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## A Typology of Hackathon-use

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**Abstract:** This paper addresses the typology of the hackathon concept. Specifically, it focuses on describing the four archetypes of hackathon use: 'designing', 'crowdsourcing', 'learning' and 'community building' discovered from the literature. The typology is a continuation of the conceptualization of hackathon, which aims to clarify the concept of hackathons and their use in various contexts. As a result, the paper describes the characteristics that typify the hackathon, 'body of participants', 'focal interest', 'setting' and 'creation method'. The two main themes that arose from the studied literature, 'body of participants' and 'focal interest', are used as the axis to compose a 2x2 matrix of the archetypes. Therefore, this paper contributes to the conceptual clarity of the hackathon phenomenon.

As the main result, this proposed paper fills a prominent research gap in hackathon literature: the typology of the hackathon-use. Thus, this paper reports the typology by differentiating known archetypes of the hackathon.

**Keywords:** Hackathon; typology; conceptualization; hackathon archetypes; hackathon-use; innovation contest; crowdsourcing; learning; community building; designing

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## 1 Introduction

Hackathon as an innovation management method has spread from its origins within the Information Technology industry to other sectors. In the corporate world, hackathons promise endless possibilities for innovation (Granados and Pareja-Eastaway, 2019). Hackathon is mainly developed outside the scientific community, and researchers' interest has arisen not until 2012 (Porras et al., 2019). Thus, hackathon is a novel phenomenon, and its research is mostly exploratory and descriptive. Prior studies present the hackathon phenomenon in many respects in detail, e.g. regarding their design elements or choices (Komssi et al., 2015; Pe-Than et al., 2019; Porras et al., 2018). Descriptive research often yields typologies or taxonomies. According to (Medina Angarita and Nolte, 2020a), there have been some overviews of different types of hackathons created previously in the domain, yet no unified view of their typology. However, clear concepts and construct clarity are the foundation for any research (Molloy and Ployhart, 2012; Podsakoff et al., 2016; Suddaby, 2010). More thoroughly researched hackathon typology is still missing, yet required for the concept clarity of hackathon as a phenomenon. Thus our research question is:

*"What is the typology of the hackathon-use?"*

Therefore, this study aims to fill in this gap by presenting a thoroughly researched hackathon typology required for the conceptual clarity of hackathon as a phenomenon.

## 2 Theory building and typology

Innovation management theory building is still in early phases, and most of the innovation management studies are exploratory and descriptive (Saunders et al., 2008). Solid theory-building calls for clear constructs that are "simply robust categories that distil phenomena into sharp distinctions that are comprehensible to a community of researchers" (Suddaby, 2010, p. 346). Moreover, "a good definition should also specify the extent to which values of the construct are expected to differ across cases, conditions, and time." (Mackenzie, 2003, p. 325) Multidimensional constructs should be conceptualized in a manner, that the relations between the subdimensions and the superordinate constructs should be specified (Jarvis et al., 2003; Mackenzie, 2003). Therefore besides the construct clarity, also conceptual clarity is demanded in the management literature (Locke, 2012; Podsakoff et al., 2016), since: "If one does not have a clear idea of what the concept means, it is difficult to identify related concepts or to specify whether they are antecedents, consequences or correlates of the focal concept" (Podsakoff et al., 2016, p. 166) Separation the phenomenon from other similar phenomena, it is essential to describe and distinguish the phenomenon into different kind of things, i.e. classify. The focal role of concept classification, i.e. typologies and taxonomies, is emphasized in the theory-building process by describing it as a partway between a simple concept and a full-blown theory (Neuman, 2014) without having a theory status, they can still lead to theories and used as stand-alone frameworks (McGregor, 2020). Typology is, "a classification system that breaks something down into different types or kinds" (Johnson and Christenen, 2012, p. 784) utilized in social sciences., which helps to organize abstract, complex concepts (Neuman, 2014). Lambert 2006 highlights the characteristics of typologies to be: specific/arbitrary/artificial

classification, categories (types) are conceptually derived, the reasoning is by deduction, consider only a few characteristics, the classification is mostly qualitative, and it provides a basis for only limited generalisations.

### 3 Hackathon concept and types of hackathons in literature

#### *Hackathon conceptualization*

The study of hackathons is still in its infancy. In their attempt to conceptualize hackathon Halvari et al. (2020) have defined it:

"A hackathon is one type of organized, goal-driven innovation contest, a short time-bounded event with a challenge to be solved creatively in co-competition and collocation of teams, whose results are presented and recognized in a ceremony at the end of the event."

In their conceptualization process resulting in the definition, Halvari et al. (2020) specified nine necessary attributes of the hackathon (Table 1): 1) organization, 2) short time bounded event, 3) collocation, 4) challenge, 5) ceremony process, 6) team, 7) goal, 8) collaboration and 9) creation process. That is, if all necessary attributes are present, the event can be categorized to be a hackathon. Yet it still does not explain what type of hackathon it is.

**Table 1** Hackathon concept (adapted from Halvari et al., 2020)

<i>Hackathon Concept</i>		
<i>Logical rule</i>	AND	
<i>Structural rule</i>	If and only if all 9 attributes are present	
<i>Attribute substitutability</i>	No	
<i>Theme</i>	<i>Attribute</i>	<i>Sufficient feature</i>
<i>Co-opetition</i>	1 Organization	n $\geq$ 1 internal and/or external organizer n $\geq$ 1 internal and/or external facilitator n $\geq$ 1 interested party
	2 Short time bounded event	t < week
	3 Collocation	Team in 1 space 1 space contains n $\geq$ 1 teams
	4 Challenge	n $\geq$ 1 challenge
	5 Ceremony process	n $\geq$ 1 recognition n $\geq$ 1 presentation of achieved results
<i>Co-creation</i>	6 Team	n > 1 teams n > 1 participants per team
	7 Goal	n $\geq$ 1 interested party objectives
	8 Collaboration	n $\geq$ 2 participants interaction in team
	9 Creation process	Consistent ideation and deployment n $\geq$ 1 results

### *Hackathon types and typologies in the literature*

Hackathons have been studied and described with various participant groups and contexts. Pe-Than et al. (2020) highlight that hackathons presented in the literature typically exist outside any stable organisational context and bring together people who generally have not worked together or even met each other before, such as in digital innovation contests or open data hackathons. Therefore, they have specified a distinct type, a corporate hackathon, comprising people from a specific organisation. Furthermore, hackathons have been utilised in university-industry collaboration for higher education purposes (e.g. Jussila et al., 2020; Suominen et al., 2019), even in virtual events (Jussila et al., 2021), among others. Yet, there is no unified typology of hackathons utilized for various purposes.

In their literature review of 91 journal and conference papers of hackathons, Medina Angarita and Nolte, (2020a), discovered that there has been some overviews of different types of hackathons created previously in the domain. For example, Drouhard et al., (2017) typified hackathons as communal, contributive, and catalytic, and Starov et al., (2015) as educational, communicational, and innovative. However, a more thorough typology of these various types of hackathon events, especially focusing on the design from an innovation management point of view is still missing.

From the innovation theory viewpoint, the participants, especially hackers, play a focal role as participants in the innovation process and contributors to innovation outcome in hackathons. Huizingh (2011) has categorized the various ways of innovation based on the openness of both the process and the innovation outcome. He has come up with a 2\*2 matrix of four ways of innovation: 1) Closed (Closed-closed), 2) Private Open Innovation (Open process - Closed outcome), 3) Public innovation (Closed process – Open outcome), 4) Open Source Innovation (Open-open). Medina Angarita and Nolte, (2020a) have categorized the hackathon output into tangible and intangible categories. The tangible outcomes can be either technical (e.g. new prototypes, product features and bug fixes), and non-technical artefacts (e.g. visualizations, new or improved documentation, and publications). The intangible outcomes can be learning about the main issue, using new technologies, or acquiring industry and in-university skills, networking, opportunities for collaboration, developing new ideas, entrepreneurship, fostering existing enterprises or awareness about the hackathon theme.

## **4 Research design**

We have followed Lambert's (2006) view of the characteristics specific to typologies. Our exploratory research for hackathon typology was run with a thematic analysis of literature to collect specific types of hackathons events (King and Brooks, 2018). As our subject of interest, hackathon, is too recent to carry out extensive literature reviews by applying bibliometric analyses or meta-synthesis to provide more quantified conclusions about the current stock of knowledge, our approach to reviewing is qualitative. Moreover, it is too early for systematization, cluster aggregation or citation mapping of hackathons. However, it is necessary to identify relevant differentiation criteria and corresponding types of hackathons.

The entire research process for hackathon typology was carried out by three researchers in triangulation with multiple rounds. All three researchers are familiar with hackathons in academia as well as in practice: all have studied the concept via literature,

but also arranged hackathons in various organizational contexts, e.g. in educational as well as intra-organizational events.

The process was started with the previously carried out output of the conceptualization process of the hackathon with its nine attributes (Halvari et al., 2020, 2019). We utilized the abductive theory-building process (Dubois and Gadde, 2014), where the typology formation is a continuum to the conceptualization and definition of the concept.

Next, the set of hackathon literature to be researched was selected. To avoid an inbred view to the literature, we utilized the recent systematic literature review carried out by Medina Angarita and Nolte (2020a) that included only hackathon cases in altogether 91 journal and conference articles (Medina Angarita and Nolte, 2020b). Utilizing the literature set systematically collected and evaluated by researchers outside our group to identify a literature-derived inventory of types and typology criteria is part of literature triangulation, to avoid the biased conclusions. All the 91 articles were uploaded to Atlas.ti 9 research management system.

In the pre-coding phase, all the 91 articles were auto-coded. The term "hackathon", "team" and "participant" were the most common words in the auto-coded articles. The "hackathon" appeared 5660 times, but the word count for the term "participant" was 2481 and similarly, the word count for "team" was 3310.

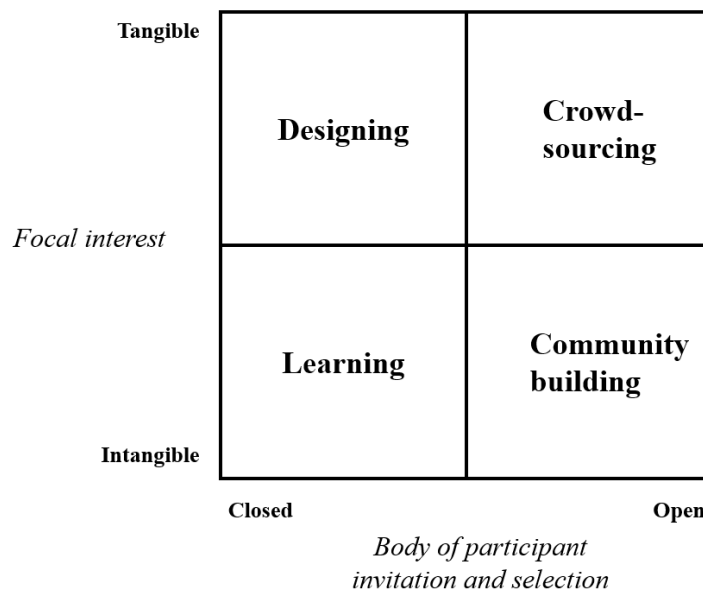
After that, the research group created a preliminary list of codes and code groups, and test coded a few articles. However, the quality of reporting in conference papers was discovered miscellaneous, i.e. lacking accuracy. Therefore, the decision was made to limit the study only to the 28 journal articles, listed in the Medina Angarita and Nolte, (2020b) literature set. Moreover, 3 new articles were added to the set: one journal article (Jussila et al., 2020) and two new conference articles (Jussila et al., 2021; Legardeur et al., 2020). All the 31 journal articles were coded in terms of the cases described in the papers. The coding was carried out as hypothesis coding (Saldana, 2012) with a predefined list of codes, and code groups, that were added with new ones if needed during the process. The predefined list included codes derived from the hackathon conceptualization (Halvari et al., 2020), and more specifically from hackathon attributes such as "goal", "organizer/facilitator", "participant/team", "location", "collaboration", "creation", "outcome", "domain", and "hackathon name".

In the next phase, all the codes and code groups, predefined and arisen from the case data in the literature were discussed and grouped thematically to those that can be considered a type according to the innovation theory. Therefore, the thematic analysis of typology differentiation criteria was innovation theory-driven. As a result, four themes were formed: "Body of participant", "Setting", "Focal interest", and "Creation method". Finally, these themes form logically complementary archetypes according to each of the typology criteria 1) Designing, 2) Crowdsourcing, 3) Learning and 4) Community building hackathons, thus all the themes have multiple sub-types that specify a hackathon for different uses.

## 5 Results

### *Archetypes*

By applying and maintaining four innovation categories by Huizingh, (2011) and supplementing it with our results thematic analysis (Table 2) on the journal publications of the systematic literature review by Medina Angarita and Nolte, (2020a), the typology of hackathon-use with four archetypes was discovered (Figure 1). The four archetypes are: 1) Designing, 2) Crowdsourcing, 3) Learning and 4) Community building hackathons. The four archetypes compose a 2x2 matrix. The main axes of the matrix are derived from the two main themes that arose from the studied literature – 1) the focal interest of organising the hackathon and 2) invitation and selection of the body of participants. The four archetypes of hackathon-use explain the processes that are applied to attain the focal interest of the hackathon. The body of participants is the actors and enablers of the process.



**Figure 1** Four archetypes of hackathon-use.

In the first archetype, 'Designing', the focal interest of hackathon is to produce a tangible outcome e.g. prototype, concept, or services by prototyping the co-created ideas.

The second archetype is 'Learning'. Learning is the outcome in most of the hackathons, but not a focal interest as in pedagogical hackathons aiming to produce education, even credits, sometimes called 'educational hackathons' or 'Edu-hacks'. With such hackathons the learning is resulted with 'learning-by-doing' -method.

The third archetype is 'Community building'. Community building, networking and collaboration are often mentioned as a goal and outcome of hackathons', but it is also a focal interest of some hackathons (Angelidis et al., 2016). In such hackathons, the

specific interest is in enabling as good collaboration and networking as possible. E.g. D'Ignazio et al., (2016) considered the community building already in the planning phase by committing to relational and maintenance work to nurture the community building.

Archetype 'Crowdsourcing' is a special type of hackathon used to solve problems that would benefit from multiple solutions (Boudreau and Lakhani, 2013). Hackathons can be used for crowdsourcing technical artefacts, e.g. solutions for predefined problem (Silver et al., 2016), or non-technical artefacts, e.g., conducting pre-analysis of genomic data (Ghouila et al., 2018).

Our study found other characteristics that may typify hackathons, e.g., 'the collocation type' (radical or virtual), 'geographical focus' (national or international), 'the needed competence' and 'creation methods'. However, we classified these to be sub-archetypes that can appear together with any main archetypes.

### *The focal interest of organising the hackathon*

Each hackathon has an initial and focal rationale for its organization, i.e. the *focal interest* of an organiser. Moreover, the focal interest can also be funders' interests, which the organizers have put into practice. For the same purpose, the reviewed literature mostly applied the term goal, in addition to terms potential outcome (Medina Angarita and Nolte, 2020a), main objective (Angelidis et al., 2016) and aim (Boisen et al., 2017; Carruthers, 2014; Chandrasekaran et al., n.d.). The term goal also referred to a challenge posed by the team (Aryana et al., 2019; Chandrasekaran et al., 2018). There exists also multi-goal hackathons, e.g. The OLCF GPU Hackathons are code-development/learning events to enable attendees to utilize GPUs better (Chandrasekaran et al., 2018). Thus, the goals are 1) code development and 2) learning. Yet, while learning is the focal interest, the code-development is the method for learning-by-doing.

The thematic analysis of the goals revealed both 1) *tangible* focal interests which are technical artefacts (e.g. ICT prototypes, products or product features or data analysis) and non-technical artefacts (e.g. visualizations, concepts, ideas, methods and course credits), and 2) *intangible* focal interests such as learning, networking, collaboration, fostering entrepreneurship.

### *The body of participants*

The data analysis revealed that the participants were recruited and selected from either intra- or inter-organizationally or public sources. Thus, in recruiting the participants, there is a question of the boundaries of the organization: an invitation to participate is either restricted, targeted, or even mandated to a certain population, i.e. *closed*, or unlimited for anyone to join, i.e. *open*. The *closed* body of participants can appear when there are a specific group of students or a corporate internal hackathon with no external participants. E.g., Students majoring in either technical or business subjects participated in "Urban-Educational Hackathon" as part of the R&DI course. (Suominen et al., 2019)

The open hackathon is when the participation is open for everybody, yet, the number of participants may be sometimes limited for practical reasons. E.g., Health++ was an open hackathon, but there was a 300 participant limit, and the participants were selected among the 587 applicants (Wang et al., 2018) and 'Make the Breast Pump Not Suck!' was also open to the public to register under certain categories, but participation was limited to 150 people plus two scholarships were also offered (D'Ignazio et al., 2016).

**Table 2** Table shows the number of articles where the specific term under a theme appeared.

	<i>Themes</i>	<i>Description</i>	<i>Incident</i>	
#	Small / Regular /	Number of participants	185	mean
	Large / Massive Scale	Number of teams	47,5	mean
<i>Body of participants</i>	Intra Organizational		6	
	Inter Organizational	Source of participants	11	
	Public		16	
	Single Competence	Main competence/skill/discipline of the body of participants	5	
	Multi Competence		30	
	National	The original location of participants	20	
<i>Setting</i>	International		12	
	Radical	Physical proximity	34	
	Virtual	Virtual proximity, technology supported	1	
	Hybrid	Mixture of radical and virtual proximity	8	
<i>Focal interest</i>	Tangible	ICT prototype/technology solution e.g. mobile app., 3D, embedded system prototype, GPU and BGP development	23	
		Product	5	
		Product feature	3	
	Non-technical artifact	Data analysis	2	
		Visualizations	1	
		Concept	8	
		Service	1	
		Idea	1	
		Methods	2	
	Intangible	Education: ECTS course credits	8	
		Learning	23	
		Networking	13	
		Foster entrepreneurship	3	
		Collaboration	19	
Cultural awareness/change		3		
Crowdsourcing	Community building and development	1		
	Innovation	2		
<i>Creation Method</i>	Learning by doing		4	
	Programming / Coding		18	
	Conceptual design		10	
	Ideation		11	
	Prototyping		13	
	Designing, ie. Rapid design		5	
	Product development		1	
	Problemsolving by applying methods from another field		1	
	Problemsolving		2	
	Data analysis		2	

\* Including journal articles from Medina et al. 2020 literature review + Jussila et al. 2020a, Jussila et al. 2020b and Legardeur, 2020



## 6 Discussion

This research contributes to the innovation management theory, particularly regarding hackathons as one type of innovation contests (cf. Halvari *et al.*, 2020). The contribution is made to the concept clarity by presenting the typology of the hackathon-use and describing its four archetypes.

As our results, we presented a 2x2 matrix of two main themes of hackathon-use as axes discovered from the literature: the focal interest, and the body of participants. These two main themes produced four archetypes of hackathon-use: 1) Designing, 2) Learning, 3) Community building, and 4) Crowdsourcing. In addition to these archetypes, we discovered other sub-types of hackathons, such as Setting (Radical/Virtual/Hybrid), and Creation method, and sub-types amongst the Body of participants (National/International, Single/Multiple competences). From the innovation theory viewpoint, we do not regard sub-types such fundamental themes that would impact the discovered archetypes of hackathon-use.

Halvari *et al.*, (2020) conceptualization of hackathon was the basis of our typology building. The concept attributes were preliminary themes of our thematic analysis in Atlas.ti with the chosen hackathon literature published mainly in journals. Utilizing the clear concept attributes with defined sufficient features as the basis of the thematic analysis is functional, as attributes provide the relevant and necessary elements of the hackathon as an innovation contest.

Innovation theory was our guiding principle in thematic analysis, typology creation, and archetype formulation. Due to their nature, hackathons are often aimed to use in the cross-functional population. Thus, typifying a hackathon based on its domain is not only difficult but unnecessary. In fact, in the innovation literature, the basic innovation process is seen quite similar regardless of their sector or discipline (e.g. Tidd, 2005). Naturally, many hackathons are named after the domain or even goal, e.g. Edu, Health and Civic Hacks. However, it does not reveal the ultimate goal of the hackathon. Furthermore, many hackathon studies are reported after the event, thus the focus is on the outcomes of the event. Nevertheless, the funders and/or organizer do have their focal interest already before the event. Thus, sometimes it is hard to separate those two: the goal and the outcome afterwards, since which became first the egg or the hen? Yet, for the hackathon design viewpoint, it is important to understand the type of the hackathon, hence the focal interests before the event to do the correct design choices in terms of e.g. the participants.

All the discovered hackathon archetypes were not equally present in the studied literature. For example, only one article mentioned crowdsourcing hackathon where participants were recruited from the public (Ghouila *et al.* 2018). We know from the literature that crowdsourcing has been proven to be an effective collective method for resourcing innovative initiatives. Besides, hackathon and jams' are becoming commonplace in the world of start-ups because they offer a powerful method for facilitating innovation and shaping collaboration among the team members (Almirall *et al.*, 2014). Furthermore, collective activities integrated into open educational and manufacturing platforms and spaces like Fab Lab demonstrate benefits for learning-by-doing, as well as creating artefacts (Guthrie, 2014). The reason for the low incidences of crowdsourcing archetype could be due to the limited case studies published in journals. Besides, the published journal articles were limited to smaller or mid-size hackathon cases. This could be due to many reasons. However, one concerning observation of hackathon case reports were that from the 91 articles mentioned in the literature review of

Medina Angarita and Nolte, (2020a) only 28 were published in journals, and only one article was published clearly in innovation management discipline journal. For innovation theory building amongst innovation contests, such as hackathons as innovation method will continue, the studies on the subject should be discussed in the journals of the domain. The journal articles on hackathons were focused on the readers of the domain-specific journal, thus the effort was made in describing the outcome with the expense of the innovation process view.

For further research, we call for further development of the conceptual clarity of the hackathon concept. In the literature, strikingly visible is the inconsistent usage and intermingling, especially with the following terms: the goal, focus, objective, topic, aim, target, task, challenge, output and outcome, thus affecting the further use of the studies. Moreover, even the hackathon name seems to have a great effect on the event. E.g., the teams that participated in "Make the Breast Pump Not Suck!" took the title quite literally and avoided suction in their design (D'Ignazio et al., 2016). Therefore, it can be assumed that all these design choices impact the body of participants and even the output of the hackathon, thus the entire hackathon success.

To sum up, an unambiguous understanding of the hackathon concept and typology of the hackathon-use helps to reduce the misuse of the terminology and thus helps to detect hackathon from other innovation contests and distinguish different types of hackathons from each other. Together these will support the development of hackathon methodology, highlighting its potential, which eventually affects the success of the phenomenon and provides the big picture for practitioners that are using or considering using the hackathon methodology.

The research has its limitations. Typology itself is a figment of interpretation for specific use. Also, the quantity of the literature utilized in this study as it was restricted only to journal articles, is a limitation. As this study was subjective by nature, it created some biases. E.g., the evaluation of the significance of the reported goal was subjected to potential bias of the original researcher and us. With some studies, it was difficult to see if the reported goal was the initial goal but an outcome.

As a practical implication, from the innovation management standpoint, having a clear typology of hackathon-use with its described archetypes benefits further research and theory building, but is useful also for academics teaching various innovation pedagogy methods and techniques. Not only researchers but also hackathon practitioners who are organizing and facilitating hackathons need to have a common language and thorough understanding of the dynamics of the hackathon. Therefore, also the practitioners aiming to enhance the organized innovation processes in their events will gain from this study as the archetypes and examples can function as a road map to approach the hackathon event planning strategically. By that, a solid typology of hackathon-use enables the creation of meaningful and research-based hackathon practices.

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