 318)	AC	Quanti	212 managers of hotels

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Santos; Begnini; Carvalho (2020)	The effect of the use of social media and dynamic capabilities on market performance of micro, small and medium-sized firms	DC increase the speed and efficiency of small and medium-sized companies' responses to environmental turbulence (p. 169)	OA	Quanti	143 small and medium enterprises
Ganjeh; Khani; Tabriz (2019)	Social media usage and commercialization performance: role of networking capability	This study analyzes the networking (collaboration) capability as DC (this is described along the paper)	CO	Quanti	220 managers and experts in knowledge-based firms
Mention; Barlatier; Josserand (2019)	Using social media to leverage and develop dynamic capabilities for innovation	Social media are relevant to organizational DC, including improving collaboration (this is described along the paper)	CO	Conceptual	Introduction of nine papers for a special issue
Wang and Kim (2017)	Can Social Media Marketing Improve Customer Relationship Capabilities and Firm Performance? Dynamic Capability Perspective	Investment in social media can be considered resource inputs to developing new marketing-related capabilities, which engage customers in collaborative conversations and enhance customer relationship (p. 17)	CO	Quanti	232 firms
Dong and Wu (2015)	Business value of social media technologies: Evidence from online user innovation communities	Online user communities enabled DC as a firm's ability to collect user-generated ideas about potential innovation from these communities (p. 114)	AC	Quanti	1676 firm-day observations

[1] Among other variables/constructs, dynamic capabilities can be analyzed as organizational agility (OA), absorptive capacity (AC) and collaboration (CO)
[2] Quantitative (quanti) or qualitative (quali) studies
Source: the author

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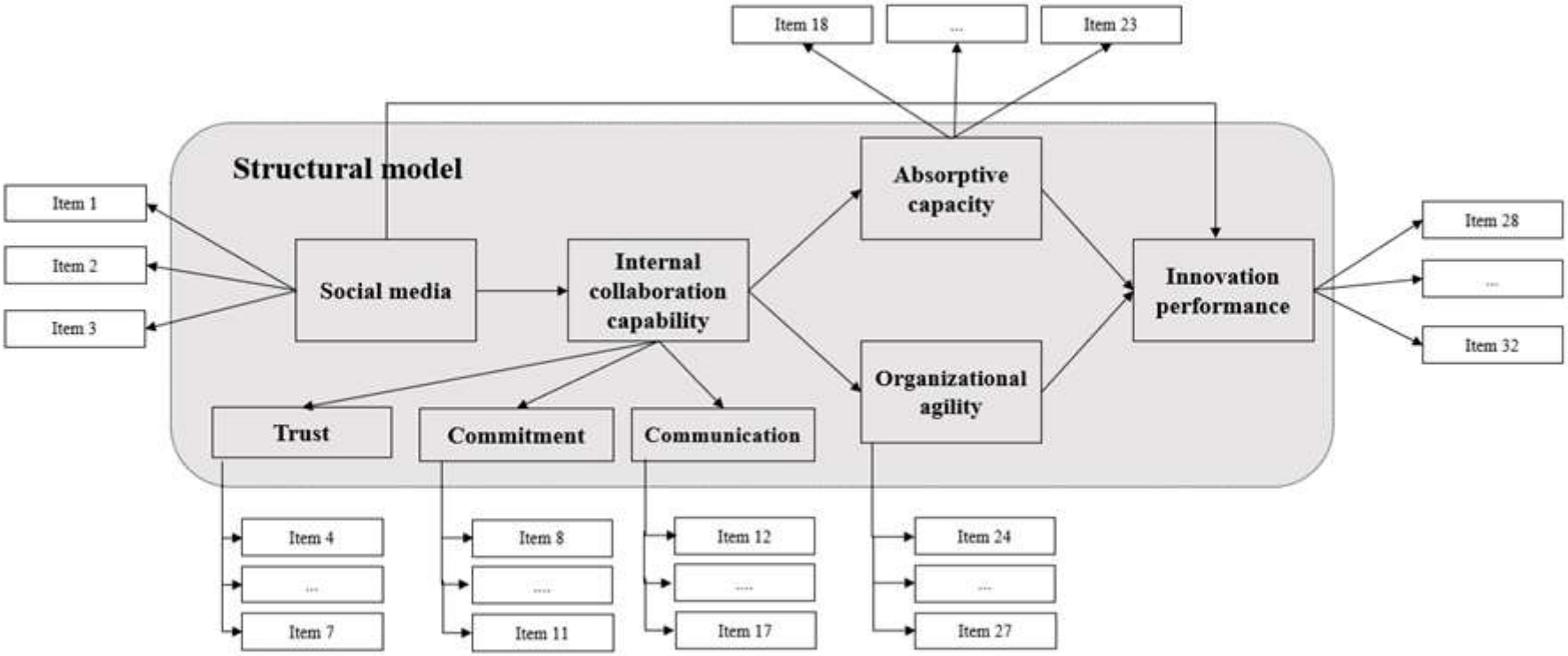
APPENDIX 2 – Model proposed with the statements



APPENDIX 3 – Questionnaire in Portuguese

Prezado respondente,
Este questionário é parte de uma tese de doutorado em Administração da Universidade do Vale do Rio dos Sino (UNISINOS), sobre o papel das mídias sociais e de capacidades dinâmicas no sentido de melhorar o potencial de inovação em startups do segmento do agronegócio. **As informações coletadas serão usadas exclusivamente para fins acadêmicos e será garantido o anonimato dos respondentes.**
Se você ocupa algum cargo de gestão (por exemplo, CEO, diretor, administrador) e atua em uma AgTech, você pode responder o presente questionário.
O questionário não é extenso, levando em média 15 a 20 minutos para o seu total preenchimento. Agradeço muito a tua participação.
Muito obrigado! Cristian Foguesatto
Professor Adjunto da Universidade Federal de Goiás (UFG)
Doutor em Agronegócios (UFRGS) e Doutorando em Administração (UNISINOS)
E-mail: cristian17agro@gmail.com Telefone: (51) 99716-8517

A. Caracterização do respondente			
1. Caso tenha interessa em receber os resultados da pesquisa, descreva seu e-mail:			
2. Gênero: M ( ) F ( ) outro ( )			
3. Escolaridade: Ens. Fundamental ( ) Ens. Médio ( ) Ens. Superior Incompleto ( ) Ens. Superior ( ) Mestrado ( ) Doutorado ( ) Pós-Doutorado ( )			
4. Nome da AgTech que atua:			
5. Qual seu cargo na AgTech (por exemplo, CEO, diretor, administrador)?			
6. Quantidade de pessoas que trabalham na AgTech:			
7. Quantidade de pessoas que atuam no seu setor/departamento:			
8. Há quantos meses a AgTech está no mercado?			
9. Em qual Estado brasileiro a (sede da) AgTech está localizada?			
10. Em que estágio de ciclo de vida a AgTech se encontra atualmente: **( ) Validação –** fase inicial, refere-se a concepção e desenvolvimento da ideia de negócio **( ) Organização e tração –** o negócio começa a ganhar forma e é lançado no mercado **( ) Crescimento e escala –** aumento no volume de vendas do produto ou serviço **( ) Consolidação –** quando a startup se consolida e processos de expansão (por exemplo, expansão física, diversificação dos negócios, entre outros) ocorrem			
11. No presente estudo, mídias sociais referem-se a **uma gama de ferramentas de comunicação entre pessoas, interna à organização e também externa. Intranet, blogs, Facebook e fóruns virtuais são alguns exemplos**. Dada essa descrição, assinale todas as mídias sociais que você usa na startup para se comunicar com colegas e com pessoas externas à startup (como clientes, empresas parceiras, órgãos governamentais, entre outros):			
( ) Facebook	( ) Google Meeting	( ) LinkedIn	( ) Fórum em geral
( ) Twitter	( ) Whereby	( ) Yammer	( ) Intranet*
( ) Microsoft Teams	( ) WhatsApp	( ) WeChat	( ) Telegram
( ) Zoom	( ) Instagram	( ) Blogs	( ) Youtube
12. Utiliza outra(s) mídia(s) social(is)? Se sim, qual(is):			
13. Com que frequência usa as mídias sociais para se comunicar com colegas e ou pessoas externas a AgTech?			
( ) Diariamente	( ) Uma vez por semana	( ) Uma vez por mês	
( ) Duas a três à vezes por semana	( ) Quinzenalmente	( ) Outra frequência. Especifique	

*****Mídia social interna da AgTech

B. Perguntas sobre mídias sociais, capacidades dinâmicas e desempenho de inovação							
As questões abaixo (1 a 27) referem-se as mídias sociais, capacidades dinâmicas e inovação. Elas estão estruturadas de forma escalar, onde 1 refere-se a discordo totalmente e 7 concordo totalmente. Assinale-as conforme sua percepção							
Statements	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. Costumo usar as mídias sociais para obter informação e conhecimento relevantes relacionados ao meu trabalho							
2. Uso as mídias sociais para manter e fortalecer a comunicação no meu trabalho							
3. Utilizo as mídias sociais regularmente no meu trabalho							
4. Meus colegas de trabalho podem contar uns com os outros							
5. As pessoas que trabalham na startup são confiáveis							
6. As pessoas que trabalham na startup são amigáveis							
7. Os membros da startup consideram os sentimentos dos outros							
8. Os membros da startup gostam de pertencer à esta organização							
9. Os membros da startup sentem como se os problemas desta organização fossem seus							
10. Os membros da startup sentem-se emocionalmente ligados a ela							
11. Os membros da startup sentem-se parte da família ao longo das rotinas de trabalho							
12. Se temos uma decisão a tomar, todos contribuem no processo decisório							
13. Os membros da startup tem medo de expressar suas preocupações							
14. Dizemos um ao outro como estamos nos sentindo							
15. Na startup, a opinião de todos é ouvida							
16. Na startup, as pessoas dizem o que realmente querem dizer							
17. Os membros da startup são incentivados a expressar suas preocupações abertamente							
18. Os membros da startup são capazes de identificar e adquirir conhecimento interno e externo à organização							
19. Na startup há rotinas eficazes para identificar, valorizar e importar novas informações e conhecimentos internos e externos							
20. Na startup há rotinas adequadas para assimilar novas informações e conhecimentos							
21. Na startup é possível integrar com sucesso o conhecimento existente com as novas informações e conhecimentos adquiridos de fontes externas							
22. Os membros da startup são eficazes em transformar informações existentes em novos conhecimentos							
23. As pessoas que trabalham na startup podem explorar com sucesso informações e conhecimentos internos e externos em aplicações concretas							
24. Atendemos às novas demandas do mercado de forma rápida, quando tais demandas surgem							

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(Continuação)

25. Podemos aumentar/diminuir rapidamente nossos níveis de produtos/serviços frente as flutuações na demanda do mercado							
26. Somos rápidos em tomar decisões frente às mudanças do mercado							
27. Procuramos maneiras de reinventar/reprojetar a startup para atender melhor ao mercado							
As questões 28 a 32 referem-se ao desempenho de inovação. Leia-as e as responda conforme sua percepção. As perguntas abaixo estão estruturadas de forma escalar, onde 1 refere-se a um desempenho muito abaixo dos concorrentes e 7 um desempenho muito acima dos concorrentes. Comparado com seus concorrentes, sua startup conseguiu criar inovações/novos métodos operacionais nas seguintes áreas no ano passado?							
28. Criou novos produtos ou serviços para seus clientes?							
29. Desenvolveu novos métodos e processos organizacionais?							
30. Criou novas práticas de gestão entre seus colaboradores?							
31. Elaborou novas práticas de *marketing* e relacionamento com seus clientes?							
32. Fez melhorias no(s) seu(s) plano(s) de negócio(s)?							

APPENDIX 4 – Questionnaire in English

Dear respondent,
This questionnaire is part of a doctoral thesis in business management at the Universidade do Vale do Rio dos Sinos (UNISINOS) on the role of social media and dynamic capabilities in improving the innovation performance in startups from the agribusiness sector. **The information presented here will be used solely for academic purposes, guaranteeing total confidentiality**.
If you hold a management position (for example, CEO, director, administrator) and work in an AgTech, you can answer this questionnaire.
The questionnaire is not extensive, taking an average of 15 to 20 minutes to complete.
Thank you very much for your participation.
Thank you! Cristian Foguesatto
Adjunct Professor at Universidade Federal de Goiás (UFG)
PhD in Agronegócios (UFRGS) and PhD candidate in Administração (UNISINOS)
E-mail: cristian17agro@gmail.com Phone: (51) 99716-8517

A. Respondent characteristics			
1. If you are interested in receiving the survey results, please describe your email address:			
2. Gender: M ( ) F ( ) other ( )			
3. Education level: Elementary school ( ) High school ( ) Incomplete higher education ( ) Complete higher education ( ) Master degree ( ) Doctoral degree ( ) Post-doctoral ( )			
4. AgTech name:			
5. What is your occupation at AgTech (*e.g.*, CEO, director, administrator)?			
6. Number of people working at AgTech:			
7. Number of people working in your sector/department:			
8. How many months has AgTech been on the market?			
9. In which Brazilian state is AgTech located?			
10. What lifecycle stage is the AgTech currently in: **( ) Conception –** initial phase, refers to the conception and development of the business idea **( ) Organization and traction –** the business begins to take shape and is launched in the market **( ) Growth and scale –** increase in the sales volume of the product or service **( ) Consolidation–** when the startup consolidates and expansion processes (for example, physical expansion, business diversification, among others) occur			
11. In the present study, social media refers to **a range of internal and external communication tools between people. Intranet, blogs, Facebook and virtual forums are some examples**. Given this description, check all the social media you use in the startup to communicate with colleagues and people outside the startup (such as customers, partner companies, government agencies, among others):			
( ) Facebook	( ) Google Meeting	( ) LinkedIn	( ) Fórum em geral
( ) Twitter	( ) Whereby	( ) Yammer	( ) Intranet*
( ) Microsoft Teams	( ) WhatsApp	( ) WeChat	( ) Telegram
( ) Zoom	( ) Instagram	( ) Blogs	( ) Youtube
12. Do you use other social media(s)? If yes, which one(s):			
13. How often do you use social media to communicate with colleagues and/or people outside of AgTech?			
( ) Daily	( ) Once a week	( ) Once a month	
( ) Two to three times a week	( ) Fortnightly	( ) Other frequency. Specify	

*AgTech internal social media

B. Questions about social media, dynamic capabilities and innovation performance							
The questions below (1 to 27) refer to social media, dynamic capabilities and innovation. They are structured on a scalar basis, where 1 is strongly disagree and 7 is strongly agree. Tick them according to your perception							
Statements	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. I often use social media to obtain relevant information and knowledge related to my work							
2. I use social media to maintain and strengthen communication in my work							
3. I use social media regularly in my work							
4. My colleagues in AgTech can count on each other							
5. The people working at the startup are reliable							
6. The people working at the startup are friendly							
7. Startup members consider the feelings of others							
8. Startup members like to belong to the AgTech							
9. Startup members feel as if this organization's problems are their own							
10. Startup members feel emotionally attached to it							
11. Startup members feel part of the family throughout work routines							
12. If we have a decision to make, everyone contributes to the decision-making process							
13. Startup members are afraid to express their concerns openly							
14. We tell each other how we're feeling							
15. At startup, everyone's opinion is heard							
16. People say what they really mean in the startup							
17. Startup members are encouraged to voice their concerns openly							
18. Startup members are able to identify and acquire internal and external knowledge to the organization							
19. In the startup there are effective routines to identify, value and import new information and internal and external knowledge							
20. In the startup there are adequate routines to assimilate new information and knowledge							
21. In startup it is possible to successfully integrate existing knowledge with new information and knowledge acquired from external sources.							
22. Startup members are effective at turning existing information into new knowledge							
23. People working in the startup can successfully exploit internal and external information and knowledge into concrete applications.							
24. We respond to new market demands quickly, when such demands arise							
25. We can rapidly increase/decrease our product/service levels in the face of fluctuations in market demand							
26. We are quick to make decisions in the face of market changes							

(Continue on next page)

(To be continued)

27. We look for ways to reinvent/reengineer the startup to better serve the market							
Questions 28 to 32 refer to innovation performance. Read them and answer them according to your perception. The questions below are structured on a scalar basis, where 1 refers to performance far below competitors and 7 to performance far above competitors. Compared to your competitors, has your startup been able to create innovations/new operating methods in the following areas in the past year?							
28. Has the startup created new products or services for its customers?							
29. Has the startup developed new organizational methods and processes?							
30. Has the startup created new management practices among its employees?							
31. Did the startup develop new marketing and relationship practices with its customers?							
32. Did the startup make improvements to the it business plan(s)?							