An Exploratory Study of the Benefits of Time-bounded Collaborative Events for Startup Founders

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Abstract—Time-bounded collaborative events attract people with different backgrounds to work in small teams to develop a project that addresses a particular problem in a very short amount of time. Previous research acknowledges that event participants have the opportunity to learn new things, meet people, and gain recognition, among other benefits. However, there are few studies exploring the relationship between these events and startups. Basically, these studies report that some projects developed during these events result in startups. This paper aims to explore how startup founders benefit from time-bounded events. We used a qualitative exploratory approach to collecting data through semi-structured interviews with 20 startup founders. The benefits cited by the interviewees include the development of new products, raising money, gaining visibility, and identifying opportunities for action, learning and networking. In particular, learning can be divided into many types, including learning about software development and business methodologies, new tools, and soft skills. Networking can benefit startups by allowing them to identify founders, partners, customers, and employees. Our results suggest that participation in time-bounded collaborative events helps startup founders to satisfy some of the needs of their startups. We conclude by presenting recommendations for event organizers.

Index Terms—Time-bounded collaborative events, hackathons, startups

I. INTRODUCTION

Time-bounded collaborative events (or simply, TBCEs) such as hackathons, ideathons, code fests, Startup Weekends, hackdays, game jams and others, attract people with different expertise and goals to work in small teams during one to two days developing a project that aims to solve a certain problem [1], [2]. These events provide a supportive environment for innovation using digital technologies in a wide variety of domains such as music, physical well-being, open data, education, and many others [3].

TBCEs can be organized to achieve different goals, such as solving urban problems faced by the citizens of a locality [4]; providing a collaborative learning environment for students [5]; or developing a company's workforce [6]. They encourage collaboration, experimentation, and learning [1]. Through the experience gained from working in these events, participants have the opportunity to increase their professional network [5], [7]–[9], develop new software prototypes [1], [10] or even receive job offers [8], [9]. TBCEs also provide participants learning opportunities to put into practice the knowledge acquired in the classroom [5], [7], [8], about new technologies [1], [11], and finally, they allow participants to develop and improve soft skills such as teamwork, time management, decision making and problem solving [9], [12], [13] as well as entrepreneurial skills [14]–[16].

Time-bounded collaborative events also play an important role in innovation. It is possible to find cases of ventures – especially startups[1] – originated from prototypes developed in these events [18]–[20], although this takes place under specific circumstances [21]. Because of that, TBCEs contribute to the development of startup ecosystems [14], [22], [23]. Despite this previous research about the relationship between time-bounded collaborative events and startups, most of these studies point to these events as solely an opportunity to develop a project that can lead to a startup [21]. In addition, these studies focus on participants who started their startups *after* a TBCE took place. A exception is the work of Nolte [21] who reveals a different pattern: most Estonian startup founders started participating in hackathons *after* they founded their companies. In a different study, Medina and Nolte [24] observed that some entrepreneurs attended TBCEs to learn something new, network, receive feedback on an idea, and develop prototypes.

In general, we argue that further research is needed to understand what motivates startup founders to attend TBCEs and how their participation benefits their startups. Thus, this paper aims to answer the following research question: *How do startup founders benefit from participating in time-bounded collaborative events?* To answer this question, we conducted an exploratory study based on semi-structured interviews [25] with 20 startup founders who participated in several time-bounded collaborative events. We qualitatively analyzed the interviews taking into account the maturity, or phase, of the startup [26].

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[1]Startups are usually small emerging companies with the possibility of rapid evolution as they explore problems that still do not have a well-defined solution [17]

The analysis allowed us to identify the benefits TBCEs provided to the informants before or after their startups were founded while combining and contrasting their experience in different types of events, such as hackathons, entrepreneurship events and game jams. We go beyond existing literature by unveiling the different types of learning and networking that take place during these events. More importantly, our results indicate when – during the startup journey – these benefits were found to be more important.

The rest of this article presents a contextualization of the topics discussed in this paper in section II. Section III reports related work, followed by section IV which covers the methodology we used, while section V presents our results. This is followed by a discussion of these results and our limitations. Finally, our conclusions, implications, and plans for future work are presented in section VII.

II. BACKGROUND

A. Startups

The term startup can have many definitions, e.g. a small emerging company that may have a rapid evolution by exploring problems that still do not have a well-defined solution [17]. In general, startups create new products and services under extreme uncertainty about the market, product characteristics, competition, people and finance [27]. They seek to achieve a replicable, profitable, and scalable business model [28].

A startup can go through 3 phases of maturity until it reaches a stage where it can support itself with its own resources and move on to the condition of a mature company: (1) Ideation; (2) Stabilization and (3) Growth [26].

The first phase, *Ideation*, is the period during which the first startup product is conceived. In this phase, the founder will take their ideas off the paper and try to put them into practice, which means there will be constant interaction with customers to understand their problems and explore different business models [26]. Therefore, it is important that startups assemble a founding team who is knowledgeable about product design, user experience, development and testing [29]–[31]. It is also necessary to gather resources, such as additional co-founders, funding, and the first set of employees [32]. This phase ends when the first sale of the startup product occurs [26]

In the second phase, *Stabilization*, the startup is ready to market its product and search for additional customers since, at this point, it has already acquired its first customer. At this stage, entrepreneurs begin to develop the skills needed to run the business. In addition to starting to structure the company, expanding and consolidating its organizational capabilities, it is important that the company starts to hire people with some knowledge of administrative, legal and/or financial aspects, marketing and sales [31]. It is also important that the startup reinforces its development team so that the product can handle the new customers [29], [31], [32]. This phase lasts until the startup can make its product or service available to more customers without overwhelming the company [26].

Finally, the third and last phase is the *Growth* phase. At this point the start product is available to more customers, therefore the startup is even more concerned with scaling its business, that is, it will seek to grow without losing its essence. In addition, it is important to strengthen the company's knowledge base, so it is important to hire *more* people who understand aspects of product development, operations and administration, legal, financial, marketing and sales [31].

B. Time-bounded collaborative events - TBCEs

1) Definition: Time-bounded collaborative events include hackathons, codefests, Startup Weekends, hackdays, game jams, edit-a-thons, and map-a-thons, service jams, among others [2]. These events attract participants with different backgrounds, skills, education levels and experiences [10].

In these events, participants organize themselves into small teams to solve challenges proposed by the event organizers [1]. In general, each team member assumes a certain role (team leader, developer, designer, etc) based on previous experience or personal interests [10]. These teams usually meet in a place provided by the organizers, where resources are available to carry out the work, such as food, resting space, internet connection, software development or other software tools, and professionals who will work as mentors [1]. Mentors play an important role during the event as they help teams achieve their goals by offering advice and guidance based on their experience [33], [34].

Based on their ideas, and with feedback from mentors, participants work on their projects, with all teams having *limited* time, usually one or two days. In this way, they work tirelessly to produce an initial version of their ideas that will be presented at the end of the event to an audience [1].

2) Types of Events: Time-bounded collaborative events may vary in their purposes and undergo adaptations to work in many contexts [2]. For instance, hackathons are a type of coding marathon that are most often attended by people who are software developers, graphic designers, product managers, or undergraduate students in Computer Science [35], [36]. This type of event can have some variations, such as *academic* hackathons that are organized by educational institutions aiming to provide a collaborative and learning environment in which their students can have a more realistic experience and test their skills and knowledge [5], [36], and *corporate* hackathons, which are organized by companies that want to develop their workforce, generate new ideas or test new products [6], [37].

There are also events like ideathons, derived from hackathons [38], in which participants develop a prototype for their solutions. This type of event focuses only on the process of conception of ideas and seeks to attract a more diverse audience [38], [39].

Another type of TBCE has a focus on *entrepreneurship*, such as the Startup Weekend. This event has a similar structure to hackathons, but it mainly seeks to provide an environment in which participants can learn about entrepreneurship, develop innovative ideas, and get closer to the entrepreneurial community [22], [40], [41].

Finally, game jams are TBCEs focused on the development of games. They attract people from different areas including programming, art, design, and music, among others. In these events, there often is a common theme to be used and results are made public [42].

We will not detail other types of TBCEs here since our interviewees did not participate in them.

3) Benefits of attending TBCEs: Due to the great popularity of time-bounded collaborative events, especially hackathons [8], there is growing research on this topic. One of the studied aspects is their benefits to their participants. In this case, we can find that these events: (i) are a means of enriching the participants' portfolios [1], [8], [12]; (ii) are a way to gain recognition and visibility, so participants can get job offers [8], [9]; (iii) an opportunity to develop a project that can give rise to a new venture [18], [20]; (iv) provide opportunities for participants to meet new people [5], [8], [13], [43], [44] while strengthening preexisting ties [5].

There is a significant number of publications that show the use of hackathons as a structuring and facilitating means of learning [45]. In some of these studies [46], hackathons are incorporated into formal educational environments to improve the participants' skills. While they may not have such a significant positive impact on students' grades, these events can help them to be more confident in their coding skills and better cope with stressful situations [46]. In other cases, these events are used at the end of a course as a mechanism for students to apply the knowledge acquired in the classroom in a practical way, which contributes to knowledge consolidation [5], [7].

Other studies show that time-bounded collaborative events can also contribute to the learning of their participants, even if they are *not* related to their formal education [45]. Again, hackathons proved to be important for the development and improvement of the participants' skills including teamwork, time management, communication, decision-making, critical thinking, etc [9], [12], [13]. Finally, these events are hands-on environments, in which participants feel safe to make mistakes and count on the help of others to do something right. Therefore, these events allow their participants to explore new technologies and deepen their knowledge in others [11], [47].

III. RELATED WORK

The studies focusing on TCBEs focus mostly on the event itself including the collaboration [48] and networking [8], [13] that take place during them. Meanwhile, there are still few studies exploring the *consequences* of these events [13]. For instance, regarding the relationship of these events with startups, initial results [21] suggest that these events can mainly contribute to the development of a project that can give rise to a startup. While this is important, this is not enough, since after an event the participants may face several difficulties [23], such as the lack of: (i) support of a startup ecosystem; (ii) experience in developing a business; (iii) knowledge about the operation of the enterprise; (iv) business development guidance; and (v) connections with potential investors.

In relation to these difficulties, the lack of support from the startup ecosystem can be caused by a matter of maturity or culture of the ecosystem itself. In this case, it is possible to use TBCEs to help the ecosystem mature and introduce a culture of collaboration among its actors. An example of this is reported by Cervantes and Nardi [22] when they discuss the Mexican startup ecosystem: through the *Startup Weekend* event, it was possible to introduce certain qualities that were not very common in the Mexican ecosystem, such as the ability to learn from their failures, to collaborate with each other, and to be resourceful using whatever was on hand [22]. In addition, the event contributed to attracting new actors to the ecosystem, as by participating in the event, they were able to understand more clearly what their role was within it.

As mentioned in the previous section (II-B3), time-bounded collaborative events provide an environment for learning and knowledge exchange.Therefore, they are important for participants to learn about entrepreneurship and develop an entrepreneurial mindset [14]–[16], in addition to allowing participants to connect with experts from various fields to help them better scope the problem and structure viable steps to develop their solutions and businesses [49]. In other words, these events can contribute to disseminating knowledge about entrepreneurship to their participants [14]–[16], as well as to develop the entrepreneurial ecosystem and change its culture [14], [22], [23].

In general, previous studies show how TBCEs can help startup founders, but most studies focused on a certain event and they mainly reveal the benefits for participants *before* they founded their startups. To the best of our knowledge, only two studies [21], [24] focused on startup founders who began to participate in these events *after* they had their startups because they wanted to learn something new, network, got feedback on their ideas and/or develop prototypes [24].

IV. METHODOLOGY

Figure 1 presents our two research phases: the first one in the first line and the second one in the second line. Each phase is composed of a data collection and analysis steps, and more importantly, a step aimed at validating the identified results. Each one of these steps will be described in detail in the rest of this section.

A. Data collection

Semi-structured interviews were conducted with startup founders who had participated in at least one time-bounded collaborative event. We adopted semi-structured interviews because they allowed collecting the same background information from participants (using an interview guide), while at the same time, they gave us the flexibility to ask questions that are not included in the guide, thus allowing us to explore interesting aspects that emerged during the interview [25].

A total of 20 startup founders chosen through convenience sampling were interviewed. They were contacted by referral from the authors' networks of contacts. The criteria selection would be any tech startup founder who participated in at least
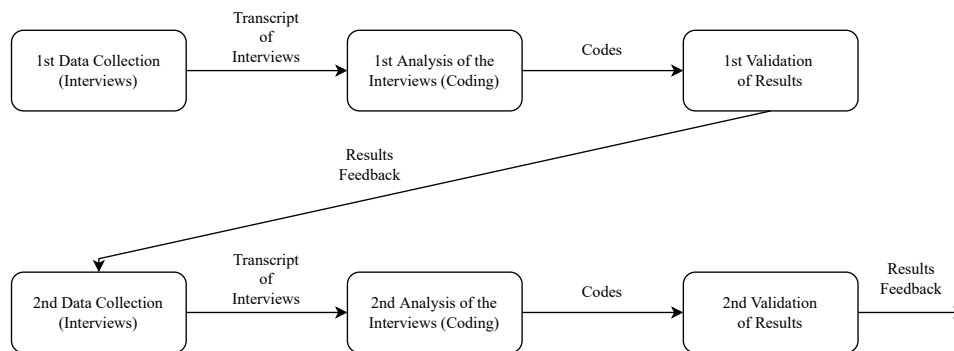
Fig. 1.   The first phase of the research is represented in the upper boxes and the second phase is in the lower boxes, after getting results feedback

one TBCE including hackathons, entrepreneurship events, game jams, and ideathons. In the first phase, nine exploratory interviews were carried out using an interview guide that had three main parts. The first part had questions about the interviewees such as age, gender, and background. The next part focused on the startup, such as its maturity level, founders, product, and time of existence. The last part of the interview guide focused on the time-based collaborative events in which the interviewee participated, and thus it focused on the benefits that the interviewees obtained from this participation. The interview guide can be found online [50] for more details. The profile of the first group of interviewees can be found in Table I.

After analyzing the data from these nine interviews and validating their results with two additional interviews (see section IV-C), another seven interviews were conducted in our second research phase using a new interview guide [50]. This new guide was based on the first one. However, in addition to collecting additional data, it aimed to explore in more detail two aspects: learning and networking, which were the two recurring themes in the first set of interviews. In other words, the second phase of our research aimed to unveil the types of learning and networking associated with time-bounded collaborative events. After these interviews, our results were again validated through 7 additional interviews. Information about the second group of interviewees can be found in Table II.

All interviews were conducted online using a video communication service and were recorded with the permission of the participants following university rules. All data collection was conducted in Portuguese, as well as the data analysis. Quotes and codes presented later in this paper are free translations to English.

B. Data analysis

All interviews were transcribed to assist in the analysis process and were imported into the MAXQDA tool, a software designed to support qualitative data analysis. The tool facilitated the coding process, the organization of codes, and the visualization of the documents that were analyzed, among other aspects.

During the data analysis, we adopted two Grounded Theory [51] coding techniques. Initially, *open coding* was performed: the first author analyzed all interview transcripts line by line assigning codes that represent or make sense for the selected text excerpt. Given our research question, our focus was on identifying the benefits the interviewees obtained from participating in the events. In a second step, an analysis of the codes was carried out to verify the relationships between the codes and try to group them into categories, which corresponds to *axial coding* [51]. In this particular case, we aimed to group the reported benefits into broader categories, namely Learning, Networking, and Miscellaneous. We also identified the phase of the startup (see section II-A) when the interviewees participated in the events: Before its creation, Ideation, Stabilization, or Growth. Therefore, we mapped the benefits of participating in the events to these four phases. As we will show in the next section, some benefits were identified in different phases, while others were specific to particular phases. The first author conducted the qualitative analysis, while the other authors reviewed the results.

It is important to mention that we did not conduct a complete grounded theory study since we did not achieve theoretical saturation [51]. In addition, while we aimed for theoretical sampling, this was not possible due to the difficulty in finding informants. However, we did validate our results using member-checking as described in the next section.

C. Data validation

To increase the accuracy and reliability of our results [52], they were presented to other startup founders so that we could receive feedback from them. This was done at the end of each phase of our research. We combined different techniques such as *peer debriefing* in the first phase and *member checking* in the second phase. Peer debriefing consists on discussions with peers where the inquirer's biases are probed, meanings explored, and the basis for interpretations clarified [53]. This first validation was conducted with two new participants: (i) informant P10 who owns a startup and had already participated in 5 time-bounded events as a competitor and mentor, and (ii) informant P11 who, despite not being a startup founder, has contacts with several other founders, conducts research on

TABLE I
PROFILE OF THE FIRST GROUP OF INTERVIEWEES

Participant	Age	Gender	Participation in Events		Startup Phase When Participating in Events	Event Type
			Before Startup	After Startup		
P1	42	Male	1	4	Ideation	Entrepreneurship Event, Game Jam
P2	25	Male	2	0	N/A	Hackathon, Entrepreneurship Event
P3	32	Male	1	0	N/A	Hackathon
P4	24	Male	0	2	Ideation, Stabilization	Hackathon, Entrepreneurship Event
P5	23	Male	14	1	Stabilization	Hackathon
P6	28	Female	1	0	N/A	Hackathon, Ideathon
P7	35	Female	0	1	Ideation	Hackathon
P8	32	Male	0	1	Ideation	Entrepreneurship Event
P9	32	Male	0	27	Ideation, Stabilization	Hackathon

TABLE II
PROFILE OF THE SECOND GROUP OF RESPONDENTS

Participant	Age	Gender	Participation in Events		Startup Phase When Participating in Events	Event Type
			Before Startup	After Startup		
P12	37	Male	5	0	N/A	Entrepreneurship Event
P13	-	Male	2	4	Ideation	Hackathon, Entrepreneurship Event
P14	44	Male	0	7	Ideation and Stabilization	Hackathon,Entrepreneurship Event
P15	33	Male	6	3	Ideation	Hackathon, Entrepreneurship Event
P16	30	Male	2	0	N/A	Entrepreneurship Event
P17	27	Male	0	7	Ideation, Stabilization, and Growth	Hackathon, Entrepreneurship Event, Ideathon
P18	33	Male	10	1	Ideation	Hackathon,Entrepreneurship Event

time-bounded collaborative events and has already organized several of such events. Information about the participants of the validation interviewees is presented in Table III.

TABLE III
PROFILE OF THE VALIDATION INTERVIEWEES

Participant	Age	Gender	Startup Maturity	Participation in Events
P10	34	Male	Stabilization	5
P11	43	Male	N/A	30
P19	38	Male	Growth	10
P20	37	Male	Growth	1
P21	28	Female	Growth	1

The second validation step was carried out at the end of the 16th interview. Member checking consists on feedback on the findings from the informants who provided the data [52]. Our results were presented to 4 *previous* interviewees (P12, P14, P15, and P17) and to another 3 *new* startup founders (P19, P20, and P21), which in this latter case is not exactly member checking. Again, our goal was to get feedback from them to find out whether what we observed was in agreement or disparity with their experience.

Validation interviews were conducted similarly to the other interviews: they were online, recorded, and followed the university's guidelines for human research. However, they also included a quick presentation about the context, objectives and results of the research. Afterwards, the informants were free to give their opinion on the research results.

V. EMPIRICAL RESULTS

In this section, we present the benefits obtained by startup founders when participating in time-bounded collaborative events. These benefits are grouped into three major categories: Learning, Networking, and Miscellaneous. The first two categories are particularly important because they are widely cited in the literature (see II-B3), but never explored in detail. Furthermore, we also point out *when* the reported benefits took place during the phase of the startup: before its Creation, or during the Ideation, Stabilization, or Growth (see section II-A).

A. Learning associated with the participation in TBCEs

Figure 2 overviews the knowledge acquired in the time-bounded events according to the maturity stages of the startups at that time. This figure shows that time-bounded collaborative events played an important role in transmitting different types of knowledge to the interviewees. This mainly occurred while they had not yet founded their startups or while the startups were in the Ideation phase, since during this period most startup founders still need to learn many things. In fact, P12, who validated our results, argued the following:

"It seems that the result [you presented] *makes sense, it is well aligned, you can see that when people go to this type of event it is because they are still learning, they are still starting their businesses, so these people have a lot to absorb." (P12)*

It is important to mention that, according to our informants, the events were the *starting points* for the learning process. This does not mean that informants were experts in a particular methodology, or tool, or in applying certain soft skills *during*
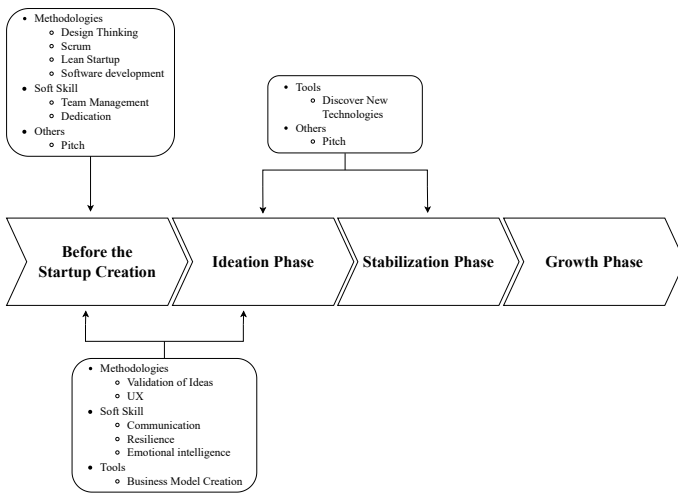
Fig. 2. Knowledge acquired during TBCEs

after participating in a TCBE lasting about 48 hours. Specifically, our data suggest that respondents had the opportunity to learn about a variety of topics that were useful to their startups, including:

1) Methodologies and Approaches: Time-bounded collaborative events contributed to introducing methodologies and approaches to their participants. Examples of methodologies include Scrum [54], Lean Startup [27] and Design Thinking [55] as illustrated below:

"I think from what came out of Startup [Weekend], *hackathon and such, I think some methodologies ... I started working with Scrum" (P15)*

In more general terms, our informants reported learning different "approaches" during the events. Examples include the idea validation process, software development, and UX (User Experience). For instance, informant P16 reported learning about the how to validate business ideas during a time-bounded collaborative event:

"Startups have a logic that I need to quickly validate uncertain premises, so at the Startup Weekend you will do this in practice in a very fast and very experiential way. I think this is very useful, because a startup that doesn't operate lean doesn't stand a chance." (P16)

2) Tools: We found that some participants had the opportunity to learn tools that later proved to be useful to carry out some work in the startup. Note that we are using the word tool without distinguishing between a software and a non-software tool. One these tools was the Business Model Canvas [56], which allows participants to reflect and structure their startups' business models. This is illustrated in the quote below:

"This event was very important precisely for taking the initial step, for giving us at least the direction of how to open a company, how to create a business model, how to pitch, do those things that are important and that we didn't know anything about before." (P4)

In addition, informants incorporated *software* tools that they learned in these events including programming languages, APIs, frameworks/libraries, etc. P17, for instance, reported that what (s)he learned improved the startup development process:

"We learned React.js and Node.js that were being released, we learned the 'low code and no code' paradigm, which is another development paradigm, so this accelerated our process, even to develop products and that we still apply today."(P17)

3) Soft Skills: It is important for startup founders to develop certain soft skills for them to succeed during their entrepreneurial journey [57], [58]. In this sense, our interviewees reported that time-bounded events contributed to the development of soft skills like resilience, teamwork, dedication and communication.

"Being resilient because you will have several challenges, from having to pivot the solution, having people giving up within the team itself, so the person [the startup founder] *has to be resilient." (P17)*

4) Other Learning: In addition to learning approaches, methodologies, tools, and soft skills, time-bounded collaborative events allowed informants to learn about other topics. For instance, interviewees learned what the pitch[2] was and how to present them.

"The mentor gave me insights and suggestions on how I can 'humanize' my pitch, so this was something I took as a learning experience that I'm using in several things." (P5)

It is interesting to note in the quote above that what P5 is still using what he learned about the pitch.

B. Networking during TBCEs

By networking, we mean: "a way for individuals to grow their relationships for their job or business" [59]. In general, the studied events helped informants to meet people from different areas and with different experiences. Establishing new contacts in these events can occur in any phase of the startup (see Figure 3). These new contacts can play different roles in relationship to the startup: employees, customers, mentors, etc, and accordingly, generate different benefits depending on the phase of the startup.

In general, establishing new contacts during time-bounded collaborative events was useful for:

1) Finding Co-Founders: Our empirical data suggests that collaborative events allow startup founders to meet people with the same motivation and interest in entrepreneurship, i.e., find co-founders. According to the informants, during these events it is possible to observe how people actually work, including gauge their level of interest in continuing work in the startup after the event. Note that, according to the informants, the contacts with these co-founders was established in startups which had not yet been created or that were in the ideation phase.

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[2]Basically, the "pitch" consists of a short presentation that aims to show a business or an idea to an audience. It is usually very short, only a few minutes, therefore being able to present a "good" pitch is regarded as very important among entrepreneurs.
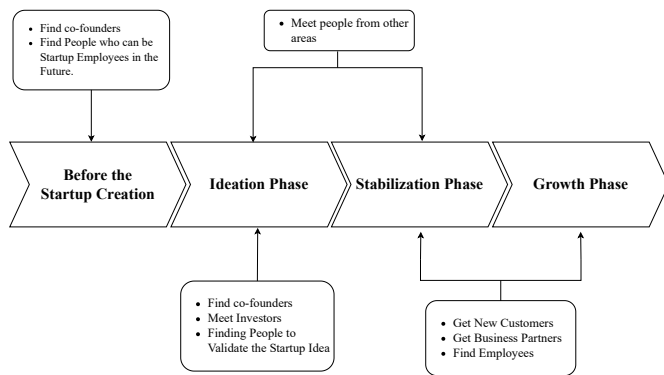
Fig. 3. Networking benefits according to the startup phase

"At these events I was able to meet a lot of people and I was able to network, it was there that I met someone, who now is my friend, and who is also a founding partner of my startup [...], he followed my work, he kept helping me as a mentor on the project and then he ended up calling me to work with him." (P2)

Interviewee P16 mentioned something important: when looking for potential co-founders, one also needs to identify people with *different* skills and knowledge:

"The fact that there are motivated people [during the event] who are aligned in the purpose, engaged, emotionally invested in the project, with skills that I don't have, and that help a business make it work. It is very practical!" (P16)

2) Finding People to validate the Startup Idea (Experts): Our results also suggest that during TBCEs founders can find mentors and judges who are experts or, at least, knowledgeable in the domain of the startup idea. These events also allow founders to meet potential users or customers. All these new connections can be used to validate the startup idea by providing feedback and even guidance. Quotes from informant P5 below illustrate this:

"Because it is a way of validating and receiving insights and inputs from people who are in the market and in the area and, many times, you are looking for consultants ... and it ends up being a little expensive for you to pay them ... and in these events you can have access to several people from the area and [they are]very renowned people." (P5)

Note that P5's quote illustrates an important startup limitation: lack of financial resources (see section II-A).

3) Getting New Customers or Business Partners: During the Stabilization and Growth phases, startup founders mainly focus on the evolution of their ventures [32]. According to our results, they seek to attract new customers and establish partnerships with other companies. So, when startup founders network with other event participants, mentors, jurors and organizers, they might find potential customers or business partners as illustrated by P9:

"(...) the main thing is that, it's the connections, because there are people I met in 2014 and I have contact to this day, and that also generates ... and ends up impacting [the

startup] *because some people have turned from friends to customers to possible hiring." (P9)*

Again, our informants who reported this particular benefits were founders of startups at more mature phases. In fact, they usually were either mentors or judges in these events, since these activities were less time-consuming and stressful when compared to regular participation. This can be illustrated by the following quote:

"As a mentor, it is very good, [to participate in a time-bounded collaborative event] *because you network with those who organize the event, so usually with people who have money, who have more networking, who can call you to another event, with possible clients, with possible partners, so the people who work with this, they are very active in the innovation ecosystem, so it's great for you to be a mentor in such an event." (P18)*

4) Meeting Investors: Another finding of this research is that time-bounded collaborative events are sometimes attended by investors, and consequently, our interviewees had the opportunity to establish contact with them and pitch their startups during the event seeking a possible financial contribution to the startup in the near future.

"We spent about two and a half years without developing [the idea,] *I was almost giving up, but at the beginning of 2019 I went to an event, and I met ... an investor. She was like, 'What a cool idea, are we going to continue it?' So she kind of pulled me back and I kind of didn't let go of the idea. She didn't invest with money, but she helped me a lot with the smart money part." (P13)*

"I could also talk a little about the exposure, so you show your idea, because sometimes there is an investor who finds it interesting and talks to you (...) he contacts you in a few months to see how things are going." (P13)

5) Recruitment: Time-bounded collaborative events can be a good opportunity to meet qualified people who can work in a startup. While startups in the Ideation phase seek partners, startups in the Stabilization phase are searching for talent:

"I think it is a process that if you know how to use it well, you can approach the right people there and you can even find; like I have already met a lot of people who are part of my team today in this type of event, so for me it [the event] already works as a selection process, because I was seeing people working, understanding the demands, I could see that the guy was in the same vibe as the startup, so let's try to absorb the guys." (P17)

6) Meeting people from other areas: During the time-bounded collaborative events, our participants had the opportunity to meet and work with people from other areas who had different skills By establishing contact with these people, they can count on their help to solve a problem.

"I realized that the application [I was developing] wouldn't work, because people have to download it, so the idea was to make an API ... When I was talking to this person I met at an [time-bounded collaborative] *event he said: 'why don't*

you make an API? you can reach a greater number of users this way.' " (P6)

As we can see from P2's and P6's quotes, sometimes the contacts established during the events were not useful at the moment, but were useful *later*.

C. Miscellaneous Benefits

The previous two sections explored in detail two benefits afforded by time-bounded collaborative events: learning and networking. This section describes other types of benefits we identified. Figure 4 presents these benefits.
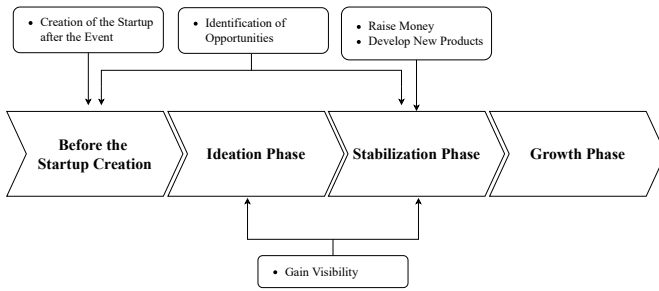

Fig. 4. Miscellaneous Benefits Generated by Time-bounded Events

1) Startup Emergence: Our results suggest that participation that took place *before* the creation of a startup was somehow important for the startup itself, that is, the events helped to stimulate the interest of its participants to venture:

"So it was a Startup Weekend event and a colleague invited me to go there as a mentor. So I was motivated, because I'm helping people there to be able to create ideas and have their ideas and I don't have my own ideas to put forward, so from now on I'm going to start putting my own ideas forward." (P1)

P1's quote above shows that the desire to be entrepreneurs is not limited only to people who go to these events as *participants*, i.e., it is possible that other people involved in these events such as mentors, organizers or judges may have this same interest after the event.

2) Identification of Opportunities: Other interviewees informed us that TBCEs can be a good opportunity to identify new ideas. In the case of interviewee P9, who had a startup in the Stabilization phase, his participation in events aimed to help him find new opportunities for his company:

"[by participating in these events] I ended up acquiring a lot of knowledge and also understanding a lot more, it's a way for me to be connected with the technology area, understanding real problems of private, public or social companies, so with that I can see opportunities for action." (P9) [in my startup]

On the other hand, interviewee P15, who did not yet have a startup, had access to some data made available by the event organizers and with that, he saw a demand that a new startup could be explored.

"My startup came from an innovation event, it was an open data challenge to develop a technological solution for the city using open data. This was already a topic that I was interested in ... I was always very interested in developing some solution to occupy the city's rivers and during the hackathon we were able to validate this with the challenge itself, we were able to use data from the city hall and data from companies to see that the problem existed, that the potential existed, that the project was viable." (P15)

3) Gain visibility: In some cases TBCEs can be used to market a startup. Our informants mentioned examples of startups, in the Ideation (P1) and Stabilization (P9) phases, that gained visibility by participating in these events.

"They [the events] influenced mainly on networking and whether or not I wanted visibility too, because as I was sometimes able to win a podium position, this translates into visibility for me, as an individual, but in addition it ends up bringing visibility to the startup, because people often ask what I do or where I work. (P9)

4) Raise Money: Some time-bounded events offer cash prizes for the best projects, so some of our informants tried to raise money for their startups through these prizes. Their goal was to use the money to support themselves while the startup did not yet provide financial returns. P10 illustrate this:

"I know founders who are doing what we call bootstrap, they are staying there, or have quit their jobs and made some money to support themselves for a year. Anyway, so sometimes the guy's money starts to run out, that's when he's already out of it,[his job] then really, he's not going to participate in the hackathon for the sake of participation, because the guy already has experience, he founded his startup and he's going to participate in a hackathon for him and his team to get about [an amount of money,] that gives a survival of about two months three months". (P10)

5) Develop New Products: Startup founders also reported having idea for new products or new features in their current products during TBCEs. For instance, P4 used a hackathon to start the development of a new service; he explains that by doing so he could speed up the development process and had managed to explore a new group of customers:

"These [time-bounded collaborative] events after the foundation of my startup were catalysts that helped us to accelerate processes, like in this hackathon we developed another product that we had not yet developed, so it was something that gave us a start for a govTech sector that connects with government and we developed a MVP prototype over a weekend so that was a really big catalyst." (P4)

VI. DISCUSSION

As mentioned in the Background section (see II-A), startups can have up to three stages of maturity, and in each of them, the founders focus on solving certain problems so that their startups can evolve to the next maturity level. To grow, startup founders need additional resources, including, money, knowledge, or personnel [29], [31]. Table IV presents a list of these resources identified in the startup literature. This table also summarizes the benefits our research has identified

and therefore answers our research question. In summary, this Table shows how time-bounded collaborative events can help founders to get some of the resources they need.

A. Ideation Phase

During the Ideation phase, startups mainly focus on developing their product/service and their first business model [26], [31], [32]. Therefore, it is important for these companies to assemble a founding team that is knowledgeable about the product development process [29]–[31] as well as the first employees [32]. Our results illustrate the importance of networking during the event to bring startup founders closer to people who may have the same interest in founding a startup or working as employees (section V-B1 and V-B5, respectively). Using time-bounded collaborative events to find co-founders has been reported by Medina Angarita and Nolte [24]. However, our results are more nuanced because they also indicate that start founders look for co-founders with different and/or complementary skills and knowledge.

In addition, we have seen that startup founders can also acquire different types of knowledge that are necessary when developing a product. For instance, they reported having the opportunity to learn about software development in general (see section V-A1) as well very specific aspects like new programming languages, libraries and frameworks (see V-A2). This knowledge is necessary to develop the startup's prototypes, if its solution is software-based. Learning about tools and technologies have been reported by other authors, especially in the context of corporate hackathons [6], [37]. However, to the best of our knowledge, learning about specific software development methodologies like Scrum [54], has not been reported before.

Knowledge about sales is also important for startups in the Ideation phase. Even if the startup does not yet have a product on the market, it is important for founders to know how to communicate what their company is creating to attract other co-founders, customers, partners and investors [29], [30]. In addition to sales, learning to pitch can be used in more advanced stages of maturity to get investors and resources necessary to enable the startup's Growth [69].

Previous research [32] argues that startup founders can search for funding while still in the Ideation phase. Our results show that startup founders can even find such funding by participating in time-bounded collaborative events, since they might attend these events focusing on the cash prizes. In one of the startups, the founders' plan was to use this cash to allow them to work solely in their startups.

B. Stabilization Phase

Startups in the Stabilization phase seek to develop and market their product or service to generate profit [26], [29], [31], [32]. This means founders are expected to grow their enterprises, e..g., recruiting additional talent to their teams. As discussed in the previous sections, time-bounded events can help this because they allow founders to find new employees based on the actual observation of how these people work

(see V-B5). Stabilization also means attracting new customers, a challenging aspect per se [17], while also focusing on presenting the startup to potential investors [62]. Again, our results illustrate that interviewees were able to meet people who later became their customers or investors during time-bounded collaborative events.

Previous research on startups [31] suggest that founders should have different types of knowledge available to them including management, law, finances, marketing and sales. Our informants reported establishing contacts with people from different areas during TBCEs. Later on, these contacts were useful to solve specific problems.

C. Growth Phase

When a startup reaches the Growth stage, it already has a sustainable revenue and finds itself with a more mature organizational structure. So, at this moment, its founders need resources and knowledge to manage a series of activities related to the production, sale and distribution of their product or service, i.e., they need additional knowledge about product development, operations, law, management, marketing and sales [31]. As shown in previous sections, time-bounded collaborative events can help founders on some of these issues through the social networks established during these events. Due to the short-time and intensive nature of these events, it is expected that startup founders and other participants do not use social networking sites (SNSs) during the events, but studies show they use these later on [70]. We did not explore how SNSs were used by startup founders, but we plan to do it in our future work.

Finally, during the Growth phase, founders look for opportunities for greater investments while also searching for new customers and partners to scale their businesses [26], [62]. Our informants reported that they do not see many benefits for their startups when they participate in time-bounded collaborative events as regular competitors. However, they can still participate in these events as *mentors* because this allows less dedication time, while still establishing new contacts with potential employees, customers or business partners.

D. Non-supported Startup Needs

Table IV presents three startups' needs that were not identified in our results, namely: (1) acquire *Government Incentives*, such as seed capital provided by government funding or participation in a startup support program [65], [66]; (2) integration into a *Startup Ecosystem* to work and collaborate with other startups and large companies to obtain common benefits [67]; and (3) arrange a *Distribution Channel*, in which startups make products or services available for consumers to buy [68]. Since our focus was mostly on digital startups, this last item is not relevant for us given the fact that digital assets are, to some extent, easy to make available when compared to other products. Ferro's [70] suggests that entrepreneurs use SNSs to engage with innovation ecosystems, but our informants did not report any evidence of that.

TABLE IV
STARTUPS' NEEDS AND BENEFITS FROM TIME-BOUNDED COLLABORATIVE EVENTS

Maturity stages of startups	Resources required by Startups according to the Literature — Resources	Benefits from time-bounded events
Ideation	Founding Team [29]–[31]	Meeting Co-Founders
	Initial Capital [32], [60]	Earning Cash Rewards
	Develop a Business Model [29], [61]	Learning about business model creation
	Specialized Employees [29]–[31], [62]	Meeting Employees
	Knowledge about Product Development [29]–[31]	Learning new technologies; Meeting people from other areas; Meeting Employees; Learning about: Lean Startup, Design Thinking, Idea Validation, Scrum and Software development
	Knowledge about Marketing and Sales Aspects [30], [31]	Learning about the Pitch
Stabilization	Specialized Employees [29], [29], [30], [62]	Meeting Employees
	Knowledge about Product Development [29]–[31]	Learning new technologies; Meeting people from other areas; Meeting Employees; Learning about: Lean Startup, Design Thinking, Idea Validation, Scrum and Software development
	Knowledge about Marketing and Sales Aspects [30], [31]	Learning about the Pitch
	Knowledge about Legal Aspects [30], [31]	Meeting people from other areas
	Knowledge about Business Management aspects [29]–[31], [63]	Meeting people from other areas
	Investors [62]	Meeting investors
	Customers [62]	Finding new customers
Growth	Specialized Employees [29], [29], [30], [62]	Meeting employees
	Knowledge about Product Development [29]–[31]	Learning new technologies; Meeting people from other areas; Meeting Employees; Learning about: Lean Startup, Design Thinking, Idea Validation, Scrum and Software development
	Knowledge about Marketing and Sales Aspects [30], [31]	Learning about the Pitch
	Knowledge about Business Management aspects [29]–[31], [63]	Meeting people from other areas
	Investors [62]	Meeting Investors
	Customers [62]	Finding New Customers
	Business Partners [64]	Meeting new business partners
Non-reported	Government Support [65], [66]	Not Identified
	Integration with a Startup Ecosystem [67]	Not Identified
	Distribution channel [68]	Not Identified

The fact that these needs were not reported by our informants does not mean they can not be fulfilled during a time-bounded collaborative event. It only means that our set of informants did not report them. In other words, since we conducted a *qualitative* research, the identified needs are solely related to the group of informants we interviewed. We can not generalize our results. A larger, or even different, set of informants could potentially lead to other benefits. We do not see the fact that we conducted a qualitative study as a limitation of our work. However, we will discuss other limitations in the next section.

E. Limitations

There is a major limitation concerning the gender bias in the sample, majorly composed of men (only two women were interviewed). It is possible that this bias is a reflex of a higher proportion of men as startup founders. Our informants reported having participated in different types of time-bounded collaborative events including hackathons, ideathons, entrepreneurship events, and game jams. As mentioned in section II-B2, each one of these events have their own goals and peculiarities. Despite their differences, we are not able to separate our results according to the type of event in which the informants participated, because most of them attended several events from different types. This means that we can not specialize our results to particular types of events (like hackathons) nor generalize our results to all types of events.

In fact, we argue that it is likely that some benefits can be seen in only certain types of events. For example, learning about software development may be limited to hackathons and game jams since these events require the development of software prototypes [1] and are attended mainly by people with the necessary background [35], [36]. Meanwhile, events like ideathons and other entrepreneurship events (e.g. Startup Weekend or 3-Day Startup) usually do not require the development of software prototypes, but instead focus on entrepreneurship, bussiness models, and developing innovative ideas [22], [40].

In a few cases, as some of the events that the informants participated in took place years ago, it is possible that there is a natural limitation of the interviewees' memory. Therefore, they may have forgotten to inform relevant data or provide more detailed descriptions that would allow separating the results by type of event or by stage of maturity more precisely. We tried to address this limitation by conducting several interviews and member-checking our results.

VII. CONCLUSIONS AND FUTURE WORK

A. Contributions

In the last decade, time-bounded collaborative events (TBCEs) gained interest [13] because of the benefits they provide to participants. More recently, researchers started to explore what happens *after* these events take place. For instance, they provide an environment in which participants

develop software projects that might lead to startups or new businesses [21].

This study extends previous work about the understanding of how TBCEs can help startup founders by providing opportunities for learning, and networking, and providing miscellaneous benefits. People interested in creating a startup or who already founded one, but who lack knowledge about the necessary topics to run a startup can have the opportunity to learn a variety of useful topics for their startups during TBCEs. According to our results, these topics include the creation and validation of ideas, the establishment of successful business models, how to present a pitch, methodologies like Lean Startup and Design Thinking, as well as software development process methodologies, tools, and frameworks.

Overall, *networking* plays a key role in the growth of startups, as founders can search for potential investors, mentors, employees, and business partners [22], [70]. Our results suggest that time-bounded events can help startup founders to meet these new contacts.

Among the *miscellaneous* benefits, we observed that TBCEs might contribute to the development of soft skills that are important for a startup founder to succeed, such as dedication, resilience and communication [57]. We also observed that TBCEs might help founders to identify new products, as well as meet people who can validate, evolve, develop and commercialize these products.

B. Implications for Organizers of TBCEs

First of all, innovation ecosystems, governments, and other actors interested in the success of startups should organize different types of time-bounded collaborative events including those entrepreneurship-oriented (e.g., the Startup Weekend or similar) and programming-oriented (like hackathons) to enable different types of benefits to emerge. By doing so, they can better support different startup founders' needs.

Second, since founders have different, yet sometimes overlapping, needs according to the phases of their startups, event organizers should design focused events. In other words, while planning an event, organizers should decide the expected participants they have in mind. Accordingly, they should target their advertisement efforts to reach this group as well as to inform all potential participants about what they should expect of the event. This is particularly important to avoid wrong expectations about these events since a mismatch between participants' motivation and event goal might lead to a unsuccessful event. Focus is necessary because, for instance, a startup in the Ideation phase might not be as interested in learning about legal aspects as one in the Stabilization phase.

Third, we believe there should be a way to connect information from Social Networking Sites (SNSs) to time-bounded collaborative events' sites[3] so that participants can have a chance to identify people who are relevant for them – for instance, founders and /or mentors with specific knowledge,

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[3]For instance, the Devpost (https://devpost.com/hackathons) has 7,156 registered hackathons while this paper is written.

new hires that are familiar with specific technologies, etc – before, during, and after the event.

Finally, our results suggest that the information about events' participants should be available long after the event since we observed that some contacts established during the event were only activated months after it finished. To be more specific, we believe professional SNSs (e.g., LinkedIn) are more relevant, in contrast to more focused on personal aspects (e.g., Instagram, Facebook), because professional ones focus on the educational and job-related background of its users. As suggested by [70], SNSs can be used for multiple purposes.

C. Future Work

We have several plans for future work. First of all, we plan to create a questionnaire to be distributed among start founders to find out whether our results are, or are not, different across several startup ecosystems. We also plan to explore how Social Networking Sites (SNSs) and other digital technologies have been used by entrepreneurs to benefit their startups after they participate in time-bounded collaborative events.

Other interesting areas to explore concern the longevity of startups originating in TBCEs and gender-related issues among startup founders who participate in TBCEs. These events many times foster innovation but there are difficulties in continuing projects issued from TBCEs [13]. Understanding successful approaches to supporting startups with projects originating in such events can help change the innovation landscape. There are many barriers for women to join TBCEs [71] and this may limit the opportunities that they can take advantage of in these events. Finding strategies to foster women's participation in startup-oriented TBCEs can stimulate more gender equality in that context.

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