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Research Article

The use of agile methodologies and their contribution to innovation of the business model: a study of multiple cases in the context of incubators and startups

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Abstract

Purpose: to understand the phenomenon of agile methodologies and their application in the innovation of existing business models. **Methodology:** a qualitative study, with a multiple case approach. **Main results:** the empirical findings confirmed the importance of incubator contributions to the development of innovation in incubated startups. **Theoretical or methodological contributions:** the research corroborates what the literature says on the subject and contributes useful information to the process of implementing agile methodologies. **Relevance and originality:** this study is relevant because it deals with challenges that are still little known in the implementation of agile methodologies, thus collaborating to fill the gap in the literature. **Social or managerial contributions:** the results of this study can help startup managers to deal with the adversities in implementing and adapting to agile methodologies; and to seek a more effective monitoring of the incubator throughout this process.

Keywords: Agile methodologies. Innovation in the business model. Startups. Business incubator.

Resumo

Objetivo: compreender o fenômeno das metodologias ágeis e sua aplicação na inovação dos modelos de negócios existentes. **Metodologia:** um estudo qualitativo, com abordagem de casos múltiplos. **Principais resultados:** os achados empíricos confirmaram a importância das contribuições da incubadora para o desenvolvimento da inovação nas *startups* incubadas. **Contribuições teóricas ou metodológicas:** a pesquisa corrobora o que diz a literatura sobre o assunto e contribui com informações úteis ao processo de implementação de metodologias ágeis. **Relevância e originalidade:** este estudo é relevante porque trata de desafios ainda pouco conhecidos na implementação das metodologias ágeis, colaborando, assim, para preencher a lacuna existente na literatura. **Contribuições sociais ou para a gestão:** os resultados deste estudo podem ajudar os gestores das *startups* a lidar com as adversidades em implantar e de se adaptar às metodologias ágeis; e a buscar um acompanhamento mais efetivo da incubadora ao longo desse processo.

Palavras-chave: Metodologias ágeis. Inovação no modelo de negócios. *Startups*. Incubadora de empresas.

INTRODUCTION

The dynamics generated by changes in the market, such as technological development and new consumption habits, accelerated the convergence of organizational resources in the search for innovation for business models. We are in the scenario of markets with extreme uncertainty and business models designed to be repeatable and scalable, and startups emerge (Kollmann *et al.*, 2021). These companies, characterized by their persistence and differentiation from competitors, have as a guide the perception of the value of customers about their business (Amit & Zott, 2010; Lasso *et al.*, 2019).

The business model of startups is used to commercialize new ideas and technologies (Chesbrough, 2010), in addition to how the company captures, transforms, and delivers value to customers (Langley *et al.*, 2021; Osterwalder *et al.*, 2005). However, the initializing of the companies is still complex and dynamic and may become obsolete soon after its foundation or become something different from the initial intention (Shepherd & Gruber, 2021).

Innovating the business model is the key to adaptability and the creation of new ways to generate value (Foss & Saebi, 2018; Miranda *et al.*, 2016; Schneider & Spieth, 2013) and is a necessary process for implementing radical or continuous changes in the architecture of the business. It is, therefore, a complex exercise that requires approaches and tools that are adjustable to the development of startups (Ghezzi & Cavallo, 2020).

Business incubators emerge as an alternative for startups to minimize the impacts of resources, time, and market in their initial phase (Van Rijnsoever *et al.*, 2017). To this end, offer an environment that stimulates innovation and can assist in organizational and technological development, thereby enhancing the survival of the business (Iacono & Nagano, 2014; Mas-Verdú *et al.*, 2015).

To succeed in this process, skills, and initiatives, both from incubated startups and incubators, are expected, which requires organization, management, and structuring of dynamic control (Iacono & Nagano, 2014).

Agile methods in this context are business planning tools that provide a broad view of needs and the most appropriate way to do it (Cooper & Sommer, 2016). Its implementation generates significant benefits to the business model, such as accelerating the product development cycle (Xu & Koivumäki, 2019); improve the use of resources; the reduction of uncertainties due to better management, the direction of the team, and results (Cooper & Sommer, 2016); alignment between the idea of the business, and the ability to respond to customer needs (Cooper & Sommer, 2020; Ghezzi, 2019).

Aligned with these expectations is the special attention of researchers in understanding the increased application of agile methods (Cooper & Sommer, 2020; Nurdiani *et al.*, 2016; Xu & Koivumäki, 2019). In this case, some studies address the scope outside the digital landscape. These methods are also applied for product development (Cooper & Sommer, 2016; Könnölä *et al.*, 2016); and on the impact of its implementation (Nurdiani *et al.*, 2016). Under another bias, the research seeks to list the aspects related to its assimilation (Ghezzi, 2019; and their subsequent abandonment for lack of guidance, perception of value, and acceptance of the team (Nurdiani *et al.*, 2019).

Incubated startups perform better in adopting advanced technologies, internationalizing ability, and accessing public subsidies more easily (Colombo & Delmastro, 2002). However, little is known about the challenges these companies face when implementing agile methods (Ghezzi & Cavallo, 2020; Hampel *et al.*, 2020). In addition, it is necessary to understand how business incubators and their innovation environments connect innovation management, the business model, and the application of agile methods (Guillen & Veras, 2018).

The relevance and scarcity of information on the theme in question motivated the development of this research, whose central objective is to describe how incubators and startups implement agile methodologies and what their contribution to the innovation of their business models is. To this end, answers were sought for the following questions: What are the challenges in implementing agile methodologies? How does the incubator contribute to the implementation of agile methods? What results do startups and incubators perceive with using agile methodologies in their innovation process? Moreover, how do agile methods contribute to the innovation of the startup business model?

The chosen approach, which contributes to the expansion of the literature on the subject, aims to understand the phenomenon of agile methodologies and how its benefits can enhance or innovate existing business models, in addition to describing the reasons (if any) that limit their implementation process in startups incubated.

Our article has five parts: theoretical discussion on the innovation of business models, their relevance, and applications; design of agile methodologies and an indication of how their implementation can contribute to the business model innovation process; methodological procedures used; analysis of the results; and conclusion.

THEORETICAL FRAMEWORK

Innovation in business models

Incubators provide an innovative environment for companies helping to boost their business and support, especially in the early stage of their development (Van Rijnsoever *et al.*, 2017). It generate societal improvements, contributing to regional development, job creation, and emerging new technologies (Mas-Verdú *et al.*, 2015).

Startups – companies in the embryonic phase which seek a repeatable and scalable business model in an environment of extreme uncertainty Ries (2011) – are, in many cases, the one stum of by incubators. For Blank (2013), it is a temporary organization with disruptive innovations and a high potential for rapid growth.

The nomenclature "business model" (BM) emerged with the arrival of the "New Economy," a term used to define models impacted by technologies and has been a rising theme in academic research (Arend, 2013; Morris *et al.*, 2005; Schneider & Spieth, 2013). Its concepts have been renewed and continuously expanded since 2010, a time marked by radical changes in the competitive environment, to promptly meet the expectations of

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customers (Cosenz & Bivona, 2021; Ghezzi & Cavallo, 2020; Xu & Koivumäki, 2019).

Langley *et al.* (2021) reinforce that the diversity of definitions causes the terminological confusion of its application. BM can be various concepts including the governance model and strategy for financial gains (Morris *et al.*, 2005). To understand it is necessary to consider usefulness, structure, logic, measurement, comprehensiveness, and operationalization (Morris *et al.*, 2005).

In this research, BM is treated as an architecture of an organization's creation, delivery, and value capture and how it is transferred to customers (Arend, 2013; Cosenz & Bivona, 2021). Thus, in the organization, the BM develops the articulation between the value proposition and the identification with a market segment; and specifies how to generate revenue (Chesbrough, 2010). This dynamic and continuous process is based on experimentation and learning about customer needs (Xu & Koivumäki, 2019).

Companies have seen innovation as a competitive differential. However, in the current scenario, it is necessary to have a more innovative BM (Keiningham *et al.*, 2020; Cosenz & Bivona, 2021).

The innovation in the business model (IBM) is the application of new or significantly improved changes in the BM or its strategic elements (Foss & Saebi, 2018). Thus, IBM corresponds to changes in the axis of value creation, representing small and continuous changes in the existing BM (Schneider & Spieth, 2013).

Innovating also establishes changes in business activities, making it possible to transform the market. With this, new standards are established, which allows companies to disseminate innovation among competitors, expands the team's ability to access technology, and the chances of the organization becoming a reference in innovation (Casadesus-Masanell & Zhu, 2013).

IBM can be a powerful competitive tool because it limits replication by competitors (Schneider & Spieth, 2013), but it makes BM more flexible and amenable to change (Foss & Saebi, 2018). Therefore, it seeks new logic for the existing BM through the performance of radical or incremental changes in its components, the introduction of parallel models, the readjustment of roles and functions in the current dynamics, and the generating new ways to create and capture value for the network (Cosenz & Bivona, 2021; Foss & Saebi, 2018).

It is worth noting, however, that the changes brought about by IBM are planned to significantly alter the architecture that connects the strategic elements of the business (Ghezzi & Cavallo, 2020). In addition, the development of IBM can find barriers to its application in companies, such as the cost of failure, the lack of analysis of the environment, and problems in the leadership process (Chesbrough, 2010).

Xu and Koivumäki (2019) discuss that the process of creating value for an organization needs to worry about competitors since product innovation no longer offers enough competitive advantage for its differentiation in the market. Moreover, ignoring IBM can decrease productivity in research and development (R&D) and, consequently, impair the creation of new products and prioritization of projects, and result in resource waste.

Therefore, to avoid impacting the negative results of companies, their managers should carefully observe the BM. It will help maximize portfolio value, create the right combination of projects, and balance resource needs (Cooper & Sommer, 2020). To do so, IBM offers opportunities to realign value creation activities and build a sustainable competitive advantage.

Agile methodologies

In some scenarios, agility is the ability to respond quickly to changes in an uncertain environment. In business, it means the ability to offer customers products and services with the same result but in shorter development cycles (Xu & Koivumäki, 2019).

Previous research points to agile methods represented as a stage model with tools appropriate to organizations' planning (Cooper & Sommer, 2016) and intensified adoption of high technology (Xu & Koivumäki, 2019).

Agile methodologies emerged from the agile manifesto, elaborated by the Information Technology (IT) leaders, in 2001 (Cooper & Sommer, 2016; Könnölä *et al.*, 2016). Although the presentation was directed at software engineering, there was interest in expanding it into product development (Könnölä *et al.*, 2016).

It focuses on a group of methodologies that uses tools to provide products adaptable to the changes requested by customers (Cooper & Sommer, 2016; Nurdiani *et al.*, 2016; Wang *et al.*, 2012).

Several agile methods can be applied in organizations according to the type of business, the deployment phase, the size of the company, the number of employees, the culture, and the expected result. Among them are extreme programming (EP (Beck, 2000); Scrum (Schwaber & Beedle, 2002); Kanban (Ikonen *et al.* 2010); Lean Software Development (LSD) (Poppendieck & Poppendieck, 2003); Agile-Stage-Gate (Cooper & Sommer, 2016); Dynamic Business Model (DBM) (Cosenz & Bivona, 2021); Lean Startup (Ries, 2011) and Lean Startup Approaches (Ghezzi, 2019).

In short, implementing agile methodologies brings organizations speed of response to market changes, can shorten the development time of products and services, and reduce lower costs (Nurdiani *et al.*, 2019; Xu & Koivumäki, 2019).

These methods also promote a sense of ownership, increase motivation, and improve knowledge sharing in the organization (Cooper & Sommer, 2016). The application also benefits small and medium-sized businesses (Cosenz & Bivona, 2021), since it reduces time and investment in activities that cannot, at the end of the day, be assertive (Cooper & Sommer, 2020; Ghezzi, 2019).

According to Ghezzi (2019), not all entrepreneurs can perform an assertive implementation because they do not understand which round the methodology should be applied. Nurdiani *et al.* (2019) support this idea, stating that it is complicated for the organization to indicate an order to introduce the agile method because the implementation work is not so simple. Ghezzi (2019) also points out that this occurs mainly in the stages of defining and designing the "minimum viable product" (MVP), identifying the target audience, setting priorities for testing, and discovering the potential competitive advantages.

Other barriers are constituted by individual factors limiting the team, such as lack of integration, organization, culture, and regulation (Nurdiani, Börstler, Fricker, & Petersen,

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2019; Nurdiani, Börstler, Fricker, Petersen, & Chatzipetrou, 2019).

The agile method goes through the process of innovation assimilation when understanding and interaction with the company's culture occurs to avoid difficulties (Cooper & Sommer, 2016; Wang *et al.*, 2012). As an emerging form of innovation development, it helps companies solve complex problems by suggesting possible interactions and treating mistakes as learning chances (Ghezzi & Cavallo, 2020). For this reason, evaluating the adequacy, use, and results of methods in startups is essential since BM is considered an intricate system with modular processes.

METHODOLOGY

This study's objective is to explain how incubators and startups implement agile methodologies and contribute to the innovation of their business models. We adopted the method to generalize conclusions when accepted because of subsequent external validation using triangulation requirements (Eisenhardt, 1989).

The approach is strategically appropriate for treating cases as a series of experiments, allowing the extra researcher to go a logic between them (Eisenhardt, 1989; Yin, 2005).

We conduct and qualitative-exploratory approach to evaluate the subject, the phenomena, and the actors in their natural environments (Gephart, 2004).

Case selection

To examine incubators companies and startups we opted for incubators with Cerne certification by the National Association of Entities Promoting Innovative Enterprises (Anprotec) because it provides the numbers and incubators in Brazil. According to Anprotec (2019), the base covers 19 incubators of Level 2; and 60 of Level 1, according to Cerne certification.

To maintain a comparative approach, we choose two incubators for each level. Subsequently, each incubator's number of startups is considered a criterion for choosing at different stages of the process (pre-incubated, incubated, post-incubated, and discontinued). Those with the highest number of projects were contacted and invited to join the research.

The selection of startups was performed randomly, observing only their phase in the incubation process. The invited companies, which expressed interest in participating, had their interviews scheduled. Table 1 contains the nomenclature used to protect sensitive information.

Four incubators were identified, including I1, I2, I3, and I4, startups incubated, S1 to S13. The selection of cases from several states increases heterogeneity and allows exploration until reaching the degree of saturation; and allows that research permeated various scenarios, reducing any bias or regional vices (Gephart, 2004).

Data collection

Data were collected throughout the interviews with managers responsible for implementing agile methods in business incubators and with entrepreneurs at different stages of the incubation process.

To this end, two interview scripts were structured: one applied to incubator managers and the other to startup entrepreneurs incubated. The questions were based on a theoretical foundation, being carried out script tests with four startups and an incubator to make the necessary adjustments.

Even so, during the interviews, we added questions to improve the understanding; and withdrawal of others, given the difficulty of experience.

There were approximately twelve hours of interviews to have more subsidies for the incubator and startups. As recommended by Yin (2005), this data was combined with those collected from other sources (Figure 1), such as documents and information from the incubators' web pages. The services cited by the incubator manager, and the business models elaborated by startup entrepreneurs, were reviewed to gather evidence for research (Dubé & Paré, 2003).

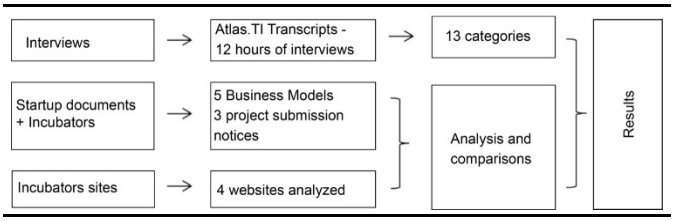

Figure 1
Description of the sources
Note: Elaborated by the authors (2021).

Analysis of results

After data collection, the analyses were initiated, through the transcription of the interviews, with Atlas.Ti software. This procedure allowed the organization and codification of the

Table 1
Cases of incubators and startups

State	City	Cerne level	Incubator code	Startups internships	Cases	Startups code
Minas Gerais	Viçosa	01	I1	Pre-incubated	S1	*Startup* 1
				Incubated	S2	*Startup* 2
				Post-incubated	S3	*Startup* 3
São Paulo	Ribeirão Preto	01	I2	Pre-incubated	S4	*Startup* 4
				Incubated	S5	*Startup* 5
				Post-incubated	S6	*Startup* 6
Santa Catarina	Florianópolis	02	I3	Pre-incubated	S7	*Startup* 7
				Incubated	S8	*Startup* 8
				Post-incubated	S9	*Startup* 9
				Discontinued	S10	*Startup* 10
Pernambuco	Recife	02	I4	Pre-incubated	S11	*Startup* 11
				Incubated	S12	*Startup* 12
				Discontinued	S13	*Startup* 13

Note: Elaborated by authors (2021).

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information gathered, which led to the identification of 13 categories divided into 130 subcategories.

The basis of codifications was defined on a theoretical basis and divided into incubators, startups, and their phases of the incubation process. The analyzes of the incubator's business models and documents were divided into categories, with the exclusion of those that would not bring any contribution to the achievement of the research objectives, and the addition, when necessary, of other emerging ones, always respecting the initial approach of the concepts indicated by the literature.

RESULTS

From the data collected, it was possible to identify how incubators and startups implement agile methodologies and their contribution to the innovation of their business models.

Innovation of incubated startups with agile methodologies implemented by the incubator

The business incubator is a protected and planned environment to undertake, contributing to the survival of the business market under your care. This is based on its physical structure and people in courses, workshops, and training programs, by which knowledge is transferred to help the search for company results.

The sharing of knowledge about agile methodologies among the various services offered to foster and contribute to innovation management. The incubators surveyed reported having, as main agile tools, business model canvas (I1 and I2), business developed point (I4), design thinking (I2), lean startup (I1), jobs to be done (I2), proposition (I2) and scrum (I2 and I4).

The use of different methodologies which were not part of the literature gathered in the theoretical framework can be observed. For example, business model canvas, business developed point, jobs to be done, and proposition are not part of the curatorship of the agile methodologies researched. Extreme programming (EP), lean software development (LSD), agile-stage-gate, dynamic business model (DBM), and lean startup approaches were in the literature but were not mentioned by the incubators. Lean startup and scrum methodologies were present in the theoretical framework and the report of the incubators interviewed.

After offering training on the use of agile methods, incubators develop actions to implement in startups, in addition to accompanying, together with entrepreneurs, the adaptation and the need for possible adjustments, according to the context of the company.

In the pre-incubation phase, the process demands more proximity, and the company is assisted through fortnightly check-ins (I3) – recurrent meetings and short periods, to solve difficulties in using methodologies. There are also advisories and mentors (I1 and I4), by which external people help develop startups, presenting actions previously experienced and knowledge about agile methodologies.

Some incubators develop their monitoring form, such as the monitoring model (I1). This system verifies the development of startups, performing evaluations and measuring the achievement of goals and levels to rise in phase and could be perceived in the following reports and incubator managers.

> We check for OKR, and this follow-up too, it is more, let us say, it is more accurate, more focused on this at the beginning of the startup, in this early phase, right? *I2*

> At first, we make a diagnosis; I understood where the startup needs to develop. We draw up an action plan, and we follow this action plan throughout the check-ins, which are fortnightly meetings with entrepreneurs. *I3*

> Then we work as a model of maturity here, which was developed even inside the incubator, which we even part by the axes of Cerne, you know? Like this, we work all the axes of Core within this model and list some milestones with the company, like planning, right? *I1*

Serving the company in the incubation phase assists in implementing the tools, helps correct routes that may be out of the plan, and brings focus to the expected goals and results. In this phase, because the company is more mature, the monitoring is carried out with more space, so the entrepreneur develops autonomy in managing the company.

Mentoring is offered, with internal members of the incubator or external, aiming at solving specific problems of startups. Such mentoring and meetings aim to understand and align the needs of entrepreneurs. The incubator can offer precise support and direction through a follow-up plan for each demand.

. In the post-incubation phase, periodic follow-up visits (I3) were mentioned to maintain the relationship with these companies, demonstrate the services available in the incubator; and put, in the network mentors who have already gone through the incubation process, thereby making the contribution of these entrepreneurs to the ecosystem.

It was observed that the incubators, in the beginning, carried out the transfer of knowledge about agile methodologies, contributing to innovation development in their startups. Moreover, create follow-up processes and strategic planning and set goals for companies. The meetings mentioned are intended to verify the execution of the company's planning, survey the difficulties, and direct the evolution of the business.

Also, about the follow-up received, the startup managers highlighted the processes mentioned above, there were also periodic meetings (S4 and S5), promoted by the incubator, to assist them in the five axes defined by the core (entrepreneur, management, capital, technology, and market).

Difficulties in the process of implementing agile methodologies

Implementing an agile method to develop the business model innovation generates challenges in all process stages, from learning to analyzing results. Difficulties may vary according to the phases of the incubation process. For example, in pre-incubation, in which startups start implementation, the problems are related to agile methodologies because entrepreneurs focus on understanding the approach's meaning and implementation (S7).

In this phase, the managers and the teams do not have the necessary understanding to implement the tools because they do not understand the usability and importance of developing the business model's innovation (S11). There is also a lack of engagement of the team about the new tool (S1) since the implementation of agile methodology brings changes in the way

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of managing the startup, metrics, deadlines, and team organization – changes that can cause people to worry.

> The difficulty of the beginning is to understand, then apply and understand the meaning of the tools. *S7*
>
> So, the greatest difficulty was this same, to bring a general understanding so that the team could evolve together. *S11*
>
> So, the first point of an agile methodology, which has many collections, a lot of delivery and this daily communication is essential, that was it, maybe the engagement of people. People feel a little pressure, and it is not a methodology everyone feels comfortable working on. Moreover, I think the main point is this. *S1*

In the incubation phase, even with more experience in the process, startups still have difficulty understanding whether the incubator's agile approach is appropriate to their business model (S5 and S8). Obstacles were observed: (a) during the implementation of the tools, due to the lack of a model to be followed and even a mentor to monitor the initial process (S8); (b) in the management of the transition process (S5), because the managers of the startups feel unprepared to understand the indicators and metrics generated throughout the development; and (c) in the integration of the team with the usability of the approach (S12).

In the post-incubation process, startups also felt difficult to understand the method (S3) and adapt some points of the application to the reality of the business (S3). The methodologies are presented in a standard way. It is necessary to be adapted to the startup culture and the nomenclatures used by the approaches, which must be adjusted so as not to generate dissatisfaction in the team (S6).

The startups that discontinued the incubation process also found it challenging to understand the application of agile methodologies (S10 and S13). The managers reported that, at the beginning of the presentation, the tool made no sense to the company; and said assimilation problems (S13) that demonstrate that the application and implementation of the methodologies have happened inappropriately. Maintaining the execution routine of the approach, making the team willing to comply, and having constancy in the development actions of the tool (S13) were other critical points mapped.

During questions about the difficulties, startup managers mentioned actions based on practice to overcome the problems encountered along the way (Table 2, the actions performed are divided into phases of the incubation process).

Table 2
Actions that entrepreneurs take after identifying the difficulties in the implementation of agile methodologies

Incubation phase	Subcategory	Action through difficulties
Pre-incubated	Learning	Application cycles promote learning, errors promote hits.
Incubated	Replacement and discontinuation	Discontinue the use of one approach to deploy a more current one. Problems with the team and investors caused the discontinuity of the use of the approach.
Post-incubated	Training and adaptation	Training and development of the team. Adapt the tool to a simpler language and team processes.
Discontinued	Organization and focus	Reorganization and use of the management tool. Align the use of the tool with the goal and focus of the startup.

Note: Elaborated by authors (2021).

At the beginning of the implementation, in the pre-incubation phase, the startups realized that, during the application, errors generated learning, not being replicated in the next cycle (S7 and S11). Startup managers learn each process and avoid repeating actions that failed in the previous deployment.

In the incubation phase, in the case of problems with agile methodologies, to learn from the implementation process (S5 and S8), managers have discontinued using these tools. It has sought others more adaptable to their business's reality (S5, S8, and S12).

Then, in the development process, if the low support for the company's culture was identified, managers sought to replace the tool with a more applicable one capable of meeting the team's specificities and the investors' demand.

The post-incubated, in turn, felt that empowering the team was a path to pain for the development of the methodology (S3). The training allows the team to adapt the tool, through a simple and closer language, with the "fitting" of the routine (S6).

The startups discontinued in times of difficulties to ram and reevaluate the application of the tool (S13), looking at the positive aspects to deciding what would be discarded in the process. In development, startup managers have identified that it is necessary to have focus, bring the team closer and align their attention with the metrics of start, middle, and end of execution (S10).

Therefore, based on the data collected, it is possible to say that, in the process of implementing agile methodologies, as much as startups are closely monitored and regularly monitored by incubators, obstacles will always appear, with the need for intervention by managers. Such difficulties occur: (a) during the training because the entrepreneurs do not understand and what is the appropriate tool and its application in the startup; and (b) in the adaptation of tools to the segment and business model, which demonstrates a lack of monitoring and close people with experience in the process, to guide managers with a more transparent and more accessible language.

On the other hand, the difficulties shaped the knowledge of startup managers, who learned from their mistakes and corrected them in the following process, adapting approaches, adjusting the standard to the company's model, empowering their employees, following the development, and contributing to achieving the results.

Results and metrics obtained with the use of agile methodologies in the business model

After going through the challenges, not the implementation process and the use of agile methodologies, it is perceived that it is possible to present concrete results for startups and incubators.

One of the main results of incubators during the application of methodologies was the learning obtained by the entrepreneur (I2 and I4). Therefore, the experiences acquired in innovation development bring maturity to the startup manager, both personal and professional, enabling him to propagate the culture of learning in a way that professionals with innovative thinking.

The use of methodologies is also relevant to the managerial part of the incubation process because entrepreneurs, after learning, become protagonists of their development, becoming more engaged in meeting the program's goals (I1 and

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I3). Moreover, fulfilling goals, in turn, makes companies more prepared to receive investment contributions and allows the subsequent phases of the incubation process to be advanced.

After finishing the incubation process, the perceived result of using agile methodologies is its contribution to the sustainability and survival of startups (I1 and I3). The survival rate, formed by the percentage of companies that remained active after the incubation process, demonstrates the program's quality, and is marketed to more startups interested in the incubation process (I3).

93% of our startups in the last five years have remained sustainable; they have not broken down.	*I3*
The survival rate right, for sure, and not to mention that the more successful companies are, the more attention it draws for new companies to come too, right?".	*I1*

Startup managers also reported the results and metrics you get using agile methodologies and experience with your application.

In the pre-incubation phase, one of the main results is the rapid construction of an MVP (S1). Having a product minimally appropriate to the customer at the beginning of development provides a quick validation and market entry. The company's internal organization (S11) is also improved due to the order of the procedures addressed, which encourages more proactive team management.

Another point of improvement is the learning acquired with the use of agile methodologies (S7) because when the startup is in the incubation phase, the use of these methods can speed up product development (S12), reducing the waiting time for insertion in the market, and increasing the chances of achieving more satisfactory financial results. Market volatility can be a decisive factor for companies working with innovation because of accelerated commercial growth, mainly using tools that helped evolve the sales team (S2 and S8).

The results, cited by startups in the incubation phase, directly impact metrics, showing an increase in prospected customers (S2, S8, and S12) and growth in the company's revenues (S8). Growing prospecting and sales is the goal of a company's development cycle, as this confirms the customer's choice for the created product and allows financial health to fund the process. The financial return is also responsible for fostering the increase of positions and jobs created by the company (S8).

The post-incubated s realized that using agile methodologies improves the team's performance (S3) since their methods bring results, not the rhythm and speed of the team, impact, and directly the metrics achieved in this phase. It can be observed, for example, that the company's revenue increases due to the team's performance and adherence to the competitive market (S9).

The results and metrics that startups use agile methodologies in their business model generate social and economic impacts. Innovation development promotes workforce training, entrepreneurs and employees, income generation, and jobs. The incubator is also impacted because the augmentation of survival of the incubated enterprises functions as attractive for others to integrate their environment.

Analysis of the contributions of agile methodologies in the innovation of the business model of incubated startups

After analyzing the points related to the implementation, its difficulties, and results, the research investigated the contribution of agile methodologies to the development of innovation in the business model, from its validity to the achievement of results.

For startups in the pre-incubation phase, using these methodologies contributed to the organization of the project (S7), enabling the entrepreneur to an overview and, at the same time, the necessary focus at each stage of its development. The methodology offers a panoramic view of the managers' beginning, middle, and end so that adequate team management, allocating efforts, conforming to the implementation stage, and interaction for co-creation (S11).

The focus on the solution is one of the contributions identified by the pre-incubated (S1), given direct attention to the goal, without wasting much time with the preparation of extensive documents, thus speeding up decision-making and the search for solutions to the difficulties encountered.

The tool that is already a methodology that already has templates, and objectives, right, so we sit with the team, it is even easier for us to understand and co-create, right.	*S7*
They helped me organize a flowchart of ideas and make the project start, middle, and end, within what we propose.	*S11*
So, the methodology helped us a lot in this way, not to lose focus, to see up front as a difficulty that we are, is overcoming, a difficulty that we are facing.	*S1*

Validating the business model with the customer is when the company presents its value proposition to users and, from its experience of use, extracts that sum up feedback for product improvement. This validation impact pre-incubated startups (S7), helping to understand customer needs. Moreover, in the incubation phase, contribute so that companies reach one hundred more effective sales cycles and offer products more aligned to their needs (S2).

Agile methodologies also contributed to those incubated in the internal organization of the team (S5 and S8), promoting a planned environment for the team to develop and achieve efficiency and productivity. The increase in productivity combined with validation brings faster business development (S2 and S5), shortening schedules, and validation.

The business model validation also favored companies in the post-incubation phase (S3, S6, and S9), providing greater proximity to the client and testing the value proposition. It is noteworthy that the validation focus is not on the product but on delivering value to the customer (S9). In addition, it helps reduce the loss of time and resources, even in the face of error (S3).

Agility was, in fact, an essential factor for post-incubated startups because the use of agile methodologies promotes a "shrinkage" of six months in the time of product development (S6). This economy brings a faster validation for the company's entering the market, with a reduction in labor and resources (S3), enabling possible changes to the product and other changes that present themselves as needs (S9).

In the companies that have discontinued the incubation process, the economy contributes to the perception that there are

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no ways to develop, even within the same scope and with existing resources (S13). The agile methodology expands the strategic vision of the entrepreneur, directing the focus to achieve the result (S10). Table 3 traz as contribuições geradas em cada fase do processo de incubação.

Table 3
Contribution of agile methodologies to the innovation of the business model of startups

Incubation phase	Subcategory	Contribution to business model
Pre-incubated	Organization, focus and validation	The tool promotes co-creation with the team's help and keeps the focus on the solution without wasting time. It allows the entrepreneur to have a vision of the beginning, middle, and end of the project. Promotes understanding of what the customer needs.
Incubated	Organization, learning, validation, speed, efficiency of the team.	The internal organization of the team brought identification of bottlenecks and generated new development. The mistakes made bring learning. The validation process promoted by the tool can understand the needs of customers. Allows quick testing, change and quick testing. Improves team efficiency.
Post-incubated	Organization, involving the client, validation of the value proposition, speed, and economy.	The organization promoted by the tool helps in internal communication. You can understand your customers' needs. Customer involvement in product construction helps a lot in defining the problem. The tool brings feedback and an overview of the company. Reformulates the value proposition offered to the customer. It enables quick testing, change, and brings quick feedback and a more effective sales cycle. The agility of the tool application anticipates the execution time and resources spent.
Discontinued	Organization, economy, and focus.	It allows the entrepreneur to have a vision of the beginning, middle, and end of the project. Resource management. The focus on the solution determines the effectiveness of execution.

Note: Elaborated by authors (2021).

Regarding the business model, the contributions permeated all phases of the incubation process, from the beginning of product development to the final phase, with the perception of the economy. The validation of the value proposition was significant for the business, at different incubation times, given its ability to promote the reduction of time and resources and to enable a rapid entry into the market. This agility is the result of the planning that the methodology brings to the organization of the team and its functions in the product development cycle.

DISCUSSIONS OF RESULTS

After describing, throughout this text, how incubators and startups implement agile methodologies and the contribution of such a method to the innovation of their business models, the results corroborate the existing literature, highlighting the importance of the services offered by the incubator.

Among these services is the controlled environment, which gives support and legitimacy to startups (Ocampo *et al.*, 2019) and, at the same time, helps in improving the business model of new companies (Lukeš *et al.*, 2019; Patton, 2014).

In this sense, the training and monitoring of agile methodologies (Guillen & Veras, 2018; Shepherd & Gruber, 2021) by incubators, which is especially relevant for innovating the business model (Mas-Verdú *et al.*, 2015). The incubators interviewed reported close follow-up, mostly fortnightly, interspersed with consultancies, mentoring, and advisory services (Hampel *et al.*, 2020; Ocampo *et al.*, 2019), a fact that reinforces the effects of the incubator on companies, as argued by Van Rijnsoever *et al*. (2017) e Patton (2014).

On the other hand, it was observed that, even with monitoring, startups face challenges in implementing agile methodologies. According to Ghezzi (2019), the complexity in the initial adaptation process lies in defining and designing the MVP, validating the product, and getting information from the market, ensuring a competitive advantage for the startup.

The startups interviewed confirmed the findings of the previous studies of Chesbrough (2010), Könnölä *et al.* (2016), e Nurdiani, Börstler, Fricker e Petersen (2019), Nurdiani, Börstler, Fricker, Petersen e Chatzipetrou (2019) on ignorance constitute a critical factor for the implementation of agile methodologies, depending on the limitation imposed on the performance of the team, organization of the project, and making room for validation to happen.

It is noteworthy that the monitoring offered by the incubator sometimes does not reach the expectation of startups in different business contexts or with specific needs for each incubation phase (Iacono & Nagano, 2014).

This research also evidenced the difficulties experienced by entrepreneurs regarding the understanding of agile methodologies (Könnölä *et al.*, 2016), their implementation process (Nurdiani, Börstler, Fricker, & Petersen, 2019), the barriers to the creation of routines of use (Wang *et al.*, 2012), and problems in integrating and managing processes, as well as no team engagement (Könnölä *et al.*, 2016).

Even in the face of the challenges related to agile methodologies, this research described some strategies for entrepreneurs to minimize the effect of this problem. In more extreme cases, in which the methodology does not contribute to the innovation of the business model, entrepreneurs were able to replace it with another tool more suited to the processes and reality of their business.

The reasons for abandoning agile practices complement the research by Nurdiani, Börstler, Fricker e Petersen (2019), as they include the lack of perceived values and the influence of team members' discomfort. No strategies were found to reverse this problematic situation in the literature studied..

After facing the challenges of implementing agile methods, incubators show results as the research of Mas-Verdú *et al.* (2015), that is, they can boost regional development, promoting the circulation of income and the generation of jobs.

In analyzing the final points, this research reinforces the literature on the focus, control, and dynamism of agile methodologies concerning incubated projects (Guillen & Veras, 2018), besides allowing startups to develop planning with daily work control and progress reports (Cooper & Sommer, 2016). Its utilization accelerates the product development cycle and responsiveness to customer needs (Xu & Koivumäki, 2019). It also contributes to increased productivity, with a view to the best communication with the team, the adaptability to change, and the equalization of the load during projects (Könnölä *et al.*, 2016).

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Research on the contributions of agile methodologies to business model innovation indicates market changes (Nurdiani, Börstler, Fricker, & Petersen, 2019; Xu & Koivumäki, 2019); and innovation to better compete with competitors, limiting the imitation of the business model (Casadesus-Masanell & Zhu, 2013). In our study, however, these attributes were not perceived by startup managers, denoting that the innovation of the business model could have gone to be significant.

Thus, the training and the environment proposed by the incubators may not be effective in developing agile methodology, limiting the possibilities to small increments in the business model. If the incubator performs an initial mapping and then offers the tool and follows the effect of its particularities on business, perhaps these limits did not exist.

To minimize this problem, the incubator could define which agile methodologies would be most appropriate for the segment and the startup phase, noting that they are not easily applied to any business (from IT companies to traditional businesses). Moreover, customize the support and monitoring offered to monitor, more clearly and effectively, its development and application, to contribute to innovation in the business model of startups through agile methodologies, as stated by Cooper e Sommer (2016).

The literature does not describe how these relationships must be constructed to improve the process of implementing agile methodologies. The difficulties in applying these tools are particular to each business, so the parameters and development time cannot be the same for all companies (Nurdiani, Börstler, Fricker, & Petersen, 2019).

CONCLUSIONS

The analysis of the data collected by this research reinforces the importance of implementing agile methodologies by incubators and startups to develop new business models or innovate existing ones.

The incubator offers knowledge about these methods through courses, workshops, and mentoring to its incubated companies. With this, it is possible to start monitoring its implementation with periodic meetings with managers.

It helps companies in their daily doubts about the methodology, achieving goals, and adapting to the startup culture. Even so, at times, entrepreneurs felt unassisted due to the standard treatment received on occasions when specific actions were required.

Startup managers develop their actions to overcome difficulties and have learned from their mistakes by adapting the tool to the specificities of their business, empowering their internal team, and, in extreme cases, replacing the agile methodology with one more appropriate to the reality of the company.

The innovation of business models was based on management aspects with low impact, but, with the contributions of agile methodologies, this model should be validated, following the rapid changes of the market, to reduce time and cost in the development of products and, above all, make the business competitive in the face of the competition.

With the difficulties overcome, the incubators can achieve the involvement of startups, promoting greater sustainability for the incubated businesses. The startups, in turn, signaled greater agility in creating their products, the best performance of the team, learning acquired by those involved, metrics such as increased billing, and the number of customers and employees.

It was also observed that agile methodologies contributed to the company's internal organization, which was oriented to planning, executing, and allocating employees. The process of developing and innovating, promoted by this approach, indicated to startup managers the need to focus on the project and reduce the costs of developing products and services.

Through the results and metrics, with the use of agile methodologies, it was perceived that startups did not enjoy all the benefits the tools could offer. Due to the effort to address the difficulties, the focus on innovation in the business model may have shifted to taking care of problems rather than focusing on potential contributions.

Future research can follow, through a longitudinal study, the implementation of agile methodologies, inserting the researcher along all phases of the startup incubation process, thereby evaluating the difficulties and advances of each stage.

Other studies must verify the effectiveness of agile methodologies, changing incubated companies with non-participation in an incubation environment, to understand the strategies used to innovate the business model and its results.

The research had relative limitations: (a) the number of cases of incubators and startups, and a larger sample could contribute to evidence more experiences, thus increasing the parameters of comparison; (b) the actors involved in the incubation process, since the research did not analyze the perspective of mentors and university managers, cited throughout the interviews. This aspect could expand the vision of the innovation process in business models and the relevance of implementing agile methodologies.

Among the contributions of this research, which contributes to enrich the literature on the implementation of agile methodologies to innovate the business model of startups in the incubation process, are (a) the description of the companies that experienced incubation, highlighting the difficulties faced, their effects and results; and (b) the panoramic view of the incubation process, which allows the verification of the fundamental importance of the incubator for the innovation of the BM, since it supports the enterprises in their difficulties.

Startups expressed the desire that the monitoring of the incubator is already specific to each company, concerning its particularities, learning, and execution time. This gap impacted the contributions of agile methodologies, given the numerous difficulties faced by these companies, which are no longer focused on the application or made it superficially, just to validate the product, team management, and planning.

This superficiality does not allow startups to take advantage of the possibilities that innovation brings to the business model, such as improving quality, establishing a competitive differential, and attractiveness to attract investors. Thus, the incubator could format a more customized model, allowing startups to make the most of the potential and benefits of agile methodologies.

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Conflict of interest statemen

The authors declare that there is no conflict of interest.

Authors' statement of individual contributions

Rules	Contributions		
	Mota PG	Silva ALB	Limongi RFC
Conceptualization	■		
Methodology		■	
Software	■		
Validation		■	■
Formal analysis		■	■
Investigation	■		
Resources	■		
Data Curation	■	■	■
Writing - Original Draf	■	■	■
Writing - Review & Editing		■	■
Visualization	■	■	■
Supervision		■	
Project administration	■		
Funding acquisition	■		

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