DOI: 10.5902/1983465969319

HACKATHONS AS A STRATEGY FOR OPEN INNOVATION: INSIGHTS FROM EVENTS IN BRAZIL AND CANADA

HACKATHONS COMO ESTRATÉGIA PARA INOVAÇÃO ABERTA: INSIGHTS DE EVENTOS NO BRASIL E NO CANADÁ

Submission: 17/02/2022
Accept: 08/10/2022

Flávio Régio Brambilla[1]
Douglas Wegner[2]
Cecilia Schaedler[3]

1 Universidade de Santa Cruz do Sul, Santa Cruz do Sul, Rio Grande do Sul, Brazil
2 Fundação Dom Cabral, Nova Lima, Minas Gerais, Brazil
3 Universidade do Vale do Rio dos Sinos, São Leopoldo, Rio Grande do Sul, Brazil

ABSTRACT

Purpose: The present study aims to analyze the elements and practices used in hackathons for software development and how they contribute to the success of the events.
Design/methodology/approach: Through a qualitative and exploratory approach, a multiple case study was used to analyze two hackathon events in Brazil and Canada organized by a multinational technology company. Data collection was carried out through semi-structured interviews and document analysis. Data analysis was conducted using content analysis.
Findings: The results illustrate that the participation of people with different profiles and knowledge is important for hackathon results. The support provided to participants and the choice of the proposed challenge affect participants' perception of the event and the solutions developed.
Research limitations/implications: As this is a multiple case study of a qualitative nature, it is infeasible to establish generalizations based on the results, and it is only possible to present evidence and proposals based on the specific cases.
Practical implications: Proposed best practices to be followed in organizing hackathons, specifically in the context of software development.
Originality/value: Few studies treat the subject of hackathons, and rarer still consider different countries to analyze the enabling elements based on different structures and their contributions to innovation. The development of hackathons as an alternative for innovation in the software area is also investigated.

Keywords: Hackathons; Open innovation; Results; Multiple case study.

RESUMO

Objetivo: O presente estudo tem por objetivo analisar os elementos capacitadores utilizados em *hackathons* de desenvolvimento de software e como eles contribuíram para o sucesso dos eventos.
Método: Mediante abordagem qualitativa e exploratória, o método empregado foi o estudo de casos múltiplos, tendo como unidades de análise dois eventos no formato *hackathon*, organizados por empresa multinacional de tecnologia no Brasil e Canadá. A coleta de dados foi desenvolvida por entrevistas semiestruturadas e análise documental. A análise dos dados foi conduzida com a técnica da análise de conteúdo.
Resultados: Os resultados mostram que a participação de pessoas com perfis e conhecimentos diferentes é importante para os resultados de um *hackathon*. O suporte fornecido aos participantes e a escolha do desafio proposto são aspectos que afetam a percepção dos participantes sobre o evento, assim como exercem influência nas soluções desenvolvidas.
Limitações da pesquisa: Por se tratar de um estudo de casos múltiplos e de caráter qualitativo, não é viável estabelecer generalizações com base nos resultados do estudo, sendo apenas viável apresentar evidências e propostas com base nos casos concretos estudados.
Implicações práticas: Proposição de melhores práticas a serem seguidas para a organização de *hackathons*, em específico no contexto das maratonas para desenvolvimento de soluções.
Originalidade: Poucos estudos são direcionados para a aplicação de *hackathons*, e mais raros são aqueles desenvolvidos considerando diferentes países para análise dos elementos capacitadores baseados em estruturas distintas e suas contribuições na inovação. Investiga-se o desenvolvimento de *hackathons* como alternativa para inovação na área de software.

Palavras-chave: *Hackathons*; Inovação aberta; Resultados; Estudo de casos múltiplos.

1 INTRODUCTION

The way companies innovate has changed significantly in recent decades, moving from a closed innovation model to open innovation, in which collaboration with people and partners outside the company is encouraged (Mehta & Shah, 2022; Anshari & Almunawar, 2021; Obradović *et al*., 2021; Tucci et al., 2018). In open innovation, companies can and should use external and internal ideas to generate value for their products and services (Chesbrough, 2004). Many companies are starting to invest in entrepreneurial environments, which encourage their employees to generate new ideas and, simultaneously, look for ideas outside the company to co-create solutions (Flores *et al*., 2018). As an example of the use of value co-creation principles, Feldmann and Teuteberg (2021) developed their study on success factors in hackathon events in the context of the German banking sector through an investigation of three banks that used hackathons to generate value through the types of interactions common to this kind of work. Palmeira et al. (2014) emphasize that interactivity between the different actors involved, a work format that allows for more significant value generation for all who participate in the process, is essential for transferring knowledge.

Turning an idea into a prototype can take weeks or months, but hackathons nevertheless seek to accomplish this process in a shorter timeframe (Komssi et al., 2014). Programmers and other actors collaborate horizontally over a short period to conceptualize, develop and present an application prototype or asset that solves a given problem or achieves a stipulated objective (Dwivedi, 2022; Mahmudova, 2022; Seravalli & Simeone, 2016; Briscoe & Mulligan, 2014; Komssi et al., 2014; Rosell, Kumar & Shepherd, 2014). Most of the studies on hackathons present the format and structure of the events and the benefits for the organizer and participants (Pe-Than et al., 2020; Serek *et al*., 2020; Covic & Manojlovic, 2019). Leveraging hackathons to accelerate open innovation through

collaboration has occurred more recently, focusing on collaboration between companies, partners, and other individuals, such as educators (Mehta & Shah, 2022) and students (Naumović et al., 2022).

The present study aims to analyze the enabling elements used in software development hackathons and how they contribute to event success. The following research question is explored: what enabling factors of hackathons contribute to better results? Enabling factors are strategies and practices used by organizers to increase the event's chances of success. Therefore, understanding these elements and their use can help organizations organize more effective hackathons and to make this model successful.

Two case studies were conducted to achieve this objective, analyzing hackathons organized in Brazil and Canada by a multinational technology company. The results contribute to management theory and practice by demonstrating that choosing people with diverse profiles and knowledge is important for the hackathon results. In addition, the support provided to participants and the choice of the proposed challenge affect the participants' perception of the event and influence solutions developed.

The article is structured in four sections, in addition to this introduction. In the second section, we present the enabling elements of hackathons and how they affect the event's results. In the third section, we describe and justify the research method, followed by the study's findings in the fourth section. Implications and final considerations are presented in the fifth and last section of the article.

2 LITERATURE REVIEW

2.1 Conceptualization and use of hackathons

Before the 2000s, having a solid internal research and development (R&D) department was a strategic factor for companies in different segments. This innovation strategy has generated large returns for big companies, especially regarding explicit knowledge and intellectual property (Chesbrough, Vanhaverbeke & West, 2017). As this represented a high cost, large companies were much more likely than small and medium-sized companies to generate innovations and compete in the market (Chesbrough, 2004). However, with the acceleration of technological transformations, companies realized that much relevant knowledge lay outside the organization's borders and that R&D success could depend on its access and integration. This movement came to be called open innovation, a term coined by Henry Chesbrough in 2003 to refer to innovation strategies in which the company interacts and collaborates with external actors (Chesbrough, Vanhaverbeke & West, 2017).

Mehta and Shah (2022) highlight hackathons as an open innovation strategy that makes competencies and skills emerge. Franco et al. (2022) classify them as a strategy for fostering innovative ideas. Franco et al. (2022) laud hackathons as an engagement strategy and inspiration for businesses that harness collaborative and sustainable economic principles. This work methodology facilitates cooperation and innovation exchange for specific results, offering relevant solutions thanks to the favorable environment for generating and sharing ideas (Franco et al., 2022).

Hackathons are events in which programmers and other actors working in software development collaborate horizontally, over a short period, to conceptualize, develop and present an application prototype or good that solves a given problem or achieves a stipulated objective (Seravalli & Simeone, 2016; Briscoe & Mulligan, 2014; Komssi et al., 2014; Rosell, Kumar & Shepherd, 2014). They emerged in the late 1990s, based on technology-oriented companies (related to companies'

structures and practices), aiming to develop ideas and solve problems using creative approaches (Mehta & Shah, 2022). These challenges can be related to new products, services, processes, or markets and, therefore, can be used by companies of all segments, sizes, and objectives (Komssi *et al*., 2014; Pe-Than et al., 2020; Serek et al., 2020).

Hackathons can also be conceptualized as activities or friendly competitions used by software programmers and other experts in specific subjects to develop solutions for a specific challenge over a short and previously determined timespan (Mehta & Shah, 2022). Franco et al. (2022) describe hackathons as events that focus on resolving a specific problem, considering the exchange of ideas, development, testing, and application of prototypes and their conversion into products and services intended for the marketplace.

Werlang and Werlang (2021) developed a study linking absorptive capabilities with innovation, focusing on business management by young entrepreneurs. They identified that young entrepreneurs are more receptive to innovation and knowledge absorption to be put into practice. Mehta and Shah (2022) mention this appeal to young audiences when they suggest student-oriented hackathons as alternatives to pedagogical innovation.

During the 2000s, hackathons became more popular among companies "as an approach to rapidly developing new software technologies and locating areas of innovation and funding" (Briscoe & Mulligan, 2014, p.4). With the popularization of solution development marathons, the professional organization of these events also increased, with sponsorship from companies and investors' participation (Briscoe & Mulligan, 2014). Based on the study by Muller and Dal Forno (2017), it was identified that, in general, the predominant behavior of Brazilian companies in software development follows the principles listed in the literature; that is, it ends up following technical-academic standards. Petry et al. (2020) further demonstrate the influence of contingent factors such as company size, environment, structure, strategy, and technology on the performance of software development companies, which illustrates the importance and pertinence of the hackathon approach to obtain better results.

2.2 Enabling elements and benefits of hackathons

The Lean Innovation Model was developed in 2014 by the Lean Analytics Association (2018) and presented a framework covering the various innovation practices, including methodologies, tools, or techniques such as open innovation and co-creation (Prahalad & Ramaswamy, 2004). The model (Figure 1) was created by studying and analyzing different models and successful cases of lean innovations (Lean Analytics Association, 2018). Its structural composition applies to hackathons due to its innovative and collaborative principles. As Mehta and Shah (2022) highlight, hackathons are developed to solve technological and business issues and even attract and develop talent.

Tucci et al. (2018) state that the organization of co-creation events, such as hackathons, incorporates the following elements of the Lean Innovation Model:

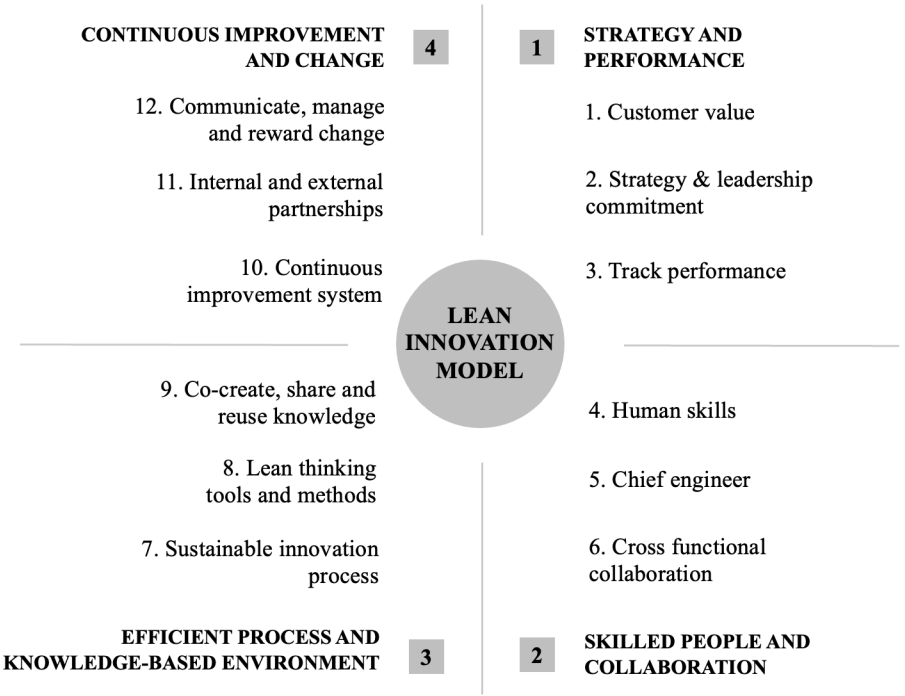
a) Leadership strategy and commitment: the event must be aligned with the organization's vision. Leadership needs to support the event, communicate with potential attendees, and ensure that the results have potential.

b) Cross-functional collaboration: a wide range of participants with different backgrounds ensures that different and 'out of the box' ideas emerge.

c) Sustainable innovation process: having a defined innovation process is essential. Methodologies commonly used in hackathons are Design Thinking and Scrum.

d) Internal and external partnerships: an essential part of the organization of co-creation events, these partnerships range from the provider of the event venue through the facilitators and experts, including the judges.

Figure 1. **Lean Innovation Model**



Source: Adapted from Lean Analytics Association (2018)

Mehta and Shah (2022) make it clear that hackathons can result in strategic initiatives with the possibility of alignment with the decision-making process. The authors complement this reasoning by highlighting the possibility of advancing, through hackathons, prototypes or ideas with broad applicability.

The results of empirical studies underscore the benefits of hackathons. In general terms, extant studies usually mention the need for specific case studies (as is the example of the applicability of this article), as well as calling for quantitative studies and the development of scales to verify the results of hackathons (Mehta & Shah, 2022; Franco et al., 2022; Feldmann & Teuteberg, 2021; Kitsios & Kamariotou, 2019).

Mehta and Shah (2022) present the main benefits of hackathons: learning skills and knowledge, learning in pairs and groups, identifying and resolving organizational or technological problems, and generating ideas and discussions. Other advantages include learning oriented to the business context, ability to promote outside-the-box thinking, experience-based learning (a similar concept to co-creation), approximation of the academic (theoretical) and business (practical) environments, assistance in professional development, as well as other possibilities for expanding knowledge capabilities and even consulting. Franco et al. (2022) studied the generation of business ideas, considering face-to-face and virtual hackathons. They found that face-to-face events furnished better results in generating innovative ideas, overlapping online limitations, and specific psychological difficulties.

Feldmann and Teuteberg (2021) developed their study on the success factors in hackathons in the banking sector based on events conducted at three banks in Germany, immersed in co-creation principles. They identified the variety of decisions involved in the design and planning

of hackathons and verified the difficulty of establishing definitive parameters. They defined as central elements for hackathons the concept of temporal adequacy in their realization and experience (Feldmann & Teuteberg, 2021).

In turn, with a view to innovation strategies and entrepreneurial intention through open data in hackathons, Kitsios and Kamariotou (2019) highlight the relevance of open data and investments for the success of hackathons, especially as a tool to aid in the development of startups. Seravalli and Simeone (2016) studied two hackathon environments in their country, taking into account what they defined as the importance of the stakeholder network in hackathons. This article follows their lead with a study on two hackathons, one in Brazil and the other in Canada, directed at hackathon events as a strategy to promote open innovation. It was developed based on the analysis and gaps shown by the results of the empirical works cited in this literature review (Mehta & Shah, 2022; Franco et al., 2022; Feldmann & Teuteberg, 2021; Kitsios & Kamariotou, 2019; Seravalli & Simeone, 2016). Next, the research method adopted in this study is elucidated.

3 METHOD

This study adopted a qualitative approach, suitable for the exploratory phase in which limited knowledge exists on the research topic (Roesch, 1999). The main characteristics of qualitative research are a) selection of the correct methods and theories; b) recognition and analysis of the different perspectives extant among participants; c) researcher reflections as part of the process; and d) diversity of approaches and methods (Flick, 2004).

In this paper, Case Study Research was used, characterized by an in-depth analysis of a unit of instantiation (Godoy, 1995). This method was chosen because it allows for research of a contemporary phenomenon, verifying how it occurs (Yin, 2015). Yin (2015, p. 4) highlights another benefit of using this method: "a case study allows researchers to focus on a 'case' and retain a holistic perspective of the real world."

3.1 Case selection

The case selection for empirical research utilized two criteria: a) hackathons that took place less than two years ago, ensuring that those involved remained clear about the development of the event and its enabling elements; b) hackathons that have involved employees of the promoting company and that have had facilitators to conduct the process, thereby guaranteeing the presence of a planning process for the events.

Initially, to identify potential cases, contact was made with companies installed in the technology park of a Brazilian university. A technology company (which will be called Alpha Company in this paper) reported having carried out hackathons in the previous two years with the participation of employees (trainees) in its Brazilian and Canadian branches and made itself available to carry out the study. The two events organized by this company were then selected for analysis. Alpha Company develops business management software for more than 425,000 customers in more than 180 countries and has more than 90,000 employees in 130 countries. This company is a leader in its field and promotes hackathons as part of its innovation policy. The present study follows a similar structure to that of Ferreira et al. (2022), in the use of two cases, in this instance, two hackathons, to obtain a better understanding of the phenomenon via the establishment of comparisons and relationships between the cases.

The company's training program ran the two hackathons that are the object of this research, so all participants were trainees. We chose to study these two hackathons to verify whether the enabling elements mentioned in the theoretical review are present in these internal events promoted by the company and how their presence or lack of influence affects the events' outcome. A further benefit was that, during the analysis and discussion of the results in this article, it was possible to compare the different characteristics present in the two events studied.

3.2 Data collection

The sources of data collection used in this research were in-depth interviews and document analysis. To carry out the research, 12 interviews were carried out, six for each case, with participants and organizers of the two hackathons. The interviews were semi-structured, and two scripts were prepared, one for participants and the other for organizers. The scripts were developed from the theoretical review and involved the topics presented in Table 1. This table presents the concepts of study orientation, developed for an approach from two perspectives: the participants and the organizers of the hackathons:

Table 1. **Concepts guiding the research with participants and organizers of hackathons**

Participants	**Basic Concept for Question Formulation**
Cross-functional collaboration	A wide variety of participants ensures that different and "out of the box" ideas emerge. (Tucci et al., 2018). The participation of people with different academic backgrounds is a key success factor in organizing a hackathon (Cobham et al., 2017b)
Leadership strategy and commitment	The event needs to be aligned with the organization's vision. Leadership must support the event, communicate with potential participants, and ensure that the results have potential. (Tucci et al., 2018). During hackathon hours, there must be multiple leaders and coordinators who can provide support. (Cobham et al., 2017a). Clear goals are essential to keep participants focused, which is critical for them to feel satisfied with their results (Filippova, Trainer & Herbsleb, 2017)
Defined innovation process	Having a defined innovation process is essential. Design Thinking and Scrum are commonly used in hackathons (Tucci et al., 2018)
Organizers	Basic Concept for Question Formulation
Cross-functional collaboration	A wide variety of participants ensures that different and "out of the box" ideas emerge. (Tucci et al., 2018). The participation of people with different academic backgrounds is a key success factor in organizing a hackathon (Cobham et al., 2017b)
Leadership strategy and commitment	The event needs to be aligned with the organization's vision. Leadership must support the event, communicate with potential participants, and ensure that the results have potential. (Tucci et al., 2018). During hackathon hours, there must be multiple leaders and coordinators who can provide support during the event. (Cobham et al., 2017a). Clear goals are essential to keep participants focused, which is critical for them to feel satisfied with their results (Filippova, Trainer & Herbsleb, 2017)
Defined innovation process	Having a defined innovation process is essential. Design Thinking and Scrum are commonly used in hackathons (Tucci *et al*., 2018)
Internal and external partnerships	An important part of organizing co-creation events, these partnerships range from the venue provider, photographers, facilitators, and experts, to the judges. (Tucci et al., 2018). The venue for the event and other resources must be of high quality to promote a business-like environment (Cobham, 2017a)

Source: Elaborated by the authors

After the scripts were completed, they were validated by two hackathons experts: a Doctor in Business Administration, who developed his thesis on the hackathon co-innovation process, and an employee of Alpha Company, who has already organized several events. Some language changes were made based on expert considerations, and the final script was tested with a hackathon participant in Brazil to ensure the script was complete and understandable. With the script finalized, interviews with participants and organizers were scheduled.

Invitations were sent to all the people who participated in the hackathons and were still working at the company at the time of the survey (March 2020). The interviews were scheduled as the participants responded, confirming their interest. All interviews were conducted remotely in April 2020. The interviews continued until information saturation was reached after the sixth interviewee in each case. To preserve the anonymity of each interviewee, a code was created for each of the respondents, indicated in Table 2, shown below:

Table 2. **List of interviewees**

Hackathon	Role	Profile	Interviewee Code
Brazil	Participant	Area: Business Time in the company: 1 year and 5 months	SLP1
Brazil	Participant	Area: Development Time in the company: 1 year and 2 months	SLP2
Brazil	Participant	Area: Development Time in the company: 9 months	SLP3
Brazil	Participant	Area: Business Time in the company: 11 months	SLP4
Brazil	Mentor	Area: Technical Mentor Time in the company: 3 years and 6 months	SLM1
Brazil	Organizer	Area: Organizer Time in the company: 1 year and 3 months	SLO1
Canada	Participant	Area: Development Time in the company: 11 months	VCP1
Canada	Participant	Area: Development Time in the company: 8 months	VCP2
Canada	Participant	Area: Business Time in the company: 9 months	VCP3
Canada	Participant	Area: Design Time in the company: 1 year and 2 months	VCP4
Canada	Organizer	Area: Organizer Time in the company: 1 year and 1 month	VCO1
Canada	Organizer	Area: Organizer Time in the company: 9 months	VCO2

Source: Elaborated by the authors

In addition to the interviews, the researchers asked the company for all documents related to the hackathons that could contain relevant information on the process and the participants' perceptions. The company made available a document referring to the hackathon held in Brazil (Doc1) that indicates the event's agenda, the activities that took place during the event, their respective times, and the organizing committee members. In addition, it made available two documents about the Canadian hackathon: structure and guidelines for the event planning process to be followed

by the members of the organizing committee (Doc2) and a collaborative document created by the organizers that recorded decisions about the budget, agenda, partners, awards, and checklists of activities to be done before, during and after the hackathon (Doc3).

3.3 Data analysis

The data analysis technique used was content analysis with qualitative data. These data points are sourced from texts found during data collection, which can be documents, interviews, and reports (Saccol et al., 2012). Bardin (1977) mentions that content analysis consists of an organization of analysis techniques of the reports obtained in an organized and systematic way. The objective is the "description of the content of the messages, indicators (quantitative or not) that allow the inference of knowledge related to the conditions of production/reception (variables) of these messages" (Bardin 1977, p.42). For content analysis, Atlas.ti software was used. Free category analysis was first carried out in this research, after which the theory supported the categories found. For document analysis, the documents and reports generated in the development of the hackathons were used.

4 Results and Discussion

Case 1 is a hackathon that took place in Brazil in October 2019 at the headquarters of Alpha Company. The event lasted 24 hours, from 11 am on a Saturday to 11 am on Sunday, with 5 teams of 5 to 6 participants, totaling 28 trainees (DOC1). To propose the challenge that should be solved during the event, Alpha Company brought in a local urban collective startup that creates innovative and sustainable solutions to generate social impact and transform cities. The problem that the startup presented to participants was: how to manage ideas to promote citizenship.

The Case 2 Hackathon occurred in Vancouver, Canada, in November 2019. The event lasted 24 hours, with 12 hours on the first day and another 12 on the second, with a 12-hour break at night. It comprised 12 teams of 3 to 4 participants, totaling 47 trainees (DOC3). To propose the challenge that had to be solved during this hackathon, the organizing committee partnered with the team of an innovation center at Alpha Company. Based on the United Nations 2030 Agenda, the team chose one of the 17 sustainable development goals as the theme of the event. The chosen objective was 'Goal 13,' related to sustainability and climate change. Thus, the trainees were challenged to develop a solution to help achieve this aim.

4.1 Enabling elements present in hackathons

Regarding cross-functional collaboration, the interviews show that the existence of participants with different profiles ensures that the idea creation phase is fruitful. Participants in both hackathons reported that different profiles contribute to better solutions regarding technical, design, and business perspectives. This finding confirms the results of Tucci et al. (2018), who maintain that a wide variety of profiles fosters "outside of the box" ideas. In the study by Mehta and Shah (2022), it was found that the perception of the results of a hackathon varies between participants and advisors according to elements such as age and professional and academic experience. However, similar performance profiles tend to represent perceptions of results with closer judgments.

In Case 1, all teams had heterogeneous profiles, as the organizers divided the teams seeking to equalize the distribution of knowledge. In Case 2, trainees could sign up with an already formed team or alone if they didn't have a team. Although the organizers encouraged the participation of

trainees with diverse profiles, some teams did not have people from the design or business area. Cobham et al. (2017) reiterate that the participation of people with different academic backgrounds is a key success factor for hackathons. However, the Case 2 marathon-winning team was only made up of developers. Despite this, the interviewee who was part of the winning team stated that having someone with experience in the business area would have improved the final solution proposed by the team. According to Komssi et al. (2014), with the existence of different profiles and knowledge, some divergences of ideas end up emerging, which can be a challenge if communication within the team is ineffective. However, none of the interviewees reported any discussion or disagreement that affected the team's work.

In Case 1, the teams had 5 to 6 participants, plus a mentor. In Case 2, the teams were smaller, with 3 to 4 participants and no mentors. From the analysis of the interviews, it is possible to perceive that the number of participants is a factor that must be considered when organizing the hackathon. This is because if teams are too small, they may not be able to deliver a prototype in the short time available. In addition, a small number of participants can mean a smaller number of different ideas and perspectives, which negatively influences an innovation event's outcome. However, large teams are also not ideal, as too many different opinions need to cycled through to reach a decision. This is inefficient when working with time constraints, a point brought up by interviewees in Case 1. In addition, the number of entries needs to be considered. If there are many participants in total and the teams are small, many products will be presented in the final pitch, which can be tiring for both the judges and the participants. In Case 2, evidence showed that the presentations took longer than planned due to a large number of teams; therefore, the hackathon ended up extending beyond the scheduled time (Doc2).

Another aspect that was different from one case study to the other was the process of defining the teams. As mentioned in Case 1, the organizing committee itself formed the teams. As a result, the trainees could meet new people and add to their network of professional contacts. Briscoe and Mulligan (2014) assert that marathons are a good opportunity to meet and collaborate with new people, creating connections. In Case 2, the trainees could sign up with preformed team, so not everyone had the opportunity to meet new colleagues. However, some interviewees commented that working with people they knew contributed positively to team conflict resolution and decision-making. As such, it can be inferred that prior acquaintance with team members facilitates interaction.

In general, it is possible to conclude that the variety of profiles and areas of expertise on the same team contributes to creating innovative and complete solutions but does not necessarily guarantee the team's success. This contradicts the findings of Cobham et al. (2017b). They claim that the participation of people with different academic backgrounds is a key success factor in organizing a hackathon.

About leadership strategy and commitment, Tucci et al. (2018) state that the event needs to be aligned with the organization's vision. Briscoe and Mulligan (2014) also claim that bringing up an issue of importance to event participants helps with engagement. Flores et al. (2018) point out that, for a hackathon to be successful, the challenge must be specific and concrete. In both cases studied, the interviewees stated that the proposed challenge was aligned with Alpha Company's aims for the future.

However, in Case 1, some interviewees commented that they had difficulty addressing the proposed challenge because it was too vague. The startup that instigated the challenge had internal problems that overshadowed some teams' initial problem. In this line of thinking, Filippova, Trainer and Herbsleb (2017) highlight the importance of having clear goals to keep participants focused and satisfied with their results.

In Case 2, some participants did not perceive the higher purpose of the hackathon—that is, brainstorming a solution to a problem—but believed that the event's purpose was to participate and meet people, which demotivated them. Furthermore, as a result, they did not see much value in the event or its results.

From this, it can be seen how vital it is to decide well on the challenge that will be presented for the hackathon participants to solve. In addition to being aligned with the company's vision and strategy, it must be adequately delimited; too vague and it can end up impeding team success, mainly due to the existing time constraint, as the participants do not have much time to propose ideas for the solution that must be delivered.

Leadership commitment is also manifested in the support provided to participants by the organizers. To organize the hackathon, a team needs to be formed. This team includes facilitators, experts, presenters, jurors, and people who will assist as consultants for the participating teams (Flores et al., 2018; Tucci et al., 2018). Regarding the infrastructure and technology support provided by the organizers, in both cases studied, the interviewees were satisfied, as the events took place in the company's offices. Hence, they had access to all the equipment and facilities available. As for the support of people, in Case 2, some interviewees reported that it was insufficient. Unlike in Case 1, this hackathon had no help from mentors and consultants. Given this, it is possible to verify that, especially in hackathons where there are many first-time participants, the presence of people working as guides is relevant and positively perceived. In this context, mentors and consultants are people with experience in at least one of the areas of the hackathon. They help participants by giving opinions, tips, and advice, which can result in a higher quality solution.

The duration and format of the event were also different in both cases. In the first, the hackathon took place for 24 straight hours. In the second case, the hackathon was divided into two 12-hour parts, with an interval of 11 hours between them. The interviews show that the second format is more suitable, as some trainees and the organizer commented that they were exhausted by the first. In addition, one of the interviewees reported that he had to sleep for a few hours around dawn during the event, as he was exhausted and, therefore, could not contribute to his team.

Regarding partnerships signed by the event's organization, Tucci et al. (2018) state that they are essential to organizing co-creation events, ranging from event venue providers, photographers, facilitators, and experts, to the judges. The main difference between the two hackathons studied was the partnership with senior employees of Alpha Company to act as mentors and consultants for the teams, which occurred in Case 1, but not in Case 2. The interviewees noted that these partners played important roles in Case 1 and helped the teams significantly. In Case 2, some interviewees reported that they missed having people who were available and dedicated that they could contact to ask questions and talk through ideas.

However, there were some differing opinions about the mentors in Case 1. Although all the trainees interviewed agreed that their help was necessary for the team, some mentors took too much control of the team in certain situations, which reduced participants' autonomy and may have affected the development of essential skills. An example of this was a situation reported by one of the interviewees in which two team members wanted to present the final pitch. Instead of trying to help the team in decision-making and managing the conflict, the mentor decided to give the presentation. This attitude took away an opportunity for a trainee to develop public speaking skills.

Another example where the constant presence of a mentor was not so positive was during brainstorming and selecting an idea to pursue. Some interviewees reported that the mentor tried to influence their work in the direction he believed would increase the team's chance of winning the final prize. While mentors occupy a vital role as mediators of the brainstorming session, who

help participants reflect on the problem and possible solutions, they should not try to influence the direction participants should take. Despite this, several interviewees commented that the support provided by the mentor was essential, especially in terms of time management and conflict resolution. Therefore, partnering with mentors who can guide the participants is good practice, but they must be guided in their role beforehand to protect the team members' autonomy.

Tucci et al. (2018) emphasize that the location where the hackathon will take place needs to encourage participants' innovation and creativity so that the resulting ideas and prototypes are as original and diverse as possible. In both cases studied, the marathon took place at Alpha Company's office, which has the necessary infrastructure and technology for the teams and is an environment familiar to the participants.

Another partnership the organizers must decide on is the food and drinks suppliers. Organizers usually provide the meals and the structure that the teams need so that they can focus only on developing the solution (Komssi et al., 2014). Tucci et al. (2018) also state that the food and drinks offered must be sufficient to maintain the energy level of the participants. Several meals and energy drinks were made available to trainees in both cases, freeing up brainpower to concentrate on the challenge.

Flores et al. (2018) and Tucci et al. (2018) state that, due to the short duration of hackathons, there must be a well-defined process for participating teams to follow. The authors also comment that the most popular process in hackathons aimed at programming and software development is Scrum. When it comes to a corporate or business hackathon, Design Thinking is the most common methodology, as it considers the end user's needs, understanding the problem through interviews, research, and observation. However, in neither case was there a definition of a specific work methodology that the participants had to follow. In Case 1, the organizer interviewed pointed out that the organizing committee decided not to stipulate a methodology so as not to run the risk that one team would have an advantage over another, in case some members were already familiar with the method. Even so, the organizers presented the participants with the main options they had to carry out the planning and development of the solution and also made the entire infrastructure available. In Case 2, the interviewed organizers reported that they did not want to propose a methodology to avoid limiting the participants, as they wanted to see all the innovative solutions they would present. Even so, all teams delivered a prototype solution at the end of the event. Therefore, it is not strictly necessary to have a defined innovation process. However, it is good practice to present the different options to the participants and provide the necessary infrastructure and materials for whatever methodology they follow. This result offers a new perspective to the studies by Flores et al. (2018) and Tucci et al. (2018).

After the teams' presentations in the pitches, the winning idea's announcement, and the event's closing, the post-hackathon phase, also called the reflection phase, takes place. Some organizers may forget or neglect this step, but at this stage, the organizing team receives feedback on what can be improved for upcoming events (Flores et al., 2018). In addition, it is at this moment that the ideas and prototypes developed are analyzed more deeply, and it is verified whether they can be taken forward and developed as a solution. Finally, the reflection phase is also used to communicate about the hackathon and announce its results (Flores et al., 2018).

In Case 1, participants could pass their feedback on to the organizers after the event. In addition, the winning team had some meetings with the startup that proposed the challenge to discuss the solution; unfortunately, the idea ended up not working. In Case 2, the organizing team passed all the feedback and suggestions from the judges to the participants, but the winning idea also ended up not being developed.

Table 3. **Comparison between cases based on similarities and differences in hackathons**

Case 1	Case 2	Initial Categories	Intermediate Categories
X	X	Having people with different profiles is positive	Cross-functional collaboration
X	X	Different profiles can generate different ideas and conflicts	
X		All teams had people with different profiles and knowledge	
X		Varied competencies within the same team generate knowledge sharing	
X		Organizers formed teams	
	X	Participants were able to choose their teams	
	X	The low number of participants per team is positive	
X	X	The proposed problem was in line with what the company aims for the future	Leadership strategy and commitment
X		The proposed challenge was very comprehensive	
X	X	The purpose of the hackathon was unclear to the participants	
X	X	Participants were satisfied with the organizers' support (people, technology, and infrastructure)	
X		Participants had access to mentors and consultants to assist them	
	X	Participants wish they had mentors	
	X	It was challenging to find people to help the team	
	X	Before the hackathon, there was an event for participants to interact	
X		Mentors helped teams manage time, create ideas, and resolve conflicts	Internal and external partnerships
X		Mentors played a more active role on the team than just helping the trainees	
X	X	The jury was composed of employees with extensive experience in the market and at Alpha Company with different areas of knowledge.	
X	X	There were speakers during the event	
X		The partnership with food and beverage suppliers was important to keep the trainees focused	
X	X	The organizers established no defined innovation process	Defined innovation process
X		The methodologies to be used were presented	
X		Teams followed specific methodologies or steps to plan and develop the solution	
	X	Teams were not formal with the steps they followed	
X	X	Development of technical and interpersonal skills	Hackathon results
X	X	Networking	
X	X	Feeling of accomplishment when creating an innovative solution	
X	X	Feedback and insights on what can be improved in upcoming hackathons	

Source: Elaborated by the authors

Finally, about the results for the participants, the main ones mentioned by the interviewees were individual learning and development and the opportunity to meet new people and to learn from them (Komssi et al., 2014). For Alpha Company, the two hackathons' main objective was not to create a new product but to provide the experience of a marathon to the trainees to develop new skills and grow their contacts. Based on the analysis of the interviews, it can be said that Alpha Company achieved its objective.

5 Implications and Conclusions

This research aimed to analyze the enabling elements used in software development hackathons and how they contributed to the success of the events. Therefore, a case study of these hackathons was carried out in a technology company. The survey involved employees in a branch in Brazil and another in Canada.

From a theoretical point of view, this research generates the following contributions. First, the results show that while cross-functional collaboration is positive, it is not a key success factor for a hackathon. The research demonstrated that the participation of people with different backgrounds leads to creating ideas through diverse perspectives and knowledge. However, it does not necessarily guarantee the emergence of the best ideas. This contrasts with the results presented by Cobham et al. (2017b). As a second theoretical contribution, the results show that the demarcation of an innovation methodology by the hackathon organizers is not mandatory, as the participants can self-organize to deliver the solution in the stipulated time, even without a specific methodology or process. This offers a different perspective than the studies by Flores et al. (2018) and Tucci et al. (2018), who claim that this definition is essential for events such as solution development marathons. Another contribution is that this research tested the theoretical model of Tucci et al. (2018), who proposed the enablers analyzed in this study but had not yet been operationalized empirically.

The study results also contribute to practice. The first managerial contribution consists of the precept that the presence of mentors to help hackathon teams is important but that they cannot become active members of the team because it diminishes the participants' autonomy and opportunities to learn and employ skills. The second is that the number of teams and participants on each team is something the organizers must consider that has not been stressed in the literature. The results of this research show that, in large teams, there is much divergence of ideas and opinions that need to be heard and resolved, which may not be efficient in the limited time of a hackathon. On the other hand, having smaller teams may foster fewer creative and innovative ideas. As much as possible, it is recommended that all hackathon teams be composed of developers, designers, and businesspeople, with heterogeneous profiles, thus capturing the group's most comprehensive possible range of contributions.

From a methodological viewpoint, this research had some limitations. As the two hackathons had already taken place, it was impossible to carry out participant observation or direct observation of the events. Therefore, only two data collection techniques were used: document analysis and in-depth interviews. Interviews were also conducted with some participants of each hackathon. However, it was not possible to interview a member of each team. The research was also limited to analyzing hackathons promoted solely by Alpha Company and intended only for trainees, which does not allow the generalization of the results under different conditions.

As a proposal for future studies, it is suggested to test the theoretical model of the enablers in other co-creation events or other types of hackathons, which also involve people external to the company promoting the event, to compare the results and expand understanding of the model. An-

other point to be developed is the importance and analysis of co-creation practices in the hackathon dynamics, as well as deepening the study of more traditional methodologies used in this type of events, such as Design Thinking and Scrum.

REFERENCES

Anshari, M., & Almunawar, M.N. (2022). Adopting open innovation for SMEs and industrial revolution 4.0. *Journal of Science and Technology Policy Management*, 13(2), 405-427. https://doi.org/10.1108/JSTPM-03-2020-0061

Bardin, L. (1977). *Análise de conteúdo.* Lisboa: Edições 70.

Briscoe, G., & Mulligan, C. (2014). Digital innovation: The hackathon phenomenon [*Working Paper* Nº 6]. *Creative Works London,* Londres.

Chesbrough, H. (2004). Managing open innovation. *Research-Technology Management, 47*(1), 23-26.

Chesbrough, H., Vanhaverbeke, W., & West, J. (2017). *Novas fronteiras em inovação aberta.* São Paulo: Blucher.

Cobham, D., Gowen, C., Jacques, K., Laurel, J., & Ringham, S. (2017, março). From appfest to entrepreneurs: using a *hackathon* event to seed a university student-led enterprise. *International Technology, Education and Development Conference*, Valencia, Espanha, 11.

Cobham, D., Gowen, C., Hargrave, B., Jacques, K., Laurel, J., & Ringham, S. (2017, July). From *hackathon* to student enterprise: an evaluation of creating successful and sustainable student entrepreneurial activity initiated by a university *hackathon*. *International Conference on Education and New Learning Technologies*, Barcelona, Espanha, 9.

Covic, Z., & Manojlovic, H. (2019, setembro). Developing Key Competencies through Hackathon Based Learning. *International Symposium on Intelligent Systems and Informatics*, Subotica, Sérvia, 17.

Dwivedi, N., Katiyar, D., & Goel, G. (2022). A Comparative Study of Various Software Development Life Cycle (SDLC) Models. *IJRESM*, 5(3), 141–144.

Feldmann, A., & Teuteberg, F. (2021). Success factors for hackathons: German banks collaborate to tame the economic crisis. *Journal of Business Strategy*, 42(6), 428-438. https://doi.org/10.1108/JBS-06-2020-0114

Ferreira, K. F. O., Guimarães, L. de O., Salume, P. K., & Doyle, M. L. de F. C. P. (2022). Analysis of the entrepreneurial process from effectuation and causation logic: a case study in two companies from Minas Gerais. *Revista de Administração da UFSM*, *15*(1), 83–104. https://doi.org/10.5902/1983465964831

Filippova, A., Trainer, E., & Herbsleb, J. D. (2017, maio). From diversity by numbers to diversity as process: supporting inclusiveness in software development teams with brainstorming. *International Conference on Software Engineering*, Buenos Aires, Argentina, 39.

Franco, S., Presenza, A., & Petruzzelli, A.M. (2022). Boosting innovative business ideas through hackathons. The "Hack for Travel" case study. *European Journal of Innovation Management,* 25(6), 413-431. https://doi.org/10.1108/EJIM-06-2021-0300

Flick, U. (2004). *Uma introdução à Pesquisa Qualitativa* **(**2a ed.). Porto Alegre: Bookman.

Flores, M., Golob, M., Maklin, D., Herrera, M., Tucci, C., Al-Ashaab, A., Williams, L., Encinas, A., Martinez, V., Zaki, M., Sosa, L., & Pineda, K. F. (2018, agosto). How can *hackathons* accelerate corporate innovation? *International Conference on Advances in Production Management Systems*, Seoul, Coréia do Sul.

Godoy, A. S. (1995). Pesquisa qualitativa: tipos fundamentais. *Revista de Administração de Empresas, 35*(2), 57-63.

Kitsios, F., & Kamariotou, M. (2019). Open data hackathons: an innovative strategy to enhance entrepreneurial intention. *International Journal of Innovation Science*, 10(4), 519-538. https://doi.org/10.1108/IJIS-06-2017-0055

Komssi, M., Pichlis, D., Raatikainen, M., Kindström, K., & Järvinen, J. (2014). What are *hackathons* for? *IEEE Software, 32*(5), 60-67.

Lean Analytics Association. (2018). Lean Innovation Model. *Via Colombei,* 2018. Disponível em: http://lean-analytics.org/lean-innovation-model/. Acesso em: 31 out. 2019.

Mahmudova, S. (2022). Development of a Conceptual Model for Intelligent Software System Designing. *Review of Information Engineering and Applications*, 9(1), 12–22. https://doi.org/10.18488/79.v9i1.2967

Mehta, N., Bist, S.S., & Shah, P. (2022). Hackathons: what do engineering educators think about it?. *Higher Education, Skills and Work-Based Learning,* ahead-of-print. https://doi.org/10.1108/HESWBL-03-2021-0064

Muller, F. M., & Dal Forno, G. B. (2017). Construction and validation of an Instrument for Evaluation of Critical Factors in Software Development Projects. *Revista de Administração da UFSM*, *10*(4), 725–746. https://doi.org/10.5902/1983465926726

Naumović, T., Vajagić, B., Cvetković, L., & Proročić, M. (2022). Open innovations and the role of hackathons. *E-Business Technologies Conference Proceedings*, *2*(1), 42–45.

Obradović, T.; Vlačić, B., & Dabić, M. (2021). Open innovation in the manufacturing industry: A review and research agenda. *Technovation*, 102, 1-16. https://doi.org/10.1016/j.technovation.2021.102221

Palmeira, E. P.; Lima, R. T.; Oliveira, E. R. & Serralvo, F. A. (2014). A eficácia na utilização do paradigma de inovação aberta pelas empresas como um diferencial de competitividade e criação de valor. *Revista Brasileira de Administração Científica*, 5(1), 236-247. http://dx.doi.org/10.6008/SPC2179684X.2014.001.0014

Pe-Than, E. P. P., Nolte, A., Filippova, A., Bird, C., Scallen, S., & Herbsleb, J. (2020). Corporate hackathons, how and why? A multiple case study of motivation, projects proposal and selection, goal setting, coordination, and outcomes. *Human–Computer Interaction*, 1-33.

Petry, D. R., Oro, I. M., Suzana, J., Lorentz, J. A., Piekas, A. A. S., & Paludo, J. C. (2020). Organizational performance: influence of contingency factors in Santa Catarina software development companies. *Revista de Administração da UFSM*, *13*(1), 202–219. https://doi.org/10.5902/1983465929370

Prahalad, C. K., & Ramaswamy, V. (2004). Co-creation Experiences: The next practice in value creation. *Journal of Interactive Marketing, 18*(3), 5-14.

Roesch, S. M. A. (1999). *Projetos de estágio e de pesquisa em administração: guia para estágios, trabalhos de conclusão, dissertações e estudos de caso* (2a ed.). São Paulo: Atlas.

Rosell, B., Kumar, S., & Shepherd, J. (2014, May). Unleashing innovation through internal *hackathons*. *Innovations in Technology Conference*, Warwick, Rhode Island, EUA.

Saccol, A. (Org.), Vasconcellos, L., Machado, L., & Azevedo, D. (2012). *Metodologia de pesquisa em administração: uma abordagem prática.* São Leopoldo: Unisinos.

Seravalli, A., & Simeone, L. (2016). Performing hackathons as a way of positioning boundary organizations. *Journal of Organizational Change Management*, 29(3), 326-343. https://doi.org/10.1108/JOCM-04-2013-0060

Serek, A., Zhaparov, M., Yoo, S. M., Talasbek, A., Kim, Y. K., & Jin, M. W. (2020). Best Practices in Running IT Hackthons Based on Paragon University Dataset. *International Journal of Emerging Technologies in Learning (iJET), 15*(19), 231-238.

Tucci, C., Maklin, D., Golob, M., & Flores, M. (2019, junho). Speeding Up Innovation with Business *Hackathons*: Insights into three Case Studies. *Academy for Design Innovation Management Conference*, Londres, Reino Unido.

Yin, R. K. (2015). *Estudo de Caso: planejamento e métodos* (5a ed.). Porto Alegre: Bookman.

Werlang, B. L., & Werlang, N. B. (2021). Absorptive capacity and innovation: an analysis of business management of young entrepreneurs. *Revista de Administração da UFSM*, *14*, 1123–1139. https://doi.org/10.5902/1983465964692

AUTHORS

1. Flávio Régio Brambilla
Institution: Universidade de Santa Cruz do Sul – UNISC
Santa Cruz do Sul, Rio Grande do Sul, Brazil. Doctor in Administration (UNISINOS), graduated in 2010 (Ph.D in Management)
E-mail: flaviobrambilla@terra.com.br
ORCID: https://orcid.org/0000-0002-9398-7240

2. Douglas Wegner
Institution: Fundação Dom Cabral
Nova Lima, Minas Gerais, Brazil. PhD degree in business administration from the Federal University of Rio Grande do Sul (2011)
E-mail: dwegner@fdc.org.br
ORCID: https://orcid.org/0000-0001-8634-5971

3. Cecilia Schadler
Institution: Universidade do Vale do Rio dos Sinos – UNISINOS
São Leopoldo, Rio Grande do Sul, Brazil. Bachelor in Business Administration from Unisinos University (Brazil).
E-mail: schaedlercecilia@gmail.com
ORCID: https://orcid.org/0000-0002-6427-9843

Contribution of authors

Contribution	[Author 1]	[Author 2]	[Author 3]
1. Definition of research problem	√	√	√
2. Development of hypotheses or research questions (empirical studies)	√	√	√
3. Development of theoretical propositions (theoretical work)	√	√	√
4. Theoretical foundation / Literature review	√	√	√
5. Definition of methodological procedures	√	√	√
6. Data collection			√
7. Statistical analysis			
8. Analysis and interpretation of data	√	√	√
9. Critical revision of the manuscript	√	√	
10. Manuscript writing	√	√	√

Conflict of Interest

The authors have stated that there is no conflict of interest.

Plagiarism Check

The ReA/UFSM maintains the practice of submitting all documents approved for publication to the plagiarism check, using specific tools, e.g.: CopySpider.