
Conceptualization of hackathon for innovation management

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Abstract: Although hackathons have become a popular phenomenon beyond the IT industry, the current use of the concept is ambiguous. However, concept definitions are essential building blocks of theory. Therefore, this paper addresses the hackathon as a concept. Following the conceptualization model of Podsakoff et al. (2016), this paper studies the attributes of the hackathon concept. Specifically, it focuses on the necessary and sufficient concept structure of the hackathon as a phenomenon and presents the eight necessary and sufficient attributes of the hackathon. Moreover, it proposes three main categories for the eight attributes, i.e. the concepts of 1) short time-bounded event, 2) coopetition, and 3) radical collocation. Furthermore, this exploratory paper defines the hackathon as an innovation contest. The results will benefit both academics studying hackathons and companies who aim to enhance their innovation management, especially in the fuzzy front end of innovation.

Keywords: hackathon; conceptualization; concept; definition; innovation contest; innovation competition; radical collocation; coopetition; innovation management; case study.

1 Introduction

Hackathons, as one type of innovation competition or contest (Hartmann *et al.* 2019a, 2019b), originated among information technology (IT) practitioners (e.g. Leckart 2012) and spread to multiple domains with various focuses and designs. Thus there has been a vast proliferation of the concept (Angarita and Nolte 2019). As a novel phenomenon, the research on hackathons is exploratory and descriptive. Most of the studies are cases that describe hackathon design elements or choices, for instance (Komssi *et al.* 2015; Porras *et al.* 2018; Pe-Than *et al.* 2019). These case studies describe the phenomenon, yet do not define it. Therefore, hackathon is lacking a clear concept definition. According to Podsakoff *et al.* (2016), concept definitions are essential building blocks of theory and moreover, it is vital to articulate their fundamental attributes clearly. A theoretical concept provides a common language for communication, thus reducing the risk of misunderstanding, and also lays out the foundation for any research. In addition, lack of clarity would also impede identification of the focal concepts or specifying of their relation to their antecedents, consequences or correlates. (Podsakoff *et al.* 2016) Moreover, as a phenomenon developed outside the academic community, with IT practitioners (e.g. Leckart 2012), the hackathon as a concept lacks theoretical roots. However, today there is also a growing interest in hackathons in the academic community. Nevertheless, a clear understanding of hackathons and, for instance how they deviate from other innovation contests and events, is needed in order to further research and discuss the phenomenon. Thus, this study aims to define the concept of the hackathon. This research focuses on the conceptualization of the hackathon by studying its necessary and sufficient attributes.

RQ: What are the necessary and sufficient attributes of the hackathon as a concept?

In the pursuit of our goals, the paper is structured as follows: in the introduction, we first acknowledge the need to clarify the concept of hackathons. In the second section, the theory regarding conceptualization and the hackathon as a concept is presented. The third section introduces the research design. The fourth section portrays the results of our literature study. In the fifth section, the discussion and further research, we contemplate the results of our conceptualization of the hackathon and its impact on innovation management theory and practice.

2 Conceptualization process and Hackathon as a phenomenon

Conceptualization process in research

Theoretical concepts help us to organize phenomena into meaningful categories. Attributes and features are utilized to distinguish the focal concept from related concepts. (Podsakoff *et al.* 2016) have recommended a concrete set of steps for developing a good conceptual definition in organizational, behavioural and social sciences. They define the concept as follows:

“..cognitive symbols (or abstract terms) that specify the features, attributes or characteristics of the phenomenon in the real or phenomenological world that they are meant to represent and that distinguish them from other related phenomena.” (Podsakoff et al. 2016, 161)

Podsakoff *et al.* (2016) present two different types of structures: 1) ‘the necessary and sufficient concept’ and 2) ‘family resemblance structure’, which differ in their logic and structural rules (see Table 1).

Table 1 The two ways to define concepts according to Podsakoff *et al.* (2016)

	<i>Necessary and sufficient concepts</i>	<i>Family resemblance concept</i>
Logical rule	AND	OR
Structural rule	If and only if all n attributes are present	If at least m of n attributes are present
Attribute substitutability	No	Yes

According to “necessary and sufficient concepts” structure, a case has to include all the necessary attributes to qualify as part of a specific concept. The “family resemblance concept” structure signifies that a case has to include m of n criteria or attributes, i.e. not all attributes, but at least the necessary amount, in order to qualify as part of a specific concept. The attributes of the concept definition should be chosen so that their relevance and importance are taken into account in the concept development. A good conceptual definition is developed in four stages:

1. Identification of the potential attributes of the concept by collecting a representative set of definitions.
2. Organization of potential attributes by theme and identification of any necessary and sufficient shared attributes.
3. Development of the preliminary definition of the concept.
4. Refinement of the conceptual definition. (Podsakoff *et al.* 2016)

Podsakoff *et al.* (2016) stress that the approach may have practical limitations that prevent the researcher from applying all the suggested guidelines, but versatile use of different techniques is encouraged, nevertheless.

Hackathon as a phenomenon

The roots of Hackathons date back to MIT in the 1960s, where students gathered together to code in self-imposed 24-hour ‘marathon bursts’ (Leckart 2012). It was first popularized in the IT community, with hackathons shaped into contests with pitches and prizes to produce functional prototype applications. The spread of the concept to other domains and usages besides coding (Leckart 2012; Zukin and Papadantonakis 2017), has caused proliferation of the concept (Angarita and Nolte 2019). First of all, regarding the term itself,

both “code camp” and “hackathon” have been used to define similar contests, although hackathon is more widespread (Porrás *et al.* 2019), as well as datathon (Li *et al.* 2017), markathon (Calco and Veeck 2015), data dives, codefests, hack days, sprints, edit-a-thons, mapa-thons (Filippova *et al.* 2017) etc. Proliferation has advanced, as the versatile possibilities of hackathons have been seen in many domains: as an educational method (Porrás *et al.* 2019), a way to crowdsource solutions (Gama 2017), and to find new potential employees (Komssi *et al.* 2015; Pe-Than and Herbsleb 2019), to attain public engagement and collaboration between citizens (Gama 2017), the creation of prototypes, and possible new businesses (Komssi *et al.* 2015). As a novel phenomenon, the research on hackathons is exploratory and descriptive. Most of the existing studies are cases that describe hackathon process phases, design elements or choices etc. (Komssi *et al.* 2015; Porrás *et al.* 2018; Pe-Than *et al.* 2019). These case studies describe the phenomenon, yet do not define it. Therefore, hackathon as a concept lacks an undisputed definition. Design choices or elements include identification of a suitable mixture of attendee skills, the selection process for projects and teams, and the decision whether to hold a competitive or collaborative event (Komssi *et al.* 2015; Porrás *et al.* 2018; Granados and Pareja-Eastaway 2019; Pe-Than *et al.* 2019) Only (Rosell *et al.* 2014) for example, have aimed at finding a characterization of the essential hackathon attributes.

Innovation and Hackathon process

The innovation process can vary from project to project, but in general, it includes four phases, of which idea generation is regarded as the first (Salerno *et al.* 2014), also known as the Fuzzy Front End of Innovation (FFEI) (Koen *et al.* 2001). At its best and in its broadest form, the hackathon process includes all stages of the innovation process. The hackathon process is divided into the pre-hackathon, hackathon (event) and post-hackathon processes (Rosell *et al.* 2014; Komssi *et al.* 2015; Granados and Pareja-Eastaway 2019) As a process, the hackathon has both input and output (Komssi *et al.* 2015). In this conceptualization, the focus is on the hackathon event process.

The success of a hackathon seems to depend on the design of the hackathon event. Therefore, we refer to ‘*Hackathon design elements*’. These design elements are determined in the pre-hackathon phase and generate the input for the hackathon event. One such design element is that the invitation should attract attendees with relevant skill sets, as well as formulating goals for the organizer and anticipating the goals for both the event and the participants themselves. These design elements should be contemplated carefully with upfront planning. (Pe-Than *et al.* 2019) After the hackathon event there is often a celebration: the evaluation of the demos and decision on further steps (Komssi *et al.* 2015). The outputs for the post-hackathon phase include the ideas, concepts and learnings that the hackathon event has generated. Furthermore, the post-phase determines the ways that the hackathon results are implemented.

Hackathons have been regarded as beneficial from various points of view. First of all, hackathons are considered to provide participants with the great meaningful ‘by-product’ of personal development and sense of achievement from working with new technologies, meeting and collaborating with new people, and generally having a lot of fun. Thus, the hackathon’s potential for building strong communities and cultures could be a primary reason for organizing such an event. (Komssi *et al.* 2015) In addition, the diversity of the participants is seen as being beneficial for yielding a rich mix of ideas. (Rosell *et al.* 2014) Furthermore, hackathons are regarded as a valuable resource for learning (Kayastha 2017).

However, hackathon events have also been criticized. (Briscoe and Mulligan 2014) point out that hackathons can potentially suffer from a lack of institutional memory. Moreover, the goal achievement of hackathons, in particular, is questionable. The output of prototypes is considered, if not exactly useless, then secondary, as the more interesting products of civic hackathons are so many versions of ‘civic imaginary’ (DiSalvo *et al.* 2014). Furthermore, the ideas resulting from hackathons are regarded as rarely being effective or adopted in addressing the problems that inspired the hackathons. Participants have also experienced frustration resulting from expectations about the results of the hackathon. (Granados and Pareja-Eastaway 2019) Likewise, the lack of commercialized results led (Komssi *et al.* 2015) to conclude that there is still something missing from the hackathon method, which they regard as rather a simple process from the software development viewpoint, i.e. the commercializing of the key results. However, they recognize the potential discrepancy between the winning idea and the company’s business strategy, as well as the satisfaction with the hackathon event experienced by both the organizers and participants. Nevertheless, reasons for the criticism have been pinpointed as a misunderstanding of the hackathon process as a whole and the outcomes of various sub-processes, such as the relevance of the post-hackathon phase (Lodato and DiSalvo 2015; Granados and Pareja-Eastaway 2019). Furthermore, criticism refers to either ignorance of the importance of the design elements of hackathons throughout the process or incompetence to define the goals of a short time-bounded event and design the event tasks accordingly (Granados and Pareja-Eastaway 2019).

Hackathon descriptions

Hackathon researchers in various fields, mainly from software engineering, have given descriptions of the hackathon as a phenomenon according to their literature studies, case study observations and interviews.

Table 2 Descriptions of hackathons in publication

<i>Authors</i>	<i>Descriptions</i>
Almirall <i>et al.</i> 2014, 393	“A ‘hackathon’ is typically a 1- to 2-day event where computer programmers and others involved in software development intensively collaborate to develop a new software application that meets the challenge posed by sponsors.”
Angarita and Nolte 2019, 1	“Hackathons are time-bounded events during which participants gather in teams and attempt to complete a project of interest to them (Pe-Than <i>et al.</i> , 2019).”
Briscoe and Mulligan 2014, 1	“A hackathon is an event in which computer programmers and others involved in software development collaborate intensively over a short period of time on software projects. These hackathons are encouraging of experimentation and creativity, and can be challenge-oriented.”
Gama <i>et al.</i> 2018, 248	“Hackathons are short-lived events, typically lasting from 1 to 3 days, where participants gather into groups to tackle a challenge and present a proof of concept in the form of a software or hardware prototype, motivated by a common theme.”

Table 2. Continued Descriptions of hackathons in publications

<i>Authors</i>	<i>Descriptions</i>
Granados and Pareja-Eastaway 2019, 2	<i>Hackathons are problem-focused events that bring people (insiders and outsiders) together to work collaboratively on a solution to a problem or challenge over a short period of time (Chowdhury, 2012), and in this way are an example of a bottom-up form of innovation.</i>
Hartmann et al. 2019, 1	<i>“Hjalmarsson & Rudmark (2012, p. 10) define such a contest as “an event in which third-party developers compete to design and implement the firmest and satisfying digital service prototype, for a specific purpose, based on open data.” This idea is taken one step further by the concept of app competitions or hackathons (hack marathons) where governments and citizens develop new (mobile) applications in cooperation.”</i>
Kayastha 2017, 3	<i>“Community and competition provide the support and encouragement needed for innovation. Hackathons combine these two essentials. They are 1-2 day competitions during which teams form, build and pitch ideas. This is an effective technique to experiment with bleeding edge technologies, generate and prototype new ideas, grow as an engineer.” (Kayastha 2017).</i>
Kienzler and Fontanesi 2017, 13	<i>“During such events, enthusiastic individuals come together for a time-bound period, form teams to solve defined challenges, and in collaboration, find innovative solutions from scratch. At the end of the hackathon, the solutions are formally presented and evaluated based on whether they work, are good ideas with a suitable problem/solution fit, show a well-designed experience and execution, have the ‘wow factor’ (Bremner 2011).</i>
Komssi et al. 2015 b, 60	<i>“Hackathon” combines the terms “hacking” and “marathon” and implies an intense, uninterrupted, period of programming. More specifically, a hackathon is a highly engaging, continuous event in which people in small groups produce a working software prototype in a limited amount of time. (Raatikainen et al. 2013)”</i>
Leckart 2012, 1	<i>“It’s a hackathon—a contest to pitch, program and present a functioning Android mobile application in 48 hours.”</i>
Pe-Than et al. 2019, 16	<i>“In general, hackathons are time-bounded events, typically of two to five days, during which people gather together and form teams, each of which attempts to complete a project of interest to them. (Filippova et al. 2017, Trainer et al. 2016). The teams are usually collocated and often composed of people with diverse backgrounds, experience, and expertise.”</i>
Rosell et al. 2014, 1	<i>“..we can define a hackathon as an event where people come together to collaboratively build and launch a new application or finished good aimed at solving a particular problem built on top of a new or existing technology enabler. They usually work in small teams of up to five people over a day or two, with the goal of generating a working prototype at the end of the event.”</i>

Short time-bounded event

The duration of a hackathon as a short, time-bounded event is mentioned in multiple hackathon descriptions in various domains e.g. (Briscoe and Mulligan 2014; Kienzler and Fontanesi 2017; Chowdhury 2018; Angarita and Nolte 2019; Granados and Pareja-Eastaway 2019; Pe-Than *et al.* 2019) Sometimes the researchers have specified the length of the event as “*over a day or two*” (Rosell *et al.* 2014), “*short-lived events, typically lasting from 1 to 3 days*” (Gama *et al.* 2018), “*typically of two to five days*” (Pe-Than *et al.* 2019), “*in 48 hours*”(Leckart 2012), “*1- to 2-day event* (Almirall *et al.* 2014), “*1-2 day competitions*” (Kayastha 2017). Furthermore, the bounded time was also emphasized “Hackathons have a set starting and stopping time, between which teams focus solely on creating a demo-able version of their idea (Komssi *et al.* 2015). In contrast, the ‘semesterathon’ and ‘summerathon’ are workshops that have similarities with the hackathon. In these events, students innovate industry projects during the whole semester or during the summertime. (Avalos *et al.* 2017) However, such events do not have the short time-bounded nature of hackathons. (Filippova *et al.* 2017) describe hackathons as one of the more prevalent examples of the phenomenon of ‘*time-bounded collaborative events*’.

Team cooperation

Hackathons are regarded as innovation competitions or contests (Hartmann *et al.* 2019a, 2019b) and as one of the most widespread collaborative practices (Granados and Pareja-Eastaway 2019). Hackathon combines the community and competition, providing the support and encouragement needed for innovation (Kayastha 2017). Gathering people together into small groups or teams is mentioned by many authors (e.g. Angarita and Nolte 2019, Gama *et al.* 2018, Kayastha 2017, Kienzler and Fontanesi 2017, Komssi *et al.* 2015 b, Pe-Than *et al.* 2019, Rosell *et al.* 2014.) Besides competition, cooperation or collaboration is emphasized by many researchers (e.g. Briscoe and Mulligan 2014, Granados and Pareja-Eastaway 2019, Kienzler and Fontanesi 2017, Rosell *et al.* 2014, Hartmann *et al.* 2019 a.) The concept of simultaneous competition and collaboration is considered to be cooperation, which can exist on the organizational level as well as the individual, team or network level (Bouncken *et al.* 2015). However, other researchers see a dichotomy between competition and collaboration. For example, Pe-Than *et al.* (2019) distinguish the hackathon either as competitive or cooperative based on its goal.

Challenge

Challenge is related to the concept of competition or contest; it incorporates a call to participate in a competitive situation. The manner in which it is discussed in the literature is described in Table 3. The challenge is therefore what the participants work on collaboratively in teams that compete against each other during the hackathon. In addition to learning, the challenge is also regarded as a motivation factor for the participants (Gama *et al.* 2018).

Table 3 Descriptions of challenge in hackathons

<i>Authors</i>	<i>Description</i>
Oxford Dictionary of English, OED Online 2019	"a call to someone to participate in a competitive situation or fight to decide who is superior in terms of availability or strength"
Almirall et al. 2014	"meets the challenge posed by sponsors"
Angarita and Nolte 2019,	"attempt to complete a project of interest to them"
Pe-Than et al. 2019	
Briscoe and Mulligan 2014	"hackathons...can be challenge orientated"
Gama et al. 2018	"Tackle a challenge"
Granados and Pareja-Eastaway 2019	"work...on a solution to a problem or challenge"
Granados and Pareja-Eastaway 2019	"problem-focused events"
Kienzler and Fontanesi 2017	"to solve defined challenges"
Rosell et al. 2014	"aimed at solving a particular problem...with the goal of generating a working prototype at the end of the event"

To distinguish challenge from hackathon goal, according to Pe-Than et al. (2019) goal is a design element, meaning that it is outlined prior to the event. Goals may vary from one company and/or hackathon to another, and goals can be either short- or long-term (Chowdhury 2018; Pe-Than et al. 2019). In fact, the hackathon can be organized around goals (Pe-Than et al. 2019) and, in order to attain the goal, the organizers can define the task for the participants (Briscoe and Mulligan 2014). A goal can be, for instance the enrichment of a social network, facilitation of collaborative learning or development of the workforce. Many descriptive papers on the IT industry describe a prototype or demo as the aim, goal or objective of the hackathon (Raatikainen et al. 2013; Briscoe and Mulligan 2014; Komssi et al. 2015; Zukin and Papadantonakis 2017; Gama et al. 2018), or achieving social betterment (Briscoe and Mulligan 2014), new business opportunities (Komssi et al. 2015) and building a mission (Zukin and Papadantonakis 2017).

Creation process

Hackathons are regarded as innovation practices, with a two-fold contribution to innovation: firstly, by promoting exploration activities, such as new external solutions, and secondly, by enhancing some preconditions of innovation, e.g. attracting talent or building a community of experts (Granados and Pareja-Eastaway 2019). In their hackathon descriptions, researchers mention "find and innovate solutions from scratch" (Kienzler and Fontanesi 2017), that "hackathons are encouraging of experimentation and creativity" (Briscoe and Mulligan 2014), and that hackathons are "an effective technique to experiment with bleeding edge technologies, generate and prototype new ideas, grow as an engineer" (Kayastha 2017). Thus, hackathons are considered "an example of a bottom-up form of innovation" (Granados and Pareja-Eastaway 2019). Also, creativity can be regarded as "attempts to complete a project of interest to them" (Angarita and Nolte 2019; Pe-Than et al. 2019). Many hackathon descriptions in the IT industry describe the creative

process as the development or programming of a new software application (Leckart 2012; Almirall *et al.* 2014) or designing, generating or producing a prototype (Rosell *et al.* 2014; Komssi *et al.* 2015; Hartmann *et al.* 2019a). Innovation and development are also seen as a major reason for participating in a hackathon. In internal hackathons, the hackathon may provide a space for the project team to develop something that management does not prioritize (Pe-Than *et al.* 2019), be a minibreak from daily routines with something new that is self-directed with less discipline (Raatikainen *et al.* 2013; Komssi *et al.* 2015). People have been found to have an urge to build products (Briscoe and Mulligan 2014) and to try something new and work with new technologies (Komssi *et al.* 2015). Thus, hackathons always involve some kind of creative process as the aim is to innovate and create something new.

Ceremony process

The end of the hackathon event has been described by researchers as consisting of pitching, i.e. presenting or demonstrating the idea or prototype to the audience (Leckart 2012; Komssi *et al.* 2015; Kayastha 2017) or to a panel of judges, who select the winning team and give out prizes, which may be monetary or non-monetary, such as job offers (Briscoe and Mulligan 2014; Pe-Than *et al.* 2019). Participants seem to want recognition in several ways; by impressing current managers by drawing attention to their skills (Pe-Than *et al.* 2019), building up their resumé or CV (Zukin and Papadantonakis 2017), attracting investors or finding employment (Briscoe and Mulligan 2014) and using hackathons to market a product (Zukin and Papadantonakis 2017). In other words, the climax of the hackathon event can be regarded as a ceremony process. During the ceremony, ideas are presented, the jury meets to select the winner/s, potential solutions are recognized and rewarded.

Radical collocation

Hackathons are described mainly as an event where participants collaborate intensively (Almirall *et al.* 2014; Briscoe and Mulligan 2014), during which participants come together and gather in or form teams (Rosell *et al.* 2014; Kienzler and Fontanesi 2017; Gama *et al.* 2018; Angarita and Nolte 2019; Granados and Pareja-Eastaway 2019; Pe-Than *et al.* 2019). Furthermore, hackathon “implies an intense, uninterrupted, period of programming.” (Komssi *et al.* 2015) and (Pe-Than *et al.* 2019) have stated that “the teams are usually collocated”. Radical collocation is a situation where team members are together in a physical space for the duration of the project (Teasley *et al.* 2000; Pe-Than and Herbsleb 2019; Pe-Than *et al.* 2019). Collocation is seen as beneficial for technical work, speeding up software development, facilitating enduring relationships (Trainer *et al.* 2016) and improving productivity (Teasley *et al.* 2000). Also known as a ‘war room’, radical collocation is seen to help coordination, problem-solving and learning (Teasley *et al.* 2000).

3 Research design

In the research design of our conceptualization of the hackathon as an innovation contest, we applied the recommendations by (Podsakoff *et al.* 2016). More specifically, the three first steps of the development model of a good conceptual definition are as follows:

1. Identification of the potential attributes of the concept by collecting a representative set of definitions.
2. Organization of the potential attributes by theme and identify any necessary and sufficient of shared attributes.
3. Development of the preliminary definition of the concept.

As our aim is to distinguish the hackathon from other innovation contests, we decided to apply the necessary and sufficient concept definition by (Podsakoff *et al.* 2016). Identification of attributes was started by identifying what is already known about this phenomenon and as recommended, it was conducted by means of a literature search, including dictionaries. The method for the literature review was snowballing (Greenhalgh and Peacock 2005). The organization of potential attributes was carried out by theme and the necessary and sufficient attributes were identified. As some of the attributes together belonged to or constituted already defined or definable concepts, the identified attributes were categorized by these concepts. The preliminary definition of the hackathon concept was developed using these category concepts and identified attributes. This three-phased process was carried out by researcher triangulation, with researchers that had practical experience of hackathon research, event observation and organization.

4 Results

Identifying potential attributes

According to the reviewed literature it was discovered that the hackathon concept had been described but not defined. Furthermore, the clearly defined attributes that characterize the concept were missing. However, when the descriptions from various studies were collected and compared (Table 4), it was determined that certain distinctive aspects of hackathons were repeated in the descriptions.

Table 4 Comparison of aspects repeated in hackathon descriptions

	<i>Short time-bounded event frame</i>	<i>Intense collaboration</i>	<i>Competition</i>	<i>Collocation</i>	<i>Offline: people meet locally</i>	<i>Challenge (e.g. complete project)</i>	<i>Ideation, Experimentation and creativity</i>	<i>Teams</i>	<i>Pitching/Presenting</i>	<i>Recognition</i>
Almirall 2014	X	X				X	X			
Angarita and Nolte 2019	X	X	X		X	X	X	X		
Briscoe & Mulligan 2014	X	X	X			X	X	X		X
Gama <i>et al.</i> 2018	X	X				X		X		
Granados & Pareja-Eastaway 2010	X	X				X	X			
Hartmann <i>et al.</i> 2019 a	X	X	X		X		X			
Kayastha 2017	X	X	X				X	X	X	
Kienzler and Fontanesi 2017	X	X				X	X	X		
Komssi <i>et al.</i> 2015	X	X					X	X	X	
Leckart 2012	X		X		X		X	X	X	
Pe-Than <i>et al.</i> 2019	X	X	X	X		X		X		X
Rosell <i>et al.</i> 2014	X	X				X	X	X	X	X*

*) Not in the definition, but elsewhere in the paper

Organizing the potential attributes

Next, the identified distinctive aspects of hackathons that were repeated in the hackathon descriptions were analysed, and eight attributes stood out as necessary and sufficient. As a result, we propose the following selected necessary and sufficient attributes to define the hackathon as an innovation concept: short duration, team, challenge, creation process, ceremony process, collaboration, collocation and consistency. These attributes are also presented and categorised in themes in Table 5. The attributes that are included in the theme ‘co-opetition’ describe the innovation contest. ‘The radical collocation’ and its attributes explain how radical collocation appears in the hackathon. There are several ‘short time-bounded events’ in which the attribute ‘short duration’ defines the length of the event. In the literature, much has been written about the goal; however, we consider this to be a design element, which is defined prior to the event. The challenge, however, is an essential part of the event itself, i.e. the issue people work on collaboratively and compete against other teams on.

Table 5 Comparison of aspects repeated in hackathon descriptions

<i>Necessary and sufficient concept</i>			
<i>Logical rule</i>	AND		
<i>Structural rule</i>	If and only if all 8 attributes are present		
<i>Attribute substitutability</i>	No		
<i>Theme</i>	<i>Attribute</i>	<i>Sufficient feature</i>	<i>Example of non-sufficient feature</i>
Short time-bounded event	1 Short duration	t < week, ideally 1-3 days	cooperation lasts for one month or whole semester (semesterathon)
	2 Team	n > 1 teams, with 1 > participants per team,	One team or teams with only one participant per team
	3 Challenge	Task	
Cooperation	4 Creation process	A team formation, creation process	Testing existing solution, building a product that is already specified
	5 Ceremony process	An idea pitching, jury, possible winner recognition	Ideas are not presented to the audience and jury
Radical Collocation	6 Collaboration	Individuals and teams, organizers and participants	No team interaction needed,
	7 Co-location	Separated from daily business, food often served	Team is not located in the same space.
	8 Consistency	Intensive and consistent	Creation at the same time with other work. Team members alternate with the task.

The results of the literature review show that there is no general definition for the hackathon, only descriptions, yet some design attributes have been identified. Therefore, with the necessary and sufficient attributes of hackathons, as well as the themes that represent the attributes, we suggest that the hackathon as a concept be defined as follows:

A hackathon is one type of innovation contest, a short time-bounded event with a challenge to be solved creatively in cooperation and with the radical collocation of teams, whose output is recognized in a ceremony at the end of the event.

Figure 1 illustrates the environment of our hackathon definition. The hackathon event is defined in blue. The pre-hackathon process with its design elements comes prior to the event. After the hackathon comes the post-hackathon phase when the output of the hackathon event, e.g. commercialization, is worked on.

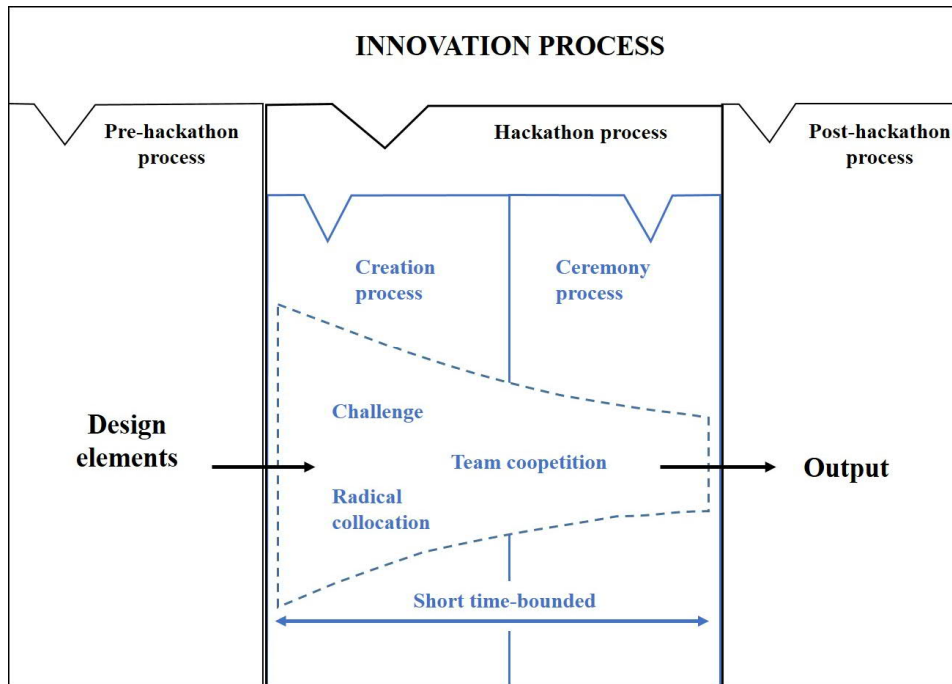


Figure 1 Three-phased hackathon process with hackathon event attributes

5 Discussion and further research

This article contributes to the literature on innovation management methods, in particular the concept of the hackathon as an innovation contest. More specifically, the conceptualization distinguishes the hackathon from other innovation contests and broadens the concept's applicability to other domains beyond innovation management. The contribution is achieved by conceptualizing the hackathon in terms of its necessary and sufficient attributes. The conceptualization has been carried out according to the recommendations of the first three stages of a four-stage model for creating a good conceptual definition by (Podsakoff *et al.* 2016).

Answering our research question: “*What are the necessary and sufficient attributes of the hackathon as a concept?*” our results showed that, conceptually, the hackathon includes eight necessary and sufficient attributes, namely short duration, team, challenge, creation process, ceremony process, collaboration, collocation and consistency. These eight necessary and sufficient attributes fall into three main categories. Short duration belongs to the category of “short time-bounded event”; team, challenge, collaboration, creation process and ceremony process belong to the category of “coopetition”. In addition, the attributes collocation, consistency and collaboration are part of the “radical collocation” category. Collaboration is the one attribute that belongs to both “coopetition” and “radical collocation”. “Coopetition” and “radical collocation” are defined concepts themselves, and “short time-bounded event” is definable. Thus our conceptualization also reveals the typological structure of the hackathon.

As a result, we propose the following definition of the hackathon:

A hackathon is one type of innovation contest, a short time-bounded event with a challenge to be solved creatively in cooperation and with the radical collocation of teams, whose output is recognized in a ceremony at the end of the event.

The literature on hackathons is mainly descriptive and practitioner-driven. Therefore, in situations where the scientific literature is scarce, the use of empirical material, preferably case studies, is recommended by (Podsakoff *et al.* 2016) as the confirmation of findings from the literature. Therefore, as further research, we recommend the confirmation of our findings with case studies from various domains. Moreover, for further research, we suggest studying the pre-hackathon phase design elements in various hackathon types, and their relations to the hackathon attributes and outputs. Furthermore, the entire post-hackathon phase also seems to be unresearched and sometimes even neglected, since unsuccessful commercialization, for example, is regarded as a hackathon-derived problem (cf. Komssi *et al.* 2015).

Practical implications

As most of the literature regarding hackathons consists of descriptive studies in the field of information technology, we suggest that as the practice of hackathons has spread to other domains, the conceptualization should also be all-inclusive. Views beyond that of the IT industry would benefit the building of a theory, specifically regarding innovation management methods, where the hackathon is one type of innovation contest. From an innovation management standpoint, having defined concepts of various innovation contest or competitions makes comparison regarding their usability as well as productivity in various situations more manageable. Comprehending the event that is under design is essential. Without understanding the attributes of the event, various design elements may also be overlooked. Designing a hackathon, a short time-bounded event that incorporates cooperation in a radically collocated situation has its benefits as well as its drawbacks. Therefore, being aware of the essence of the hackathon, for example regarding the goal setting of the event, may lead to more successful goal achievement for organizers, sponsors and participants. Our findings will benefit academics studying innovation management, particularly those focusing on innovation contests or hackathons. Additionally, practitioners operating in various domains, aiming to enhance their innovation processes, will gain from this study: it gives a condensed conceptualization of what the hackathon is as an innovation contest.

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