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Hackathon as Emerging Innovation Practice: Exploring Opportunities and Challenges through 8 in-depth Case Studies

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Abstract

The lack of academic literature on hackathon has created confusion over a phenomenon that is increasingly gaining traction. To address this topic a definition of hackathon is provided collecting and integrating the definitions given by the most relevant authors found in the literature. In addition, a comprehensive literature review is carried on reviewing all the main models that have been studied so far as well as the main theories that hackathons refer to: Open Innovation and temporary group organization.

A model is created from the literature with a dual objective: analyzing hackathons, and providing a framework for their organization and assessment post-event. This is then used to analyze a sample of eight hackathons that took place in Italy from April to November 2017. The data collected serve to the generation of results that both provide relevant theoretical contributions and managerial implications in the form of advices to organizations that wish to run a hackathon.

1 Executive summary

1.1 Problem setting

The term hackathon comes from the juxtaposition of the words *hack* and *marathon*. *Hack* stands for the research and explorations of software and lines of code, not to the crime activity. The terms indicate the concentrated and focused effort – like in a marathon – of finding technological solution that involve software or hardware development – hack. Starting from the 2000's hackathons have begun to be increasingly seen by tech and non-tech companies and as a way to quickly develop new software technology and to prototype and test digital solutions in few days or hours. It is estimated that more than 200 hackathons were hosted in 2016 in the USA and approximately the same number in the rest of the world.

Hackathons are events where people gather to think and generate technological innovations. These events are taking place worldwide promoted by organizations that look outside their boundaries for innovation to improve their businesses. Hackathons can serve a variety of purposes apart from the one of the generation of an innovation but few literature has been written on these events. Of the literature written, the greatest part is non-academic and consists of online articles by relevant magazines and blogs. Few academic papers have been written on the phenomenon and even fewer are those that approach the hackathon to create a model that helps in their understanding. The majority of academic papers is limited to the description of one or more hackathons.

It is important to address this topic from an academic perspective because not only it would enrich the theoretical background, but also it would help organizations to run a hackathon that is most suited to their structure and needs. Regarding the enrichment of the theoretical background, this thesis aims at enriching the literature on hackathon as well as the one on the main theories that hackathons refer to (Open Innovation and temporary group organization).

1.2 Research objectives and methodology

To define the research question the following steps have been taken:

- Problem definition: hackathons are increasingly used by more and more organizations as a way to open themselves to people from outside the company and to foster, or take steps towards, technology. These are events that potentially serve a variety of purposes and no academic literature and managerial advices have been written yet.
- Problem statement: the lack of academic literature and managerial advices has left a gap that was mainly covered by online articles. Most of them are a repetition of the other and no one refers to academic literature. There is the need to address this topic with an academic perspective taking into consideration the academic literature and enriching it with results found from a systematic field research.
- Research question: hackathons are gaining popularity among tech and non-tech related companies. Yet there is not a comprehensive study about this topic in the literature, apart from sporadic description of some hackathons.

  Do hackathons support the innovation process of the company? What are the typical problems that are best to face in hackathon-like events? Are hackathons limited to the generation of an innovation or are there other objectives? How far does the current literature answer to these questions?

This thesis' objective is to answer the research question. In addition, this thesis aims at finding a model with which it is possible to analyze a hackathon and to provide a support to the promoter during the organization and throughout its whole duration.

In order to reach this objective, the methodologies that were used are:

- Review of primary and secondary sources: in the first section of the thesis the literature review is carried out taking in consideration both academic (primary sources) and non-academic (secondary sources) literature. Non-academic literature consists in online articles from relevant magazines and blogs. These are considered as they represent a large portion of the overall literature that has been written on the theme of hackathons so far. As a matter of fact, hackathons are a quite new phenomenon and since it

takes time to publish an academic paper, online articles are the most updated source of information, even if it is less trusted;

- Ethnographic observation: this was carried out while observing the hackathons. The cumulative hours of observation are 236 for a sample of eight different hackathons. This was used to gain insights on the mechanism that take place during the formation of the teams, during the phase of creative problem solving and in the last phase of the preparation of the presentation;
- Interviews: interviews were done both with promoters and with organizers of the different hackathons. The same script was used for each interview but is was considered mainly as a guideline. As a matter of fact, most of the questions made followed the discussion to eventually go back to the script;
- Survey: participants from every hackathon were surveyed with the same questions in order to understand the reasons for participation, the expected output and the general information of the participants. In total, 150 answers were collected;

1.3 Literature review

Hackathons have grown into a variety of typologies and often the literature, especially the non-academic one, confuses hackathons with other forms of events. Different authors agree that the term hackathon covers more than just one type of event. "Hackathon events" can have different objectives as well as different subjects participating in the event. There are civic hackathons, iconathons, code sprints, data days, internal hackathons, and company promoted hackathons. Moreover, some non-coding events have been classified as hackathons adding confusion to the discussion. For the sake of clarity, this thesis will not analyze internal hackathons as the objective is to study those hackathons that are open to external participants.

Given the confusion around the term hackathon the first step of the literature review was the one to provide an integrated definition of hackathon that would take into account the most relevant definitions found in the literature. To do this,

33 papers (29 academic papers and 4 articles from relevant tech magazines) that report the definition of hackathon were analyzed (table 3). To generate a definition that would take into account all the definitions written in the papers, six characteristics were extracted. These constituted the distinctive elements that make hackathons.

The integrated definition of hackathon is reported in the following and the validation was left to do during the field research:

Integrated definition of hackathon:

"Hackathons are events that last between 8 to 48 hours in which participants are challenged to generate a technological innovation in the form of a functioning software or hardware prototype. The best idea, selected by a jury, is rewarded with a prize. This could have the form of a monetary or non-monetary (e.g.: access to online or offline courses, incubation or acceleration programs, technological gadgets) reward. Hackathons are open to different categories of participants such as business-related figures, designers and computer experts. Also, the participation of experts, in hackathons that require expert knowledge, is welcomed. Every hackathon follows a structure: team selection, creative problem solving, coding and preparation of the presentation. In the initial phase of every hackathon participants are required to create a team. In the second phase participants engage in creative problem-solving activities, in the third phase the program gets written and in the last one the pitch is created. Hackathons are an effective way to literally "hack" existing problems and find creative and tangible technological solutions"

The continuation of the literature review made an overview on hackathon analyzing them over five dimensions:

1. Field of application: from the integrated definition, it appears that hackathons must deal with technology and that teams must provide an output in the form of a technological prototype. However, hackathons are applied in a variety of

fields. In this section, all the fields of applications as well as the background of participants were studied;

2. Similar events: hackathons are often confused with other events such as code-fest, hack-fest and many others. This section reveals all the attempts to differentiate these events as well as a presentation of similar events that companies use as alternatives to hackathons;
3. Objectives of the hackathon: there are many reasons why a company may choose to run a hackathon. Although all the authors agree that one objective is the development of an innovative solution aimed at solving a problem, they do not agree on the indirect objectives that a company can achieve with the promotion of a hackathon. This section provides an overview on all the objectives cited by the different authors and attempts at a classification of these. It also shows divergent point of views as it reveals the arguments to the fact that hackathons are not a mean to achieve those indirect objectives;
4. Benefits and drawbacks: different papers attempted to classify pros and cons of participating to and running a hackathon. This section gives an overview on all these and groups authors that reason likewise;
5. Models and classifications: finally, the works from the authors that attempted to develop a model are presented. Also, a framework to guide an organizer in the preparation of a hackathon is presented.

The most important information gathered with this overview is that the literature analyzes four different objectives of the hackathon – innovation, recruitment, community build, and education.

The literature review also analyzes how hackathon fit into the theoretical frameworks of the Open Innovation and the temporary group organizations. In particular a consistent review of the literature is carried out for both the theoretical frameworks as well as an analysis on how hackathons fit into each framework. From this analysis, it resulted that hackathon function as a sourcing method of opening innovation and that teams in hackathons indeed work as temporary groups.

The last section of the literature review made a comparison between hackathons and other two events that have the objective of generating an innovation and work

as temporary groups. The selection of the two events was made on the basis of the amount of academic literature present on the event. The events chosen are Design Sprints and innovation contests. This comparison is carried out with the objective of finding the unique characteristics of hackathons that arise from the differences with similar events. From this study, it resulted that hackathons are a specific way to run innovation contests. As a matter of fact, if an organization promotes an innovation contest regarding technology nowadays, chances are very high that it will be organized, advertised and performed as a hackathon.

1.4 Research methodology and field research

After the literature review the model was constructed. The construction of the model consisted in scouting the literature to find existing models that could be applied, in the verification of the consistency with the literature review and in the actual construction of the model.

The model found in the literature is one that is used to analyze innovation contests (Bullinger, Moeslein, 2010) and can be found in table 10. The consistency with the literature review considers the model that was used to compare hackathon, innovation contests and Design Sprints (table 9). The joint use of the model by Bullinger and Moeslein and the one created to compare the events are complementary: the model by Bullinger and Moeslein provides the structure and the one created for the comparison of the events provides the variables.

The process that leads to the construction of the model consists in the deconstruction of hackathons in their design elements and a further analysis of each design element to find the building blocks that constitute them. Therefore, there are three levels of analysis: the variables that are taken from the model used for the events' comparison represent the first layer, the design element that constitute the hackathon the second, finally, the building blocks that analyze each design element even further, the third.

The model is presented below. A larger and clearer representation of the same table is shown in page 96 (table 12).

Variable	Design Element	Building Block	Attribute				
//	Promoter	Industry	Tech			Non-tech	
		Does it involve a community?	Yes			No	
		Popularity	Low			High	
	Organizer	Does it involve a community?	Yes			No	
		Popularity	Low			High	
Objective	Problem	Description					
		Objective	Innovation	Recruitment		Community build	Pedagogy
	Challenge	Number	1	2	3	4	More than 4
		Challenge specificity	Low (open challenge)			High (specific challenge)	
Participation	Call	Target number					
		Target background	Only tech experts			Open to every background	
		Cost of participation	Free			Paid	
	Attendees	Number of participants					
		Participants' background	Only tech experts			Participants from every background	
		Selection	Yes			No	
		Application as...	Team		Individual		Both
Structure	Phases		Team formation	Creative problem solving		Coding	Preparation of the presentation
	Duration						
	Mentors		Only tech experts		Mentors from every field		Not available
	Team formation	Number of participants in the team					
		Who defines the teams	Organizer		Participants		Both
		Rules on the participant's background	No rules			Only teams with mixed backgrounds	
	Reward		Cash	Coupon	In kind rewards	Recruitment	Project development	Visibility
Output	Performance	Participation (Participants/target)=%					
		Output usefulness	Yes			No	
		Recruitment	Interview			Job offer	
		Community build	Yes			No	

The field research was conducted from April to November 2017 on a sample of eight hackathons organized in Italy. The sample was decided on the basis of a set of building blocks that were considered to be the most important discriminant factors on which to differentiate hackathons. These are:

- If the promoter involved a third-party organizer;
- If the hackathon was only open to participants with a tech background or not;
- What type of reward the hackathon promised: in particular the differentiation in this case was made on monetary/non-monetary (table 13 shows the sample)

The data collection consisted in the gathering of information with different methods ranging from event documentation, to interviews with promoters, organizers and participants, to surveys that were submitted to participants. In addition, each hackathon was studied with an ethnographic approach observing how teams and participants behaved throughout the hackathon.

The overall data collected consists of 236 hours of on-site ethnographic observation. A collective database of 150 answers from the participants of every hackathon and 8 interviews with promoters and organizers. These were made to understand their expectations of the hackathon and to have a comment of the results. Finally, at every hackathon photographs of the event space, work area and break area were captured.
A thorough description of every hackathon is carried on for each one of them from 6.2.1 to 6.2.8 and the model built in the previous phase is applied to each hackathon (table 14 to table 21).

To carry on the study on the results, the cross-case analysis was made (table 22). From this, it is possible to appreciate three different types of information:

- *Type 1: most promoter took the same decision on the building block*: this happens in those cases where, in the majority of the hackathon (all of them or seven out of eight), promoters decided to run the hackathon in the same way, regarding a specific building block. For example, if all the promoters independently decided to screen people, this would be part of these type of information;
- *Type 2: some promoters took a decision and some others took the opposite:* in the case of binary decisions, e.g. whether to make participants pay for their participation or not, it may be that some promoters decided for one option and the other decided for the other. These cases are the ones that are going to be studied. In particular, each one of these cases will be compared to one performance at a time;
- *Type 3: each promoter took a different decision:* it could be the case that promoters decided to run one building block of the hackathon completely differently from each other. For example, for the case of the duration of the hackathon it is possible that every promoter decided to run the hackathon for different times (one for 24 hours, one for 32 hours, one for 56 and so on). It would be nearly impossible to find a result from these cases.

From type 1 information it was possible to obtain the first results which represent the characteristics of the hackathons:

- Objective: all the hackathon visited had the objective of building or creating a community. Seven out of eight had the objective of producing an output that could be useful to the promoter and few had the objective of recruiting. From the analysis of these numbers it is safe to state that promoters see in hackathon a mean to engage a community –build it in the case they do not have one – and to gather innovative ideas and concepts.
- Cost of participation: out of eight hackathons visited, only one asked to pay a fee to participate. All the other promoters considered the hackathon an investment to be done. In fact, they paid for all the needs the participants had throughout the whole duration of the hackathon, from the rent of the location, to the catering, to the gadgets teams used for prototypes.
- Participants background: in all the hackathons that were observed the promoter was looking for participants with a technological background. This means that not only developers were welcomed but all sorts of tech related figures from data analysts to web designer. Most hackathons though, opened their doors to participants with backgrounds different from the tech ones. Still, these participants had to be passionate about technology. The important fact is that this phenomenon was constant for every hackathon, be this promoted by a company in the tech industry or not. This remarks the fact, discovered during the review of the literature that hackathons are indeed a way to bring technology where it is not yet present or where it is harder to implement.
- Phases: the four phases of the hackathon were followed by almost every hackathon. In two occasions they were not followed. In the first case participants could only apply as a team and the first phase of team creation was not carried out. In the second one the challenge was so specific that there was no place for the participants to apply creativity to find different ways to solve it.
- Duration: the majority of hackathons lasted 30-32 hours. Although there were also hackathons that lasted much less than this – one lasted 8 hours – it is safe to consider that the majority of hackathons last around 30-32

hours. Indeed, even if the sample is reduced to 8 cases, 6 of them last around 30-32 hours, one lasted 8 and another one 48 hours.

- Mentors: in seven out of eight hackathons, participants could count on the support of mentors. The presence of mentors seems to be something that participant expect when they decide to take part in hackathons.

These results are mere confirmation of the literature but they are of extreme importance for the thesis as they served to validate the integrated definition.

A table that describes what type of information holds each building block was created to identify the building blocks that are potentially useful for the generation of the results (table 23). As a matter of fact, it was important to identify the building blocks that held type 3 information as they were not possible to be used to find results. All those building blocks that were identified to hold type 2 information were selected as they could provide meaningful results.

In order to generate results, the information from the most relevant building blocks are presented in the form of a 2x2 matrix where the vertical axis represents the performances and the horizontal one the building block. All the performances and the building blocks are in the form of binary information therefore it was possible to plot them in 2x2 matrixes. Each matrix shows the relationship of one dimension of the performance (participation – usefulness of the output – community build) and the relative building block. The objective of this analysis was to find two polarities on the matrix: one on the top right and one on the bottom left. As a matter of fact, the presence of both is key to consider the matrix a source of result: a result is such when a decision brings a certain output and the opposite brings the opposite output. Five relationships building block – performance generated polarities and were therefore used for the creation of results.

1.5 Main results

The results that are found with this thesis come both from the analysis of the literature and the field research. From the review of the literature it was discovered that hackathons are a sourcing method to perform Open Innovation, that they represent a specific way to run innovation contests and that teams in

hackathons function as temporary group organizations. Also, from the event's comparison it was discovered that hackathons are a specific way to perform innovation contests.

From the field research of the thesis it was found that the integrated definition of hackathon is validated and most of the characteristics that are analyzed in the literature review are validated as well. In addition to the general characteristics of hackathons, the results from type 2 information are showed in the following:

- The involvement of communities is beneficial for all the dimensions of performance;
- The more a promoter is popular the more the output of the hackathon will be useful to it;
- There are greater chances of generating a useful output for the organizer with the involvement of a third-party organizer;
- Among two typologies of reward – monetary and non-monetary – if the hackathon promises a monetary reward, there are more chances that the hackathon will generate an output useful to the promoter;
- Enforcing participants to create teams of mixed backgrounds increases the chances that the hackathon generates a useful output.

These results provide both an enrichment to the literature and managerial implications. In addition, the thesis overviews the main limitations as well as indicates further works on possible directions that this thesis has initiated

Hackathon as Emerging Innovation Practice: Exploring Opportunities and Challenges through 8 in-depth Case Studies

2 Introduction

This thesis is carried on to study the phenomenon of hackathons. These are events where people gather to think and generate technological innovations. Increasingly, these events are taking place worldwide promoted by organizations that look for innovation outside their boundaries to improve their businesses. Hackathons can serve a variety of purposes apart from the one of the generation of an innovation but few literature has been written on these events. Of the literature written, the greatest part is non-academic and consists of online articles written by relevant magazines and blogs. Few academic papers have been written on the phenomenon and even fewer are those that approach the hackathon to create a model that helps in their understanding. The majority of academic papers is limited to the description of one or more hackathons.

It is important to address this topic from an academic perspective as not only it would enrich the theoretical background, but also it would help organizations to run a hackathon that is most suited to their structure and needs. Regarding the enrichment of the theoretical background, this thesis enriches the literature on hackathon as well as the one on the main theories that hackathons refer to (Open Innovation and temporary group organization).

3 Literature Review: overview of the most relevant literature regarding hackathons, Open Innovation and temporary organizational forms

The literature review is divided in two main parts. The first one, analyzes the hackathons with an introduction to the phenomenon. Also, the definition of hackathon is provided together with a review of the most relevant models found in the literature. Also, a classification of the current literature on hackathon is carried on.

In the second part, a review of the main theories with which hackathons are analyzed (namely, Open Innovation and temporary organizational forms) is carried on.

3.1 Origins of the hackathon phenomenon – When, why and how

The term hackathon comes from the juxtaposition of the words *hack* and *marathon*: hack stands for the research and explorations of software and lines of code, not to the crime activity. The terms indicate the concentrated and focused effort – like in a marathon – of finding technological solution that involve software or hardware development – hack (Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015). Hackathons are events in which teams compete with each other to develop the best solution to the problem of the promoter of the event

3.1.1 When – Brief history of the birth of hackathons

The term first appeared in 1999 when a group of developers at OpenBSD used it for describing a cryptographic event held in Calgary in June 4th, 1999 ("OpenBSD, Hackathons", 1999). During this event 10 developers came together to avoid the legal problems caused by the American regulation on cryptographic software.

Interestingly enough, during the same year and the same month, a team from Sun Microsystems, a company now acquired by Oracle, used the term hackathon to refer to the JavaOne conference that lasted from from the15th to the 19th of June 1999. During this event, participants were asked to write a program in Java for the Palm V (Aviram, 1999).

Starting from the 2000's hackathons have begun to be increasingly seen by tech and non-tech companies, and venture capitalists as a way to quickly develop new software technology and to prototype and test digital solutions in few days or hours. Also, venture capitalists visit hackathons to explore new possibilities of funding (Leckart, 2012). As the tech scene grows (Mumm, 2012), so do hackathons: in 2016 more than 200 hackathons were held in the US and a similar number was estimated to be held worldwide (Priestley, 2016).

Hackathons first started as events held internally to a company. It is famous the case of Facebook, where from 2006 the company has held more than 50 internal hackathons until 2016 (Terdiman, 2016). The reason Facebook is holding so many hackathons relies in the fact that "innovation is the result of moving quickly and trying a lot of things", Zuckerberg says, "at Facebook we really built our company and our culture around this. We do things like ship code every single day and we have this tradition of hackathons, which are events where all of our engineers and, really, the whole company stays up all night building things. Whatever they want, they stop working and think of what is not working and innovate it".

Facebook's hackathons resulted in different innovation for Facebook itself like the "Like" button and Facebook's timeline. "We have this saying at Facebook that code wins arguments," Zuckerberg said. "The idea isn't that you're going to build something in one day that is fully formed that you can then go ship. That, I don't think, is the way the world works" (Terdiman, 2016).

3.1.2 Why – Reasons behind the increasing spread of Hackathons

From Facebook's lead, many companies from different fields have held their own internal hackathon and have also started to open it to participants from outside the company, usually offering a reward to the best ideas. The reasons why firms decide to host hackathon are different: not only companies look for innovative products, services and ideas but also they take hackathons as occasions to create a connection with participants and build a network around it. This generates awareness from participants and sometimes it also results in a job offer to some participants that performed brilliantly (Briscoe, Mulligan, 2014).

Some major firms were born from Hackathons such as GroupMe ("Inception: A Hackday Dream (The Story of GroupMe)", 2010), a platform for grouping SMS messages. Jared Hecht's (one of GroupMe's two founders) wife had problems in organizing travels with chain mails as one's would lag and the other would not receive the email. He had the idea and proposed it to Steve Martocci (the second founder). Together they decided to take part to the TechCrunch's hackathon in 2010 where they pitched the idea but came out without any award: "we may have received a Top 10 honorable mention". The two founders liked the idea and decided to test it on the market. It turned out that the market appreciated their idea and GroupMe raised US$ 10,6 million in the first year to be then acquired by Skype in 2011 for US$ 85 million ("GroupMe | Informazioni su GroupMe", 2012) (Leckart, 2012).

In the end hackathons are proving grounds for new ideas. At these events people are intellectually and creatively stimulated by the environment and the number of people they are surrounded with. Unlike jobs, where risk taking is quite high, in hackathons the cost of failure is relatively low, if non-existent. Moreover, hackathons are a way to involve people with different backgrounds that usually would not work together to wrap their heads around the same problem (Grijpink, Lau, Vara, 2015). This is the main reason why the hackathon format has also been used in fields different from the tech one (Olson, Walsh, Garg, Steel, Mehta, Data, 2016). Olson et al. argue that hackathons are a good way to bring innovation in the medical field where typically only doctors and scientist have the knowledge and the skillset to deliver innovation. Only in hackathon-like settings physicians get to meet with tech experts like software developers or data analysts. In these settings, different backgrounds complete each other allowing for a wider innovation potential.

3.1.3 How - Transformation of the concept from its origins to the present days

Today hackathons have grown into a variety of typologies. Driven by the willingness of defining the boundaries of hackathons different authors agree that the term hackathon covers more than just one type of event. "Hackathon events" can have different objectives as well as different subjects participating in the

event. In the following, a comprehensive classification of the different events that are informally called hackathons is provided (Filippova, Chapman, Stuart, Herbsleb, Kalyanasundaram, Trainer, Moser, Stoltzfus, 2017), (Fowler, 2016), (Briscoe, Mulligan, 2014), (Palazzuolo, 2013):

- Civic Hackathons: technologist, designers and civic engaged citizens making applications for their communities
- Iconathon: designer and artists coming together to make reusable icons for everyone
- Code Sprint: coders reuniting for a short time frame to code a new software release
- Data Day: data analysts trying to "liberate" and utilize public data
- Internal Hackathons: mostly similar to Code Sprints but only open to employees of a company
- Company Promoted Hackathons: technologists, coders, designers and really everyone involved in computer and technology in general, respond to a company's call to develop an innovation in exchange of an award (Briscoe, Mulligan, 2014).

Some non-coding events have been categorized as hackathons: British Airways in 2013 launched UnGrouded, an initiative for which the company invited 100 innovators from Silicon Valley on a transatlantic flight for an 11 hours events to develop new concepts (Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015). Although British Airways did not advertise this as a hackathon, several magazines and blogs wrote about the event as one (Warren, 2013).

An aspect that divides authors is the participant's background. While some say that business profiles should not be part of hackathons (Leckart, 2012), others argue that profiles that differ from the tech savvy ones are exactly the reason why hackathons are considered as a powerful tool for innovating (Spaulding, Caimi, 2017).

This thesis aims at giving a comprehensive overview over hackathons considered as events open to people from outside the company that promotes it. Anyhow, to

have a complete vision, company held ones must be analyzed as well. This format is gaining momentum as an alternative way to make employees focus on innovation and creative problem solving for the company (Priestley, 2016). Priestly adds that internal hackathons, given the fact that a small percentage of employees have IT knowledge, could be used indeed to focus on the creation of innovative business model, challenging employees to find new ways to expand the firm's revenues streams or to lower costs. As a matter of fact, Priestly argues that internal hackathons should be adopted by every company, not only tech ones.

In order to be as clear as possible, in the continuation of the thesis the term "hackathon" will be used to define those events that are open to the public while the term "internal hackathon" will be used to describe those events that are closed within the company's boundaries.

3.2 Integrated definition of hackathon

As previously seen, there is confusion around the term hackathon as it points to different formats depending on the speaker and the listener. When talking hackathons, one could mean company held ones while the other understands code sprints. In addition to that, even within the same format, it is quite impossible to find one hackathon identical to the other: the multitude of building blocks that constitute hackathons must be shaped around the requirements of the promoter in a unique way every time.
Also, hackathons have become a tool to position a company as smart and innovative. Consequently, different companies have started to host hackathons that do not fit into neither one of the formats explained before.

In the attempt to give clarity to this confusion, it is necessary to find a comprehensive definition of hackathons that agrees with every definition provided by existing academic papers. To develop it, a careful analysis of the literature has been carried out.
The methodology used to obtain a global definition for hackathons follows the structure that Estellès-Arolas et al. developed to provide an integrated definition

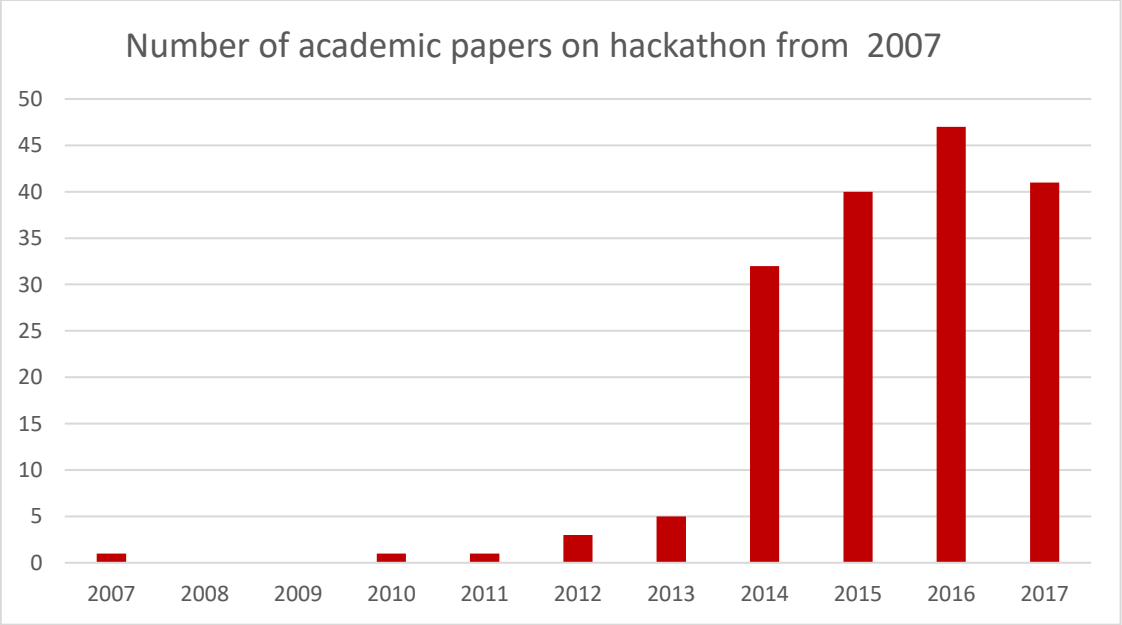
for crowdsourcing (Estellés-Arolas & González-Ladrón-de-Guevara, 2012). The process consists of three steps:

1. Search of documentation on hackathons via a systematic review of the literature with its corresponding filters;
2. The creation of an exhaustive definition based on commonly detected elements;
3. Validation of the definition through testing during field research.

3.2.1 Information search: review of every relevant paper that provides a definition of hackathon

The search for literature on hackathon took place on the two most used search engines for academic and conference papers: scopus.com and scholar.google.com. The first search engine used was scopus.com where it was inputted the keyword "Hackathon". The search resulted in 106 papers published from 2007 to 2017. It is interesting to see the growing number of papers published on hackathons from 2007 (Image 1). It may seem that this trend is decreasing as in 2017 there are fewer paper than in 2016. This is not true as this image refers to mid-2017 and it is likely that the number of publications on hackathon in 2017 will double.

Image 1 - Number of academic papers on hackathons from 2007



These were filtered from the most cited to the least. To select between the papers only those with the keyword "Hackathon" appearing in the title or in the abstract were added to the document repository. After this selection, 13 papers were added in the repository. Of these papers 10 are academic papers and 3 are conference ones. The search was then repeated using the same approach of searching and filtering on scholar.google.com. This search engine found 7.370 results. Of these, 16 new relevant paper were found and added to the document repository. The results of the search before and after the selection are shown in table 1.

Table 1 – Results from the search of academic literature

Document type	Scopus	Scholar	Total
Total number of papers	106	7370	7476
Selected papers	13	16	29

The search of academic papers created a list of 29 papers that were added in the repository. Although different papers were published in 2017, due to search, writing and publication time, the most recent dealt with hackathons that happened in 2015. In order to have a comprehensive view on the evolution of this phenomenon, a search among the most important magazines and websites has also been carried on. This search was made from the search engine google.com typing the keyword "hackathon". The selection of the article to read or the website to open was made based on whether the page would deal with information on past hackathons or on guidelines to host a hackathon. This selection resulted in four articles of tech and management magazines and websites created with the explicit intent to give an overview on hackathons. Table 2 shows the results from the search of both academic and non-academic papers.

Table 2 – Collective results from the search of academic and non-academic papers

Document type	Scopus	Scholar	Google.com	Total
Academic paper	10	15	//	25
Conference paper	3	1	//	4
Article or website	//	//	4	4
Total	13	16	4	33

The definition that each paper selected provides about hackathon is shown in table 3:

Table 3 – Definition of hackathon from every paper that was analyzed

Document	Page	Definition:
(Briscoe, Mulligan, 2014)	3	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 orientated. From holding large numbers of these events, the *Hackathon phenomenon* has emerged as an effective approach to encouraging innovation with digital technologies in a large range of different spaces (music, open data, fashion, academia, and more).
(Celi, Ippolito, Montgomery, Moses, Stone, 2014)	3	Traditionally, Hackathons are 24- to 48-hour events at the front end of the innovation process that provide an accessible forum to pitch complex, difficult problems and develop initial solutions and prototypes in a quick, iterative manner"
(Depasse, Carroll, Ippolito, Yost, Santorino, Chu, Olson, 2014)	1	Hackathons are based on three core principles; emphasis on a problem-based approach, cross-pollination of disciplines, and "pivoting" on or rapidly iterating on ideas. Hackathons also offer enormous potential for innovation in global health by focusing on local needs and resources as well as addressing feasibility and cultural contextualization. Although relatively new, the success of this approach is clear, as evidenced by the development of successful startup companies, pioneering product design, and the incorporation of creative people from outside traditional life science backgrounds who are working with clinicians and other scientists to create transformative innovation in health care.
(Serravalli, Simeone, 2016)	1	...Hackathons, a format originated within the hacker culture as 24-48 hour events where participants gather for collaboratively developing software or building things and nowadays often used in platforms for opening production as occasions to foster collaboration between diverse stakeholders through the engagement of building something...

(Frey, Luks, 2016)	2	Some software-centric companies invite external software developers as well as other experts, like user interface experts, graphic designers, and product managers, to specific programming events or rather challenges, to collaboratively create an innovative solution or gather external input. This kind of events are called "Hackathons" and usually last 1-3 days
(Alba, Avalos, Guzman, Larios, 2016)	1	Hackathons are events in which persons with different profiles, e.g. computer programmers, entrepreneurs, designers, and marketers collaboratively build solutions towards a specific theme in a determined period of time. Typically, these events have a length of one or two days for participants to work intensively on their projects and can be extended to become an overnight competition. These types of contests can even last as long as a week or even months. These events can be focused on developing certain types of applications, such as mobile, web, videogames, wearables, etc., built on specific platforms, frameworks, programming languages or APIs.
(Angelidis, Berman, dela Luz Casas-Perez, 2016)	3	A Hackathon brings people from various backgrounds together for problem-solving. They are typically organized as intense, short-duration competitions where teams generate innovative solutions. The Hackathon model integrates collaboration, idea generation and group learning by bringing together different stakeholders in a mutually supportive setting
(Rosell, Kumar, Shepherd, 2014)	1	For our purpose, 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 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. These teams may be either defined in advance of the event or dynamically formed at the event. In most Hackathons, the applications are mobile or web apps and the underlying technology enablers are communications or social media platforms. However as long as the enabler is capable of being exposed through an interface or API, the Hackathon generalizes considerably

(Nandi, Mandernach, 2016)	1	Hackathons are events where computer programmers and others involved in software development, including graphic designers, interface designers and project managers, collaborate intensively on software projects in a short period of time, typically 24-36 hours.
(Olson, Walsh, Garg, Steel, Mehta, Data, 2016)	1	The term 'Hackathon' combines 'hack'—a solution reached through intense innovation—and 'marathon'—an event of defined length and concentrated effort. Healthcare Hackathons champion the process of 'co-creation', in which serendipitous meetings of people across geographies and disciplines such as healthcare, design, engineering and business enable diverse teams to develop potential solutions in a time-limited format. Hackathons are often incorrectly described as 'crowdsourcing' occurrences. First appearing in 2006, 'crowdsourcing' is a portmanteau of 'crowd' and 'outsourcing' to indicate a process of obtaining ideas or services from a large—usually online—community. In contrast, healthcare Hackathons are 48-hour events in which a group of curated individuals from different backgrounds come together to drive innovation in healthcare. Hence, we suggest that Hackathons instead represent 'enriched crowdsourcing'.
(Leckart, 2012)	1	a contest to pitch, program, and present a functioning Android mobile application in 48 hours
(Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015)	1	"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. Hackathons vary wildly in their purpose and execution but generally have a common structure and characteristics.
(Priestley, 2016)	1	A Hackathon is an event which has become synonymous with software and hardware development teams collaborating and coming together to create something new, or to solve a particular problem given to them, typically the event lasting anything between a day and a week.
(Gerber, 2017)	1	Hackathons are marathon problem solving session that bring together people with different backgrounds to produce a technical solution, sometimes in exchange for a cash prize or bragging rights.

(McCann, 2014)	1	For several years now, Hackathons—gatherings of programmers (and, sometimes, issue-area practitioners) for deep dives into particular data-sets, problems, or concepts—have been deployed like flytraps, tenuously designed to attract and entertain developers so that "tech" could be tied to this or that event, with extra cool points assigned for maximizing opportunities for free labor and "community building"
(Tauberer, 2014)	1	Hacking is creative problem solving. (It does not have to involve technology). A Hackathon is any event of any duration where people come together to solve problems. Most Hackathons I've run also have a parallel track for workshops. Participants typically form groups of about 2-5 individuals, take out their laptops (if the event is technology themed), and dive into problems. Training workshops are a great parallel track especially for newcomers but also for all participants
(Munro, 2015)	1	hackathon event, which can be described as the collaborative development of software projects in a concentrated time period
(Trainer, Kalyanasundaram, Chaihirunkarn, Herbsleb, 2016)	1	Hackathons are events where people who are not normally collocated converge for a few days to write code together
(Mainka, Hartmann, Meschede, Stock, 2015)	1	In these hackathons members of government institutions and citizens come together and work on new innovations
(Fowler, 2016)	1	Hackathons are events that have been described as problem focused computer programming events. These events typically provide the opportunity for participants to pitch, program and present prototype computer software applications (Apps). The term hackathon is a portmanteau from the term hack and marathon. The term to hack is from the original use of the word hack and not from the recent use of the term as a reference to a computer crime. Technological Hackathons are typically organized events that are typically focused on the creation of a software application. Some hackathons also involve hardware prototyping and development. However, hackathons are not exclusively digital. A hackathon used the LillyPad Arduino set (a sewable device designed build soft

		interactive textiles), to engage females. This "Stichfest" hackathon combined the skills of crafting and textile creation with software engineering.
(Lara, Lockwood, 2016)	1	A hackathon is a computer-programming event in which volunteers work intensely in small teams for a short amount of time to develop a program prototype
(Lederman, 2015)	22	Hackathons are fast-paced events organized by non-profit organizations, universities, corporations, and online communities. They invite participants from different demographics and backgrounds to collaborate, generate new ideas and solve problems. Most Hackathons are open to the public, but others are private, open only to the employees of the company that organizes. The outcome of their work can be quantified based on scores provided by the judges, or, in a corporate Hackathon, how many resources are eventually allocated to the ideas. Traditionally, Hackathons are 24-48 hour events. A presentation covering the subjects and goals of the Hackathon opens the event, followed by a pitch stage in which participants can describe their ideas in one minute. Once the pitch stage is over, participants are free to discuss these ideas and form teams. They then spend most of the remaining time on raw implementation of their ideas, either as working prototypes or as business plans. Finally, each group pitches its idea to the judges, who assess them and announce the winning teams.
(Briscoe, Hon, 2014)	1	A hackathon has been described as a problem-focused computer programming event, as well as a contest to pitch, program, and present instances of prototype digital innovation (e.g. a prototype mobile application).
(Marthe, 2014)	1	A hackathon is a time-limited event where inter-disciplinary teams are put together to collaborate intensively on a specific idea or challenge, aiming to have a functional prototype by the end of the event. The purpose is to provide hackathon organizers and participants with insights on how to encourage, facilitate, and foster business creation within the framework of a hackathon.

(Novello, 2014)	16	A hackathon (also known as a hack day, hackfest or codefest) is a highly engaging, continuous event in which experts from different fields of computer science, like software developers, programmers, graphic designers, interface designers and project managers, produce in small groups working software prototypes, in a limited amount of time. These meetings typically last between a day and a week and tend to have a specific focus, but, in some cases, there is no restriction on the type of product to create
(Richterich, 2017)	2	During hackathons, participants meet in physical public or private spaces in order to create software and/or hardware prototypes. They receive catering and might even stay overnight, since these events usually take several days. Nowadays, there are still hackathons organized by nonprofit communities or foundations aimed at the development of technologies for the common good.
(Väljamäe, Evers, Allison, Ongering, Riccio, Igardi, Lamas, 2017)	1	A typical hackathon/hack day can be described as a problem-focused computer programming event where different parties – engineers, programmers, designers - collaborate intensively over a short period of time to prototype and pitch their ideas. However, artists and designers might not always start their work from the problem-focused approach. Therefore, hackathons should not be viewed as a platform for building a concrete product but rather as a collaboration space for creating new concepts
(Page, 2016)	2	hackathon was originally conceived as an *"event where developers, programmers, designers and computer amateurs in general meet and work intensively to create software projects"*. Yet it now seems to have evolved its own hybrid forms and embraces other event styles like "Sprints" or "Jams". Each hackathon is typically organized around a broad theme like health and wellbeing, or sustainability and community for example. Many also offer the prospect of a prize or even a work placement, thereby motivating or inspiring likeminded individuals to attend. The main drive for participation comes from the opportunity to interact and co-create with others, as well as the chance to experiment with design and open hardware and software platforms. Unlike the design jam however, a hackathon can often include pre-event and post-event planning

(Karlsen, Sundnes Løvlie, 2017)	1	In recent years hackathons have become an increasingly popular way to facilitate practical engagement with new tools and techniques, expanding beyond the field of software development to other areas such as civic engagement and culture
(Filippova, Chapman, Stuart, Herbsleb, Kalyanasundaram, Trainer, Moser, Stoltzfus, 2017)	1	[...] Time-bounded collaborative events, sometimes called hackathons, [...]
(Alkema, Levitt, Chen, 2017)	3	"IT-based and time-limited competitions arranged by an organization or individual calling on the general public or a specific target group to make use of their expertise, skills or creativity in order to submit a solution for a particular task previously defined by the organizer who strives for an innovative solution".
(Artiles, Wallace, 2013)	2	The hacker culture has expanded across nations and disciplines. Originally used to describe someone who makes furniture with an axe, this makeshift nature reflected onto the first programming-oriented use of the word, one who makes "a quick job that produces what is needed, but not well" and then matured to include [one who makes] "an incredibly good, and perhaps very time-consuming, piece of work that produces exactly what is needed". Hackathons are gatherings of programmers to collaboratively code in an extreme manner over a short period of time on whatever he or she wants, and strive to embody the tone of "No Talk, All Action". [...] Hackathons are catered to a challenge, or theme, and aim to maximize the talents of its audience: some boast a rigid structure for its participants while others embrace the open-ended nature of playful and exploratory interaction not directed towards any goal

This table shows the definition of hackathons given by the most relevant academic authors. The table follows the structure from the paper by Estellès and Gonzàlez (Estellés-Arolas, González-Ladrón-de-Guevara, 2012) where on the columns there are the authors, the number of the page where the definition is found and the definition itself, while on the rows there are the different definitions.

3.2.2 Creation of the definition: analysis over six dimensions

From the analysis of this definitions and the study of the literature three common elements are identified (duration, participants, object of the event). From these elements, some characteristics are extracted to create the distinctive common elements that make hackathons:

About the duration:

- How long do hackathons last?

About the background of participants:

- What kind of participant do hackathons host?
- What do participant get in exchange of their participation?
- What do participants do during hackathons?

About the object of the event:

- What are hackathon's goals?
- What do hackathons deal with?

3.2.2.1 How long do hackathons last?

Although most of the papers agree on the fact that hackathons should last from 8 to 48 hours (Munro, 2015), (Celi, Ippolito, Montgomery, Moses, Stone, 2014), (Serravalli, Simeone, 2016) (Frey, Luks, 2016), (Angelidis, Berman, dela Luz Casas-Perez, 2016), (Rosell, B, Kumar, S., &Shepherd, J, 2014), (Nandi, Mandernach, 2016), (Leckart, 2012), (Frey, Luks, 2016), (Lara, Lockwood, 2016), (Lederman, 2015), (Novello, 2014), some other authors consider a hackathon also an event that last up to one week (Priestley, 2016), (Trainer, Kalyanasundaram, Chaihirunkarn, Herbsleb, 2016).

Although authors do not agree on the duration of the event, all of them agree on the fact that hackathons should be events where participants are intensively focused on their tasks and objective. One characteristics of hackathons is the fact that participants have the possibility to hack (write code) continuously without sleeping. This is the main reason why the literature tends to define hackathons as events that last anything from 8 to 48 hours as it is highly unlikely that people do not sleep for one straight week. In addition to that, hackathons are open to every

person willing to take part on it. Students and workers represent the majority of participants (Briscoe, Mulligan, 2014), (Munro, 2015), (Lara, Lockwood, 2016), (Page, 2016). Whereas those figures are happy to dedicate a weekend to participate to a Hackathon they cannot leave their educational or job places for a whole week.

How long do hackathons last? Conclusion: on the basis that hackathons are intensive, focused events and that participants take part to hackathons as a secondary activity, hackathons are defined as events that last anything from 8 to 48 hours. Also, the majority of authors support this statement.

3.2.2.2 What kind of participants do hackathons host?

This is perhaps the most controversial part of the definition as divides the authors into two factions. A portion of the authors define participants as computer programmers or, more in general, figures related to computer programming such as graphic designers, data analysts and developers (Briscoe, Mulligan, 2014), (Frey, Luks, 2016), (Nandi, Mandernach, 2016), (Leckart, 2012), (Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015), (Priestley, 2016), (Gerber, 2017), (McCann, 2014), (Munro, 2015), (Fowler, 2016), (Lara, Lockwood, 2016), (Briscoe, Hon, 2014), (Novello, 2014), (Richterich, 2017), (Väljamäe, Evers, Allison, Ongering, Riccio, Igardi, Lamas, 2017), (Page, 2016), (Artiles, Wallace, 2013).

The other portion considers participants all the people that want to take part to the event, being these entrepreneurs, marketers, designers, field experts and, also, computer programmers (Depasse, Carroll, Ippolito, Yost, Santorino, Chu, Olson, 2014), (Serravalli, Simeone, 2016) (Alba, Avalos, Guzman, Larios, 2016), (Angelidis, Berman, dela Luz Casas-Perez, 2016), (Rosell, B, Kumar, S., & Shepherd,J., 2014), (Olson, Walsh, Garg, Steel, Mehta, Data, 2016), (Tauberer, 2014), (Trainer, Kalyanasundaram, Chaihirunkarn, Herbsleb, 2016), (Mainka, Hartmann, Meschede, Stock, 2015), (Lederman, 2015), (Marthe, 2014), (Karlsen, Sundnes Løvlie, 2017), (Alkema, Levitt, Chen, 2017).

The first portion considers hackathons as they were originally conceived: events to bring together coders and people involved in computer programming to think

over problems and solve them together. The second portion argues that technology has developed to such an extent that is used in fields where coders are not real experts anymore. For this reason, it is fundamental to open what was initially closed to computer experts to field experts. One emblematic example is the one of medicine. Technology is impacting the world of healthcare in a drastic manner. Although it is coders and computer experts that create the technology, they need a guide to tell them what to code and how to do it. This guide comes from physicians and healthcare experts.

What kind of participants do hackathons host? Conclusion: nowadays, hackathons are used in different fields and for addressing different sort of problems. Considering hackathons those events where only computer experts take part would be too restricting; therefore hackathons' participants are defined as all those figures that are involved in the field of the specific hackathon (field experts, marketers, entrepreneurs, designers and computer experts).

3.2.2.3 What do participants get in exchange of their participation?

All authors agree on the fact that Hackathons are organized as a competition where the best output wins a reward. The reward can be of many forms. Cash, coupons, in-kind, recruitment opportunity and project development. There are also some promoters that, together with the reward offer the possibility of gaining visibility of the group/startup. This award can be either monetary or non-monetary (Jin, Huang, 2014) in the form of incubation programs, online and offline courses and technological gadgets. The award is always assigned by a jury.

What do participants get in exchange of their participation? Conclusion: participants compete for an award. This can be either monetary or non-monetary.

3.2.2.4 What do participants do during the hackathon?

The majority of authors state that participants are challenged to perform activities to generate an innovation (Briscoe, Mulligan, 2014), (Celi, Ippolito, Montgomery, Moses, Stone, 2014), (Depasse, Carroll, Ippolito, Yost, Santorino, Chu, Olson, 2014), (Serravalli, Simeone, 2016) (Frey, Luks, 2016),

(Alba, Avalos, Guzman, Larios, 2016), (Angelidis, Berman, dela Luz Casas-Perez, 2016), (Rosell, B, Kumar, S., & Shepherd,J., 2014), (Olson, Walsh, Garg, Steel, Mehta, Data, 2016), (Priestley, 2016), (Alkema, Levitt, Chen, 2017), (Artiles, Wallace, 2013).

Some authors analyze the matter deeper reasoning on the kind of activities that participants engage in: Tauberer and Gerber state that participants engage in creative problem solving with the aim of an enriched innovation (Tauberer, 2014), (Gerber, 2017). Some authors, the ones that consider hackathons as a computer-experts-only events, argue that hackathons are indeed events where participants should only engage in activities aimed at software and hardware development (Briscoe, Mulligan, 2014), (Frey, Luks, 2016), (Alba, Avalos, Guzman, Larios, 2016), (Nandi, Mandernach, 2016), (Leckart, 2012).

Finally, there are some authors that state the phases that compose hackathons. Although every author calls every phase by a different name there is a general agreement that participants go through four main phases: team selection, creative problem solving, coding, and preparation of the presentation (Angelidis, Berman, dela Luz Casas-Perez, 2016), (Rosell, Kumar, Shepherd, 2014), (Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015), (Tauberer, 2014).

What do participants do during the Hackathon? Conclusion: it is clear, also in this case, the division that exists between authors that believe hackathons should be closed to the computer experts' community and authors that consider hackathons as events open to the public. Although to answer to the question of what participants do during Hackathon there is no need to divide authors as it was previously done. As a matter of fact, both statements are true. It is true that participants should engage in creating a software or a hardware prototype but it is also true that not every person of the team should engage in those activities and that it is necessary for the quality of the output to perform some creative problem solving in the beginning of the hackathon.

In addition, hackathons are composed of four phases: team selection, creative problem solving, coding, and preparation of the presentation.

3.2.2.5 What are hackathon's goals?

There is no discussion over the goals of hackathons as all the authors agree on the fact that these events must solve problems and generate an innovation. Also, authors agree on the fact that the solution should have the form of a functioning software or hardware prototype.

What are hackathon's goals? Conclusion: the definition of a hackathon's objectives is "the solution of problems and the generation of an innovation". With this in mind it is possible to give a more complete answer to 3.1.2.4. Participants engage in different activities and not all of them are related to the technological field (e.g. coding). All these activities serve the greater purpose of generating an innovation, which is the final objective of hackathons all authors agree on. The innovation should be presented in the form of a functioning prototype. The previous reasoning can be summed into:" every hackathon's objective is to generate an innovation. To do so, participants engage in different activities that range from an initial part of creative problem solving to the phase of software and hardware programming. Participants with different skills can participate because they can provide different inputs depending on the phase of the hackathon".

3.2.2.6 What do hackathons deal with?

The term hackathon comes from the juxtaposition of the words "hack" and "marathon" (Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015), (Fowler, 2016). Although most authors agree on the fact that hackathons must deal with technology, some argue that, even if the term "hacking" was initially referred to the teach field, nowadays "hacking" can be referred, more in general, to creative problem solving (Tauberer, 2014), (Alkema, Levitt, Chen, 2017). In all the cases, the subject of the event is decided by the promoter of the hackathon. The promoter can either propose a challenge related to the tech field or one that is not related to it.

What do Hackathons deal with? Conclusion: eradicating technology from hackathons would mean to take a leap too far from their initial conception. On

one hand, all the authors but two agree on the fact that technology must be the main theme of hackathons therefore only events that deal with technology will be considered such. On the other hand, this does not mean that hackathons must only deal with technology. As a matter of fact, as explained when answering 3.1.2.5, the final goal of a hackathon is the generation of an innovation. It is now possible to precise that the objective of hackathons is the generation of a technological innovation. To do so, coding is necessary but it only represents the creation of something that was previously conceived in the creative phases.

3.2.3 Presentation of the integrated definition of hackathon

Summarizing the information collected it is finally possible to define hackathons in a way that includes all the events that are nowadays considered such.

"Hackathons are events that last between 8 to 48 hours in which participants are challenged to generate a technological innovation in the form of a functioning software or hardware prototype. The best idea, selected by a jury, is rewarded with a prize. This could have the form of a monetary or non-monetary (e.g.: access to online or offline courses, incubation or acceleration programs, technological gadgets) reward. Hackathons are open to different categories of participants such as business-related figures, designers and computer experts. Also, the participation of experts, in hackathons that require expert knowledge, is welcomed. Every hackathon follows a structure: team selection, creative problem solving, coding and preparation of the presentation. In the initial phase of every hackathon participants are required to create a team. In the second phase participants engage in creative problem-solving activities, in the third phase the program gets written and in the last one the pitch is created. Hackathons are an effective way to literally "hack" existing problems and find creative and tangible technological solutions"

3.2.4 Validation

The validation phase will be carried out during the field research, where it will be checked whether the definition provided applies or not to every hackathon that will be observed.

3.3 Relevant literature regarding hackathon: analysis over five dimensions

To review the literature that deals with hackathon, the papers that were used for the creation of the definition are examined in detail. In addition to those also other papers regarding hackathons are reviewed. These were not included before as they did not contain a satisfactory definition of hackathons and were not counted in the previous chapter. In total, the review consisted in the analysis of 42 papers. A small number of papers has been written so far and even fewer papers bring the discussion beyond the mere description of the event as it took place. However, the few attempts to model the phenomenon are a great enrichment to the literature and are the basis of the majority of the papers present in the literature. Also, the majority of academic papers has been written since 2014, when also the most cited paper on hackathons was published (Briscoe, Mulligan, 2014).

To provide a structure to the review, hackathons are analyzed on five main topics:

1. Field of application: it is clear that hackathons must deal with technology and that teams must provide an output in the form of a technological prototype. However, hackathons are applied in a variety of fields. In this section, all the fields of applications as well as the background of participants are studied;
2. Similar events: hackathons are often confused with other events such as code-fest, hack-fest and many others. This section reveals all the attempts to differentiate these events as well as a presentation of similar events that companies use as alternatives to hackathons;
3. Objectives of the hackathon: there are many reasons why a company may choose to run a hackathon. Although all the authors agree that one objective is the development of an innovative solution aimed at solving a problem, they do not agree on the indirect objectives that a company can achieve with the promotion of a hackathon. This section provides an overview on all the objectives cited by the different authors and attempts at a classification of these. It also shows divergent point of views as it

reveals the arguments to the fact that hackathons are not a mean to achieve those indirect objectives;

4. Benefits and drawbacks: different papers attempted to classify pros and cons. This section gives an overview on all the attempts and groups authors that reason likewise;
5. Models and classifications: finally, the works from the authors that attempted to develop a model are presented. Also, a framework to guide an organizer in the preparation of a hackathon is presented.

3.3.1 Field of application of hackathons: a way to foster technology and to bring it where it is most difficult

Although technology is increasingly present in the everyday life, different industries do not still make use an extensive use of technology. The reasons for it may vary but always belong to one of two reasons: excessive cost and lack of skills.

Both these reasons are the reason why hackathons became so popular in the medical field (Angelidis, Berman, dela Luz Casas-Perez, 2016), (Olson, Walsh, Garg, Steel, Mehta, Data, 2016) (Depasse, Carroll, Ippolito, Yost, Santorino, Chu, Olson, 2014), (Walker, Ko, 2016) as a matter of fact, hackathons are cheap ways to get in touch with the right skill. The paper from Angelidis et al. present the solution that Sana, an organization hosted at the institute for Medical Engineering and Science of the MIT, found to the challenge of providing quality healthcare to Low or Medium Income Countries (LMICs). Sana hosted several hackathons encouraging collaboration between ICT experts and medical professionals leveraging on the wide use of cellphones. The authors address the possibility of using this framework to other fields in the developing world.

Also referred to the medical field, the paper from Olson et al. shows how the collaboration between tech experts and healthcare professionals can bring a higher innovation potential compared to performing innovation separately. This paper presents the results from 12 hackathons performed both in developed countries (USA) and in developing ones (India and Uganda). The results are consistent through all the hackathons showing that the mixture of backgrounds provide substantial innovation. The discussion on whether hackathons represent

an enthusiastic hype or create substantial innovation leans towards the latter argument. In fact, the data showed in the papers provide a consistent picture to how hackathons can be a reliable source of solutions to healthcare challenges.
Similarly to the medical field, hackathons are sources of innovation in many other fields. In fact, these concepts have been a success in fields such as choreography (Briscoe, Hon, 2014), art (Väljamäe, Evers, Allison, Ongering, Riccio, Igardi, Lamas, 2017), sharing economy (Richardson, 2015), school (Munro, 2015), and smart cities (Johnson, Robinson, 2014), (Mainka, Hartmann, Meschede, Stock, 2015), (Alba, Avalos, Guzman, Larios, 2016), (Irani, Vertesi, Dourish, Philip, Grinter, 2010).
Especially interesting is the case of BrainHack (Väljamäe, Evers, Allison, Ongering, Riccio, Igardi, Lamas, 2017). This hackathon's objective was the engagement with the local artistic community and make its participants, artist for the most, experiment with Brain Neural Computer Interaction (BNCI).

This section also sheds light to the backgrounds of participants. In the creation of the definition, authors were divided into those who believe hackathons should only be open to tech figures and those who believe that they should be open to different background. Although most of the authors limit to state to be on one of the two sides, few discuss the reasoning behind the statements.
Leckart captures the difference between tech and business experts comparing the former to Zuckerberg and the latter to the Winkelvoss brothers with a reference from the movie "The social network". In an interview with Paul Trajan, an engineer from Facebook that follows the 10 Facebook-sponsored hackathons that happen each year in the US, he tells the trial to bring engineers and MBAs together. "It was pretty awful. MBAs build something that is exactly like a market leader and put a spin on it. Like, a Groupon clone" (Leckart, 2012). Several engineers in hackathons disdain the presence of biz-devs (business developers) to the point that they would not let they anywhere near hackathons. (Leckart, 2012).
On the other hand, some authors argue that not only biz-devs should take part, but also other figures like designers, field experts, entrepreneurs, and artists

(Väljamäe, Evers, Allison, Ongering, Riccio, Igardi, Lamas, 2017), (Angelidis, Berman, dela Luz Casas-Perez, 2016), (Depasse, Jacqueline & Carroll, Ryan & Ippolito, Andrea & Yost, Allison & Santorino, Data & Chu, Zen & Olson, Kristian. (2014), (Olson, Walsh, Garg, Steel, Mehta, Data, 2016). The reasons behind this argument reside mostly in the fact discussed in the initial part of the previous section, that is to say the increased innovation potential.

It is possible to conclude that hackathons are considered ways to bring technology where it is most difficult to apply it. However, hackathons are not only organized by low-tech companies. Indeed, many tech companies organize both internal Hackathons and open ones to foster technology and innovation (Terdiman, 2016), (Morielli, Zanchi, 2017).

3.3.2 Similar events: hackathons, hack-fests, hack-day, edit-a-thons. An overview over similarities and differences

Hackathons are often confused with Game Jams, Design Jams, Codefests, Hack-fests, Sprints and so on. If there is such a confusion around those terms there must be indeed a reason for it. Two authors attempted to provide a distinction between these events and set the discussion to an end.

The first one analyses hackathons, game jams ("About the Global Game Jam". Global Game Jam. Retrieved 19 April 2016) and game creation events. The main differences are found in the people that take part in these and in the output to be presented at the end of the event.

As far as participants are concerned the authors claims that in hackathons only tech experts take part while in game jams also people with artistic and humanitarian backgrounds participate. The main difference that game creation events have with the other ones is the fact that only students can take part in these (Fowler, 2016). Although what Fowler states may be true there is a substantial group of authors that argue that also people with different backgrounds participate in hackathons and this matter has already been discussed with the agreement to consider hackathons as events that welcome different typologies of participants. Therefore, the main difference between

hackathons and game jams that the paper expresses is not considered to be true, at least from the participant point of view.
Analyzing the output requested though, the main difference is the fact that the output of a hackathon is a working software or hardware prototype while in game jams and game creation events it is a feature of, or a complete video game.
Also, the hackathon phenomenon started a trend. Increasingly, organizers of time-bundled events, call them by the field of application + the word "thon". This is the case for choreograthons (Briscoe, Hon, 2014), makeathons, edit-a-thons (Filippova, Chapman, Stuart, Herbsleb, Kalyanasundaram, Trainer, Moser, Stoltzfus, 2017) stichfests (SIGCSE 2015 - Proceedings of the 46th ACM Technical Symposium on Computer Science Education pp. 114-119) and so on. It is to say that all these events are also called hackathons, showing the wider and wider span that this event is gaining.

3.3.3 Objectives of the hackathon: not only innovation. Running a hackathon as a way to answer different problems

The literature identifies different objectives for which a promoter should bother organizing a hackathon. First there is the one of using the solution and the innovative products created during the hackathon (Frey, Luks, 2016), (Trainer, Kalyanasundaram, Chaihirunkarn, Herbsleb, 2016), (Karlsen, Sundnes Løvlie, 2017), (Almishari, Salamah, Alwan, Alkhalifa, Al-Wabil, 2017) (Rosell, Kumar, Shepherd, 2014).
The literature has also pointed out how innovation does not happen because of the hackathon but it is the mix of different feature as technical domain, community structure, and expertise of participants (Trainer, Kalyanasundaram, Chaihirunkarn, Herbsleb, 2016). However, Frank et al. attempted at creating a framework to make all hackathons work to create an innovation: the Innovation-Driven Hackathon (Frey, Luks, 2016), (Almishari, Salamah, Alwan, Alkhalifa, Al-Wabil, 2017). This framework foresees the iteration of four phases – problem, solution alternatives, prototypes, and pitch and feedbacks – made by participants both from inside and outside the company. Its strength, the authors

argue, reside in the constant reiteration and collection of feedbacks (Frey, Luks, 2016).

Authors agree that innovation is not the only reason to perform a Hackathon. In fact, promoters could achieve also objectives of other natures: education (Page, 2016), (Nandi, Mandernach, 2016), (Artiles, Wallace, 2013), (Munro, 2015), (Karlsen, Sundnes Løvlie, 2017), (Fowler, 2016), community build (Munro, 2015), (Trainer, Kalyanasundaram, Chaihirunkarn, Herbsleb, 2016), (Lederman, 2015), (Mainka, Hartmann, Meschede, Stock, 2015), (Alba, Avalos, Guzman, Larios, 2016), recruiting (Leckart, 2012), startup foundation and funding (Leckart, 2012), (Dehli. 2014), positioning (Anna Seravalli Luca Simeone, 2016).

Not only companies have objectives but also participants. Authors point out that in most of the surveys made, participants state that the number one reason for attendance is "learning" (Fowler, 2016), (Briscoe, Mulligan, 2014).

In addition, hackathons create engagement at different levels. In fact, they build social ties within teams (Trainer, Kalyanasundaram, Chaihirunkarn, Herbsleb, 2016), but perhaps more importantly are a mean trough which governments and organization that are active within the city, engage with citizens for the creation of smart cities (Mainka, Hartmann, Meschede, Stock, 2015),
(Alba, Avalos, Guzman, Larios, 2016).

To conclude the overview of the objectives, these have been grouped into four categories:

- Innovation: in fact, all hackathons are a way to challenge participants to present an innovative product (Frey, Luks, 2016), (Trainer, Kalyanasundaram, Chaihirunkarn, Herbsleb, 2016), (Karlsen, Sundnes Løvlie, 2017), (Almishari, Salamah, Alwan, Alkhalifa, Al-Wabil, 2017) (Rosell, Kumar, Shepherd, 2014);
- Pedagogy: both because there are hackathons explicitly designed to provide education and because hackathons are a way for people to learn more (Page, 2016), (Nandi, Mandernach, 2016), (Artiles, Wallace, 2013), (Munro, 2015), (Karlsen, Sundnes Løvlie, 2017), (Fowler, 2016);

- Community build: hackathons are ways to engage a community to for a few days in intensive and focused circumstances. (Munro, 2015), (Trainer, Kalyanasundaram, Chaihirunkarn, Herbsleb, 2016), (Lederman, 2015), (Mainka, Hartmann, Meschede, Stock, 2015),
  (Alba, Avalos, Guzman, Larios, 2016);
- Recruiting: opportunities to look for jobs from the participants sides and to look for talents from the company side (Leckart, 2012).

If one hand it is true that hackathons may reach those objectives, on the other there are also factors that may impede the achievements of those. In fact, there are some inhibitors that if not properly managed, may limit the innovation potential of hackathons:

- Communication between different disciplines (Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015): if from one side the mixture of background is good, from the other there are intrinsic communication complication;
- Non-availability of mentorship (Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015), (Clark, Sanders, Davidson, Jayaraman, DiSalvo, 2015), (Leimeister, Huber, Bretschneider, Krcmar, 2009);
- Advancement of prototypes (Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015): the phenomenon known as abandonware is very common in hackathons. Usually the prototypes presented during hackathons only function as inspirations to the company that then reshapes the prototype on its needs;
- Intellectual property rights (Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015): especially the one from startup that take part to the event. Usually start ups take the challenge of the hackathons to develop their own offering. This is critical in those hackathons where the promoter keeps the IPR for its own use exclusively;
- Time pressure (Richterich, 2017), (Bowen, 2017): it makes participants concentrate on the final presentation rather than focus on the coding part thus eradication all the possibility to learn;

- Gender bias (Richterich, 2017), (Decker, Eiselt, Voll, 2015), (SIGCSE 2015 - Proceedings of the 46th ACM Technical Symposium on Computer Science Education pp. 114-119), (Bowen, 2017): the IT field holds a gender bias for which women do not belong in tech. This represents both an impediment to women to take part in tech events (hackathon in particular) and is again a limitation to the learning possibilities.

3.3.4 Benefits and drawbacks of the hackathon - from the perspective of participants and promoters

Many authors attempted at providing benefits and drawbacks of running a hackathon. Mostly these endeavors are referred either to participants or to companies. The following shows a sum of all the benefits and drawbacks identified in running or participating to a hackathon.
First these are presented from the point of view of participants:

Benefits in participating to a hackathon - participant side:

- Startups (Leckart, 2012), (Dehli. 2014): new startups see in hackathons the possibility of developing their offering and get visibility. In the US particularly it is public knowledge that most of the Venture Capitalists attend the most famous hackathons to scout for new startups to fund.
- Social networking (Lara, Lockwood, 2016): occasions of meeting new people are decreasing. Hackathons represent a mean through which people with similar interests join for work-intensive hours. Working together creates bonds that sometimes participants develop even outside the hackathon.
- Learning (Lara, Lockwood, 2016): when surveyed, most participants state the number one reason of attendance is learning possibilities (Briscoe, Mulligan, 2014). In fact, hackathons constitute occasions to get to work with new tools and new technologies that normally participants do not get to work with. Also, perhaps more important, most hackathons provide mentors to help with the particular technology or with troubleshooting (Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015), (Nandi, Arnab

& Mandernach, Meris, 2016). With mentors by the participants' side the learning possibilities increase exponentially.

- Cross pollination (Depasse, Jacqueline & Carroll, Ryan & Ippolito, Andrea & Yost, Allison & Santorino, Data & Chu, Zen & Olson, Kristian. 2014): the differences in disciplines that are present in hackathons can provide to participants the chance to learn more about the other discipline. This possibility, with the right attitude from participants, can be of great help in the personal improvement of participants.
- Possibility of getting rewarded (Masters, Delbecq, 2008): even if learning is the number one reason to attend a hackathon, the chance to compete for a reward constitutes a great motivation for participants to join. Rewards are considered external motivational factors in the form of extrinsic benefits. These factors seem indeed to be one of the main driver of efforts (Lakhani, Wolf 2003).

Drawbacks in participating to a Hackathon – participant side:

- Frustration of non-developers (Karlsen, Sundnes Løvlie, 2017): if it is true that everyone can participate to hackathons, it is also true that these are events where technology is made. Non-developers that join usually are approached in the initial and final phases, while in the central phase of coding they feel like they are doing nothing.
- Not learning (Richterich, 2017), (Nandi, Mandernach, 2016), (Bowen, 2017): hackathons may also be seen as highly competitive, time-focused events. These characteristics brought different authors to argue the fact that Hackathons are not a way for participants to learn. In a survey carried out to students they lamented that often they would participate to hackathons to miss school.
- Intellectual Property Rights (Leckart, 2012), (Dehli. 2014): IPR represents a great limitation to startups that want to present their ideas to a jury. In fact, most promoters hold a right on all the ideas that are generated during the hackathon – that is the reason why they promoted one – not letting individual nor startups to develop their idea independently.

- Gender issue (SIGCSE 2015 - Proceedings of the 46th ACM Technical Symposium on Computer Science Education pp. 114-120), (Richterich, 2017), (Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015), (Bacon, 2013): the fact that mostly men approach the tech industry is no secret - tech companies employ 12.33% women engineer on average. This is true also for hackathon where typically men represent 90% of the participants if not a higher percentage.
- Abandonware (Leckart, 2012), (Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015): finally, another problem with Hackathons is that most of the solution proposed do not evolve into final product. This has been called by the community "abandonware" – a sort of grave where all the ideas go lost.

Benefits in running a Hackathon – promoter side:

- Innovation (Gerber, 2017), (Depasse, Carroll, Ippolito, Yost, Santorino, Chu, Olson, 2014), ("Benefits of Hackathons", 2012): this is the most straightforward benefit for promoters. It is indeed the first reason why it decided to run a Hackathon
- Community creation and engagement ("Benefits of Hackathons", 2012), (Gerber, 2017): hackathons function as tools for engaging a community to get together and work in the same place for two days.
- Corporate branding ("Benefits of Hackathons", 2012) (Gerber, 2017): hackathons are increasingly trendy and companies promote them to position themselves as innovative one.
- Recruitment ("Benefits of Hackathons", 2012), (Gerber, 2017): if participants see in hackathons a possibility to get a job, there should be an employer to provide this. As a matter of fact, hackathons are a way to test the abilities of the candidate on the field and assess his hard and soft skills for a long time.
- IP development ("Benefits of Hackathons", 2012): a drawback for participants, this is why promoters run hackathons. Also, it is argued that

some companies that run hackathons do not let all the ideas into abandonware but keep them.

Drawbacks in running a Hackathon – promoter side:

- Compulsory awards (Girotra, Terwiesch, Ulrich, 2010): Girotra et al. analyze the fact that in Hackathons, promoters must provide the reward, even if there is no good solution. They argue the fact that usually promoters look at the average quality of the ideas proposed while they should look at the one best idea to award. In fact, this characteristic of hackathons might be the one for which very few ideas are actually implemented. It is not the fact that the promoter does not have intention to pursue with the implementation, but the fact that no idea is worth to be implemented.
- Cost: although no literature has been found, promoting and organizing a hackathon is costly. Not only renting the place and the provision of food, but also the resource allocation to the organization of the event.

3.3.5 Classifications: hackathon typologies and guidelines for its organization

This section reveals the only model built so far present in the literature as well as two highly descriptive guides to host a hackathon.

The model to describe hackathon has been published in 2014 by Briscoe and Mulligan (Briscoe, Mulligan, 2014). The authors claim that hackathons can be grouped as either Tech-centric of Focus-centric.

Tech-centric hackathons are the ones that focus on software development with a specific technology or application. They are further divided into:

- Single application: hackathons focused on improving one application. Example of those are application that include content management system, operating system and the development of a new programming language;
- Application type: these hackathons focus on a specific theme such as mobile apps, web development, music and so on;

- Technology specific: these hackathons focus on developing applications that use a specific language, framework or Application Programming Interface (API).

Focus-centric hackathons are aimed at software development for the contribution to a social cause or a business goal. Also in this case three typologies have been identified:

- Socially oriented: these hackathons aim at addressing a social cause such as public services or crisis management;
- Demographic specific: these are intended for specific demographic groups such as students, women or teenagers. The objective of these hackathons is the inclusivity of demographic groups that have been recognized a certain disparity;
- Company internal: even if the objective of the thesis is the description of only hackathons open to the public, these types of hackathons cannot be ignored. Some companies hold internal hackathons to encourage new product innovation and improve the current offering.

The review of the literature also brought two guides to the preparation of the hackathon – one for external hackathons (Tauberer, 2014) and one for company internal ones (Rosell, Kumar, Shepherd, 2014).

The following section sheds light over the theories hackathons refer to: Open Innovation and temporary organizational forms. The discussion then shifts to discuss the similarities and differences of similar innovation events that function as temporary group settings.

3.4 Open Innovation – how hackathons fit in the paradigm

After an initial understanding of what hackathons are, it is important to understand how hackathons have been studied so far. The literature analyses hackathons as part of the Open Innovation paradigm (Anders Hjalmarsson, Paul Johannesson, Gustaf Jüll-Skielse, and Daniel Rudmark, 2014). However, every

paper limits to the acknowledgement of hackathon as part of this paradigm and no deeper analysis have been made so far.
In a paper from Almirall et al. (Almirall, Lee, Majchrzak, 2014) that discusses the need of balancing the sense of competition and of community in civic Open Innovation, the authors list a series of approaches to civic Open Innovation in six cities from Europe and the US. Hackathons result to be the most used approach to civic application development, together with open data. This remarks the growing trend of hackathons as a worldwide phenomenon and justifies the categorization of hackathons as part of the Open Innovation paradigm.
In order to understand to what extent hackathons fit into Open Innovation a brief analysis of this paradigm will be carried out.

Open Innovation was initially referred to as a "paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology" (Chesbrough, 2003). In more recent times it is defined as "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model" (Chesbrough and Bogers, 2014). Open Innovation has been studied by many scholars since von Hippel's book in 1988 where he described the sources of innovation and wrote about sourcing innovation from outside the company. As a matter of fact, different papers on Open Innovation agree that this paradigm has always been used by companies. Most did not know until Chesbrough's paper in 2003 where he explained in detail what was intended for Open Innovation and why he urged companies to shift to the Open Innovation paradigm to create and profit from technology.
The basic idea of Open Innovation is the fact that most smart people work for someone else. This idea was popular already in 1945 and is known as Joy's law. This then developed and became popular with Chesbrough with the term Open Innovation as opposed to the earlier closed innovation model based on internal R&D. Chesbrough proposed some "erosion factors", such as increased mobility of workers, more capable universities and growing access of startup to venture

capital changed the conditions under which firms innovate (Chesbrough., Bogers, 2014)

3.4.1 Classification of Open Innovation: Acquiring, Sourcing, Selling and Revealing

In 2010 Dahlander and Gann clarified the definition of openness as it was currently used in the literature of Open Innovation (Dahlander, Gann, 2010). For the matter, a matrix was built to structure different forms of openness. They reviewed all the literature and categorized every paper using the distinction of outbound-inbound as a starting point. They further divided inbound and outbound innovation into interactions that are pecuniary and non-pecuniary. The result of this classification is shown in the table 4.

Table 4 – Methods to perform Open Innovation (Dahlander, Gann, 2010)

	Inbound innovation	Outbound innovation
Pecuniary	Acquiring	Selling
Non-pecuniary	Sourcing	Revealing

Their paper discusses every form of openness.

- Inbound innovation / Pecuniary→ Acquiring
- Inbound innovation / Non-pecuniary→ Sourcing
- Outbound innovation / Pecuniary→ Selling
- Outbound innovation / Non-pecuniary→ Revealing

Research of Open Innovation has brought to light different advantages. However, it must be taken in consideration that openness is not binary but it has to be placed on a continuum from fully close, where the sources of innovation only come from R&D and completely open, where innovation only comes from outside parties, which is quite unlikely (Chesbrough et al.,2006). It is possible to give a more complete overview to Open Innovation taking into consideration both advantages and disadvantages. To analyze Open Innovation's pros and cons the structure given by Dahlander and Gann's paper will be followed.

The categorization of the various forms of Open Innovation is done to better understand where hackathons fit into this paradigm. The aim of this analysis is the understanding of benefits and drawbacks in running a hackathon.

3.4.1.1 Acquiring

Definition: in this type of Open Innovation, the company is buying innovation from third parties. This involves the exchange of money from the company to the third party.

Advantages:

Purchasing resources to use in the innovation process is a mean through which companies with high cash flows can generate innovation without having many capabilities internally.

Disadvantages:

Firms that decide to acquire innovation from external sources must be able to acquire the right innovation at the right time. This requires expertise that is not common in every company.

The effectiveness of the purchase depends on the resources endowments of the two parties involved in the exchange. If the two parties have too much distant understanding of the topic of the innovation it will be hard for the acquirer to profit from the purchase.

3.4.1.2 Sourcing

Definition: this type of innovation sources innovation from outside the company. In different industries, it is common that external actors are willing to develop an innovation for the company. In this case R&D must function as a mean to absorb external ideas to build on those and develop the best idea possible. The first step of the innovation process is to scan the market for usable innovations.

Advantages:

This type of innovation faces the problem that most of the smartest people work for someone else. By accessing external know-how companies can work on already formed ideas, shaping them around the culture, values and objective of the company

The logic is that the broader the sources of innovation, the greater the innovation potential. This is underlined in most of the literature on Open Innovation and affirms the fact that innovation mostly leverages on the discoveries of others.

Disadvantages:

First there might be cultural divergences from the company and the external subjects the company sources innovation from. In the case the R&D department develops a product or a service from an innovation taken from a source that does not respect the DNA of the company, there might be the risk of putting time and effort into something that is wrong at its root.

Over-searching for outside innovation means loss of time and energy. A study performed in 2006 (Laursen, K. and Salter, A., 2006) on manufacturers in the UK shows that there is not a linear relationship between openness and innovation: while there might be an initial positive effect, this inverts as companies heavily use this method.

Success story:

Out of many success stories the one of Lego stands for the capability of the management to restore the brand position and escape bankruptcy in the early 2000s. In 2003, the Lego Group ran out of cash ("Innovation Almost Bankrupted LEGO - Until It Rebuilt with a Better Blueprint - Knowledge@Wharton", 2012). The group had invested too much in innovation surfing the wave of digitalization but did not make money on it. It was "strapped on wings and was flying at 30.000 feet." This comment by David Robertson professor of Information Management at Wharton university, perfectly depicts the Group's financial situation: Lego was considered too big to fail. Its customer base was more similar to a group of fans than to a group of clients. Yet, the group was one inch from failing.

The idea that came to the management was inspired by Mindstorm, a product developed with MIT Media Lab, launched in 1998. Mindstorm was initially thought as an educational platform where children could develop a design and share it online. It turns out that a remarkable community of enthusiasts embraced the product and started sharing their ideas.

This success made managers consider how the company could use its online gallery to build on the creativity of Lego's customers (Bughin, Chui, Johnson, 2008).

3.4.1.3 Selling

Definition: in this type of Open Innovation a company sells its own advancements in technology to third parties. This transaction typically takes place as a form of sale or license.

Advantages:

Research shows that licensing out innovation is a growing trend. Different firms have based their business model around licensing-out innovation in exchange of a sum of money. Chesbrough (Chesbrough, 2003) introduced the possibility of firms to profit from selling and licensing-out ideas. In different industries, many firms have developed a great number of patents because of the incentives in R&D. Many of those patents did not have a commercial purpose and were developed mainly for the sake of technology advancements, without considering its business relevance (Nerkar, 2007). By selling or licensing-out patents firms eventually found a commercial purpose to their R&D investment.

Disadvantages:

There are some inhibitors to this form of Open Innovation: the first one is the reluctance of inventors to reveal their innovations.

Also, behind such exchanges, where a party sells an innovation to the other, there is a "disclosure paradox". This happens when the innovator is willing to license its innovation. To do it some information have to be disclosed to convince the other party to accept. In this context, the licensee could act opportunistically and take advantage of the leak to steal the idea.

Firms could be too committed into developing innovations that they do not see their potential commercial value. This was studied by Chesbrough and Rosenbloom (2002) who analyzed how Xerox took advantage of its innovations creating a strategy that would bring this into practice. It is not only a matter of selling the innovation that a company has developed so far but the creation of a business model that would consistently generate innovations to sell.

3.4.1.4 Revealing

Definition: this type of Open Innovation happens when a company freely shares with a partner its innovations by showing its patents and sharing its business secrets. This method of opening innovation does not expect an immediate financial reward but look for indirect benefits for the firm such as alternative business models.

Advantages:

In some cases, the absence of IPR brings grater chances of advancements. This is underlined by the existence of free open source platforms such as Wikipedia and others where individuals get the chance to work collectively to develop innovative solutions.

In some cases, firms can engage in too harsh protection of their knowledge resulting in being too protective where there is not the need to (Laursen, K. and Salter, A. 2006).

Disadvantages:

The obvious disadvantage is the difficulty to capture the benefits that arise from opening the company's resources. Competitors might be better positioned with production facilities and other assents and steal the company's innovation to their benefit only.

The classification of the different forms of openness is useful to identify Hackathons into one of these categories. To summarize and compare in a clear manner the different forms of Open Innovation table 5 has been created on the basis of Dahlander and Gann's paper.

Table 5 – Advantages and disadvantages on the methods to perform Open Innovation (Dahlander, Gann, 2010)

	Outbound innovation Revealing	Outbound innovation Selling	Inbound Innovation Sourcing	Inbound Innovation Acquiring
Logic of exchange	Non-pecuniary—indirect benefits	Pecuniary—money involved in exchange	Non-pecuniary—indirect benefits	Pecuniary—money Involved in exchange
Focus	Revealing internal resources to the external environment	Out-licensing or selling products in the market place	Sourcing external ideas and	Acquiring inventions and input to the innovative

			knowledge from suppliers, customers, competitors, consultants, universities, public research organizations, etc	process through informal and formal relationships
Advantages driving openness	Marshal resources and support Gaining legitimacy from external environment	Commercialize products that are 'on the shelf' Outside partners may be better equipped to commercialize inventions to the mutual interests of both organizations	Access to a wide array of ideas and knowledge Discovering radical new solutions to solving problems	Gaining access to resources and knowledge of partners Leveraging complementarities with partners
Disadvantages driving closeness	Difficult to capture the benefits that accrue Internal resources can leak to competitors	Over-commitment to own product and technologies make it difficult to out-license	Many sources create an attention problem Difficult to choose and combine between too many alternatives	Difficult to maintain a large number of ties with different partners Risk of outsourcing critical dimension of the firm's business

After analyzing all the possible forms of Open Innovation this thesis will focus on why and particularly how Hackathons fit into the Open Innovation paradigm.

The literature does not analyze Hackathons in the Open Innovation paradigm to this extent and there is no previous classification of Hackathons as part of one of the four categories of this paradigm. The reasons behind the need of this classification reside both in the possibility of enriching the literature on Hackathons, defining with precision their field of intervention, and in the fact that it could provide some initial information over the advantages and disadvantages of performing Hackathons.

3.4.2 Classification of hackathons as a sourcing method to perform Open Innovation

From the definition that was previously provided, it is clear that hackathons function as an inbound method for innovation. As a matter of fact, hackathons' promoters scout for people outside of the company's walls. The objective of the search for people outside the company is found into the definition of both inbound methods for opening innovation: sourcing and acquiring.

To understand under which category it is possible to classify hackathons it is necessary to understand the variable over which they are separated: the exchange of money in the interaction.

In the definition of hackathons previously provided, it is affirmed that the ideas developed during the hackathon are voted by a jury that assigns an award to the best one. Also, it is specified that the award can have the form of a monetary and non-monetary prize. This feature could move the decision towards placing hackathons under the category "acquiring". However, it is important to understand what really the variable "pecuniary/non-pecuniary" stands for. The main difference between sourcing and acquiring resides in the fact that if a firm *sources* innovation it looks for ideas from different stakeholders (from clients to suppliers to competitors to public research organizations). This does not involve a monetary transaction between the parties. On the other hand, while *acquiring*, firms buy patented inventions and inputs for innovation from another party, the monetary transaction in this case is clear and consistent.

In hackathons, the awards promised function more in the direction of motivating participants to spend a week-end revolving around the challenge than in the one of buying an innovation. Moreover, the fact that not every idea receives the award means that these are not acquired, moving the final decision into placing hackathons under the "sourcing" category (table 6).

Table 6 – Hackathons as a sourcing method to perform Open Innovation

	Inbound innovation	Outbound innovation
Pecuniary	Acquiring	Selling
Non-pecuniary	Sourcing	Revealing

Chesbrough and Crowther (Chesbrough & Crowther, 2006) analyzed the application of Open Innovation and resulted in the finding that the model Chesbrough previously identified in 2003 was taken almost exclusively from the so-called "high technology industries". These are industries such as computers, information technology and pharmaceutical (Chesbrough, 2003).

Chesbrough and Crowther surveyed different potential early adopters of Open Innovation concepts. The results they obtained are qualitative and can only be applied to the Open Innovation practices as, by design, the object of the survey were companies that adopted Open Innovation practices. Their findings show that certain practices of Open Innovation are finding application even among industries outside the high technology industries. Within these "low technology" industries companies innovate with the objective of greater revenues or increased product range, not for lowering R&D costs. This suggest that companies competing in low technology industries can take advantage of external research to complement their R&D activities rather than substituting them. The most interesting finding of the paper is the fact that low technology companies mainly adopt inbound methods of Open Innovation, scouting for new innovations or acquiring them from stakeholders.

In 3.1 it was discussed whether if hackathons should only be open to computer experts and tech-savvy participants or also to figures such as field experts and others. It was noted how technology is impacting fields that require professional skills that go beyond the technological ones, as the one of healthcare. The discussion leaned towards opening the participation to all sorts of participants, as long as the challenge proposed involved technology.

In order to have a general picture of the literature that has been studied so far it is useful to draw some initial conclusion:

In 3.1 was analyzed the reason why hackathons should be open to participants outside the tech field. Now it is analyzed the reason why companies outside the tech field should run hackathons. These two arguments could not be separated as one drives the other and vice versa: if companies outside the tech field run hackathon, experts in that particular field are needed to guide tech experts in the solution of the problem. Also, if it is true that non-tech people can bring new point

of views to the team these should be applied also in fields different from the tech one.

3.5 Temporary Organizational forms

From the definition of hackathon provided in chapter 3.1 it is clearly stated that hackathons' participants work in teams that are formed either right before or during the hackathon and dissolve right after the its end. These types of teams have been studied extensively in the literature as temporary organizational forms (Lundin, Söderholm, 1995) or temporary group (Nisula, Kianto, 2015). An analysis of temporary groups will be carried out for two reasons: first it is necessary to understand how temporary groups are analyzed in the literature and whether if teams function differently during hackathon or not. Secondly, there are many forms of temporary groups and it is interesting to understand those that are the most similar to hackathons to see common features and where hackathon differ to understand their uniqueness.

As far as the first reason – understanding how temporary groups form – is concerned, it is necessary to define what temporary groups are. To do so a thorough study of the literature has been carried out and one of the most cited definition has been found to be the one from Lundin and Söderholm (Lundin, Söderholm, 1995). These authors have found four basic feature that function as demarcation points to understand the concept of temporary organizations.

The first one is *time*: by definition temporary organizations must have the conception of time horizon to limit its very existence.

Also, the *task* must be taken into consideration. This is the reason why the specific temporary organization has been created and its completion brings to its end. A temporary organization must depend on one, or a very limited number of, clearly defined tasks. Tasks do not need to be regarded as once-in-a-lifetime affairs and can also be of a more standardize nature as long as they are attended only by the temporary organization at that time.

Furthermore, the *team* is a factor to consider: this is the mean through which the task/s are completed. The team forms around the previous cited features: time and tasks. If a resource can be of help for the completion of the task and is

available it will be part of the team. The formation of the team focuses on individuals as bearers of skills and experience in solving the particular problem the temporary organization is set to do.

Finally, temporary organizations are created in order to fulfill a special purpose. This contains elements of change that are expected to bring qualitative difference within the temporary organization. In other words, temporary groups exist to provide some sort of *transition*.

These four elements – *time, task, team and transition* – can be used to define every form of temporary organization. As a matter of fact, these features help to define the general demarcation of temporary organizations as opposed to permanent ones. Lundin and Söderholm state that permanent organizations are more naturally defined by their goals (as opposed to tasks), survival (rather than time), working organization (rather than team) and continual development (rather than transition).

More recent works have attempted to update the definition of temporary group (Bakker, R, 2010). Bakker's approach is similar to Lundin and Söderholm's and his job mainly completes the gaps the previous authors left. Bakker refers to four central themes*: time, task, team and context*. The first three are identical to the ones that were previous identified and Bakker's paper basically updates the previous work adding some information. The last central theme is the most different one and it deploys over two levels of analysis: firm level and a wider social context level.

At firm level, the main object of analysis are PBOs (Project Based Organizations) and how the knowledge and the results achieved with the PBO can be sustained in an enduring organization and how is it possible to manage innovation through temporary ventures.

As far as the wider social context is concerned, it takes into account also all the stakeholders that the temporary organization deals with. Different scholars have studied how temporary organizational forms are influenced by the interpersonal network, communities and industries in which their participants are embedded. To better understand how the social context influences the temporary organizational forms Bakker poses two questions. First it is investigated the effect

of that the embeddedness in a wider social context has on the interior processes of the temporary organization. Secondly the investigation shifts on how are careers shaped in industries that only work with temporary organization. For the first question, it is argued that no temporary organization is an island (Engwall, 2003) meaning that temporary organizations are influenced in different ways by the social context they live in. As far as the second question is concerned, Bakker's paper notes that ad hoc assignments draw people away from their functional role mining at the progression of the career of the temporary group's participant. A deeper study has shown that there are some industries where this claim is not true though. A clear example is the Hollywood film industry, which is basically based on project works and there is no functional role people can return to. Both the level of analysis of the context focus only on posing central question so there are no findings.

3.5.1 How hackathons fit in temporary organizational forms - events where teams work as temporary organizational forms

Now that temporary groups have been studied it is possible to investigate to which extent hackathons' teams fit into the temporary group schemes studied by Lundin and Söderholm, and Bakker. For this purpose, it will be carried out an analysis on the four themes proposed by Bakker over teams in hackathons - *time, task, team and context*. The reason why it is chosen Bakker's approach and not Lundin and Söderholm's is that Bakker's one is newer and makes use of Lundin and Söderholm's to build his own. This analysis will be carried out comparing definition of hackathon that was previously defined.

- *Time:* by definition, hackathons are events where a group of people work on a problem to find a solution in a very short time span. Thus, hackathons are constrained by time.
- *Task:* a temporary organization must deal with one, or a very limited number of, task. By definition, in hackathons, teams work on one task which is the solution of the challenge provided by the promoter.
- *Team:* in hackathons, every participant must be part of a team. In hackathons teams are formed to answer to the problem in the best way

possible. As for temporary groups, teams in hackathons are formed around the skills that are needed to solve the problem.

- *Context:* how context influences the team during hackathons is a matter to study on the field so this point will be studied in detail during the field research.

These considerations can bring to the definition that teams in hackathons work as temporary groups.

There is also another theme that is recurrent both in the definition of hackathon and in the one of temporary groups. It is the fact that the task should bring some sort of change within the organization. Lundin and Söderholm refer to it as the fact that the task of the temporary organization should help the *transition* of the organization from a situation to the other. This concept can be addressed more in general as the fact that temporary groups should function as a mean to bring innovation to the company. Similarly, in Hackathons teams work to solve problems and provide the promoter with a direction to take to ignite a change and, as the definition goes, to "*generate a technological innovation*". The concept of innovation is recurrent in both the definition and it confirms that teams inside hackathons behave as temporary organizational forms.

Although hackathon's teams have been classified as temporary organizations there is still one theme that is still to discuss and it is concerned with the innovativeness capabilities of the teams. More in general it is still not clear how teams create innovative solutions or if there are some factors that enable the creativity of the team. This has been studied by Nisula and Kianto (2015) in a paper that analyses the antecedents of individual innovative behaviors in temporary group innovation. Specifically, this paper analyses what are the factors that trigger individuals to be creative and to provide good input to the discussion. Nisula and Kianto carried out this analysis in innovation camps which are considered to be temporary organizational forms. This reason lies behind the choice of considering their paper as it can also be of use to the study of hackathons. As a matter of fact, the characteristics of the innovation camps' task reminds of the hackathons' one: it is unique, complex and open-ended. This also

reminds of the definition of task provided by Lundin and Söderholm (1995). Nisula and Kianto's analyzes is based on six factors:

- *Individual creative self-efficacy:* individuals' ability to produce novel ideas and initiatives;
- *Task orientation:* this is the extent to which the group works towards a general commitment to accomplish a task to a high standard, creating a group environment where practices are questioned in a constructive manner and difference in views are cherished rather than suppressed;
- *Experimentation:* this is the creation of a climate that accepts trials and mistakes with a prototyping attitude*;*
- *Participative safety:* it is the extent to which participants feel safe and encouraged in the participation of team activities;
- *Support for innovation:* it concerns the expectation, approval and practical support to the attempts to bring new, improved practices in the work environment;
- *Vision:* this is defined as "an idea of a valued outcome that represents a higher order goal and a motivating force at work" (West, M.A. 1990)

The authors studied whether these factors positively or negatively influence innovative behaviors.

The results of their work are that individual creative self-efficacy, perceived task orientation, and experimentation have a significant impact over individuals' innovative behavior while participative safety, support for innovation, and vision do not affect individuals' innovativeness. Nisula and Kianto have also analyzed the antecedents of individuals' innovativeness in groups that work face-to-face. In this study five of the six factors that the authors identified in the previous paper have been taken into consideration (individual creative self-efficacy has not been studied). The results of this study show that only one factor is key to the overall creativity of the group: *task orientation*. It is surprising how the other factors do not actually influence the group's innovativeness.

This result should not lead to the consideration that these factors - *experimentation, participative safety, shared vision, and support for innovation* -

are not to be considered. Actually, it should guide to consider to a large extent the creation of a good group climate where participants have a clear goal and each one is committed to the achievement of the goal complying to high standards. Also, very important is the creation of a climate that builds on opposite views to generate the best solution possible and works on criticism to build a better solution. This though does not mean that the other factors are to be ignored completely. A great consideration of *task orientation* and a minor consideration of the other factors should be the way to best allow for groups in temporary face-to-face settings to be creative.

These findings may very well relate to what happens in hackathons as teams often are groups of people that did not know each other before the hackathon. The creation of a group environment where criticism is welcomed and participants share the same commitment to the achievement of the innovation should be the basis upon which build a creative innovation.

3.6 Hackathons and other forms of temporary organizations: a comparison between Design Sprints, innovation contests and hackathons

To better identify hackathons and really understand their unique characteristics, a study of comparison between hackathons and other types of temporary group forms has been carried out.

This study has followed 3 main phases:

1. Definition of the type of events to study: the objective of this study is to find some meaningful differences in order to highlight the reason why hackathons are unique. This phase defined the main characteristics that all the events should have in common.
2. Search for events: during this phase, a study of different kind of events that would enter in the boundaries defined in phase 1 has been carried out. Also, there must be a reasonable amount of literature regarding the event so to be able to find all the similarities and differences between those and hackathons.

3. Finding similarities and differences: a set of variables has been defined to study all the events and find where the different events differ and where they do not.

3.6.1 Definition of the type of events to study

The objective of this study is to define the uniqueness of hackathons by understanding where they differ from similar events. In order to understand what is similar and what is not it is useful to define some characteristics that all the events should have in common. This phase started with understanding the core of hackathons. In few words, they are events in which temporary groups generate an innovation. The main characteristics that are highlighted are that hackathons are events for *temporary groups* and that they have the objective of *generating an innovation*.

These two variables have set the boundaries for the search of events that took place in phase two.

3.6.2 Search for events

In phase one it was defined that the events to search for must be suited for temporary groups and have the objective of the generation of an innovation.

The search for events was carried out reviewing the literature. Different papers, introducing hackathons cite similar events such as Design and Game Jams and other innovation contests (Palazzuolo, 2013), (Hjalmarsson, Johannesson, Jüll-Skielse, Rudmark, 2014), (Carvalho, A. 2009). Also, an event that has gained popularity since 2016, when the book was published, is the Design Sprint (Knapp, J. 2016).

In order to prepare the comparison of these events and hackathons of phase three, it was necessary to retrieve the literature on those events. Sufficient literature has been found both for innovation contest and for Design Sprint while for Design and Game Jams no relevant academic literature has been found. For the latter event, the only literature that has been found consist of articles form web magazines and blogs. This is a very recent phenomenon and it is not a surprise that no academic literature has been written yet.

On the one hand, Jams could have been selected for the comparison, even because non-academic papers have been a fruitful source of information for the whole literature review. On the other, throughout the literature review, non-academic papers have always been analyzed in parallel with academic ones and functioned for the most just as a confirmation or as an update of previous information. Moreover, the non-academic literature that was found did not give a clear definition of Jams confusing them sometimes with hackathons and some other providing a very clear boundary to it. The final decision has been the one not to consider Jams for the comparison for two reasons: the lack of academic literature regarding Jams and the overall confusion that reigns over this new phenomenon.

To conclude the second phase, Hackathons will be compared with *Design Sprint* and *Innovation Contest*. A deep review of both the events will be given in the following.

3.6.2.1 Design Sprints

These are five-days processes that use Design Thinking to bring a meaningful product, service or feature to the market. They are used for answering critical business questions and to test ideas with customers.

Design Sprints have been developed at Google Ventures by Jake Knapp (Knapp, J. 2016), in collaboration with John Zeratsky and Braden Kowitz. Running a Sprint means to create a team of six to seven people for five days and proceed step by step each day from the conception of the problem to its solution and test with customers.

The basic steps of every sprint can be divided into the five days of the week adding one stage prior to the event for its preparation (Knapp, J. 2016):

- The first step is to set the stage: in this phase, the challenge is decided, the team is created, supplies are gathered and time and room are booked;
- On Monday, the team starts at the end and draws a map of the challenge. Then it asks experts in the company to share what they know and finally the target is chosen. This is a piece of the challenge which is ambitious and at the same time manageable to solve in a week;

- On Tuesday, the team reviews all the existing solution and search for ways to improve them and each person of the team sketches a solution;
- On Wednesday, each idea will be criticized in order to find strong and weak spots of each solution. This phase is critical as, even if there are only good idea there is always one that is better than the other and this is the one that should proceed to the prototyping phase. As the team decides the idea to proceed with, the team creates a storyboard to explain step-by-step the plan of the prototype;
- On Thursday, the team will adopt a "fake it" attitude to transform the storyboard into a prototype. It is particular how this prototype should be a façade to test with customers. This is both functional and convenient as making the team focus only on what the customer needs it is possible to create a prototype in just one day;
- Finally, on Friday, one person of the team has to interview the customer to get feedbacks and learn by watching the customers react to the prototype. Moreover, the test should function as a mean to understand where the solution can improve.

Design Sprints outputs are beneficial in many ways, even if the prototype did not receive a positive feedback. Teams can either have achieved a "flawed success", a positive feedback with some hiccups, or have reached an "efficient failure", if customers did not react well to the prototype that was built. What John Zeratsky and Jake Knapp say in the Youtube video where they describe this phase is: "at least you know, you didn't spend weeks or month building a solution and putting it out into the world. You were able to find out, in few days in your Sprint".
The Design Sprint will be detailed in the following when every variable will be discussed one by one.

3.6.2.2 Innovation contests – a comprehensive review of the literature

Innovation contests are known since the XVII century, where Emperor Luis Napoleon III offered a prize to anyone who could make a satisfactory substitute for butter to use in the military and in lower classes. The margarine was invented

but the inventor did not receive the prize since the Emperor died before. (Bullinger, Moeslein, 2010).

With the advent of the internet and the possibility for online competitions, the deployment of Innovation Contests took off. Nowadays Innovation Contests are widespread and promoted by individuals as well as firms, public organizations and non-profit organizations. (Bullinger, Moeslein, 2010).

These are events that can take place in an undefined variety of ways raging from online competitions to competitions that take place in physical places (e.g: museum, coworking spaces...) and from Agriculture and Food, to Automobile, to Medicine and so on (Adamczyk, Bullinger, Mőslein, 2012). The main idea of Innovation Contests can be applied to every industry as a way to scout for ideas that come from external sources.

Simply put, Innovation Contests, represent one way to perform crowdsourcing (Jeppesen, Lakhani, 2010). In fact, Innovation contests are analyzed as part of the Open Innovation paradigm and, as Hackathons, belong to the sourcing mechanism. Innovation Contests objective is gathering ideas, concepts and solutions (Adamczyk, Bullinger, Mőslein, 2012), (Bullinger, Neyer, Rass, Moeslein, 2010), (Bullinger, Moeslein, 2010), (Haller, Bullinger, Möslein, 2011) from a population of independent actors – the solvers – to be used in the innovation process of an organization, be this whoever wishes to use the ideas from the solver – the seeker (Terwiesch, Xu, 2008).

To better identify Innovation Contests and the role they play in the innovation process, this section reveals the most relevant literature reviewing the most cited academic papers books and showing the reasoning of the most appreciated authors. A brief introduction to Innovation Contests is made. Then an overview of the models developed over Innovation Contests is carried out to conclude with a series of the most prominent case studies and relative findings.

No analytical tool has yet provided an innovation and the human factor – creativity on top – is still the key element. Although randomness and serendipity play a role in Innovation authors agree that Innovation can be managed effectively with the use of analytical tools and empirical research. Clearly, this method provides a

more effective way to innovate compared to the one that relies on randomness alone (Terwiesch, Ulrich, 2009).

Innovation is the process of idea management (Kastelle, 2013). This starts with the collection of ideas, continues with their selection and concludes with the implementation of the selected ideas. Kastelle makes the case that all the three steps must be performed perfectly in order to achieve profitable innovations. Innovation Contests belong to the first step, which is the one where ideas are scouted for and collected.

The literature analyses Innovation Contests through five different perspectives: economic perspective, management perspective, education focus, innovation focus and sustainability focus (Adamczyk, Bullinger, Möslein, 2012). The economic and management perspectives contain papers that deal with economic models and management models of managing Innovation Contests. The focusses on education, innovation and sustainability contain publications that deal with the educational intent of Innovation Contests, the usage of Innovation Contests to foster the creation of new solutions and the purpose of Innovation Contests to promote sustainability. This shows how broad the application of Innovation Contests can be but these events are similar to each other, even if performed in different circumstances. In particular two studies have been examined that reveal the similarities of Innovation Contests. The attempt to define a series of design elements and the one to provide a common structure to run an Innovation Contest. In addition, an overview of the objectives and the limitations of Innovation Contests is carried out.

The study on Design Element has been attempted by different publications (Adamczyk, Bullinger, Möslein, 2012), (Bullinger, Moeslein, 2010), (Bullinger, Haller, Moeslein, 2009), (Bullinger, Neyer, Rass, Moeslein, 2010), (Haller, Bullinger, Möslein, 2011), (Hallerstede, Bullinger, 2010). All the publications have one author in common, Bullinger, who seems to be the leader of the discussion over the design elements. It is the paper from 2010, written with Moeslein (Bullinger, Moeslein, 2010) that seems to be the standard as it is the one that is cited in other papers (Hjalmarsson, Johannesson, Jüll-Skielse, Rudmark, 2014). In the following the Design elements are reported with table 7.

Table 7 – Design Elements that constitute the Innovation Contests (Bullinger, Moeslein, 2010)

Design Element	Attribute					
1 – Media	Online		Mixed		Offline	
2 – Organizer	Company	Public Organization		Non-profit		Individual
3 – Task/topic specificity	Low		Defined		High	
4 – Degree of elaboration	Idea	Sketch	Concept	Prototype	Solution	Evolving
5 - Target group	Specified			Unspecified		
6 – Participation as	Individual		Team		Both	
7 – Contest period	Very short term	Short term		Long term		Very long term
8 – Reward/motivation	Monetary		Non-monetary		Mixed	
9 – Community functionality	Given			Not given		
10 - Evaluation	Jury evaluation	Peer review		Self-assessment		Mixed

About the structure, the same authors that provided the design elements together with Haller, studied that Innovation Contests should be designed along five phases: preparation, communication, execution, evaluation and follow-up (Bullinger, Haller, Moeslein, 2009).

To provide the most complete overview on Innovation Contests also a review of the objectives and the limitation is exposed. As far as the objectives are concerned, these are divided into two scopes: greater good and corporate challenges. In turn, these are divided respectively into research and knowledge creation, investment in industry, skills, business, (social) welfare, sustainability and environment protection for how it concerns the greater good and into user feedback and identification of trends, idea generation, ideas/design, concepts/solutions, brand/image, organizational change, corporate social responsibility and recruiting/HR for how it concern the corporate challenges (Haller, Bullinger, Möslein, 2011). About the limitations these have been identified in two studies. The first, from Kastelle identifies Innovation Contests as part of the first step of the innovation process: the collection of ideas. Kastelle claims that all the steps of the process must be performed well to provide profitable innovations and argues that focusing on the first one is not a good strategy. In fact, the results of a survey on 300 companies (from big corporate to small startups) show that less than 10% of these are poor in ideas. Therefore, Kastelle suggests that the money spent in the Innovation Contest would represent a better investment if invested in the two other phases.

The second study analyses the barriers to innovation in Innovation Contests. These are shown in the following table (table 8).

Table 8 – Barriers to the innovative capabilities of Innovation Contests (Hjalmarsson, Johannesson, Jüll-Skielse, Rudmark, 2014)

Category	Barrier
Cost	High innovation cost
	High cost of finance
Finance	Short term economic, monetary and financial policies
	Lack of venture capital
	Lack of public funds and assistance
Innovation	Easily imitable innovation
	High risk-level of innovation
Knowledge	Lack of technical competence and market information
	Lack of marketing competence and market information
	Lack of management competence
	Lack of innovation experience
Market	Uncertain product demand
	Lack of innovation motivation
	Weak value offering
	Multifaceted market conditions
	High market competition and saturation
Organization	Lack of partner co-operation
	Lack of time
	Unsupportive organizational culture
	Weal R&D environment
Strategy	Weak innovation strategy
	Lack of strategic fit
Regulation	Hindering government policies and regulations
	Inefficient intellectual property processes
Society	Lack of public acceptance for innovation
Technology	Unavailable technology

This work has been carried out by Hjalmarsson et al. through a consistent review of 24 publications. The authors found 179 factors that grouped in 10 categories and resulted in 29 different barriers. These may either be a lack of a success factor or a barrier to innovation identified in the literature.

To conclude the section on Innovation Contests a review of the most relevant case studies and relative findings has been carried on.

A considerable amount of studies on Innovation Contest has been published in the literature. These are both intended at revealing Innovation Contests in their entirety (Carvalho, A. 2009), (Ebner, Winfried, Leimeister, Krcmar, Helmut, 2009), (Hjalmarsson, Rudmark, 2012), (Terwiesch, Xu, 2008), (Yang, Chen, Banker, 2010) or are aimed at analyzing one specific feature of these (Boudreau, Lacetera, Lakhani, 2010), (Bullinger, Neyer, Rass, Moeslein, 2010), (Füller, Hutter, Hautz, Matzler, 2014), (Wooten, Ulrich, 2011). The following briefly discloses the most interesting findings of these studies:

- the more the competitors, the better the performance of the contest for high-uncertainty problems. The higher the uncertainty, the lower the negative effect on added competitors on incentives (Boudreau, Lacetera, Lakhani, 2010);
- There are Innovation Contests where cooperation is encouraged: findings show that at the extremes (low cooperation and high cooperation), cooperation produces high degree of innovativeness while if cooperation reaches the medium levels the degree of innovativeness is low (Bullinger, Neyer, Rass, Moeslein, 2010);
- Hybrid structures (competition and cooperation) in innovation contests are beneficial to the quantity and quality of ideas. These structures are common forms of running online contests and these benefit from the interaction among their participants, their information exchange, their mutual support, community building, and cooperation;
- In every Innovation Contest, but this applies to every activity performed to source innovation from outside, as an organization utilizes these innovation capabilities it simultaneously loose significant control over the innovations' alignment with existing organizational goals (Hjalmarsson, Rudmark, 2012);
- The inefficiency of Innovation Contest resulting from the solvers' under-investment can further be reduced by changing the award structure from

a fixed price award to a performance contingent award (Terwiesch, Xu, 2008);

- Feedbacks influence the quality of the ideas. In particular the performances of the teams in Innovation Contest has been measured in relation to three different feedback treatments – no feedback, random feedback and directed feedback. The results are that directed feedback produce an improvement of the average quality of outputs while no relation is found for no feedback and random feedback as those treatments may also generate a better top-end entry quality (Wooten, Ulrich, 2011);
- Finally, a publication links the quality of an Innovation Contest's output to the quality of the solvers. Findings show that past performances are a good predictor for future ones (Yang, Chen, Banker, 2010).

3.6.3 Finding similarities and differences

Now that all the events to compare have been presented, the first step to take is to define which are the variables upon which these events are going to be classified. These variables aim at diversifying events that have been selected for their similarities. Only those variables that would allow for the identification of a meaningful difference between the events have been selected.

The selected variables are:

- Objective: this identifies the purpose of the promoter that runs the event and the reason why participants decide to take part in the event;
- Participation - open or close: since all the events' output is an innovation this variable was selected to understand whether if an event can be considered as part of the Open Innovation paradigm or not;
- Structure of the event: does the event follow a structure? Or is it always organized and run in a new way? This variable considers the organization of the event and investigate if the event follows one, single, predefined structure or if the organizer has some leverage on the organization of the event.

  Also, this variable studies if there are predefined roles that the team members must cover, if the team must be composed by a certain number

of participants and whether if the event is suited for different backgrounds or only calls for specific backgrounds.

- Output: all the events have been selected on the basis that their output must be an innovation. This variable investigates to what extent the innovation is readily implementable after the event.
- Field of application: Is it only convenient to perform the event in a specific field? Or can it be performed in every field?
- Cooperation/Competition: This variable analyzes the nature of the interaction between participants and teams. In addition, it defines if the event hosts one or more teams.

The result of the analysis is shown in table 9. As far as the column that represents hackathon is concerned, the variables "structure of the event", "roles inside the teams" and "output" have not been completed. This is because even if the review of the literature may have given some information they have been considered not sufficient as no study has ever addressed hackathon in such a structured manner.

Table 9 – Results from the comparison between Design Sprints, Innovation Contests and hackathons

	Design Sprint *(Knapp, J. 2016)*	Innovation Contest *(Bullinger, Moeslein, 2010); (Terwiesch, Xu, 2008); (Hjalmarsson,, Johannesson, Jüll-Skielse,, Rudmark,, 2014)*	Hackathon *(Briscoe, Mulligan, 2014); (Frey, Luks, 2016); (Trainer, Kalyanasundaram, Chaihirunkarn, Herbsleb, 2016);*
Objective	Answer to critical business problems *(Knapp, J. 2016)*	Two main typologies of objectives: • Corporate Challenges • Greater good *(Haller, Bullinger, Möslein, 2011)*	Direct: • Innovation Indirect: • Recruiting • Community build • Pedagogy *As explained in the litrature review*
Participation – open or close	Only open to people inside the firm	Open to everyone	Open to everyone
Structure of the event	5 days, highly structured event; Roles inside the team: • Product chief • Facilitator • Customer Rep • Designer • Engineer • Marketing *("From Google Ventures, The 6 Ingredients You Need To Run A Design Sprint". Co.Design, 2016);* (GV, 2016-03-04), Kevin Rose talks 'Sprint' with GV's Jake Knapp and Daniel Burka)	From one week to six months, many forms of innovation contest. No predefined roles inside the team. The common characteristics of participants is the interest in the specific Innovation Contest	12 to 48 hours, 4 main phases, Other information are to collect with the field research Background of participants: • Developer • Designer • Business • Field expert Additional information to collect with the field research
Output	• Implementable Innovation • Efficient Failure – iteration *(Knapp, J. 2016)*	Innovation, not viable though *(Hjalmarsson, Johannesson, Jüll-Skielse, Rudmark, 2014); (Kastelle, 2013)*	Innovation not viable. More information to find with the field research *(Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015)*
Field of application	Applicable to every field *(Knapp, J. 2016); (https://sprintstories.com/)*	Applicable to every field *(Adamczyk, Bullinger, Möslein, 2012)*	Applicable to every field, as long as it involves technology
Cooperation / Competition	Cooperation	Competition but also cooperation *(Füller, Hutter, Hautz, Matzler, 2014)*	Competition *(Frey, Luks, 2016)*

In order to appreciate the differences between these events, an initial analysis of every block of the matrix, followed by a comparison of the blocks of each row has been carried out:

3.6.3.1 Objective:

Design Sprint:

The Google Venture internet page about Design Sprints, describes Sprints as a concentrated process for "answering critical business questions through design, prototyping and testing ideas" (http://www.gv.com/sprint/). Although no in-depth description has been given about what can be considered a critical business question and what not, Google Venture is collecting the stories about other companies running Design Sprints (https://sprintstories.com/). From the analysis of this page it is possible to understand how every kind of business problem is addressed. The problem ranges from specific – like the design of a fitness app (Arntsen, 2016) - to very broad - reimagining public art in Denver (De Stefano, 2017) – but it is clearly stated and it is clear that companies run Design Sprints in order to solve a problem.

Innovation contest:

Innovation contests serve a variety of purposes. These have been classified into *greater good* and *corporate challenges* (Haller, Bullinger, Moeslein, 2011). Haller et al. provided all the objectives that an organization can reach with Innovation Contests.

First the innovation contests with the strategic scope of "corporate challenges" will be analyzed. These innovation contests are organized with the precise intention of solving a business problem but there are also other reasons to run an innovation contest and the authors identified eight different objectives:

1. User Feedback and identification of trends
2. Idea generation
3. Ideas/designs
4. Concepts/solution
5. Brand/image
6. Organizational change
7. Corporate social responsibility
8. Recruiting/HR

On the other hand, there are innovation contests that are organized with the strategic scope of a "greater good". This kind of contest are usually organized by non-profit organizations, public institutions and other non-governmental institutions, such as foundations, as their mission is the one to improve the overall conditions of society as a whole. For these contests, the authors identified seven objectives:

1. Research and knowledge creation
2. Investments in industry
3. Skills
4. Business
5. (Social) welfare
6. Sustainability
7. Environment protection

Innovation Contests with the strategic scope of generating a "greater good" are increasingly used also for educational purpose.

Hackathon:

Most papers provide a complete overview over one single hackathon and few ones take into examination the hackathon phenomenon. Although there are some papers that address the phenomenon as a whole (Briscoe, Mulligan, 2014), (Palazzuolo, 2013), no paper analyzes the objectives of the hackathons.

In order to define what are the reasons why an organization should run a hackathon, a review of the literature has been made. For every paper that would describe hackathons an objective has been extracted. This analysis provided an interesting result as it was discovered that every hackathon has mainly two objectives: the first one, which is the more clearly stated one, is the development of an innovation (Grijpink, Lau, Vara, 2015), (Briscoe, Mulligan, 2014)., (Spaulding, Caimi, 2017), (Frey, Luks, 2016), (Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015). The second one, which is sometimes difficult to grasp, can be of three natures: recruiting (Morielli, Zanchi, 2017), ("Benefits of Hackathons", 2012), pedagogy (Nandi, Mandernach, 2016), (Bowen, 2017), (Munro, 2015), (Page, 2016), and community build ("Benefits of Hackathons", 2012), (Irani, Vertesi, Dourish,

Philip, Grinter, 2010), (Johnson, Robinson, 2014), (Lara, Lockwood, 2016), (Alba, Avalos, Guzman, Larios, 2016). As a matter of fact, when organizers promote and present a hackathon, they always advertise the challenge of developing an innovation. They almost never advertise the fact that the hackathon has an indirect objective, which can be one between recruiting, pedagogy or community build, or even all of them together.

To present the reasoning with order a classification of the objectives has been made resulting in to two classes of objectives: direct and indirect. Under the direct one there is the objective of the generation of an innovation. Under the indirect class there are recruiting, community build and pedagogy.

Conclusions:

The fact that the three events have in common the generation of an innovation, should not drive to the conclusion that the events' objectives are similar. Indeed, the fact that they all deal with innovation is the reason why they have been studied. The main difference that can be appreciated with this analysis is the fact that on one hand Design Sprints only have the objective of finding the innovation while on the other, innovation contests and hackathons also have secondary objectives – the ones they have in common are recruiting and learning. This information should not drive to the conclusion that people that engage in Design Sprints do not learn anything but that learning is not an explicit objective of Design Sprints. It is possible that innovation contests and hackathons are organized with the objective of teaching participants while this is not the case for Design Sprints.

3.6.3.2 Participation – Open or close

To analyze this variable, it has been taken into consideration the paradigm of Open Innovation. The main differentiation is done over the fact of belonging or not to the Open Innovation paradigm.

Design Sprint:

Design Sprints cannot be considered part of the Open Innovation as they are run inside the company. Moreover, in order to be part of the team participants are selected. These features of the Design Sprints exclude them from Open

Innovation. This does not mean that it is not possible for people from outside the company to take part to the Design Sprint. In fact, this is possible and encouraged when the figure the team needs is not present inside the company.

Innovation contest:

Innovation contests have been analyzed as part of the Open Innovation paradigm from the literature (Terwiesch, Xu, 2008). Their main characteristic is to be open to every person that wish to participate. During the years this feature may have changed and it is possible also to find an innovation contests that screens participants with a selection process. In any case, this is a passive screening, meaning that it only starts as the candidates apply, it does not function as a scouting as it happens for Design Sprints for example. In any case the vast majority of innovation contests do not screen the candidates.

Hackathon:

Hackathons have already been considered as part of the Open Innovation paradigm in 3.3. As for innovation contests, hackathons are open to every person that wish to take part. Also in this case there are some cases where candidates go through a screening process but this is mainly done for limits in physical places, not for quality reasons.

Conclusions:

To conclude it is possible to state that innovation contests and hackathons' approach to Open Innovation is similar, if not the same. Regarding Design Sprints, the difference between Sprints and the other events is remarked with this variable.

As of now, from the variables analyzed, it emerges a clear distinction between Design Sprints on one side and innovation contests and hackathons on the other.

3.6.3.3 Structure of the event

Design Sprint:

Design Sprints are very structured and follow precise guidelines on how to run them. As a matter of fact, their strength is how the same structure is able to face, solve and test different problems.

Design Sprints structure have been explained in 3.5.2.1 when introducing them. From the description, it is possible to appreciate the structure of the event throughout the five days and even within the five days as in many cases – Monday, Tuesday and Wednesday – the day is divided in activities to perform in the morning and activities to perform in the afternoon.

Precise guidelines are given for the creation of the team, from the number of participants it must have, to the role that each participant must cover.

Teams should be composed of four to seven participants (GV (2016-03-04), Kevin Rose talks 'Sprint' with GV's Jake Knapp and Daniel Burka). Also, participants should be selected to cover a specific role inside the team. Every team has to be composed of (Melone, 2017):

- A Product Chief, which will be the one that will take the decision when required;
- A Facilitator, who takes care of the smooth development of the Design Sprint;
- A Customer Rep, who takes care that customers are always at the center of the discussion
- A Designer, this figure is essential for making things *'look good enough'*. In fact, Design Sprints are fast and there is the need of a person to take care of making the prototype look good in order to be presentable to the customer for the test.
- An Engineer, who will be the main creator of the prototype. While it is not compulsory to be a technology company to run a Design Sprint, the prototype usually needs some engineering talent.
- Finally, a Marketing specialist, who will use its knowledge for both make a marketable prototype and for the necessary storytelling to write the right words to accompany the prototype.

Innovation contest:

There are various types of innovation contests therefore it is not easy to provide a structure of these events nor it is convenient as it would pose limits to a concept that can be used in many ways. The most complete work in the attempt to give clarity to innovation contests has been carried out by Bullinger and Moelslein (Bullinger, Moeslein, 2010). They provided all the Design Elements and their relative attributes of innovation contest. The study results in having 34 attributes for ten Design Elements. The difference that would make a change in only one variable is considerable, therefore although this study actually provides a structure of innovation contests, the difference between one innovation contests and the other is too great to consider these structured events.

The difference in the structure of every innovation contests is too great to be able to provide a list of figures that must be present within the team. Also, this would be limiting as there might be an innovation contests that could need figures that were not considered useful in the first place. The characteristic that all participants in innovation contests must have in common is the interest in the particular field of application of the event.

Hackathon:

In the definition of hackathons from 3.1 the structure of the event is clearly defined: it consists of four phases that happen in every hackathon. An initial phase where teams are formed - although this phase sometime does not take place it is added for the sake of completeness. Then there is a second phase of creative thinking over the problem, followed by a coding phase and a final phase to prepare the presentation. Hackathons typically last from 8 to 48 hours and they all deal with technology. A study in the field of the structure of the hackathon is required to complete this information.

Regarding participants and teams, hackathons can be considered a halfway between Design Sprints and innovation contests. In fact, they do not require a list of figures that must be present to run the hackathon – which differentiate them from Design Sprints – but some figures are highly advised to be part of the teams.

These are:

- Developers/coders (Briscoe, Mulligan, 2014): since the output of cackathons must be a software or a hardware prototype, there must be someone with coding skills. These figures can be either specialized in front or back end development. The best configuration possible is to have inside the team one front-end developer a back-end one to be able to develop a software or a hardware that is both functioning and good looking.
- Designers (Spaulding, Caimi, 2017): even more than for Design Sprints, in hackathons time is not much and usually the prototype gets finished in the last hours and minutes. The need for a figure inside the team that makes everything look "good enough" is crucial for the presentation.
- Business figures: in hackathons, firms usually look for an innovation they can profit from. A business figure, which masters the subject of innovative business models and business model development can give the team the input to make a good idea a great one and assure the victory of the prize
- Marketing figures: as for Design Sprints, the careful wording of every sentence that appears on the prototype can be what differentiate a good solution from a bad one. Marketing figures could bring into the team the necessary set of skills needed for the creation of a great solution.
- Field experts (Olson, Walsh, Garg, Steel, Mehta, Data, 2016), (Spaulding, Caimi, 2017): hackathons can be intended as a mean to bring technology into every field. To do this it is necessary to have both people that know technology and people that know the field of application. A clear example of this is provided by hackathons in the medicine field. Physicians go through an extensive preparation and on the one hand they are the only bearer of knowledge of their field but on the other, they do not know about other fields, such as technology. Also, tech savvy people did not study as physicians and are not experts in the medicine field. Hackathons are a way to make physicians and tech people get together to bring close medicine and technology.

  Without field experts, it is impossible to develop a solution that can be used in that specific field.

This list of figures is to be intended as an advice. Every hackathon's team is composed of different figures and it might happen to have teams that are only composed of developers and teams that are mixed. In any case, since hackathons deal with technology it is preferable that every participant knows or is interested in technology.

As for the study on the structure of hackathons, also for the role inside the teams it is necessary a more complete analysis with field research. This could either validate or not what has been found in the literature and could also add important information.

Conclusions:

The difference between the events under investigation is clear with this variable. In fact, they all follow their own specific structure. Beside innovation contests, for which a structure has not been defined for the many ways there are to perform these events.

As far as participants and teams are concerned, the main subject of analysis are Design Sprints and hackathons. Innovation contests do not have specific roles inside the teams therefore they cannot be compared to the other events.

On one hand, the precise structure of Design Sprints is represented in the clear instructions of how to create a team while for hackathons, the list created only functions as an advice and it is not compulsory to respect it. On the other hand, Design Sprints and hackathons share some of the figures as a direct consequence of their similarity. Most of all the limited time calls for expert figures that solve problems in short time, being these designers and marketing experts.

3.6.3.4 Output

For each event, the degree of elaboration and the extent to which the solution is implementable have been discussed. The degree of elaboration has different stages: Idea – Sketch – Concept – Prototype – Solution – Evolving (Bullinger, Moeslein, 2010).

Design Sprint:

The authors clearly state the output of Design Sprints. This can be either an implementable innovation or an efficient failure. Both have been analyzed.

First of all, the degree of elaboration of the output is a prototype as the team works to achieve a functioning façade to show to the customer.

The customer can either like or dislike the solution. In case he likes it, the Sprint can be considered a success and the result is called a "flawed success" (Knapp, J. 2016). In fact, in five days it is barely impossible to reach perfection and the customer will very likely find some weak spot in the prototype. These weaknesses are going to be solved with an iteration of the Design Sprint or by working on it outside the Sprint.

In case the customer does not approve the prototype, the result is called an "efficient failure" (Knapp, J. 2016). The team has failed but the work done is not to throw away. On the contrary some important achievements have been accomplished during the five days: the company now has a team of experts in the particular field the Design Sprint was on, the team has created a solution in only five days instead of months and learnt how and why their solution did not work. Now it is possible to reiterate the Design Sprint and generate a better solution taking in consideration the feedbacks from the customers.

Innovation Contest:

The degree of elaboration can vary from the initial idea to the evolving part of the solution (Bullinger, Moeslein, 2010). This is because there are different typologies of innovation contest, especially if the length of the contest is considered. Innovation contest that last for months are more likely to generate a more elaborated solution than contest that last few days.

As far as how viable is the solution it depends from contest to contest. The literature is divided as some propose Innovation Contests as a good way address Open Innovation and create usable innovations (Bullinger, Moeslein, 2010), (Adamczyk, S., Bullinger, A. C. and Moeslein, K. M. 2012) and some other argue that innovation contests do not work (Kastelle, 2013).

Hackathon:

As far as hackathons are concerned, usually the degree of elaboration is a prototype as teams are required to present their ideas with a demonstration of how they work.

The viability of the solution is poor though as most of the solution that are presented only build a façade of the one to be implemented. In most cases implementing the solution to a corporate level would mean to assemble a team and work for weeks, if not months. The enthusiasm that welcomes the solutions usually is not followed with the implementation of the solution at a corporate level (Komssi, Pichlis, Raatikainen, Kindstrom, Jarvinen, 2015).

Conclusions:

Although Design Sprints and hackathons reach the same degree of elaboration of the output, only the Design Sprint actually generates solution that can be implemented at corporate level. This can be considered a consequence of the different approaches of Design Sprints and hackathon. Design Sprints spend 60% of their time to critically think the solution, 20% to build it and 20% to test it. On the other hand, hackathons spend most of their time building the prototype and no time at all to test it with the customer. Compared to what happens in Design Sprints, a realistic proportion could be 20% generation of the solution, 80% building it and 0% to test it. This is one important feature to consider but it should not bring to the conclusion that hackathons are meaningless. In fact, of the four objectives of the Hackathon, presented at the beginning of this chapter, only one concerns the creation of a solution. The other objectives may very well be reached even if the innovation is not implemented.

3.6.3.5 Field of application

Design Sprint:

This event has been used for generating innovative solution in the most various fields. To keep track of the various application, Google Venture created a website where firms and organization that run Design Sprints can share their experience (https://sprintstories.com/). So far, only Google Venture has run over 150 Sprints in different industries from communication to food to health and so on.

Innovation Contest:

Extensive literature show that innovation contest can be applied to every field (Adamczyk, Bullinger, Möslein, 2012), (Bullinger, Moeslein, 2010), (Bullinger, Neyer, Rass, Moeslein, 2010). Adamczyk et al. provide a list of all the fields where the innovation contest they studied were applied. This only serves to show how broad the spectrum of application of innovation contest can be: Agriculture and food, Automobile, Aviation, Energy and Power, Sustainability, Mathematics, Medicine, Navigation, Software, Computers and IT and Textiles.

Hackathon:

The analysis of the literature on hackathons showed that these events are mainly applied within the field of technology. Though, increasingly, these are being deployed in different fields to bring closer that specific field with technology. In fact, the concept of hackathons is not limited to the application to fields different from the technological one, as long as the event itself deals with technology and the creation of a technological solution.

Conclusions:

All the events have in common the fact that they can be deployed in every field with one exception. In the case of hackathons, they are limited to the fact that they must deal with technology.

3.6.3.6 Cooperation / Competition

This variable is useful to clearly define the differences between the events.

Design Sprint:

These are events for which people with different backgrounds join together to create a solution to a critical business problem. The nature of the event is relaxed and the team members cooperate with each other to the achievement of the best solution. Therefore, Design Sprints have been categorized as cooperative events.

Innovation Contest:

These events are, by definition, contests in which teams compete for an award. Thus, innovation contests have been classified as competitive events. Though, a

growing trend is the one of promoting innovation contests inside a community (Füller, Hutter, Hautz, Matzler, 2014). Innovation contests like those are called hybrid as their structure involves both the competition between teams but also the collaboration between participants. In any case, for the sake of clarity, innovation contests are going to be considered as competitive events

Hackathon:

Finally, the question of hackathons is not as clear as the others. On one hand hackathons can be organized in a more or less competitive manner (Frey, Luks, 2016):

- More competitive: it is clear that only the best solution will win the award;
- Less competitive: it is not stated how many solutions will receive the award;
- Complementary: teams work on different pieces of the overall solution and the combination of all the solution is the final goal.

On the other hand, in hackathons the teams compete with each other for the final prize, no matter how it has been organized. In fact, even if the hackathon is organized in a complementary manner – which may seem the less competitive for the fact that teams build together the solution – in the end one team will result to be the one that wrote the best code, or presented in the most intriguing way, or that created the most innovative part of the solution – or even all these combined – and will be awarded the prize.

It is safe to recall that, by definition, teams compete for an award during the hackathon. This reasoning brings to the classification of hackathons as competitive events.

Conclusions:

This final variable clearly defines a difference between Design Sprints on one side and innovation contests and hackathons on the other.

3.6.4 Concluding Remarks: hackathons as a specific manner to run innovation contests

After the analysis of the three events over the seven variables it is possible to draw some conclusions.

First of all, the analysis clearly defined a difference between Design Sprints on one side and innovation contests and hackathons on the other. This has been remarked on the study of the objectives, where, contrary to Design Sprints that only have the objective of answering critical business problems, innovation contests and hackathons have also indirect objectives such as recruitment and educational goals. Also, this has been highlighted when analyzing how the events call for participants. It was pointed out the fact that innovation contests and hackathons belong to the Open Innovation paradigm while Design Sprints do not. Finally, the study of the last variable resulted in the further differentiation between Design Sprints as cooperative events and innovation contests and hackathons as competitive ones.

Now that the similarities between innovation contests and hackathons have been used to differentiate these events from Design Sprints, it is necessary to differentiate between these two in order to understand the unique characteristics of hackathons.

The first differentiation is the fact that innovation contests can be applied to every field without limitations while hackathons must deal with technology. Also, hackathons have a much more clearly defined structure: time, theme and award are the same for every hackathon with little choice given for every variable. On the other hand, innovation contests do not follow one specific structure and everyone is clearly different from the other.

Although these differences are real, it is safe to consider hackathons as a subset of innovation contests. As a matter of fact, the fact that hackathons must deal with technology is a subset of all the fields of application of innovation contests. Also, the fact that hackathons follow a more precise structure can be considered as a subset of the less structured innovation contests.

In order to verify this, also a study of the literature has been carried on. Many papers describe innovation contests and one in particular from Hjalmarsson et al.

(Hjalmarsson, Johannesson, Jüll-Skielse, Rudmark, 2014) considers, among other innovation contests a hackathon.

This verification allows for the classification of hackathons as a way to perform innovation contest. Nowadays, if an organization promotes an innovation contest regarding technology, chances are very high that it will be organized, advertised and performed as a hackathon.

It is now clear what hackathons are and what they are not. In the following a brief chapter explains the objectives and the methodologies that were used during the thesis and a model is built for classifying hackathons and finding the design elements that compose them.

4 Objectives and methodologies

In this chapter, the research question of the thesis, its objectives and the gaps with the literature are identified – the latter are analyzed in order to find the best way to cover them. In addition, the methodologies that were used in this thesis will be explained in detail.

First, in order to define the research question three steps were taken:

- Problem definition: hackathons are increasingly used by more and more organizations as a way to open themselves to people from outside the company and to foster or take steps towards technology. These are events that potentially serve a variety of purposes and no academic literature and managerial advices have been written yet.
- Problem statement: the lack of academic literature and managerial advices has left a gap that was mainly covered by online articles. Most of them are a repetition of the other and no one refers to academic literature. There is the need to address this topic with an academic perspective taking into consideration the academic literature and enriching it with results found from a systematic field research.
- Research question: hackathons are gaining popularity among tech and non-tech related companies. Yet there is not a comprehensive study about this topic in the literature, apart from sporadic description of some hackathons.

  Do hackathons support the innovation process of the company? What are the typical problems that are best to face in hackathon-like events? Are hackathons limited to the generation of an innovation or are there other objectives? How far does the current literature answer to these questions?

This thesis' objective is to answer those questions. After the literature review, different information was collected that have to be verified on the field. In addition, this thesis aims at finding a model with which it is possible to analyze a hackathon and to provide a support to the promoter during the organization and the throughout the whole duration of it.

The gaps that were identified in the literature are mainly related to the lack of literature on hackathons. Taken aside few papers (Briscoe, Mulligan, 2014), (Frey, Luks, 2016), that analyze hackathons and propose models to organize them, most of them mainly describe hackathons that were visited and the relevant implications that these had. Most of these papers did not pursue a consistent literature review and therefore no consistent enrichment of the literature was made.

More in detail, no paper that explicitly deals with the role of the organizer in hackathon was found even if this figure is gaining more attention and in some cases, it could be that a hackathon performs well mainly for the decisions taken by the organizers. Also, no explicit reference has been made for mentors and only one paper analyzes the difference between the monetary rewards and in-kind ones (Jin, Huang, 2014).

The methodologies that were used in this thesis are:

- Review of primary and secondary sources: in the first section of the thesis the literature review was carried out taking in consideration both academic literature and non-academic one. Non-academic literature consists in online articles from relevant magazines. These have been considered as they represent a large portion of the overall literature that has been written on the theme of hackathons so far. As a matter of fact, hackathons are a quite new phenomenon and since it takes time to publish an academic paper, online articles are the most updated source of information, even if it is less trusted;
- Ethnographic observation: this was done while observing the hackathons. The cumulative hours of observation are 236 for eight hackathons. These were used to gain insights on the mechanism that take place during the formation of the teams, during the phase of creative problem solving and in the last phase of the preparation of the presentation;
- Interviews: interviews were done both with promoters and with organizers of the different hackathons. The same script was used for each interview but is was considered mainly as a guideline. As a matter of fact, most of

the questions made followed the discussion to eventually go back to the script;

- Survey: participants from every hackathon were surveyed with the same questions in order to understand the reasons for participation, the expected output and the general information of the participants. In total, 150 answers were collected.

In the following part of the thesis the model is created and applied to different hackathon. In addition, results are drawn from this analysis that both enrich the theoretical literature on hackathons and provide some managerial implications in the form of advices to promoters that want to run a hackathon.

5 Construction of the model: focus on hackathons with a deconstruction and an analysis of each building block

In the literature review, it was discovered how hackathons represent a specific way to perform innovation contests. In this chapter hackathons are going to be deconstructed in their building blocks and each one is going to be addressed individually: a review of the literature of each specific building block is examined. This is done to examine the current understanding of the problem, to analyze how the specific building block functions for hackathons and to provide the basis for the field research.

5.1 Steps to develop the model

The first step to take in this direction is the one to build the model to structure the analysis. In the following it is detailed the steps that were taken and the considerations that were done for the construction of the model:

- Review of the literature to scout for existing models;
- Consistency with the literature review;
- Construction of the model;
    - Definition of every design element;
    - Definition of every building block.

5.2 Review of the literature to scout for existing models

From the review of the papers on innovation contests made in chapter 3.5.2.2 a paper from Bullinger and Moeslein was found in which they reviewed the current literature on innovation contests in 2010 (Bullinger, Moeslein, 2010). To provide a consistent review the authors developed a model that distinguishes all the design elements that constitute innovation contests. These were analyzed individually and for each one a set of different attributes was identified.

The results of their paper are shown in table 10.

Table 10 – Design Elements that constitute innovation contests (Bullinger, Moeslein, 2010)

Design Element	Attributes					
Media	Online		Mixed		Offline	
Organizer	Company	Public Organization		Non-Profit		Individual
Task / Topic specificity	Low		Defined		High	
Degree of elaboration	Idea	Sketch	Concept	Prototype	Solution	Evolving
Target group	Specified			Unspecified		
Participation as	Individual		Team		Both	
Contest period	Very short term		Short term	Long term		Very long term
Reward / Motivation	Monetary		Non-monetary		Mixed	
Community functionality	Given			Not given		
Evaluation	Jury Evaluation		Peer Review	Self-assessment		Mixed

In some parts, this model does not provide sufficiently precise measures, e.g. the degree of elaboration is both difficult to measure and can be subject to different interpretation. One could identify an output as a solution while another could see in it a sketch. This structure is the one that has been chosen for the implementation of the model.

5.3 Consistency with the literature review

The analysis done with the literature review and especially the study of the similarities and differences between Design Sprints, innovation contests and hackathons is valuable and could be of use in the creation of the model. As a matter of fact, the comparison of the events was structured in such a way to compare every event through a variable as the model from Bulllinger and Moeslein does. Each variable identified one element that every event had in common and performed differently. The variables that were used in that case can also be considered as a design element, indeed they represented a unique element of the event. This consideration allows for a greater consistency of this chapter as it represents the continuation of the study initiated during the literature review.

The definition of the model will then be done taking into consideration the study by Bullinger and Moeslein and the analysis done in the literature review. It is possible to use together these two approaches as they are indeed complementary: the model created for innovation contests (Bullinger, Moeslein, 2010) provides the structure while the comparison carried out in the literature review functions as the starting point for the definition of the design elements.

5.4 Construction of the model

The construction of the model has been structured, as previously stated, on the basis of the model developed by Bullinger and Moeslein (Bullinger, Moeslein, 2010). This is a good starting point and provides a solid structure - which is both validated by the literature and functional - to build the model. Still, it is simple and does not allow for a deep study of each component of the innovation contests. To address these shortcomings, it was decided to bring the analysis one level deeper and investigate all the building blocks that constitute each design element. In other words, the analysis does not stop at the first level dividing hackathons in design elements but goes deeper to the second level, not only dividing hackathons in design element but investigating the constituents of those, which have been called building blocks.

In the following the passages to get to the creation of the model are showed.

5.4.1 Definition of every design element

The design elements that have been identified and studied for innovation contests have been reviewed and reshaped to better function as a representation of hackathons.

With the goal of providing a complete description of the reasoning that led to the creation of the model, the variables that were used for comparing the events in the macro analysis are reported in the following:

- Objective
- Participation – open or close
- Structure of the event
- Roles inside the team
- Output

- Field of application
- Cooperation / Competition

Now, to provide a deeper analysis of the Hackathon, most variables have been divided into single design elements of the Hackathon. The results of this passage are shown in table 11.

Table 11 – Design Elements extracted from the variables

Variable	Design element
Objective	Problem
	Challenge
Participation – open or close	Call
	Attendees
Structure of the event	Phases
	Duration
	Mentors
	Team
	Award
Roles inside the team	Team
Output	Performances
Field of application	///
Cooperation / Competition	///

Table 11 is explained in the following, providing all the reasoning that brought to the definition of each design element. This is done by analyzing each variable one-by-one:

- From the variable "Objective" the design elements "Problem" and "Challenge" are extracted.

  The element "Problem" functions as a way to both identify the objective of the hackathon, but also the reason why the promoter chose to organize a hackathon: the problem. In fact, the objective is a consequence of the problem as normally every organization realize the problem before defining the objectives to reach in order to solve it.

The element "Challenge" investigates the ways that the promoter literally challenges teams to the solution of the problem. This is, of course, closely related to the problem.

- From the variable "Participation – open or close" the design elements "Call" and "Attendees" are extracted.

  The element "Call" investigates the mechanism that were involved in the definition of how participants were scouted. In other words, it studies the decision making of the promoter or the organizer that brought to the advertisement, promotion, scouting and selection of the participants.

  On the other hand, the element "Attendees" investigates to which extent the targets set during the call were met. Also, it studies the mechanisms that took place between the call for participants and the participants.

- From the variable "Structure of the event" the design elements "Phases", "Duration", "Mentors", "Team" and "Award" are extracted.

  The element "Phases" analyses whether if Hackathons truly follow the four phases that have been identified with the integrated definition of hackathon in 3.1. Also, it analyses the reasons behind an eventual shift from the typical four phases.

  The element "Duration" studies whether hackathons actually last between 8 and 48 hours – as stated in the integrated definition provided in 3.1 – or not. Also in this case, if the duration shifts from the one expected, an investigation on the causes and the effects of this shift is carried on.

  The element "Mentors" is used to understand if in the hackathon the presence of mentors is expected and the implication that this has on the performances of the hackathon.

  The element "Team" investigates when and how teams are formed.

  Finally, the element "Award" studies the typologies of award that hackathons use to motivate participants and how effective they are.

  From the variable "Roles inside the team" the design element "Team" was extracted.

- From the variable "Output" the design element "Performance" was extracted.

This element analyses how the event performed and the viability of the innovation awarded during the hackathon.

- Finally, from the variables "Field of application" and "Competition / Cooperation" no design elements are extracted.

  The reasons of this choice rely in the fact that these variables have been useful during the comparison of the events to find differences among them but they would not add any meaningful information to this study. As a matter of fact, if used for hackathons no difference would be found. Indeed, hackathons' field of application is always technology and every hackathon is based on competition.

  These variables would not add any other meaningful information to the model therefore they have been excluded from it.

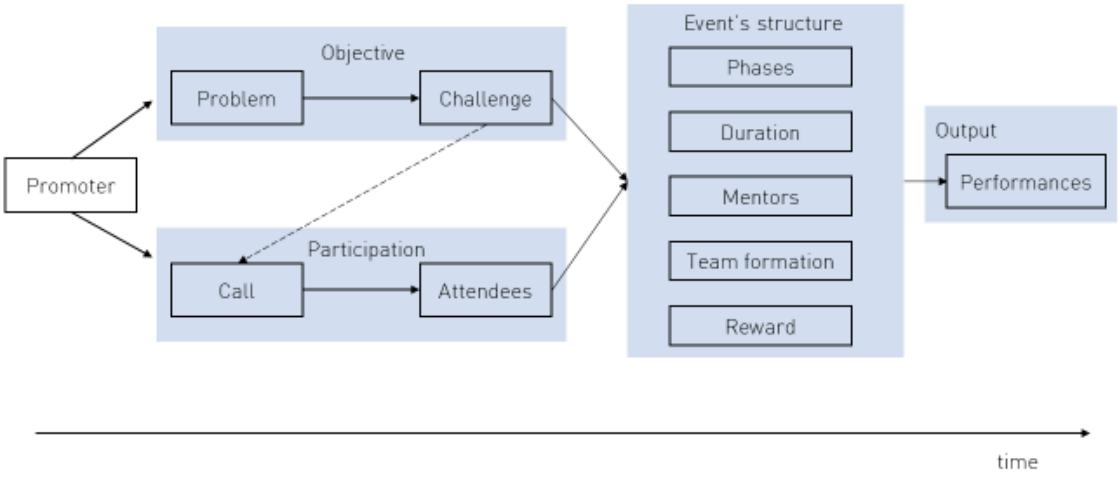
As it is true that two variables have been excluded from the model it is also possible that the model created for the comparison of the events did not consider some information that would be useful in this discussion. This consideration led to the review of the literature on hackathons in order to understand if a relevant theme was not being considered with the model built so far. This search resulted in one missing design element: the "Promoter".

The element "Promoter" analyses the nature of the promoter of the Hackathon. In particular it studies the industry where the promoter is playing and if it requested help for the organization of the Hackathon to some specialized event organizers and the relative advantages and disadvantages this choice brings.

5.4.2 Presentation of the design elements

In order to conclude on the definition of the design elements of the model, these are presented with image 2. This is a representation of every design elements and the variable from which it comes from. The design elements are placed in a timeline to define which elements refer to the pre-hackathon activities, which ones refer to the hackathon itself and the ones that refer to the post-hackathon activities.

Image 2 – Representation of the design elements and the variables each design element refers to



Promoter, Problem, Challenge, Call and Attendees refer to the pre-hackathon; Phases, Duration, Mentors, Team and Award refer to the hackathon itself; Performances refer to the post-hackathon.

5.4.3 Definition and presentation of every building block

To define the building blocks of each design element, a review of how the literature analyses each one has been carried out.

This was done with the objective of spotting building blocks from other literature streams that may also apply in the case of hackathons. For example, for the design element "Problem", it may be that the literature already deals with how an organization identifies, understands and thinks of ways to solve a problem. This may be similar to what happens in hackathons and may happen for each design element.

This is also useful as it could function as a way to fill the gaps that the literature has not yet analyzed. In fact, the particular way hackathons perform in one design element, could be a new discovery for the literature.

The review's objective is the one to identify the most precise set of building blocks and it follows the same structure for each design element:

- Review of the main theories and overview over the most cited papers that deal with that theme. In this passage, the most relevant authors are disclosed and their theories presented;

- Review of the papers that deal with hackathons and with how hackathons perform in the design element. Due to the limited literature on Hackathons, this passage does not take place for every design element;
- Definition of the gaps from the literature review;
- Definition of the building block/s of each design element and description.

This serves to verify the completeness of the data, not as a structure to follow. For the sake of readability, the literature review does not go through bullet points but a continuous discussion is made through all the points the structure highlights. Only the last point will be separated from the discussion as it represents the result of the discussion.

5.4.3.1 Promoter

This variable investigates what are the main characteristics of the promoters of innovation events in general and if hackathons are performed also by non-typical promoters.

The review of the literature shed light on the fact that typically events that deal with innovation are promoted by every kind of organization: private companies, non-profit organizations, and foundations (Bullinger, Moeslein, 2010), (Terwiesch, Xu, 2008).

The only commonality between promoters is the fact that they reached out to the public to ask for ideas. In fact, they play in the most various fields from Fashion, to Entertainment, to Food and Beverages, to Technology. Although the variety of fields, the majority of innovation events are held by companies from the tech field (Chesbrough, Crowther, 2006), also companies from other, less innovation-depended industries have started to run innovation events in the most various forms.

This relates to the trend hackathons are facing: the movement from an event closed to tech, to one that welcomes all sorts of backgrounds. As a matter of fact, many hackathons have been promoted from non-tech companies, federations and organizations such as Artusi, FIGC, and InVinoTech. Respectively, in these hackathons the promoter was looking for innovations for the kitchen, football in Italy and wine in France.

Also, as the literature was studied, it was discovered that most of the promoters are not actually the ones that organize the event (Chesbrough, Crowther, 2006), (Serravalli, Simeone, 2016) (Terwiesch, Xu, 2008). As a matter of fact, increasingly promoters – the organizations that launches the challenge and uses the results of the competition – ask for help in the organization of events. This is as true in hackathons, which are in need of specific requirements such as a big space, food, and technical support. The literature only sheds light on the fact that promoters makes use of other parties to organize hackathons and does not investigate the reason behind this fact nor the implication that the involvement of an organizer has on the performance. One fact to take into consideration is the one that non-tech promoters want to run a tech event even if they do not have the capabilities to do it. This can be identified as a gap from the literature that needs to be analyzed with the field research.

Finally, there is a need to investigate how the popularity of either the promoter or the organizer influence the performance of the hackathons.

To conclude the reasoning made for this design element, the chosen building blocks represent the main themes analyzed with the literature. These are:

- *Characteristics of the promoter:* this examines how the different characteristics of the promoters can influence the final results of the hackathons.
- *Organizer*: to take into consideration the role of the organizer in the whole preparation of the Hackathon. Also, this building block analyses the gap from the literature to understand benefits and drawbacks of involving an organizer in the organization of a hackathon

5.4.3.2 Problem

In order to understand the objective, first it is important to ask the right questions. This phase is the one that ends with the definition of the problem.

There is extensive literature on methods and approaches in Problem Solving. The following reveals the most relevant theories and approaches. Although most papers are not recent - the most recent one is from 2000 while the least is from 1991 - these papers are considered as still valid, even in the changing

environment. In fact, the approach the authors use can be remodeled to fit for every problem.

The matter is examined with a reasoning on knowledge management and how a well performed one can be itself a reason for better problem solving compared to competitors that do not do it (Leonard-Barton, 1995). In particular the discussion revolves around the theme of to what extent the Knowledge Management System of a firms should promote the development of core capabilities and to which extent promote the one of new capabilities. As a matter of fact, the author points out that core capabilities should be managed to foster critical knowledge, not to inhibit its flow. Core capabilities may be also rigidities when the competitive scheme changes or when brought to an extreme. The author argues that a firm should focus both on development of core capabilities and scouting for new ones to be updated on the changes of the market. For this objective four key activities are proposed: (1) shared problem solving across cognitive and functional barriers – the author argues that this approach allows for the achievement of new levels of creativity. (2) Implementation and integration of internally generated methodologies and processes. (3) Formal and informal experimentation – experiments, especially informal ones, protect the company from being too rigid. (4) Scout for technological knowledge outside the firm and absorb it – this may recall the concept of Open Innovation, especially the inbound methods of sourcing (non-pecuniary) and acquiring (pecuniary).

The paper shows four key activities that can be performed at all company levels and within all the functions. Also, no distinction is done to differentiate SMEs from big corporate. This distinction is made by two authors that analyze growth, innovation and problem solving in SMEs (Orser, Hogarth-Scott, Riding, 2000) and how problem solving is carried out in corporates that have offices spread in the territory (von Hippel, 1994).

Once understood how companies get to the definition of the objective it is necessary to understand what kind of objective they choose. The different objectives that Hackathons can pursue have already been discussed extensively in chapter 3.5.3.1. That discussion is considered valid for this part and is not reported also here.

To conclude, the building blocks chosen for this design element are:

- *Description of the problem:* this is the identification of a lack or the willingness to improve something;
- *Objective:* the four types of objectives are reported in this building block. Innovation, Recruitment, Community build, Pedagogy.

5.4.3.3 Challenge

The model created by Bullinger and Moeslein deals with the task in terms of its specificity. It provides three attributes: low (open task), defined and high (specific task). Also in the case of Hackathons it is possible to identify whether the challenge is open or specific. In their paper Bullinger and Moeslein describe the specificity of the task at a superficial level without going in depth with the analysis. A more in-depth study has been made by Newell (Newell, 1989) and Burger and Burger (Burger, Burger, 1994). Their study states that the more the task is close the more only people with high technical expertise are able to solve it. They do not provide a definition of open and close task.

The same considerations can be done for hackathons. In fact, the more the challenge is closed (highly technical, requires professional skills in a coding language, and so on) the more only few experts can solve the challenge. Vice versa, the more open the challenge is, the more people from various fields can join to solve it.

In hackathon, it is also usual that more than one challenge is promoted. There are cases where even eight challenges were given to the participants. The implications of these are not known and are addressed with the field research.

To conclude this section, the building blocks chosen for this design element are:

- *Number of challenges:* to measure whether if there is a difference in the organization of a hackathon and if this increases the performances of the hackathon;
- *Challenge specificity:* to measure how the difference in the specificity impacts the final results.

5.4.3.4 Call

This section reveals the reasons behind the interest of people to take part in innovation contests and hackathons in particular. Also, an overview over the levers that the promoter/organizer can manage to influence the participation is carried out.

First, an analysis over the factors that influence people to participate to hackathon is carried out. The literature analyses two forms of benefits: extrinsic (better jobs, career advancements, reward and so on) and intrinsic (enjoyment, how creative a person feels and so on). Findings show that extrinsic benefits are the main drivers of efforts, while intrinsic ones are the most pervasive driver to participation (Lakhani, Wolf 2003). Also, the possibility to learn something new and to socialize influence participants in taking part at hackathons (Karlsen, Sundnes Løvlie, 2017), (Nandi, Mandernach, 2016), (Lara, Lockwood, 2016), (Munro, 2015), (Briscoe, Mulligan, 2014). Finally, another reason for attendance is the possibility of solving a solution for the greater good, may this be a civic engagement for active citizens (Johnson, Robinson, 2014), (Irani, Vertesi, Dourish, Philip, Grinter, 2010), (Alba, Avalos, Guzman, Larios, 2016) or the solution of a health problem in LMICs (Walker, Ko, 2016), (Olson, Walsh, Garg, Steel, Mehta, Data, 2016). In other words, the main reason of attendance are the intrinsic motivations while the main drivers of effort are the extrinsic ones. As opposed to an extrinsic benefit, if people must pay to participate it is considered a deterrent.

Another theme that was already discussed in chapter 3.5.3.2 is the one on the background of the participants. In this section, the desired set of backgrounds are highlighted while in the next one the actual set and the differences between the desired and the actual set of background are analyzed.

To conclude, the building blocks chosen for this design element are:

- *Target number:* to measure how many participants the promoter/organizer intended to host at the hackathon;
- *Target background:* to understand what typologies of background the promoter/organizer initially wanted to host at the hackathon;
- *Cost of participation:* to understand if the payed participation functions as a deterrent;

The reward is not considered in this section as it represents a Design Element for itself and is explained in detail in the following.

5.4.3.5 Attendees

This section analyses the mechanism that connect the call to the participants that took part at the hackathon.

When reviewing the literature on tech events, the gender element is addressed by different papers, both academic and non. Decker et al. bring to light the fact that despite the fast growth of hackathons, it has been noted that females rarely take part to these events. Indeed, females usually represent 10% of the overall participants (Briscoe, Mulligan, 2014). Some theorize that the hackathon culture is intimidating, does not appeal to women or that it amplifies existing gender biases in computing (Decker, Eiselt, Voll, 2015). Although different attempts to reducing this gap have been carried out like the Pink Hackathon promoted by Microsoft, the TIM Girls Hackathon promoted by TIM (in Italy) and the Girl Hackathon (worldwide), no hackathon directly aimed at the involvement of women in technology has been observed due to the lack of these kind of hackathons during the period of observation, therefore the model will not analyze this element. It is to say that the presence of women in the hackathons that were observes floated around 10% or less.

To be consistent with the building blocks of the previous design element, also in this case the number of participants and the background of participants are analyzed.

Also, the participants' selection has been taken under consideration to see whether it affects the performances or not. In fact, usually the selection is made only to limit the number of participants due to limitation in space but it may be that a promoter/organizer screens the candidates on the basis of their skills.

Finally, in hackathons individuals form teams that compete with each other. The phase of team formation can take place before or during the hackathon (Leckart, 2012). If it happens before it is more likely that participants apply as a team while if it happens during the Hackathon it is likely that participants apply individually.

To conclude this section, the building blocks chosen are:

- *Number of participants:* to compare it to the target the promoter/organizer set in the previous section;
- *Participants' background:* also this is to compare with the target background from the previous section;
- *Selection:* to investigate the effects of a screening on candidates;
- *Application as…*: to see if the different ways that participants apply affect the final performances.

5.4.3.6 Phases:

In chapter 3.1, the integrated definition of hackathon was provided. The definition sheds light over the phases hackathons go through: team formation, creative problem solving, coding and preparation of the presentation. This design element is defined in order to validate the definition of hackathon. As a matter of fact, the last part of the creation of the integrated definition, the Validation, was left to the field analysis.

To conclude this design element has no building blocks as it directly analyses all the phases of the hackathon.

5.4.3.7 Duration

As for the previous design element, also this serves as a mean to validate the integrated definition of 3.1.

This design element measures the duration of every hackathon in hours.

5.4.3.8 Mentors availability

The literature considers the presence of mentors to be a key variable for good performances in innovation contests. As a matter of fact, mentors can be beneficial in different ways.

First, the presence of mentors can affect the participation (Leimeister, Huber, Bretschneider, Krcmar, 2009) as they can be the very reason why people attend a hackathon. For example, if a hackathon involves the use of a very innovative technology or an avant-garde software that participants do not know how to use, the presence of mentors is fundamental to teach participants how to use it.

Also, even if the hackathon does not involve the use of particular software and technology, the presence of mentors can be beneficial for participants as a different and informal way to learn (Nandi, Mandernach, 2016).

Moreover, mentors are not only beneficial to participants but also to the output of the hackathon. Indeed, there are hackathons that provide also business mentorship to teams that have to rethink the business model of the promoter or to add some parts to it.

Finally, there are also mentors that provide guidelines for the software prototype and help in the making of the presentation.

Mentors vary greatly both in their background - tech experts, business experts, designers – and in their purpose – teaching participants, providing guidelines, supporting the decision making of the teams.

To conclude this section, the chosen building blocks are:

- *Mentors availability:* to examine whether there are mentors at the hackathon or not;
- *Mentors' background:* to understand what kind of mentors were present in the hackathon

5.4.3.9 Team formation

This section analyses the mechanism that bring participants from a group of individuals to a group of teams.

The first thing to analyze is the team size. The literature says that teams are effective when they have the sufficient number of people inside it, but no greater than sufficient (Guzzo, 1988), (Guzzo, Shea, 1992), (Hackman, 1990). As a matter of fact, larger team size is associated with poor team process. Smaller teams have clearer objectives, higher level of participation, higher emphasis on quality and higher support for innovation than larger teams (Curral, Forrester, Dawson, West, 2001).

Another aspect to take into consideration is how teams are formed. There are different ways to form a team in hackathon-like events that it is quite difficult to summarize them all. The most generalist classification retrieved from the literature categorizes teams depending on who decides on their formation: it

could be the organizer to decide, the decision could be left to the participants, or it could be both, where participants select independently their team and the organizer places the ones that do not have found a team.

Finally, in 3.1 it was already discussed how authors are divided into who believes that hackathons should be event only open to coders and computer experts and those who think that hackathons actually can be a ground for making people from different backgrounds meet. There are hackathons where there are participants from every field but they divide in teams accordingly to their background e.g. all tech experts form a team, all business form theirs and so on. In some cases, promoter and organizers decide to make mixed teams compulsory. This variable is investigated to see if this factor influences the performances.

To conclude this section, the chosen building blocks are:

- *Number of participants in the team:* to measure how large teams are;
- *Who defines the team:* to investigate whether the change in this variable affects the performances;
- *Rules on the participants' background:* to examine if this affects performances.

5.4.3.10 Reward

Rewards of any types are used in every contest, not only in the ones for innovation. The literature analyses the differences among the most popular types of prizes and provides benefits and drawbacks of these.

A first analysis is made reasoning over the best way to pay for an innovation. The most popular contests mechanisms are the fixed-prize tournaments and the first-price auctions. In tournaments, the best innovator among the competitors receives a prize that was ex-ante defined by the promoter of the contest. In first price auctions, the promoter procures the innovation that best matches both the price and the innovation quality level. In other words, the promoter procures the most favorable combination of price and quality. The paper from Schoettner (Schoettner, 2008) shows that the best way to run a contest is the fixed-prize tournaments as they can dominate the first-price auctions.

A further analysis of fixed-prize tournaments can be made analyzing two ways of designing the prize for a tournament: a standard winner-take-all with a single fixed prize and a novel-proportional-payment for which the same prize is divided according to the share of total achievement. In other words, the proportional prize is a way to reward the participants proportionally on the basis of how much their solution adds value. Also, it is a way to reward more than one team as it is possible that many teams produce good ideas (Cason, Master, Sheremeta, 2010) (Masters, Delbecq, 2008). In this case the findings from the research of Cason et al. show that proportional prize contests perform better compared to winner-take-all approaches.

Although these considerations are relevant most hackathons still use the winner-take-all approach as it would be both difficult to evaluate different ideas with the same parameters and would expose the jury to potential complaints.

The benefits of the reward systems have already been discussed in section 4.1.4.4 of this chapter as an extrinsic motivator. The benefits in the reward systems do not stop at making more people come to the event. As a matter of fact, rewards can also serve to accelerate innovation (Masters, Delbecq, 2008) and provide solution that add value, especially in LMICs.

On the other hand, rewards can also have a negative side. Different papers reason on the fact that in case no solution actually deserves a reward, it still gets it, especially in fixed-prize contests (Girotra, Terwiesch, Ulrich, 2010), (Gottfried, 2014), (Sastry, Penn, 2015). Still, the authors of the same papers that criticize the reward system in hackathons argue that nowadays running a hackathon without the promise of a reward is not a good idea. They advise either to run an alternative event or to promise non-monetary rewards. In fact, rewards that are purely cash attract more people that just want the prize (extrinsic motivator) and not the people that want to build a solution because they are really interested in doing so (intrinsic motivator).

To conclude this section, this design element will have no building blocks and analyze the type of reward that is promised. In fact, every hackathon has the same winner-take-all approach but differ in the type of reward promised.

5.4.3.11 Performance

The performance that were chosen to be measured reflect the overall performance of the hackathon. These are representative of the objectives that the literature identifies as the objectives of the hackathons – these were discussed in 3.5.3.1.

Also, a performance that was measured is the percentage of the participants over the target initially identified.

To conclude this section all the performances are presented:

- *Participation (participants/target) %*: this performance measures if the hackathon achieved the target of participants or not. Percentages lower that 100% mean that the objective was not achieved while all the percentages above that, achieved or exceeded the target;
- *Output usefulness*: this measure whether if the promoter used the output of the hackathon. The decision to consider the usefulness of the output and not whether if the output was implemented by the promoter after the hackathon or not, is fruit of two considerations: first not all hackathons are organized with the objective of using the output and, secondly, most hackathons' outputs only provide the concept and a functioning prototype to show the jury how the solution should work. Seldom the solution provided is readily implementable. It often goes through a revision from the company.

  This performance measures if the hackathon generated an innovation;
- *Recruitment:* this performance measures the stages of the recruitment for those promoters that used the hackathon as a recruiting event. It is divided in interview and job offer, to examine if the hackathon really served as a recruiting platform;
- *Community build:* this last performance investigates the functionality of the hackathon as a community builder. Indeed, hackathons are a fertile ground for the creation of a community but not every promoter is able to create one;

There is no performance that measures the educational purpose of the hackathon as no hackathon that was observed had the direct objective of teaching a new skill to its participants.

To conclude the chapter on the construction of the model, a table has been created to show all the design elements and the building blocks in one page (table 12). With this view of the model it is possible to appreciate how it takes into consideration all the passages the thesis has made so far. As a matter of fact it shows the variables that were used to compare the events in chapter 3.5, it shows the design elements which have been studied with the literature review on innovation contests - carried out in 3.5.2.2. Finally, it shows the building blocks and the attributes that were discussed in this chapter. It is important to remind that the discussions over the literature made in this chapter are nothing but an enrichment to the discussion that was carried out during the literature review. As a matter of fact, all the papers that have been cited in this chapter are present also in the chapter of the literature review chapter 3.

Table 12 – Representation of the model with the building blocks and their relative attributes

Variable	Design Element	Building Block	Attribute					
//	**Promoter**	Industry	Tech	Non-tech				
		Does it involve a community?	Yes	No				
		Popularity	Low	High				
	Organizer	Does it involve a community?	Yes	No				
		Popularity	Low	High				
Objective	**Problem**	Description						
		Objective	Innovation	Recruitment	Community build	Pedagogy		
	Challenge	Number	1	2	3	4	More than 4	
		Challenge specificity	Low (open challenge)	High (specific challenge)				
Participation	**Call**	Target number						
		Target background	Only tech experts	Open to every background				
		Cost of participation	Free	Paid				
	Attendees	Number of participants						
		Participants' background	Only tech experts	Participants from every background				
		Selection	Yes	No				
		Application as...	Team	Individual	Both			
Structure	Phases		Team formation	Creative problem solving	Coding	Preparation of the presentation		
	Duration							
	Mentors		Only tech experts	Mentors from every field	Not available			
	Team formation	Number of participants in the team						
		Who defines the teams	Organizer	Participants	Both			
		Rules on the participant's background	No rules	Only teams with mixed backgrounds				
	Reward		Cash	Coupon	In kind rewards	Recruitment	Project development	Visibility
Output	**Performance**	Participation (Participants/target)=%						
		Output usefulness	Yes	No				
		Recruitment	Interview	Job offer				
		Community build	Yes	No				

6 Field research: research methodology, case analysis and application of the model to every case study

This chapter reveals the field research carried out in seven months – from mid-April to early November 2017 - on eight hackathons. Each hackathon has been analyzed through ethnographic research to grasp the mechanism in action within teams, interviews both to the promoter and to some participants, and a survey to the participants.

6.1 Research methodology

To answer the research question, a multiple case study (Yin, 2014) of eight hackathons was conducted. In Italy, nearly 20 hackathons are carried out each year. This number is increasing year by year but is still far from the ones of some tech poles such as Silicon Valley and London where it is estimated that 200 hackathons are run every year. Typically, hackathons are not organized in August and September, respectively because in the former case, most people in on vacation and would not attend the hackathon and, in the latter, it would not be possible to make a proper advertisement of the event in less than one month. This consideration left five months to research the best sample of analysis. The following presents the reasoning that brought to the selection of the hackathons that were observed. These reasonings are made on the basis of the ones made by Trainer et al. in their paper (Trainer, Kalyanasundaram, Chaihirunkarn, Herbsleb, 2016).

First, there was not the possibility to observe a hackathon with an educational purpose. Although this kind of hackathons have already been organized in Italy, like the Pink hackathons and the TIM Girls hackathon, no hackathon with the educational intent was organized during the period of analysis.

A set of building blocks was identified as the most important discriminant factors on which to differentiate hackathons. These are:

- If the promoter involved a third-party organizer;
- If the hackathon was only open to participants with a tech background or not;

- What type of reward the hackathon promised: in particular the differentiation in this case was made on monetary/non-monetary.

The hackathons that did not involve a third-party organizer and were only open to participants with a tech background were found in the Vipera Hackathon (VH) and in the Hackathon Var Group (HVG). These two hackathons did not promise a monetary reward as the former promised a recruitment opportunity to the most promising participants and the latter a six months project to develop the work started at the hackathon.

All the other hackathons that were observed were organized by third party organizations and differed both in the background of the participants and in the type of reward. These were the Fintech Design Marathon (FDM), Moving Forward Hackathon (MFH), Allianz Now Hackathon (ANH), 2nd Transport Hackathon (2TH), the hack.developers (HD) and the TIM Open Hackathon (TOH).

Some particular notes have to be made for the reason behind the selection of the hack.developers. The main reason behind this choice was the fact that it was organized by the Team Per La Trasformazione Digitale which is particularly on the spotlight since it is guided by Diego Piacentini, Amazon's Vice President who took a two-year period off the company to build the Italian digital infrastructure. This was likely the hackathon with more participants that was ever run in Italy, with 25 cities running simultaneously the hackathon divided in direct – cities where the developers met in a physical place – and indirect – where developers could connect on the internet – places.

6.2 Data collection and application of the model to every case study

The data collected were of different nature ranging from event documentation, to interviews with promoters, organizers and participants, and surveys that were submitted to participants. In addition, each hackathon was studied with an ethnographic approach observing how teams and participants behaved throughout the hackathon.

The overall data collected consists of 236 hours of on-site ethnographic observation (8 for VH, 32 for HVG, FDM, MFH, ANH, HD, and TOH, and 48 for 2TH), a collective database of 150 answers from the participants of every hackathon and

8 interviews with promoters and organizers. These were made to understand their expectations of the hackathon and to have a comment of the results. Finally, at every hackathon photographs of the event space, work area and break area were captured.

The continuation of the chapter provides an accurate description of each hackathon and the application of the model to each one. These are presented in chronological order.

Table 13 – Description of the sample

Name of the hackathon	Description
Vipera Hackathon	Vipera organized the hackathon without any help from a third-party organizer, opened the participation only to tech experts and offered a non-monetary reward
Var Group Hackathon	Var Group organized the third edition of their own hackathon on their own, opened the participation to tech experts and offered a non-monetary reward
Fintech Design Marathon	Regione Lombardia asked Polihub to help with the organization of the hackathon. The participation was open to everybody and it was offered a monetary reward
Moving Forward Hackathon	Trenitalia asked Codemotion to help with the event's organization. The participation was open to everybody and it was offered a monetary reward
Allianz Now Hackathon	Allianz partnered with Deloitte that helped with the organization of the event. The participation was open even though there was a selection of the participants. A monetary reward was offered
2nd Transport Hackathon	ART organized the hackathon with Treatabit that helped with the logistics of the hackathon. The participation was open to everybody and it were offered non-monetary rewards

hack.developers	The Team Digitale asked Codemotion to help with the organization of the event. The participation was close to tech experts and non-monetary rewards were offered
Tim Open Hackathon	Tim partnered with Tree to organize the event. The participation was open to every background and offered monetary rewards.

6.2.1 Vipera Hackathon

Vipera is a company that plays in the mobile financial services and provides customer engagement and digital consulting services. Vipera is present in 6 countries – United Kingdom, Germany, Switzerland, Italy, Spain and United Arab Emirates, with its headquarter in Milan. Since its services are related with mobile development, Vipera was categorized as a tech company. Also, one objective that was clearly stated in the presentation of the hackathon was the creation of a community, therefore it was assumed they did not refer to any community to advertise the hackathon to. Although Vipera plays in different countries, it is very poorly known. It has no social network page and no one of the participants of the hackathon knew Vipera before hearing about the hackathon. In addition, all the participants went at the hackathon because they were interested either in the hackathon phenomenon and wanted to get to know it or in testing their abilities on the field so they all searched for events like hackathons on line and found this one. The fact that all the participants actively searched for the hackathon shows that no consistent promotion of the event was made. These factors brought to the decision to classify Vipera as a low popular company.

Vipera's objective was the one to run a small hackathon at its headquarter in Milan. The event was open to 15 people and the organizers saw no reason to involve a third-party organization to organize such a small event.

Vipera decided to run a hackathon with the intent of recruiting people interested in mobile services for banking and of creating a community. As a matter of fact, their hackathon was called "Vipera Hackathon: hacking the digital payment". The

challenge proposed was to create an app for managing the pocket money of a family. The challenge was considered highly specific as only programmers could solve it and the contribution of other figures would only add value in the problem solving and in the final phase. However, the challenge was so specific that there was only one way to solve it and no creative problem solving was applied to the creation of a solution. Specifically, the app had to be able to add as many kids as the user wanted, recharge them with the weekly pocket money and check their expenses.

The high specificity of the challenge called for very technical participants but of the ones that went to the hackathon – 9 in total – only four knew how to develop an app or to write code in general. This is odd as the event was free and this problem could be the result of the poor promotion of the event as well as the low popularity of the promoter. Also, even if there has been one call from Vipera to every participant before the hackathon, no proper selection process was made. On one hand, this could have brought to the selection of only those participants that actually knew how to write code but on the other, a screening process based on coding skills would have limited the number of participation to a higher extent. In fact, to participate, people would just visit the website of the hackathon (http://www.vipera.com/hackathon/) and apply through there. Most information about the event can be verified at the website.

Image 3 – Meeting room where the Vipera Hackathon was held

During the hackathon, which lasted 8 hours, participants were greeted in a conference room (image 3), with breakfast on the table. In the first part of the hackathon, Vipera's CEO presented the company and the hackathon's challenge was presented. Right after the presentation the participants presented themselves in order to build the best team possible. This resulted in the creation of two teams, one of 5 and the other of 4. No rules were imposed by the promoter and it left the participants manage the team formation by

Image 4 – Buffet from Vipera

themselves. One team resulted in having one coder, the other had two. After the formation of the teams the coders started to code. After a quick stop for lunchbreak offered by Vipera (image 4), the coders continued to code until the end of the hackathon, when the solution was presented. Throughout the whole duration of the hackathon, among the participants there were also employees from Vipera who were expert developers. They provided help to the coder when they needed it and guided them towards the solution.

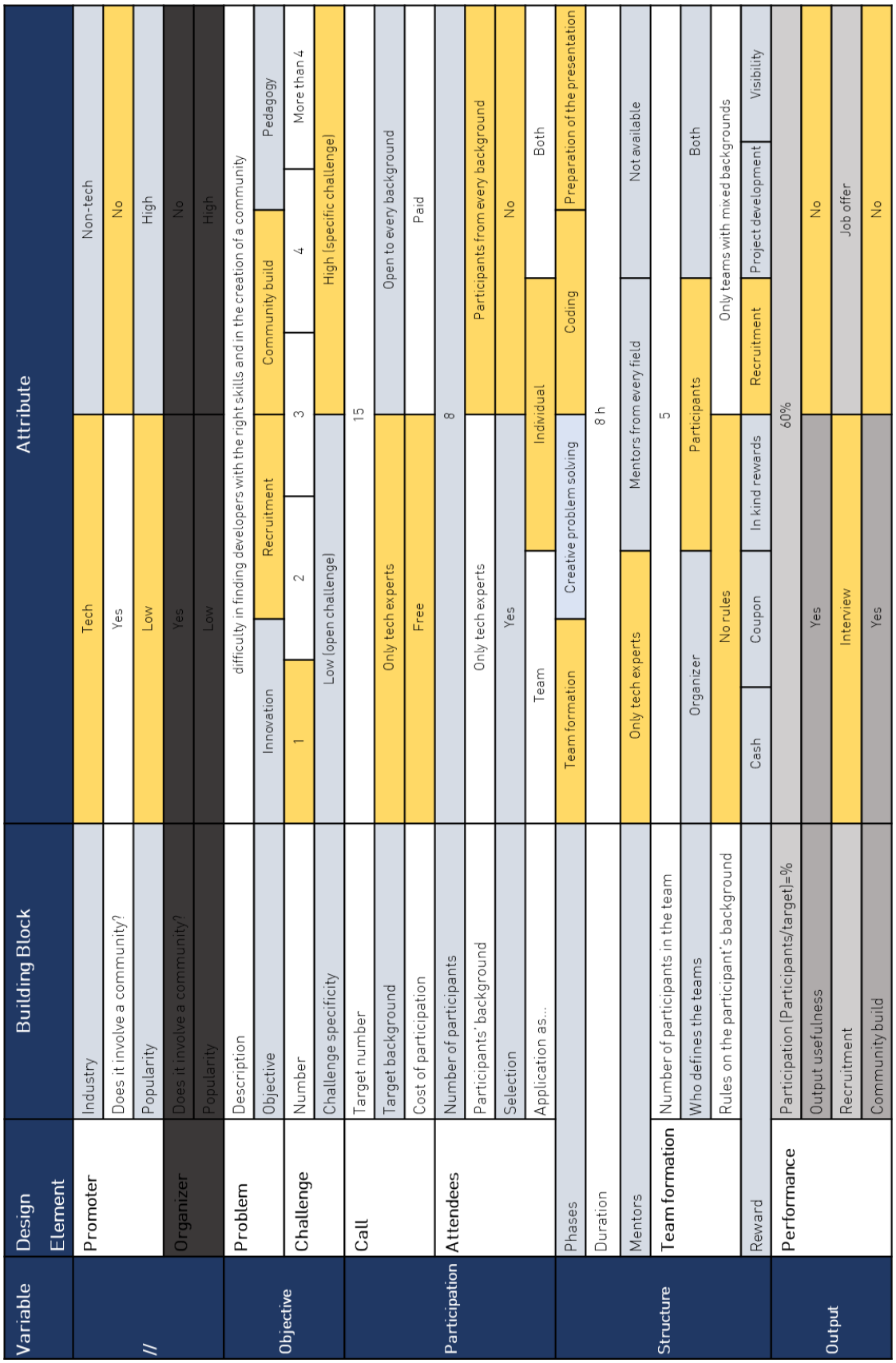
Although the solution from one team was working, the output cannot be considered to be useful to the promoter. As a matter of fact, Vipera could not use an app developed in 8 hours and the challenge was more a way to test the capabilities of the participants than the call for innovative ideas. The main objective of the challenge was to understand if there were people that were able to code a solution in few hours.

During the hackathon, some Vipera employees carried out informal interviews with the participants in order to assess their interest in Vipera and their abilities. A post-hackathon brief interview revealed that no interview resulted in a job offer though.

Finally, although the seeds for the creation of a community were sown the objective of the community building was not considered achieved as with the presence of 9 people it is not possible to consider it a community event.

The description of the hackathon carried out an overview over the design elements and the building blocks of the model built. It's application to this hackathon is show in table 14.

Table 14 – Application of the model to Vipera Hackathon



Variable	Design Element	Building Block	Attribute					
//	Promoter	Industry	Tech					Non-tech
		Does it involve a community?	Yes					No
		Popularity	Low					High
	Organizer	Does it involve a community?	Yes					No
		Popularity	Low					High
Objective	Problem	Description	difficulty in finding developers with the right skills and in the creation of a community					
		Objective	Innovation		Recruitment		Community build	Pedagogy
	Challenge	Number	1	2	3	4		More than 4
		Challenge specificity	Low (open challenge)				High (specific challenge)	
Participation	Call	Target number	15					
		Target background	Only tech experts				Open to every background	
		Cost of participation	Free				Paid	
	Attendees	Number of participants	8					
		Participants' background	Only tech experts				Participants from every background	
		Selection	Yes				No	
		Application as...	Team		Individual			Both
Structure	Phases		Team formation		Creative problem solving		Coding	Preparation of the presentation
	Duration		8 h					
	Mentors		Only tech experts		Mentors from every field			Not available
	Team formation	Number of participants in the team	5					
		Who defines the teams	Organizer		Participants			Both
		Rules on the participant's background	No rules				Only teams with mixed backgrounds	
	Reward		Cash	Coupon	In kind rewards		Recruitment	Project development
Output	Performance	Participation [Participants/target]=%	60%					Visibility
		Output usefulness	Yes					No
		Recruitment	Interview					Job offer
		Community build	Yes					No

6.2.2 Hackathon Var Group

Var Group is a company that plays in the Italian sector with more than 30 offices around Italy. Their offering ranges from Business Technology Solutions, to Managed Services, to Digital Transformation, to ERP, to Financial solutions. Due to its deep relation with technological services, it was categorized as a tech company. Var Group promoted the hackathon, which is at its third edition, for the occasion of their annual conference held in Riccione in mid-May.

Its breadth of offices all over Italy has allowed Var Group to spread the voice of the hackathon. Indeed, one objective of the event was the creation of the community and use it as an occasion for community building. Still, although its nationwide coverage, Var Group cannot be considered a popular company. As a matter of fact, its social network page has less than 1500 followers and few participants knew Var Group before joining the hackathon.

Since this was the third edition of the hackathon, and the places for the hackathon were limited to 25, Var Group decided to organize the hackathon on its own without the involvement of a third-party organizer. It appears that Var Group made extensive advertising as, even those who did not know the company encountered the advertisements on their Facebook feed as a sponsored announce.

The reason why Var Group decided to launch the hackathon are diverse. Francesco Falaschi, a Var Group employee that organized the hackathon, said "to surf the wave of cognitive computing and data analysis, it is needed on one hand to collect the needs and the information from clients and on the other to find personalities and talents that know how to approach this theme. To do this it is necessary to be able to find the right mindset and hackathons are great proving grounds to find talented young professionals that have the right skillset and mindset". As a matter of facts, the challenges proposed to the participants were directly proposed by Var Groups clients: Boggi, Itt and Alberta Ferretti. The common ground between the challenges was the fact that all the clients had a multitude of data they did not know how to use. At the beginning of the hackathon all the teams already knew what challenge they had to face. Two teams faced the Boggi challenge, two teams the Itt one and one team the Alberta Ferretti one.

These were highly specific challenges. As a matter of fact, cognitive computing and big data analysis are complicated subject also for the experts of the field. They require good programming knowledge in different programming languages. In addition, Var Group partnered with IBM to provide the use of IBM Bluemix and IBM Watson, two software that represent the cutting edge of cognitive analysis. To be able to use those software it is necessary a good programming knowledge.

The hackathon was open to 25 people that could only apply as a team of five, for five teams in total. Var Group targeted only participants with a technological background. However, one team was composed of four Management Engineers with no programming skill and only one developer. The other teams were only composed of developers. One great incentive for participation, beside the free application was the paid hotel room for two nights. All this information can be verified at the dedicated website http://www.vargroup.it/hackathon/.

Image 5 – Hotel conference room where the Var Group Hackathon was held

The hackathon lasted 32 hours during which some teams went to sleep in their bedrooms while some other stood the whole night working. The room was large and each team had one big table they could work on (image 5). Each team passed through three of the four phases as the first one – team formation – was already taken care of, by making participants apply as a team. Mostly they coded and used the initial and final hours for the solution of the problem and the preparation of the presentation respectively.

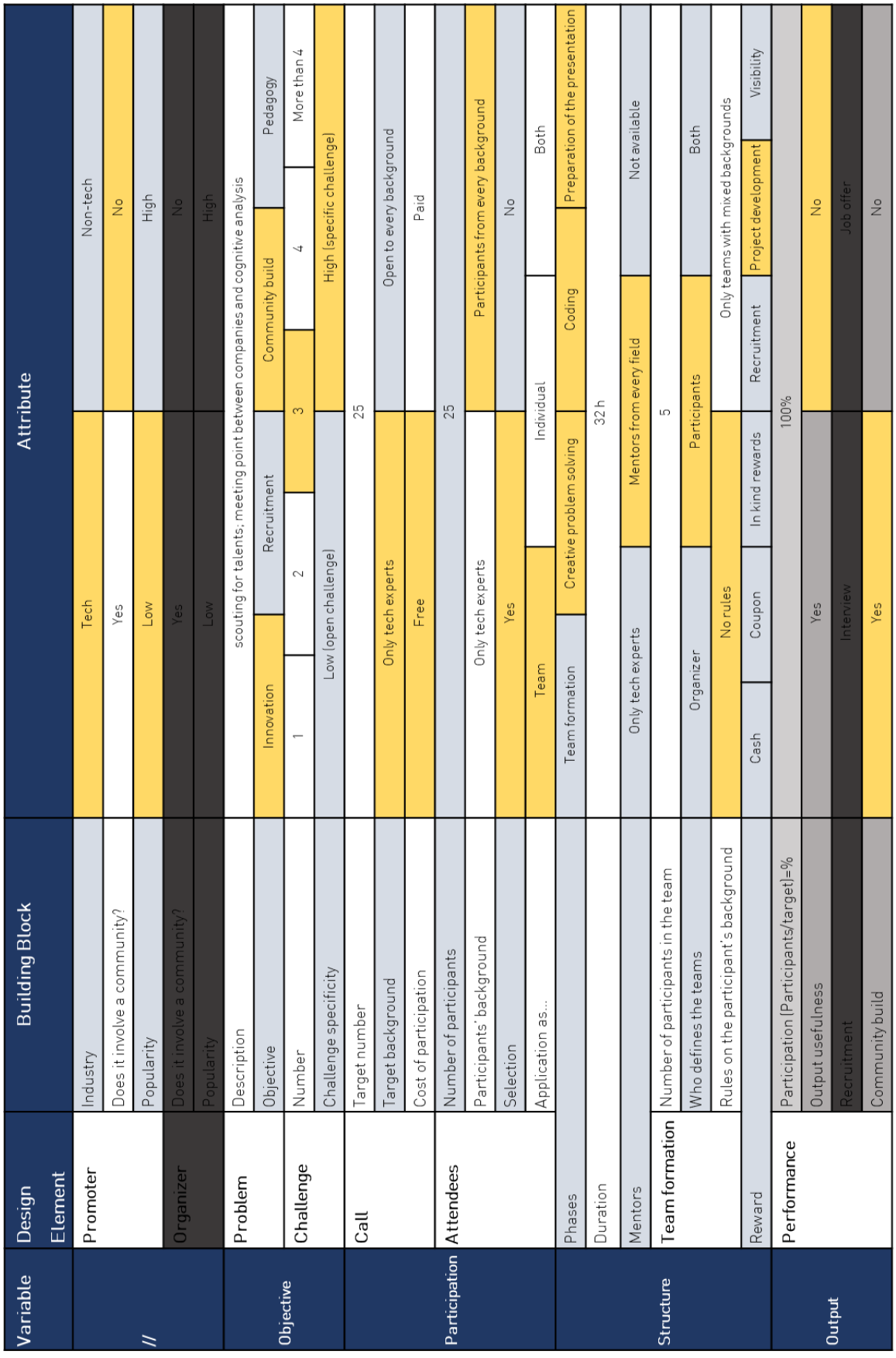
The presence of mentors was consistent throughout the whole duration of the hackathon. There were both technical mentors from IBM to help with the implementation of the code of Bluemix and Watson and employees from Boggi, Itt and Alberta Ferretti to guide the teams in the creation of the solution. Whereas the former helped with the technical side of the solution, the latter provided mentorship on the business side.

VarGroup promised 5000 € to the winner in the form of a collaboration contract to keep developing the prototype initiated. Although this is a very attractive reward, the fact that it is linked to the development of the project was a problem as the team that won started the project without finishing it. Other obligations required the effort of the participants of the winning team and it stopped.

The performances of the hackathon were positive from the point of view of the participation (100% of the target reached even with the selection) and the community build. As a matter of facts, this served not only to increase the awareness of Var Group with young professionals, but also it functioned as an engaging experience for the teams. Finally, the fact that the development of the project stopped was considered as if the output implemented during the hackathon was not useful.

As of before, the application of the model is showed below, in table 15.

Table 15 – Application of the model to Var Group Hackathon



Variable	Design Element	Building Block	Attribute				
//	Promoter	Industry	Tech				Non-tech
		Does it involve a community?	Yes				No
		Popularity	Low				High
	Organizer	Does it involve a community?	Yes				No
		Popularity	Low				High
Objective	Problem	Description	scouting for talents; meeting point between companies and cognitive analysis				
		Objective	Innovation		Recruitment		Community build	Pedagogy
	Challenge	Number	1	2	3	4	More than 4
		Challenge specificity	Low (open challenge)			High (specific challenge)	
Participation	Call	Target number	25				
		Target background	Only tech experts			Open to every background	
		Cost of participation	Free			Paid	
	Attendees	Number of participants	25				
		Participants' background	Only tech experts			Participants from every background	
		Selection	Yes			No	
		Application as...	Team		Individual		Both
Structure	Phases	Team formation	Creative problem solving			Coding	Preparation of the presentation
	Duration		32 h				
	Mentors		Only tech experts			Mentors from every field	Not available
	Team formation	Number of participants in the team	5				
		Who defines the teams	Organizer			Participants	Both
		Rules on the participant's background	No rules			Only teams with mixed backgrounds	
	Reward		Cash	Coupon	In kind rewards	Recruitment	Project development	Visibility
Output	Performance	Participation (Participants/target)=%	100%				
		Output usefulness	Yes				No
		Recruitment	Interview				Job offer
		Community build	Yes				No

6.2.3 Fintech Design Marathon

This hackathon was promoted by the Regione Lombardia with the objective of fostering the fintech environment in Lombardia. The hackathon was part of the Start Cup Lombardia, a challenge that started in April and ended in September 2017. The Fintech Design Marathon was an occasion to reunite the participants to the challenge and create a community of passionate fans of the fintech world. The Regione Lombardia is very active on the territory but its support on innovative start-ups has been lacking in the recent years. To face this problem, it decided to tackle the fintech business which is one of the most promising and innovative fields of the present days. However, although its awareness, it recently approached the fintech field and, before the hackathon it did not have a community. As a matter of fact, the hackathon was an occasion to create it.

Regione Lombardia saw in Polihub the perfect partner to organize such an event. Polihub is the innovation district and startup accelerator of the Politecnico di Milano. It had already organized other hackathons before and interacts with a community of startups and people interested in innovation all the time.

Image 6 –Conference room where the Fintech Design Marathon was held

The hackathon was hosted at Palazzo della Regione, in a very large room (mage 6) and lasted 24 hours. Participants could apply for free, both as a team and as individuals and all the backgrounds were welcome. This resulted in having a mix of backgrounds that ranged from tech experts to graduates in economics, to anthropologists, to entrepreneurs. No rules were imposed for the creation of the teams and, in the first part of the hackathon, right before the presentation of the challenges, the participants autonomously divided into teams.

There were four challenges:

- Education: how to innovatively improve the education on the themes of alternative finance;
- Follow the crowd: how innovative methods of crowdsourcing can impact the territory and the SMEs playing in it in the ways they access to credits;
- Alternative Finance in the Public Administration: how to solve the major problems in the PA in terms of security, timing, resources, automation, fund provision. How can alternative finance innovate Regione Lombardia's processes?
- No cash: build the future of digital payment. How to create services that help people to avoid cash transaction.

These all were considered non-specific challenges as no technical skill was needed beside a little knowledge on fintech. Moreover, the output required only the concept and, if available, a mock-up of the solution. Every challenge would have one winner whose reward would have been a 1000 € cash for the team. In addition, the two most promising ideas would get the chance of competing in the Start Cup Lombardia for an additional prize of 6000 €.

The large space, the popularity of both the promoter and the organizer, and the fact that each challenge was connected to a reward suggested that a big crowd of participants was expected. Contrary to what expected, only 15 participants showed up which formed 5 teams of three participants each.

Also, no mentor was present during the hackathon. There were people from Polihub that passed from one team to the other asking to explain them the solution each team thought of, but these cannot be considered mentors. As a matter of fact, mentors guide the teams to the solution and provide technical support but no such figure was present during the hackathon.

In addition, the few number of teams competing made it impossible to establish a competition between the teams. All challenges but one had one contestant only, which was mathematically the winner for that challenge. Eventually the jury decided to reward every team adding 1000 € to the available grand prize of 4000 €.

In conclusion, the hackathon promoted by Regione Lombardia performed badly in every dimension. The most critical performance was the one of the participation.

The fact that only 15 people participated made the jury spend 1000€ more for an event that already did not perform well. It was estimated a 50% of participant/target but the target could have been considered much higher. In fact, if the target was set to 60 people – which would have fitted in the room – the performance would have been 25%. Also, due to the low participation, it is not possible to consider this an event where a community was created.

The reasons of the low participation may be various and depend of a variety of factors, the first of which could be that the event was run in mid-July, when people start to leave for vacation.

About the performance of the usefulness of the output it was considered not useful. The main reason of this is the fact that no competition was created and all the ideas were rewarded. This problem has been identified by Girotra et al. where they explained that contests should adopt a proportional reward on the basis of the quality of the idea (Girotra, Terwiesch, Ulrich, 2010). In this case this is brought to the extreme, not only using a winner-take-all approach but also rewarding every team, meaning they are all winner. Arguments could be made that the most promising teams actually got the possibility to compete in the Start Cup Lombardia but this was considered just an optional.

All the consideration made for this hackathon have been summarized in the table below, where the model was applied (table 16).

Table 16 – Application of the model to Fintech Design Marathon

Variable	Design Element	Building Block	Attribute					
//	Promoter	Industry	Tech					Non-tech
		Does it involve a community?	Yes					No
		Popularity	Low					High
	Organizer	Does it involve a community?	Yes					No
		Popularity	Low					High
Objective	Problem	Description	lack of promotion of fintech from the Regione; lack of support to new concepts or new business model					
		Objective	Innovation		Recruitment		Community build	Pedagogy
	Challenge	Number	1	2	3	4		More than 4
		Challenge specificity	Low (open challenge)					High (specific challenge)
Participation	Call	Target number	30					
		Target background	Only tech experts					Open to every background
		Cost of participation	Free					Paid
	Attendees	Number of participants	15					
		Participants' background	Only tech experts					Participants from every background
		Selection	Yes					No
		Application as...	Team		Individual			Both
Structure	Phases	Team formation	Creative problem solving				Coding	Preparation of the presentation
	Duration		24 h					
	Mentors		Only tech experts		Mentors from every field			Not available
	Team formation	Number of participants in the team	3					
		Who defines the teams	Organizer		Participants			Both
		Rules on the participant's background	No rules					Only teams with mixed backgrounds
	Reward		Cash	Coupon	In kind rewards		Recruitment	Project development	Visibility
Output	Performance	Participation (Participants/target)=%	50%					
		Output usefulness	Yes					No
		Recruitment	Interview					Job offer
		Community build	Yes					No

6.2.4 Moving Forward Hackathon

This hackathon was promoted by Trenitalia, the biggest player in the train industry in Italy. Trenitalia runs most of the regional trains all over Italy as well as the high-speed trains. In the high-speed field is in direct competition with Italo, a recently created company.

Trenitalia is constantly attempting to be at the forefront of customer care and safety at work. The hackathon was an occasion to collect new ideas and inputs to then propose to its customers and utilize for its own sake.

The industry in which Trenitalia plays is not a tech one and it partnered with Codemotion to organize the hackathon. This is a company that provides different kind of services which all revolve around technology: conferences, trainings, approaching kids to technology, game development, startup services and hackathons. Codemotion is the reference point of a broad community of tech-savvy and non. Indeed, it continuously finds new ways to engage with the community organizing conferences, hackathons and all sort of technology related event. From the interview with Carlotta Cattaneo, the Chief Operating Officer at Codemotion, it was learnt that communities are the main source of participants. As a matter of fact, when asked to estimate from which source participants came she answered: "the channels we used for advertising were three: traditional (an article was written in the magazine on board each Frecciarossa), online marketing (Google and Facebook paid advertising), and communities (sending a message to each community). If I had to try to estimate the source I would say that 20% came through the traditional advertising, 20% from the online marketing and the remaining 60% from the communities."

The hackathon's aim was to find new ideas or concepts to utilize in the business. The hackathon was one step towards the achievement of the industrial plan of the holding, Gruppo FS. The first challenge was divided into four sub categories:

- Integrated ticketing;
- Check in and check out on board;
- Purchase of ancillary products;
- Mechanism for the automated interaction and vocal assistance.

The second challenge was in turn focused on the development of innovative tools for protecting the employees' health on the working stations.

The challenges were open ended as they required only the presentation of the concept and, if available, also a functioning prototype. Still the prototype had to work only for the presentation.

The hackathon was open to every background with programmers, web developers, designers, UX specialists, startuppers and makers particularly targeted. It was hosted in Luiss Enlabs office, in a large conference room that welcomed more than 100 participants from every field. The participation was free and there was no screening of the participants so everyone that applied could join the event. It was possible to apply both as individual and as a team. Those participants that applied individually found a team autonomously during the first hour of the event. Participants were labelled with their skills and the organizer encouraged the creation of mixed teams.

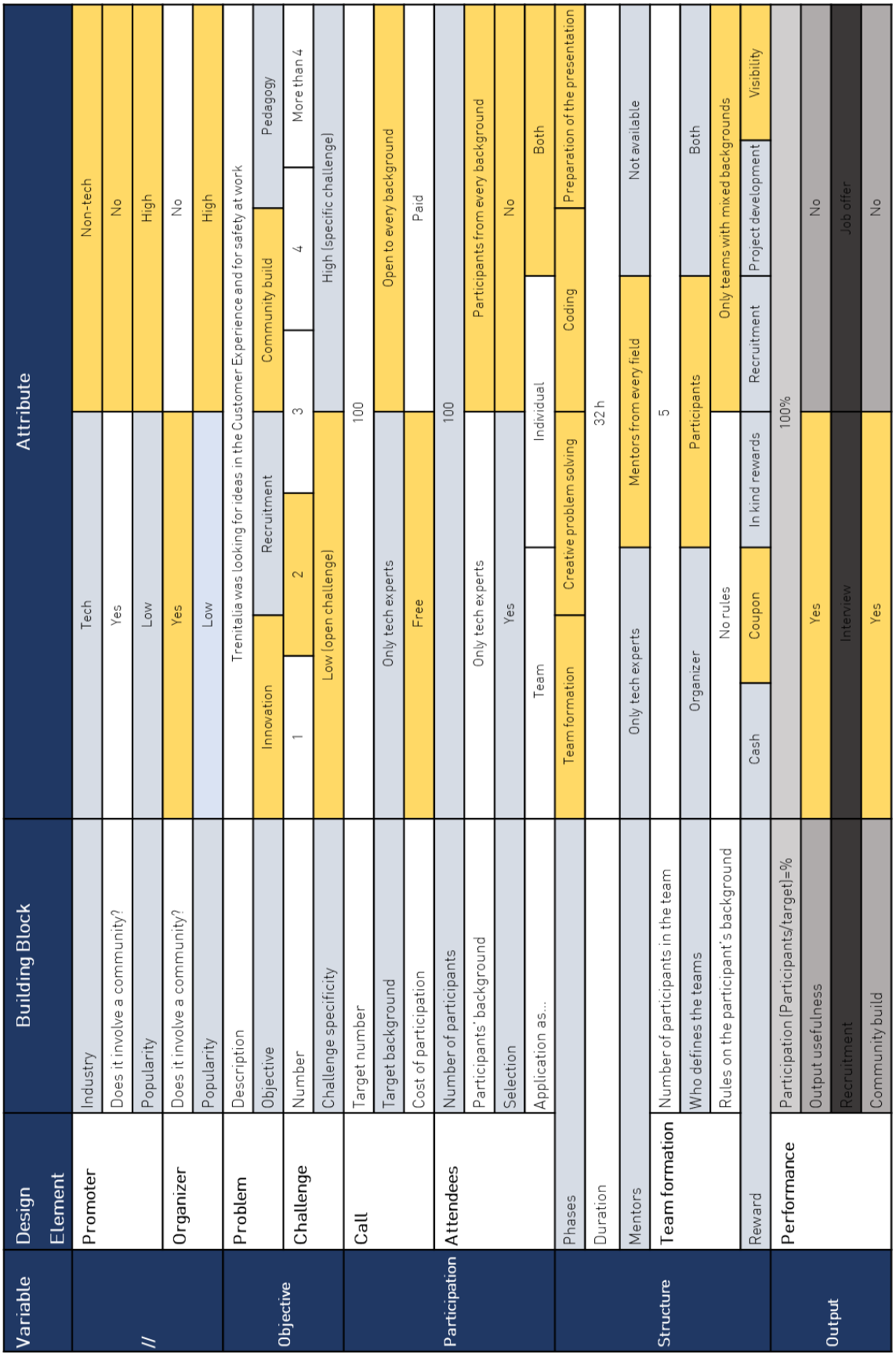
The hackathon lasted 32 hours and developed through the 4 phases of the hackathons. The first phase was the team formation: individuals gathered and formed teams and the remaining ones joined pre-formed teams. Teams were composed of five to six people and no rule was imposed to the creation of a team. Particular attention was given to the creative problem solving: as a matter of fact, the open-ended challenge allowed teams to think of many different solutions and to focus on different features of the solution proposed. Then teams started the coding phase which continued until few hours before the end of the hackathon when the teams started to focus on the presentation.

Mentors were present during the whole duration of the hackathon. There were mentors for every kind of problem: tech experts to help in the coding phase, managers from Trenitalia to support the initial part guiding the teams though the most important decisions and designers to provide a support to the presentation and to the visual parts of the prototype. There were around 20 mentors ready to help teams with every problem they might have.

The reward consisted in two coupons of the value of 4000 € each to spend on Amazon.com for the winners of the two challenges.

The hackathon performed well in all its dimensions: with 100 participants, this was an occasion to engage the community in a challenging and creative way. In addition to the reward Trenitalia proposed the two winning ideas to present them at the European Chemin de Fer conference the weekend after the hackathon. This showed the potentialities of the ideas from the hackathon and their usefulness.
The description of the hackathon and the considerations made in this section are summarized in the table below (table 17).

Table 17 – Application of the model to Moving Forward Hackathon



Variable	Design Element	Building Block	Attribute					
//	Promoter	Industry	Tech					Non-tech
		Does it involve a community?	Yes					No
		Popularity	Low					High
	Organizer	Does it involve a community?	Yes					No
		Popularity	Low					High
Objective	Problem	Description	Trenitalia was looking for ideas in the Customer Experience and for safety at work					
		Objective	Innovation		Recruitment		Community build	Pedagogy
	Challenge	Number	1	2	3	4		More than 4
		Challenge specificity	Low (open challenge)					High (specific challenge)
	Call	Target number	100					
		Target background	Only tech experts					Open to every background
		Cost of participation	Free					Paid
Participation	Attendees	Number of participants	100					
		Participants' background	Only tech experts					Participants from every background
		Selection	Yes					No
		Application as...	Team				Individual	Both
Structure	Phases		Team formation		Creative problem solving		Coding	Preparation of the presentation
	Duration		32 h					
	Mentors		Only tech experts				Mentors from every field	Not available
	Team formation	Number of participants in the team	5					
		Who defines the teams	Organizer				Participants	Both
		Rules on the participant's background	No rules					Only teams with mixed backgrounds
	Reward		Cash	Coupon	In kind rewards		Recruitment	Project development
Output	Performance	Participation (Participants/target)=%	100%					Visibility
		Output usefulness	Yes					No
		Recruitment	Interview					Job offer
		Community build	Yes					No

6.2.5 Allianz Now Hackathon

This hackathon was promoted by Allianz Italia in collaboration with Deloitte. These are two very popular companies being Allianz the 5th insurance company in the world and Deloitte the consulting company with more revenues of 2016. Allianz Italia is investing extensively in innovation. This hackathon was an occasion to bring together Allianz Italia employees and external innovators to research innovative digital solution for *sliced insurance. Sliced insurances* are a particular type of insurances that is possible to purchase on demand. For example: an Allianz client does not have the kasko (a type of insurance that allows for complete coverage of every damage to the car) and wants to buy it because he is going for a long travel with his car. As of now, this service is not available from Allianz and there are few startups that offer such a service that emerged. Allianz wishes to fill the gap that exists with the startups and leverage on its power of incumbent. To do so, Allianz has started an innovation process more than one year ago that involved innovation challenges open to employees, top management meetings to decide the direction to take, and the hackathon as the final step of this process. The innovation process followed different phases, divergent, where different ideas were brought to the table, and convergent, where few ideas were selected to bring to the next phase.

The hackathon was a divergent phase, made after the decision of the top management to focus on *sliced insurances* in three fields, which represented the three challenges.

The hackathon was open to different backgrounds: developers, UX designers and business experts from students to professionals. Each team had to be composed by two developers, one UX designer, one business expert and two employees from Allianz Italia. These were the same employees that took part in the internal challenges. Some of them were the same that even proposed the idea that was utilized for the challenge. These figures functioned as mentors inside the team to guide the choices in a way that made sense with the overall business of Allianz Italia.

In addition to the Allianz Italia's employees inside the teams, there were mentors for every problem a team could face. Expert developers to solve problems related

to coding, Allianz Italia's managers to support the decision making and Deloitte employees to help with the management.

The hackathon was located in Deloitte's Greenhouse. This is the headquarter of Deloitte's team Officine Innovazione, which is the branch of Deloitte consulting that deals with the most innovative technology on the market. The Greenhouse is a space created for the community of tech-savvy and entrepreneurs. It is an environment whose objective is to stimulate new ideas, animate brainstorming meetings and share new solutions in an interactive way (image 7).

Image 7 –Deloitte's Greenhouse in Milan

While Allianz was in charge of recruiting the employees that participated in the event, Deloitte had to recruit external participants. To do so, they advertised the hackathon online via Google and Facebook paid advertising and they connected to different communities: GDG Torino, FIntastico, SDD Milan, UX/UI/IA Milano, Fintech-Up, Milano Front End Meetup, Khronos Milano, Girls in tech, and Sketch and Design.

Allianz Italia decided to run the hackathon to meet different nature of objectives: innovation, recruitment and community build. The objective of innovation was clearly explained in the initial part of this section. The recruiting objective was pursued during the hackathon with informal reviews carried out with the participants who were interested in opening positions. However, even if both Allianz Italia and Deloitte carried out the interviews, few were made and no one transformed in an official job offer.

As previously stated, the challenge proposed were three:

- Road aggression: in Italy, every year more than 15.000 road aggressions are denounced every year in Italy. Allianz Italia wanted to create services

that would allow its clients to protect themselves when they feel it is necessary;

- Car: every year more than 100.000 cars are stolen and more than 180.000 are subject to vandalism. Allianz Italia wanted to create a solution that would allow to car possessors to activate insurance covers on demand that would complement their existing RCAuto (the basic car insurance, which is compulsory in Italy).
- Road incidents: more than 2.1 million road accidents are made every year in Italy. Allianz Italia wanted to develop a solution to allow its clients to instantly activate a complete assistance service from every place.

The challenges were considered to be not specific. As a matter of fact, teams spent most of the time figuring out the best solution and spent little time to code. This fact was also addressed by an Allianz Italia employee who was competing in the hackathon when he was interviewed. He said: "I believe that the time that programmers spend developing the prototype is just wasted. We could all continue to think of better ways to implement our idea and just present the concept. What the jury should evaluate is the quality of the idea that is behind the prototype, not the prototype itself. It was built in few hours. In any case, if they [the jury] like the idea they will never use the code developed in the hackathon. It would take a team of developers and months of work to use the propose the solution to the clients".
What he suggested was to make the presentation as interactive as possible and very similar to the program itself (an app feature for its solution) that the jury would not even know the difference. This is the same advice that was proposed by a designer that was invited to have a talk to guide teams to the best looking and feeling prototype. He said that there are many pre-set programs that help to create apps facsimile. He suggested to avoid programming because it takes time and usually the facsimile is actually nicer than a program developed in few hours.

Participation was free but participants were screened based on their Linkedin.com profile. An interview with Marina Calcagno from Deloitte revealed that the selection was actually made on the basis of the timing of the application

mostly. Participants would apply as individual and teams would form after the initial presentation from Allianz Italia and Deloitte.

The hackathon followed the four typical phases: right after the presentation of the challenges, teams were formed with the support of the organizer. Teams spent a lot of time in the thinking of the solution and then started coding. Since the presentation did not require any high-level software but just a functioning prototype, most of the teams dedicated much more time than usual to the preparation of the presentation.

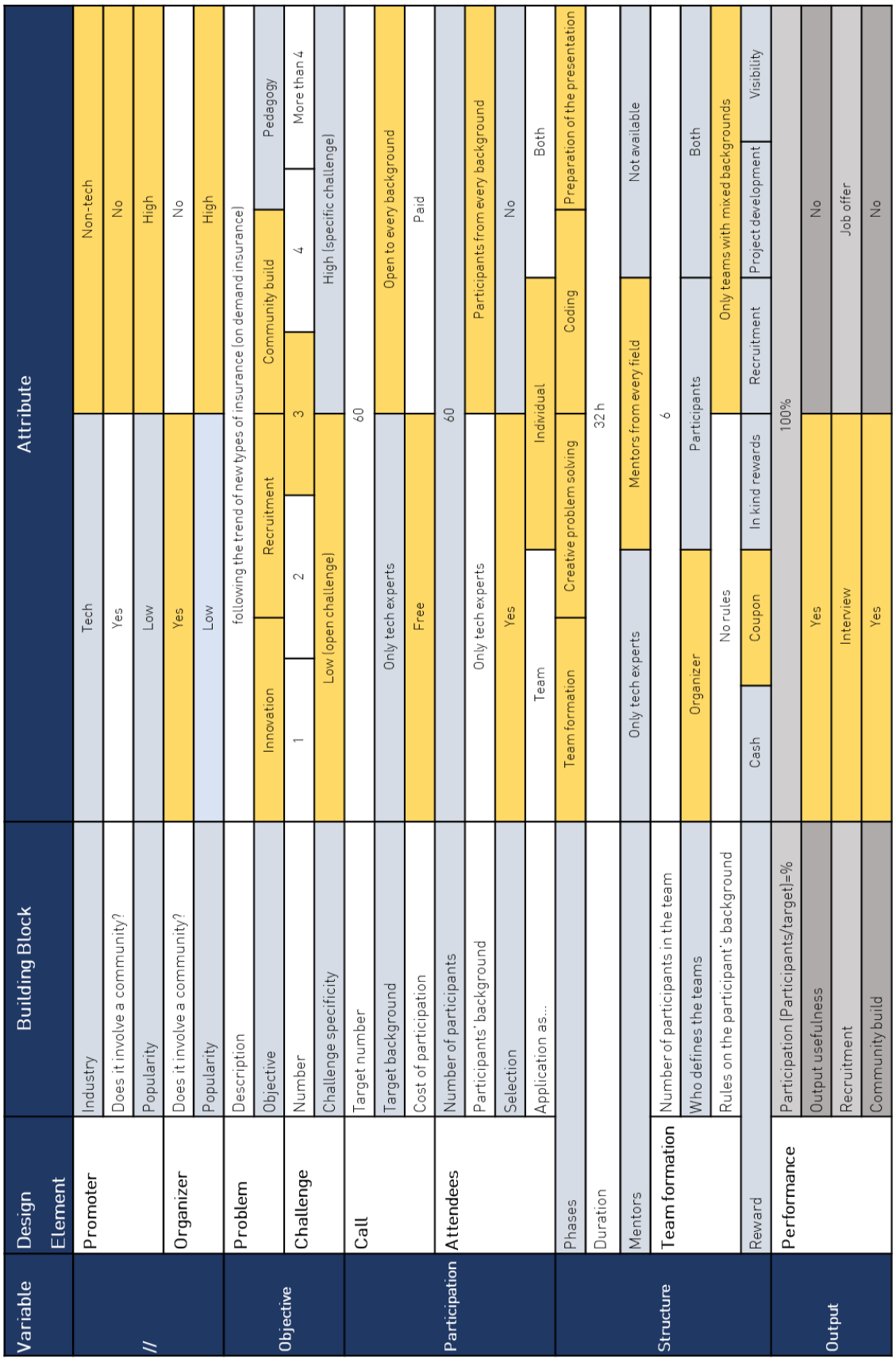
At the end of the hackathon one team from each challenge was rewarded with amazon coupons of 600 € to each member of the team.

To conclude the presentation of this hackathon, the performances are analyzed.

The hackathon performed well in every dimension: there were 60 participants that were selected from an even higher number of applicants. The output was considered useful as, from an interview with a manager from Allianz Italia it was understood that most of the solutions were more than appreciated both by the jury and by most of Allianz Italia employees. Finally, a community of interested in the innovative theme of sliced insurance was created.

For the sake of clarity, all the information reported in this section are summarized in the table below, where the model is applied (table 18).

Table 18 – Application of the model to Allianz Now Hackathon



Variable	Design Element	Building Block	Attribute				
//	Promoter	Industry	Tech				Non-tech
		Does it involve a community?	Yes				No
		Popularity	Low				High
	Organizer	Does it involve a community?	Yes				No
		Popularity	Low				High
Objective	Problem	Description	following the trend of new types of insurance (on demand insurance)				
		Objective	Innovation	Recruitment		Community build	Pedagogy
	Challenge	Number	1	2	3	4	More than 4
		Challenge specificity	Low (open challenge)			High (specific challenge)	
Participation	Call	Target number	60				
		Target background	Only tech experts			Open to every background	
		Cost of participation	Free			Paid	
	Attendees	Number of participants	60				
		Participants' background	Only tech experts			Participants from every background	
		Selection	Yes			No	
		Application as...	Team		Individual		Both
Structure	Phases		Team formation	Creative problem solving		Coding	Preparation of the presentation
	Duration		32 h				
	Mentors		Only tech experts			Mentors from every field	Not available
	Team formation	Number of participants in the team	6				
		Who defines the teams	Organizer			Participants	Both
		Rules on the participant's background	No rules			Only teams with mixed backgrounds	
	Reward		Cash	Coupon	In kind rewards	Recruitment	Project development	Visibility
Output	Performance	Participation (Participants/target)=%	100%				
		Output usefulness	Yes				No
		Recruitment	Interview				Job offer
		Community build	Yes				No

6.2.6 2nd Transport Hackathon

This event was promoted by the Autorità di Regolazione dei Trasporti ART). This is the institution that regulates all the transports and mobility in general in Italy. It is not very popular as the majority of the participants did not know of its existence before the hackathon. In addition, it is not present on social networks and its only review on the internet consists of one star out of five on google.com. On the other hand, the organizer, Treatabit is well known in Torino, the city where the hackathon was hosted. As part of the startup incubator of the Politecnico di Torino (I3P, Treatabit is connected to a various community of young entrepreneurs, startuppers and people that are interested in innovation in general.

The hackathon was promoted to develop innovative services to support mobility, improving the access to the utilization of the road network, urban areas, harbors, airports and railroads. Along the innovation objective there was also the one to engage the community. This might have been an objective more for Treatabit than ART but in the end, both would have benefitted from an engagement with a community.

The challenges proposed were six:

- Green mobility: reorganize urban mobility with a focus on environmental sustainability. Space was given to non-traditional transport ways such as bike sharing, car sharing and so on;
- Smart mobility: the future of mobility is connected, integrated and intelligent. Digitalization provides infinite opportunities to revolutionize the concept of mobility;
- Electric mobility: moving towards an all-electric mobility is both important for environmental and economical reasons. This challenge was intended at the creation of the best electric infrastructure possible to welcome electric vehicles;
- Urban Mobility: improving the mobility within the city, making it more fluid and efficient is one of the objectives of the future;

- Safety and security: from monitoring traffic to roadside assistance, from harbor to airport management. Security is one of the major fields in innovation;
- Smart payments: increasingly, digitalization allows for the creation of integrated payment systems which are faster and useful for the consumer.

The specificity of the challenge was considered to be low as no specific skills, beside creativity and a basic knowledge of mobility and the latest developments in technology were needed for generating the solution. As a matter of facts, the hackathon was open to every participant independently of their background and of their belonging to a team or not. Startups that had already developed a service, teams that had thought of a concept to refine as well as interested individuals could participate without passing through a screening process. Participants had to pay 20 € to take part to the hackathon with a 10 € discount for students.

The hackathon was a 48 hours nonstop hacking marathon and 50 people, from every background took part.

There were the usual backgrounds such as developers of every kind, business experts and designers but also architects, anthropologists and artists. Teams formed in the first part of the hackathon with an activity promoted by the organizer. After this phase, the teams that did not have the idea chose a challenge, brainstormed and focused on an idea to refine. The coding phase was brief also in this case as teams had to present the idea behind the concept rather than a functioning software. Therefore, the presentation phase was the longest one as teams put extra care to present their idea in the most interactive way possible.

Mentors were present throughout the whole duration of the hackathon. There were about 20 mentors ready to support teams. In particular mentors were divided into categories:

- Business: mentors from this category came from ART, Greenrail, Almaviva and JETop. These figures helped the teams to find the solution that best would fit with the existing one;
- Hardware/software: from ART, 5T, Almaviva and JETop, these mentors supported teams with technical difficulties in the development of physical and digital prototypes;

- Technical: from ART and Generali Car, these mentors helped with technical problems teams could face;
- Policy: the mentors came from ART. The mobility environment is very bureaucratic and solutions that seem brilliant may not be implementable for policies that would limit them. These mentors visited every team telling what could fit and what had to change in order to be feasible.

The rewards consisted in gadgets that had something to do with mobility. The first place would win a hoverboard, the second a Fitbit Charge, the third a bag for the bike. In addition to these rewards, there was also another reward for the first three startups classified: it was the possibility to present their service during the Smart Mobility World, a European event on mobility.

The hackathon performed well in terms of participation. Even though the participation was not free, the hackathon welcomed 50 participants from the most various fields and was considered an occasion where Treatabit engaged with and built its community. The same consideration that was made for the Fintech Design Marathon has to be made for how the usefulness of the output is concerned. Also in this case the projects that won the reward were not implemented but, same as before, it is possible to consider that the objective of a Public Administration such as ART was not the creation of new services but the engagement with a community of people interested in mobility to create awareness over the matters. Still, the output was considered not useful as nothing was done with it.

As always, the model created was used to summarize and visualize the information about this hackathon (table 19).

Table 19 – Application of the model to 2nd Transport Hacakthon

Variable	Design Element	Building Block	Attribute				
//	Promoter	Industry	Tech			Non-tech	
		Does it involve a community?	Yes			No	
		Popularity	Low			High	
	Organizer	Does it involve a community?	Yes			No	
		Popularity	Low			High	
Objective	Problem	Description	lack of new, innovative and sustainable services to support mobility				
		Objective	Innovation	Recruitment		Community build	Pedagogy
	Challenge	Number	1	2	3	4	More than 4
		Challenge specificity	Low (open challenge)			High (specific challenge)	
Participation	Call	Target number	50				
		Target background	Only tech experts			Open to every background	
		Cost of participation	Free			Paid	
	Attendees	Number of participants	50				
		Participants' background	Only tech experts			Participants from every background	
		Selection	Yes			No	
		Application as...	Team		Individual		Both
Structure	Phases		Team formation	Creative problem solving		Coding	Preparation of the presentation
	Duration		48 h				
	Mentors		Only tech experts		Mentors from every field		Not available
	Team formation	Number of participants in the team	4				
		Who defines the teams	Organizer		Participants		Both
		Rules on the participant's background	No rules			Only teams with mixed backgrounds	
	Reward		Cash	Coupon	In kind rewards	Recruitment	Project development	Visibility
Output	Performance	Participation (Participants/target)=%	100%				
		Output usefulness	Yes			No	
		Recruitment	Interview			Job offer	
		Community build	Yes			No	

6.2.7 hack.developers

This hackathon was hosted in 24 different Italian cities and San Francisco at the same time. Most likely this has been the biggest hackathon ever run in Italy, both for its participants and for its resonance. The hackathon was promoted by the Team per la Trasformazione Digitale, an organization guided by Diego Piacentini, Vice-President of Amazon.com who took a two year stop from his primary activity to create the italian digital infrastructure. Indeed the objective of hack.developers was to create an environement that would help developers to integrate the so called enabling platforms of what the Team Digitale calls the Operating System of Italy. These enabling platforms are the ones that the Team Digitale asked to be the base of every digital service that will be used by the Public Administration. For example, the SPID (the unique digital identity of the citizens) would allow to have one single way to upload the information needed for the creation of the identity card.

To do so it is not possible to just create laws that make this compulsory but it is needed to provide everything that a developer needs to integrate the data: SDK, technical documentation, tutorials, test environments, support channels and so on. These are non-existent technologies and the Team Digitale's objective is the creation of it.

The hackathon was as a moment to invite Italian developers and present them the first technologies added to Developers.Italia – the platform of the Team Digitale – and make them familiarize with them. The whole point of the hackathon was the creation of making open-source contributions with the objective of creating new professional skills.

The hackathon was organized in collaboration with Codemotion and many other companies participated as partners. While Codemotion provided the organization, the other companies provided the mentors: there were employees from Cisco, DXC.technology, IBM, Intesa Sanpaolo, Microsoft, Oracle, Red Hat and TIM and they were all ready and happy to help the teams.

Image 8 – Locations where the hack.developers was held

The hackathon was organized in 25 Italian cities of which 5 were direct locations and the other 20 indirect ones (image 8).

The difference between direct and indirect location resides in the fact that in the direct ones there were mentors present to help directly while if people needed help in the indirect locations, they could ask on slack, where participants could access to chat with mentors and for intra-location communication.

The nature of the challenge was highly specific and only expert developers were expected to attend the hackathon. There was no surprise in seeing that no participant from fields different from the tech one showed up. The skills that were looked for were: big data, content design, cybersecurity, data science, developer relations, digital payments, metrics and analytics, mobile/app developer, product and UX/UI, software architects, software developers and technical project managers. The participation was free and there were no rules on how to create a team.

The challenges were divided into two rewards: fast rabbit and wise turtle. Teams competing for the fast rabbit challenge had to upload their code into Developers.Italia's github page within the end of the hackathon while the ones competing for the wise turtle had one week to upload their work. The reasoning behind this diversification was the fact that some solutions needed more time to think and code than just few hours. The challenges were open to all the

technologies that the Team Digital is working on: SPID, DAF, PagoPA, Developer.italia.it / Designers.italia.it (communities), ANPR, API marketplace and cittadinanza digitale. The reward consisted of an overall 10.000 € worth of online courses on courser.org divided for the two challenges.

The hackathon lasted 32 hours and was structured according to the four phases. After the teams formed, they quickly though of a challenge on which to focus and started coding. The coding phase was clearly the longer one because of the high specificity of the challenge. Finally, the teams prepared their presentation very quickly to pitch their idea in 2 minutes to the jury and the other participants.

To conclude the description of this hackathon, the performances are reported. These are very positive over every dimension. Participation was greatly achieved as the hackathon hosted an overall 800 participants distributed in all the cities.

Also, the promoter and the organizer involved more than 80 communities that responded enthusiastically and participated to the hackathon. The hackathon was a way to create the Developers.Italia community and it succeeded not only for the number of participants but also for the continuation of the hackathon. As a matter of facts, the wise turtle challenge can be considered a metric to understand how involved were participants. More than 10 teams participated in the wise turtle ceremony accounting for more than 70 people overall.

Finally, as far as the usefulness of the output is concerned, in an interview with a member of the Team Digitale he said: "we believe that not only the projects that will win are going to be useful. Indeed, we think that we are going to utilize even more solutions than the ones we will be able to reward." This shows that the output of the challenge will be used by the promoter.

To conclude this section, the model was applied to this hackathon to summarize all the relevant information gathered with the ethnographic study and the interviews (table 20).

Variable	Design Element	Building Block	Attribute					
//	Promoter	Industry	Tech				Non-tech	
		Does it involve a community?	Yes				No	
		Popularity	Low				High	
	Organizer	Does it involve a community?	Yes				No	
		Popularity	Low				High	
Objective	Problem	Description	creation of the Italian digital infrastructure					
		Objective	Innovation		Recruitment		Community build	Pedagogy
	Challenge	Number	1	2	3	4	More than 4	
		Challenge specificity	Low (open challenge)				High (specific challenge)	
Participation	Call	Target number	600					
		Target background	Only tech experts				Open to every background	
		Cost of participation	Free				Paid	
	Attendees	Number of participants	800					
		Participants' background	Only tech experts				Participants from every background	
		Selection	Yes				No	
		Application as...	Team		Individual		Both	
Structure	Phases		Team formation		Creative problem solving		Coding	Preparation of the presentation
	Duration		32 h					
	Mentors		Only tech experts		Mentors from every field		Not available	
	Team formation	Number of participants in the team	5					
		Who defines the teams	Organizer		Participants		Both	
		Rules on the participant's background	No rules				Only teams with mixed backgrounds	
	Reward		Cash	Coupon	In kind rewards	Recruitment	Project development	Visibility
Output	Performance	Participation (Participants/target)=%	160%					
		Output usefulness	Yes				No	
		Recruitment	Interview				Job offer	
		Community build	Yes				No	

6.2.8 TIM Open Hackathon

The last hackathon observed was hosted by TIM in Milan in the first days of November. TIM is one of the major Italian telephone service provider and launched the hackathon to collect innovative ideas on the fields of Finance and Entertainment.

The hackathon consisted in 2 days of uninterrupted hacking with the API provided by TIM and its partners. It was organized in partnership with Tree, a company that helps companies, startups and individuals organizing innovation programs and learning paths. The reason why Tree was selected is because it takes care of the mentorship for TIM. Both TIM and Tree are in contact with communities on which they advertised the hackathon.

Teams had to choose one of the two challenges – finance or entertainment – and develop a functioning prototype to present to the jury. Given the fact that participants mainly had to write code during the hackathon, the challenge was considered to be highly specific. For this reason, 22 mentors were present to support the 11 teams that formed out of the 65 participants. Mainly, mentors came from the tech field and from the business one.

Participation was not limited to tech experts as TIM was also looking for participants with a business and a design background. People did not have to pay to participate but a selection was made to ensure a proportion on the background of the participants.

Participants could apply both as individual and with a team as long as the team respected the heterogeneity of background within the team.

Teams followed the four phases of the hackathon starting with the team formation that was followed by the thinking over the solution of the challenge. Once this was done teams started to code which was the longest phase of them all. Finally, teams prepared the presentation to pitch to the jury.

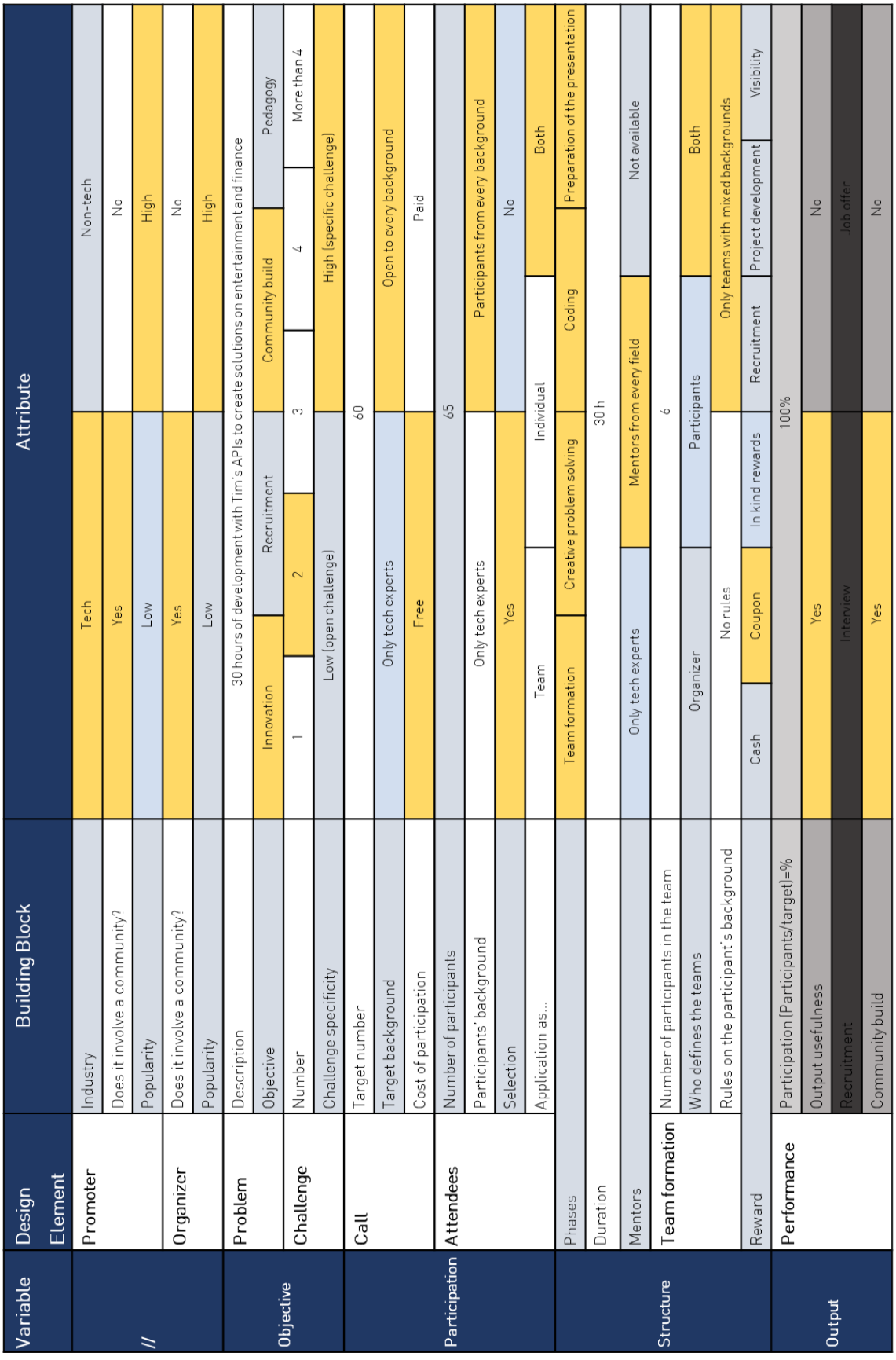
The rewards consisted in coupons to spend on amazon. Respectively there were 5000 € for the first team qualified, 2500 € for the second and 1500 € for the third.

Giulia Piermattei, a representative of TIM stated: "the hackathon was a great success. The results were of great technical quality."

The performance measured confirm the statement of the employee as there were five participants more than expected, even if they were selected. The high quality of the output made the results readily usable for TIM's purpose. Finally, TIM was able to engage with its own community and also to enlarge it.

To conclude with the descriptions of the hackathons, the last application of the model is presented below (table 21).

Table 21 – Application of the model to Tim Open Hackathon



Variable	Design Element	Building Block	Attribute				
//	Promoter	Industry	Tech				Non-tech
		Does it involve a community?	Yes				No
		Popularity	Low				High
	Organizer	Does it involve a community?	Yes				No
		Popularity	Low				High
Objective	Problem	Description	30 hours of development with Tim's APIs to create solutions on entertainment and finance				
		Objective	Innovation	Recruitment		Community build	Pedagogy
	Challenge	Number	1	2	3	4	More than 4
		Challenge specificity	Low (open challenge)				High (specific challenge)
Participation	Call	Target number	60				
		Target background	Only tech experts				Open to every background
		Cost of participation	Free				Paid
	Attendees	Number of participants	65				
		Participants' background	Only tech experts				Participants from every background
		Selection	Yes				No
		Application as...	Team		Individual		Both
Structure	Phases	Team formation	Creative problem solving			Coding	Preparation of the presentation
	Duration		30 h				
	Mentors		Only tech experts			Mentors from every field	Not available
	Team formation	Number of participants in the team	6				
		Who defines the teams	Organizer			Participants	Both
		Rules on the participant's background	No rules				Only teams with mixed backgrounds
	Reward		Cash	Coupon	In kind rewards	Recruitment	Project development	Visibility
Output	Performance	Participation (Participants/target)=%	100%				
		Output usefulness	Yes				No
		Recruitment	Interview				Job offer
		Community build	Yes				No

The analysis of the TIM Open Hackathon concludes this chapter. In the following one all the hackathons are going to be analyzed as an aggregate. The objective of the analysis is the one of finding meaningful results to be useful to the enrichment of both the theoretical literature and managerial implications.

7 Results

This chapter reveals the results that arose from the field research. This is done through the analysis of each hackathon side-by-side. In particular all the hackathons are going to be put one next to the other in order to appreciate the differences among them. The analysis will be carried out by studying the decisions of the promoter on each building block for each hackathon. This study will give as an output three possible types of information:

- *Type 1: most promoter took the same decision on the building block*: this happens in those cases where, in the majority of the hackathon (all of them or seven out of eight), promoters decided to run the hackathon in the same way, regarding a specific building block. For example, if all the promoters independently decided to screen people, this would be part of these type of information;
- *Type 2: some promoters took a decision and some others took the opposite:* in the case of binary decisions, e.g. whether to make participants pay for their participation or not, it may be that some promoters decided for one option and the other decided for the other. These cases are the one that are going to be studied. In particular, each one of these cases will be compared to one performance at a time;
- *Type 3: each promoter took a different decision:* it could be the case that promoters decided to run one building block of the hackathon completely differently from each other. For example, for the case of the duration of the hackathon it is possible that every promoter decided to run the hackathon for different times (one for 24 hours, one for 32 hours, one for 56 and so on). It would be nearly impossible to find a result from these cases.

7.1 Cross case analysis

This section shows the results of the hackathons one next to the other and the validation of the integrated definition of hackathon, which was left to be done in chapter 3.1. First a table with the building blocks on the rows and the aggregate results of the hackathons on the right column is created to have a visual representation of the differences among these (table 22).

Table 22 - Cross-case analysis

	Design element	Building block	Attributes	Aggregate	
//	Promoter	Industry	tech	4	
			non-tech	4	
		Refer to a community?	yes	2	
			no	6	
		Popularity	low	2	
			high	6	
	Organizer	Refer to a community?	yes	6	
			no	0	
		Popularity	low	0	
			high	6	
		not involved		2	
Objective	Problem	Objective	Innovation	7	
			Recruitment	2	
			Community build	8	
			Pedagogy	0	
	Challenge	Number of challenges	1	1	
			2	2	
			3	2	
			4	1	
			More than 4	2	
		Challenge specificity	Low (open taks)	4	
			High (specific task)	4	
rticipatio	Call	Target number	Number	102,5	Average
		target background	Only tech experts	2	
			Open to every background	6	
		Cost of participation	Free	7	
			Paid participation	1	
	Participants	Number of participants	Number	139,75	Average
		Participants' background	Tech Experts	1	
			Participants from every background	7	
		Selection	Yes	3	
			No	5	
		Application as	Team	1	
			Individual	2	
			Both	5	
Structure	Phases	Team formation		7	
		Creative Problem Solving		7	
		Coding		8	
		Preparation of the rpesentation		8	
	Duration			32	Mode
	Mentors	Not available		1	
		Tech experts		7	
		Business		5	
		Designer		4	
	Team formation	Number of participants in the teams		4,75	Average
		Who defines the teams	Organizer	3	
			Participants	5	
		Rules on the participants' backgroud	No rules	5	
			Only mixed backgrounds	3	
	Reward	Cash Prize		1	
		Coupon Prize		3	
		In kind reward		2	
		Recruitment opportunity		1	
		Project development		1	
		Visibility		3	
		Monetary		4	
		Non-monetary		4	
Output	Performance	Participation (participants/target) %		////	
		Output useful	Yes	4	
			No	4	
		Recruitment	Interview	2	
			Job offer	0	
		Community build	Yes	6	
			No	2	

7.1.1 Analysis of the aggregate of the observed hackathons: general characteristics of hackathons

It is possible to see that some cells of the aggregate column of table 21 are highlighted in green. This information are the ones that have been defined as type 1. From type 1 information it is possible to extrapolate the characteristics of the hackathons. As a matter of fact, this information shows the similarities among the hackathons that are most likely the typical way to run a hackathon. These are listed in the following:

- Objective: all the hackathon visited had the objective of building or creating a community. Seven out of eight had the objective of producing an output that could be useful to the promoter and few had the objective of recruiting. As explained in the initial part of this chapter no hackathon with the specific objective of teaching participants was visited as no such hackathon was organized during the observation period.

  From the analysis of these numbers it is safe to state that promoters see in hackathon a mean to engage a community –build it in the case they do not have one – and to gather innovative ideas and concepts.
- Cost of participation: out of eight hackathons visited, only one asked to pay a fee to participate. All the other promoters considered the hackathon an investment to be done. In fact, they paid for all the needs the participants had throughout the whole duration of the hackathon, from the rent of the location to the catering to the gadgets teams used for the prototype.
- Participants background: in all the hackathons that were observed the promoter was looking for participants with a technological background. This means that not only developers were welcomed but all sorts of tech related figures from data analysts to web designer. Most hackathons though opened their doors to participants with backgrounds different from the tech ones. Still, these participants had to be passionate about technology. The important fact is that this phenomenon was constant for every hackathon, be this promoted by a company in the tech industry or not.

This remarks the fact, discovered during the review of the literature that hackathons are indeed a way to bring technology where it is not yet present or where it is harder to implement.

- Phases: the four phases of the hackathon were followed by almost every hackathon. In two occasions they were not followed. The first is the case of VGH where participants could only apply as a team and the first phase of team creation was not carried out. The second was during Vipera Hackathon where the challenge was so specific that there was no place for the participants to apply creativity to find different ways to solve it.
- Duration: the majority of hackathons lasted 30-32 hours. Although there were also hackathons that lasted much less than this – Vipera Hackathon with 8 hours – it is safe to consider that the majority of hackathons last around 30-32 hours. Indeed, even if the sample is reduced to 8 cases, 6 of them last around 30-32 hours, one lasts 8 and another one 48 hours.
- Mentors: in seven out of eight hackathons, participants could count on the support of mentors. The presence of mentors seems to be something that participant expect when they decide to take part in hackathons.

The majority of these considerations are mere confirmation of what was found in the literature review but they are still precious information as it not only confirms the literature but also shows the analysis was carried out in the right way.

7.2 Analysis of the results: how the decisions over the building blocks affect performances

Type 1 information, the ones that provided the characteristics of the hackathon and validated the integrated definition, have already been analyzed in the initial part of this chapter. This section addressed type 2 and type 3 information, respectively the binary ones that showed polarities and the ones that are not possible to utilize for extracting results.

The process that is used for finding results, is composed of three steps:

- Analysis of the building blocks one by one to understand whether if they can be used for the extraction of results;

- Definition of two macro-variables which are complementary and exclusive to group all the building blocks in two categories. These must be complementary because they must contain all the building blocks and exclusive because one building block can only be contained by one macro-variable;
- Plotting the meaningful results. Of all the analysis that will be carried out only the ones that actually provide meaningful information are going to be disclosed.

7.2.1 Analysis of the building blocks

In order to find results, first, each building block is analyzed to understand what type of information it holds. This analysis also takes into consideration the information of type 1 that have already been utilized to generate the characteristics of the hackathons. For the sake of clarity, table 23 is created with all the building blocks deployed on the rows and two columns which indicate whether if the building block was selected or not and the reason why it was or not selected.

The expected output of this table is the selection of the building blocks that provide type 2 information. As a matter of fact, these building blocks are the ones from which it is possible to derive polarities and therefore results.

Table 23 – Selection of the building blocks on the basis of the information they hold

Building block	Selected	Reason of the selection
Does the hackathon involve a community?		Type 2 information: there are hackathon that involve communities and hackathons that do not. All the building blocks that deal with the involvement of communities have been condensed into this as the information needed is whether the hackathon involved a community or not, regardless of the actor that involved it. This building block examines how the involvement of a community affected the performances

Promoter's industry		Type 2 information: promoters' industries have been divided into tech or non-tech. This building block examines how hackathons perform if run by promoters of different industries
Promoter's popularity		Type 2 information: the hackathons that have been observed were promoted both by popular and less known companies and organizations. To understand the impact of the promoter's popularity, this building block is analyzed and compared to each performance
Organizer's involvement		Type 2 information: this building block analyzes how the involvement of an organizer drives the performances. The involvement of an organizer is not compulsory but some of the hackathon that were observed asked to a third party to take care of the organization.
Organizer's popularity		Type 1 information: all the five organizers that were involved for the organization of the hackathons were considered to be popular organizations therefore no result can be extracted by this information
Objective		Type 1 information: the consideration on the objectives have already been carried out previously
Number of challenges		Type 3 information: the number of challenges varied greatly across the hackathons. The variation was too great to be able to consider this as a valid information
Challenge specificity		Type 2 information: this building block provides potentially interesting information as the hackathons were perfectly divided into four that had a specific challenge and four that had an open challenge

Target number		This and the building block "number of participants" are the input to the performance "participation"
Target background		Type 2 information: the dependence of the performance from the background of the participants that the promoter/organizer directed the advertisement to, is analyzed with this building block
Cost of participation		Type 1 information: this building block has already been analyzed in the initial part of this chapter
Number of participants		This and the building block "target number" are the input to the performance "participation"
Participants' background		Type 1 information: this building block has already been analyzed in the initial part of this chapter
Selection		Type 2 information: the screening of participants was carried out by three promoters/organizers out of 5. Its influence over the performances is analyzed with this building block
Application as		Type 3 information: the data gathered from the sample are too various to extract meaningful results
Phases		Type 1 information: this building block has already been analyzed in the initial part of this chapter
Duration		Type 1 information: this building block has already been analyzed in the initial part of this chapter
Mentors		Type 1 information: this building block has already been analyzed in the initial part of this chapter
Number of participants in the teams		Type 3 information: this building block had too various information as well as being very similar with each other. Therefore, it was not considered for the analysis of the results
Who defines the teams		Type 2 information: whether if the definition of the team might be affecting the performances is examined with this building block

Rules on the participants' background (in team formation)		Type 2 information: teams might be formed of only one background or of mixed background. In some cases, the promoter/organizer requires that teams are composed only by mixed backgrounds. How this affects the performances is examined with this building block
Reward		Type 2 information: the type of reward might influence the people to join the hackathon or to perform better. This is studied with this building block. The different types of reward were grouped into monetary and non-monetary rewards in order to be able to retrieve usable information.

7.2.2 Definition of the macro-variables

To give clarity to the disclosure of the results, two macro-variable that comprehend all the building blocks used for the results are defined. This was done with the intent to define different ways to run the hackathon and reach the same performance.

The macro-variables that have been identified are:

- Engagement: this macro variable groups all those building blocks that deal with how the promoter engaged with the participants. All those variables that influence the motivations of people to participate or perform better are grouped under this macro-variable;
- Expertise: this macro-variable groups those building blocks that indicate the different expertise that were present at the hackathon.

In the following, table 24 shows the building blocks that are grouped under the macro-variables.

Table 24 – Building blocks grouped into macro-variables

Building block	Macro variable
Does the hackathon involve a community?	Engagement
Promoter's popularity	
Organizer's involvement	
Who defines the teams	
Reward	
Promoter's industry	Expertise
Target background	
Participants background	
Challenge specificity	
Selection	
Mentors	
Rules on the team formation	

This division has been done to identify what building block to consider when dealing with one macro-variable or the other. When discussing the results this will be useful to address how a promoter should reason an engagement to the participants and expertise present in the hackathon. In other words, this division helps to give clarity to the discussion on the results: in particular when building blocks have to be compared and discussed together it would be odd to discuss a building block that refers to how the promoter should engage the participants and another that refers to the different expertise present during the hackathon.
This consideration leads to the definition of the results. In the next section, the results are shown and initial considerations on the building block are done.

7.2.3 Results from the building blocks

The results are presented in the order of the building blocks of table 23.
They are presented in the form of a 2x2 matrix where the vertical axis represents the performances and the horizontal one the building block. All the performance and the building blocks are in the form of binary information therefore it was possible to just have 2x2 matrixes. Each matrix shows the relationship of one

dimension of the performance (participation – usefulness of the output – community build) and the relative building block. The objective of this analysis was to find two polarities on the matrix: one on the top right and one on the bottom left. As a matter of fact, the presence of both is key to consider the matrix a source of a result: a result is such when a decision brings a certain output and the opposite brings the opposite output.

For the sake of clarity and brevity, only those results that are useful for the final discussion are presented. As a matter of fact, even though all the building blocks that are used in this discussion were selected on the basis of whether if they presented polarities, these were such only on a mono-dimensional axis of analysis, the building block. Plotting the information on a matrix, means to bring the discussion on two axes of analysis and it might happen that the polarities get lost in this passage. In other words, only those matrixes that show two clear polarities on the bottom-left and on the top-right of the matrix were used for the discussion. However, there are some cases in which the polarities are weaker than the other but these are presented anyhow to show a result.

The considerations that are made in this section are made from a small sample of analysis and in every case there are outliers that do not fit into neither one of the polarities. These have to be considered as such and they do not change the fact that two polarities are present in the matrix.

Table 25 shows the building blocks on the rows and the performances on the columns. The intersections that are highlighted in dark green are the ones that provide a meaningful result and in light green the ones that are going to be showed in the following even if they do not report meaningful results. In order to immediately grasp the information from the matrixes, the ones that provide a meaningful result (and will be used in the discussion) will have a green tick on their side, while the other ones will have a red cross.

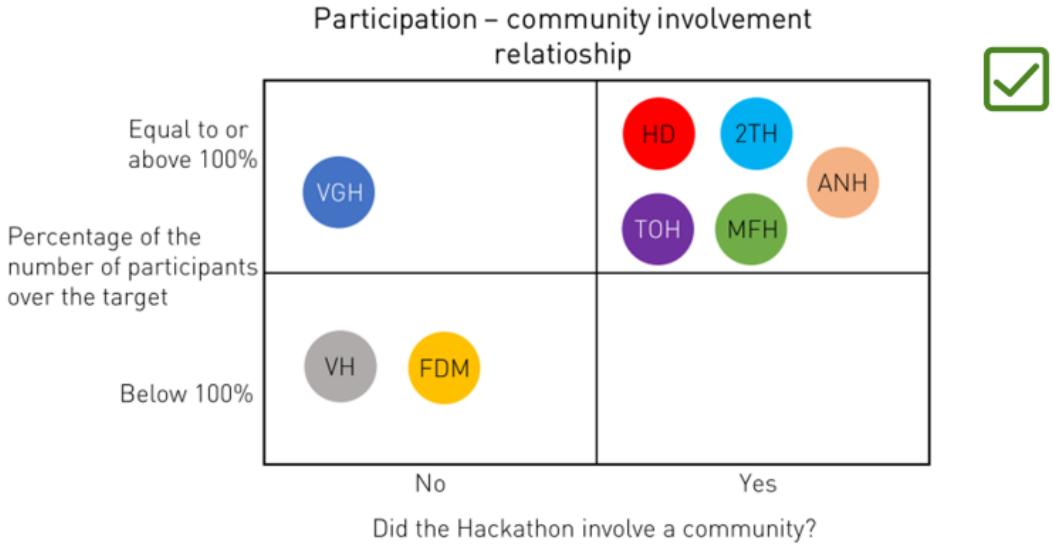
Table 25 – Building block-performance relationship that provide meaningful results

	Participation (participants /target)	Usefulness of the output	Community building
Community involvement			
Promoter's popularity			
Organizer's involvement			
Who defines the team			
Reward			
Promoter's industry			
Target background			
Participants background			
Challenge specificity			
Selection			
Mentors			
Rules on the participants' background			

7.2.3.1 Results from the building block "does the hackathon involve a community?"

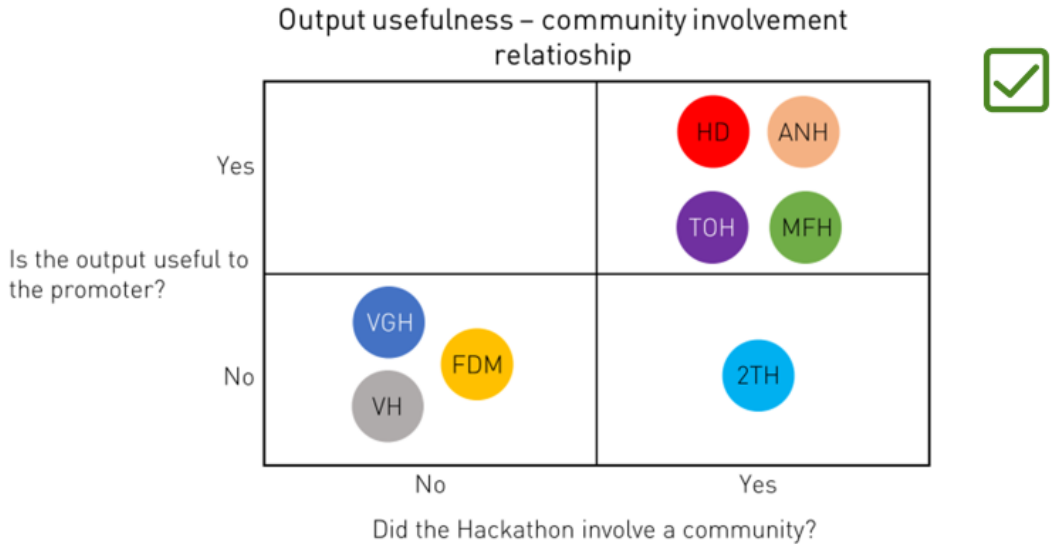
Two clear polarities are shown in the relationship between the participation and the involvement of a community in the hackathon. In particular, all the hackathons that involved a community reached or exceeded the target of participants they imposed themselves. On the other hand, of those that did not involve a community, one reached the target while the other two did not. It is possible to consider VGH as an outlier and state that if a community is involved in the hackathon, the number of participants will reach or exceed the target (table 26).

Table 26 – Relationship between community involvement and participation



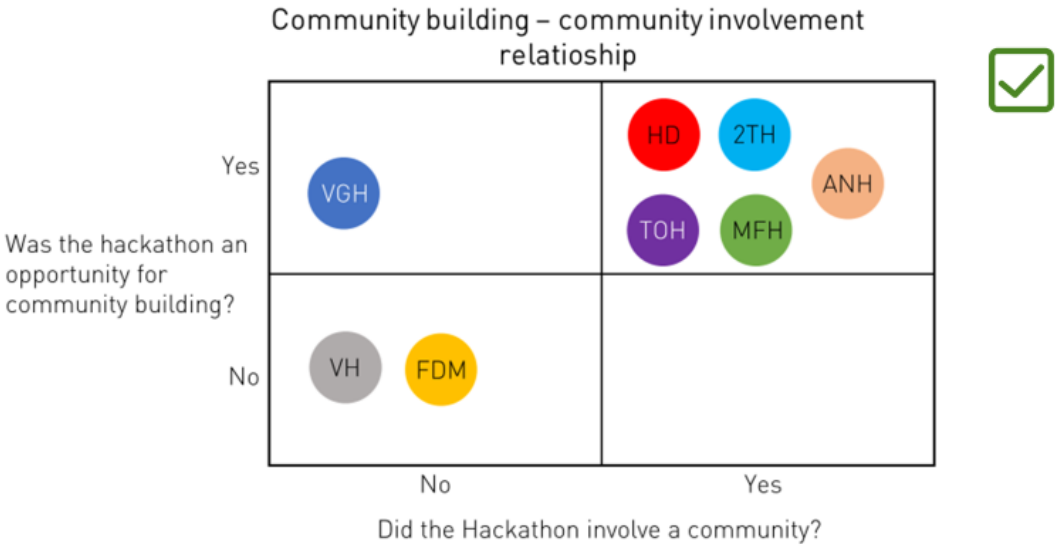
Communities seem to play a relevant role also in the case of the usefulness of the output. As a matter of fact, all the hackathons that did not involve a community did not generate a useful output for the promoter. Also, of the hackathons that involved a community, four out of five generated a useful output for the promoter. 2TH was considered an outlier (table 27).

Table 27- Relationship between community involvement and usefulness of the output



Finally, the relationship between the community building and the involvement of a community is straight forward. As a matter of fact, the expected result is that if a community is involved in an event, this is an occasion to create and enforce a community. In this case the outlier is VGH who, even without the involvement of a community managed to run an event that created a community close to it. The relationship is linear and it is similar to what was presented in the matrix below (table 28).

Table 28- Relationship between community involvement and community building

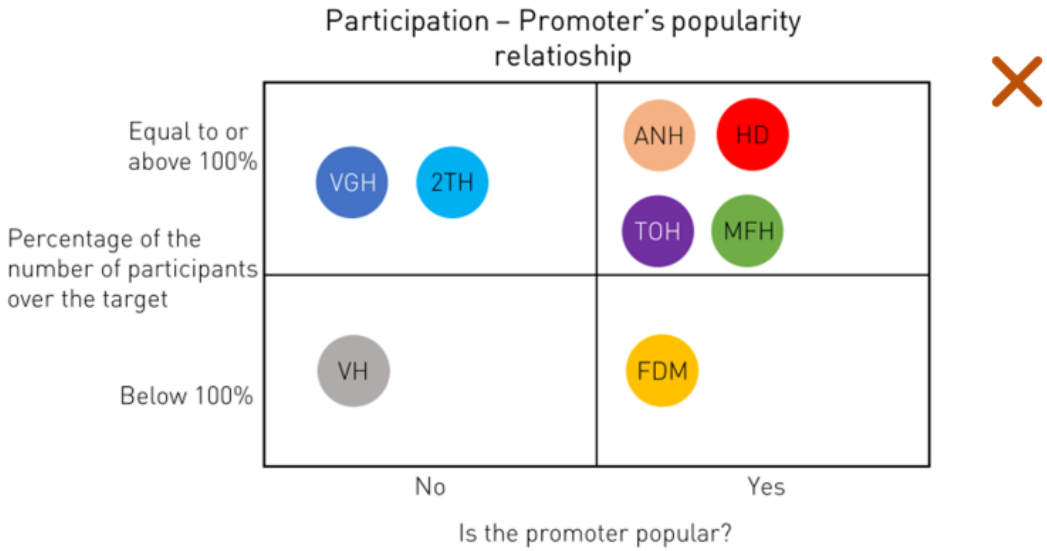


To conclude this section on the community involvement, it appears that the involvement of a community to a hackathon, positively influences all the performances. Further consideration will be made in the last section of this chapter, where all the results will be discussed.

7.2.3.2 Results from the building block "promoter's popularity"

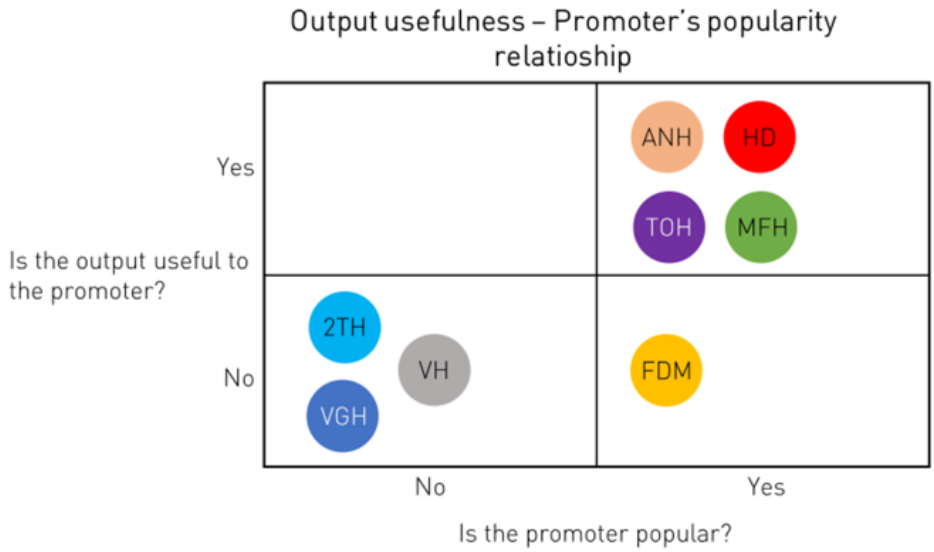
No polarities can be found in the relationship between the promoter's popularity and the participation. Although this is counterintuitive as one would expect to see more participation to the hackathons promoted by popular organization and vice versa. The fact that also promoters that are not popular managed to reach the target means that promoters that are not well known to the public can still run a successful hackathon in terms of participation. In particular the possibilities are either that the promoter did a good job at advertising the hackathon or that the promoter asked for help to an organizer to recruit the right number of people (table 29).

Table 29- Relationship between promoter's popularity and participation



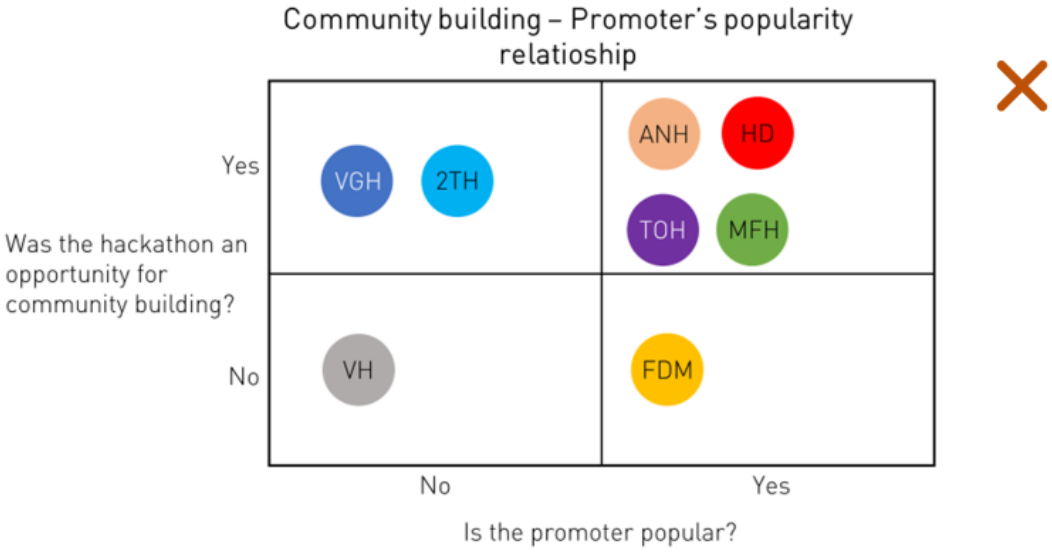
Two polarities are visible in the table that plots the relationship between the usefulness of the output and the promoter's popularity. In particular all the hackathons that are promoted by non-popular organizations did not generate a useful output while the majority of the hackathons promoted by popular organizations generated a useful one. The reason of this may be of two natures: the popularity of the promoter attracts participants of more quality compared to non-popular ones or popular promoters are able to provide a challenge that actually solves the problem they face (table 30).

Table 30- Relationship between promoter's popularity and usefulness of the output



Finally, the relationship between the promoter's popularity and the community building does not show polarities (table 31).

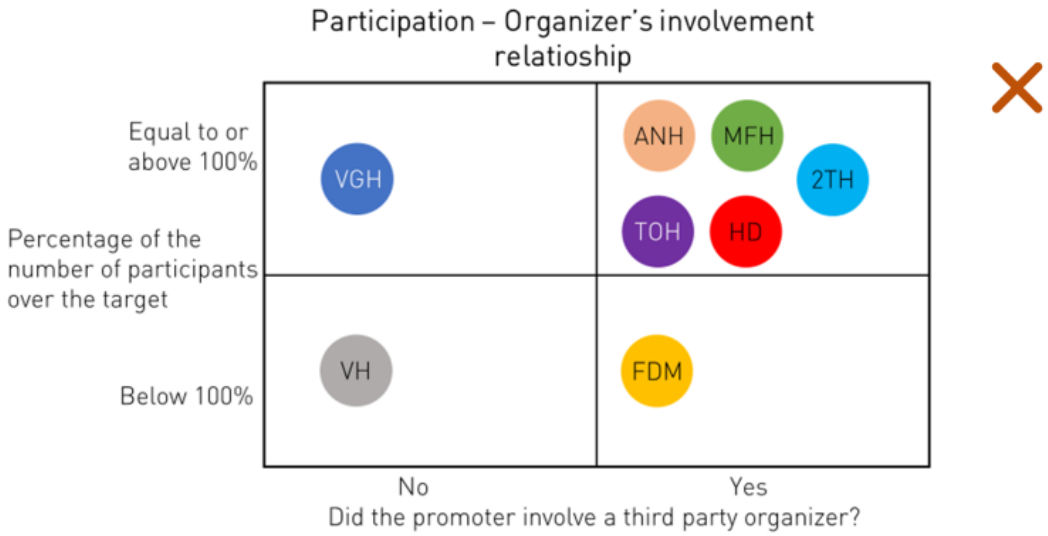
Table 31- Relationship between promoter's popularity and community building



7.2.3.3 Results from the building block "organizer's involvement"

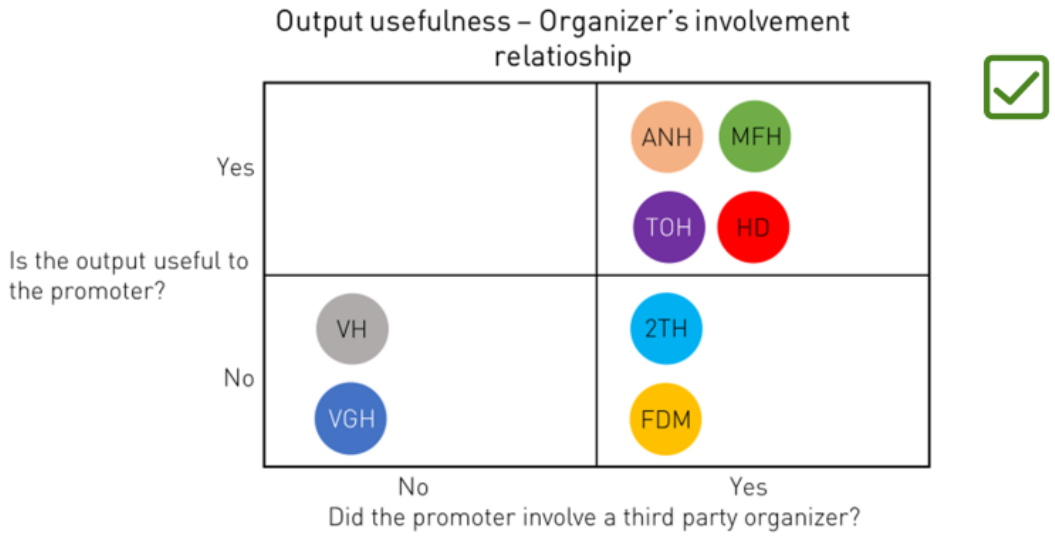
In the matrix below no polarities are found. As a matter of fact, it is only possible to see that most of the hackathons that involved an organizer reached or exceeded the target of participants. No relevant information can be retrieved from the rest of the sample as only one hackathon present in the quadrant is not enough. To have a result means to be able to provide two polarities. A result is such when a decision leads to a determined output and the opposite decision leads to the opposite result (table 32).

Table 32- Relationship between organizer's involvement and participation



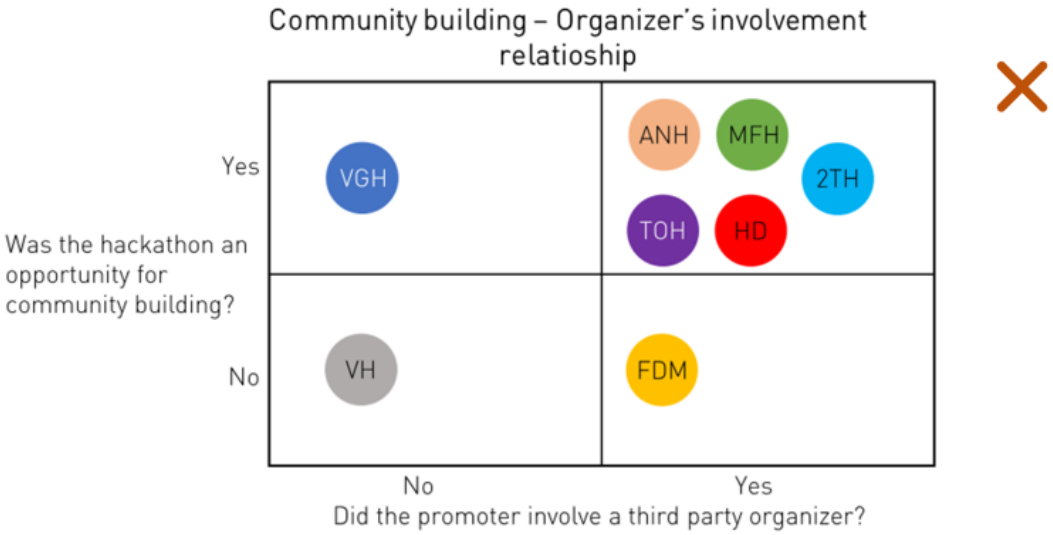
Even though not as strong as the ones previously identified, the matrix below shows two polarities. The stronger of the two being the one in the top-right corner of the table. If the hackathons on the bottom right corner are considered outliers, the polarities emerge. This is not a "clean" information but it is still possible to reason over it. The involvement of the organizer seems to be important for the generation of outputs that are useful to the promoter (table 33).

Table 33- Relationship between organizer's involvement and usefulness of the output



Finally, as in the case of the participation, no result can be retrieved from the relationship between the involvement of the organizer and the building of a community (table 34).

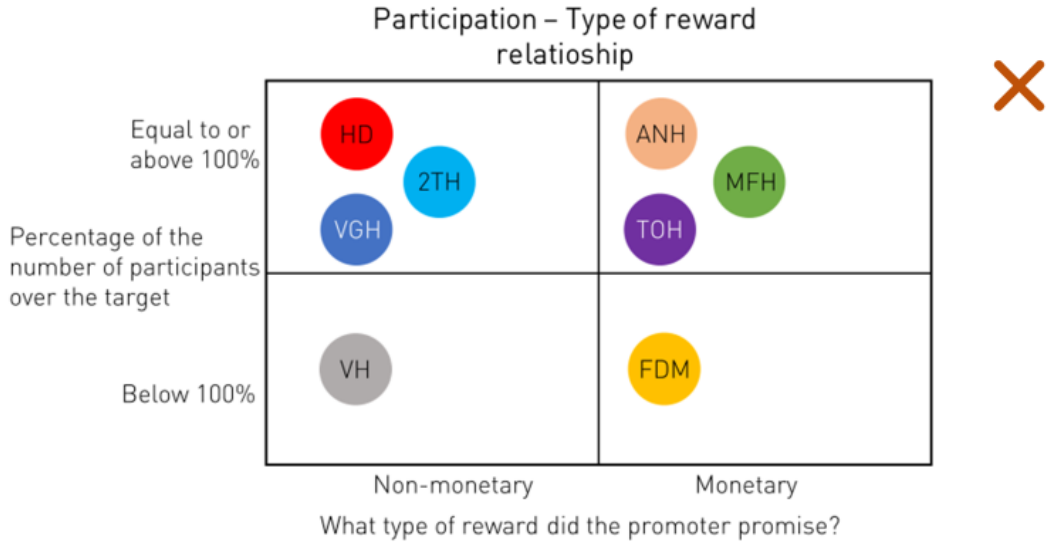
Table 34- Relationship between organizer's involvement and community building



7.2.3.4 Results from the building block "reward"

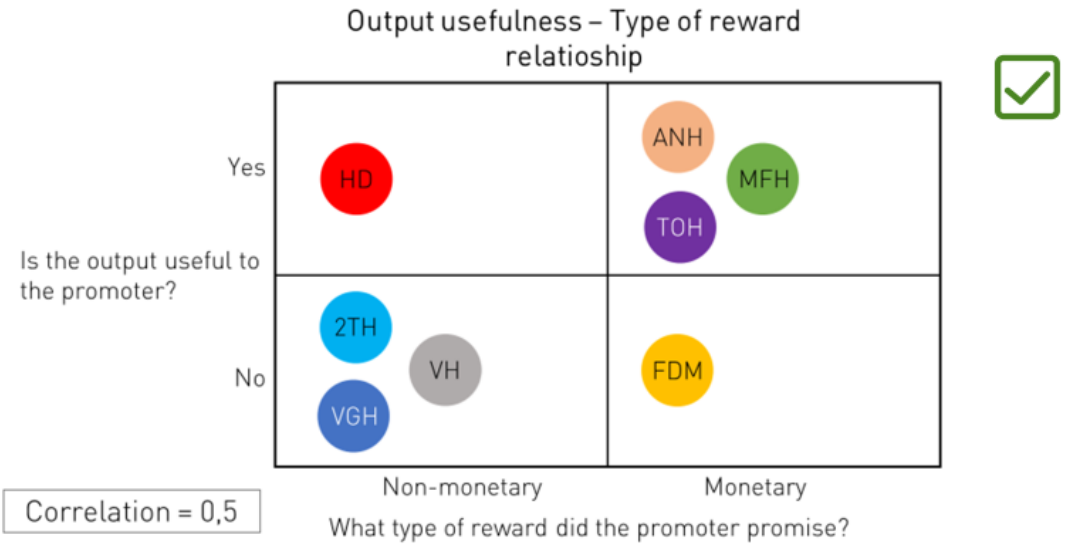
No polarities can be found in the matrix below as the six hackathons that reached or exceeded the target of participants are divided evenly in three that offered non-monetary rewards and three that offered monetary ones. However, this result is interesting as shows how the difference in reward does not actually influence the participation (table 35).

Table 35 - Relationship between type of reward and participation



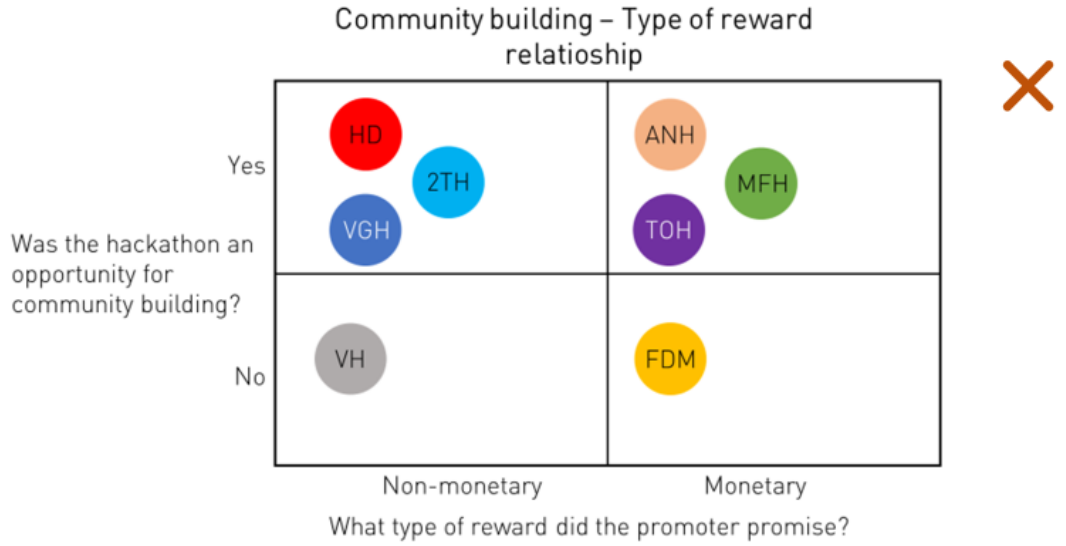
Clear polarities are shown in the matrix below. Out of eight hackathons three that offered monetary reward generated an output useful for the promoter and three that offered non-monetary reward did not manage to so do. The results shown in this table are not as "clean" as some of the other matrixes due to the two outliers, however it is interesting to see how in exchange of a monetary reward participants are able to create useful outputs (table 36).

Table 36 - Relationship between type of reward and usefulness of the output



As for the relationship with participants, the one between community building and the type of reward (table 37) does not show any polarity.

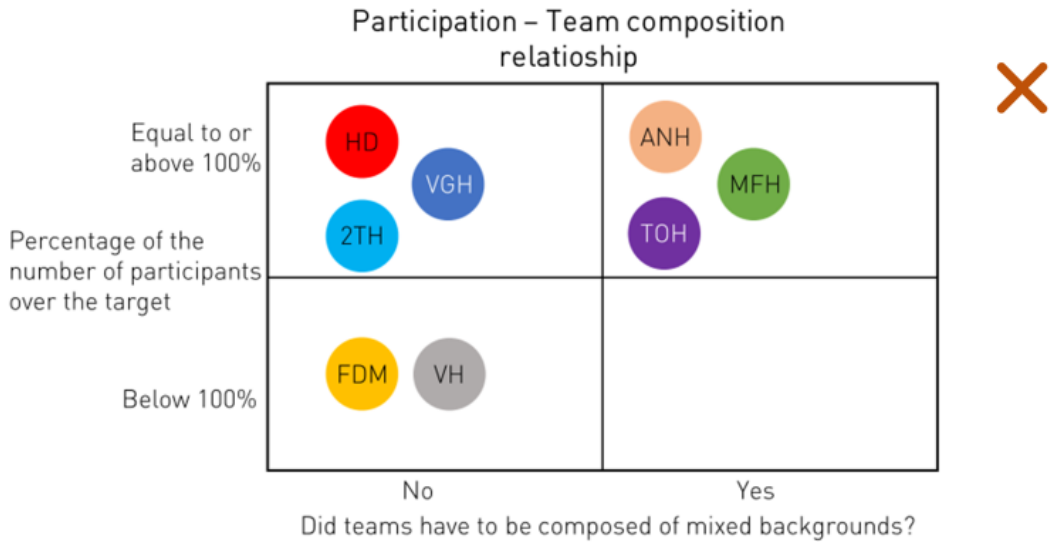
Table 37- Relationship between type of reward and community building



7.2.3.5 Results from the building block "rules on participants background" (on team formation)

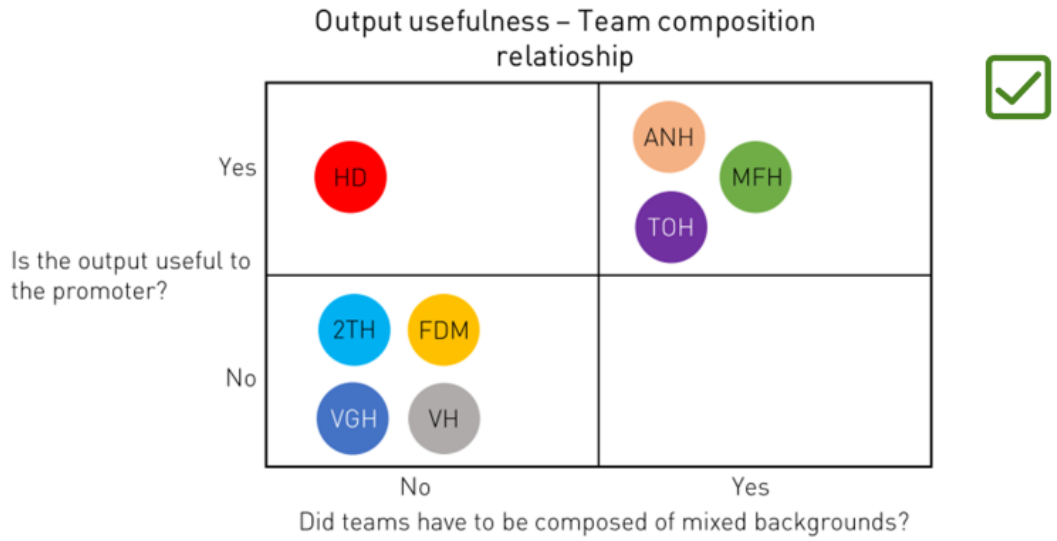
No polarity is found on the relationship between the participation and the rules on the team formation (table 38).

Table 38 - Relationship between team composition and participation



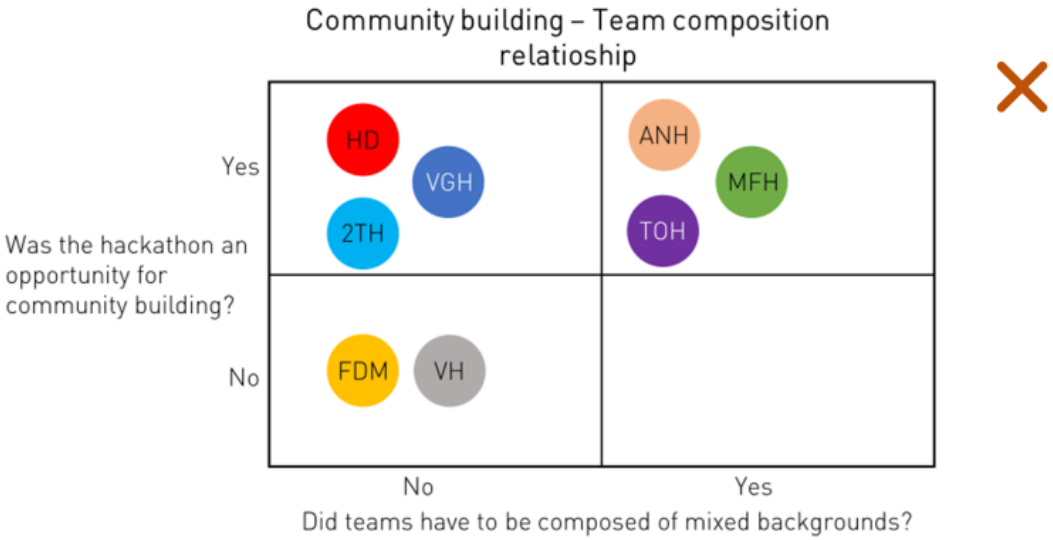
Two polarities result for the relationship between the usefulness of the output and the rules on the formation on the team. In particular it appears that heterogeneous teams are the ones that generate the useful outputs. The case of HD has to be analyzed as an outlier as there were only tech figures at the hackathon and not having mixed teams was the only possibility (table 39).

Table 39 - Relationship between team composition and usefulness of the output



The last table to analyze (table 40) does not reveal any polarity. Meaning that the community building does not depend on the mixture of backgrounds within teams

Table 40 - Relationship between team composition and community building



7.2.4 Final considerations

The analysis of results will be carried out in the next chapter where a discussion on how these enrich the current literature will also be carried on.

To conclude this part, some considerations can be made on the results. It appears that the performances of participation and community building are strictly related as those hackathons that reached the target number of participants were also the ones that managed to be an occasion for community building.

The objective of recruitment has not been analyzed as only two promoters decided to use the hackathon to recruit people. Of these two, few interviews have been done and no one of them transformed into a job offer.

It is possible to appreciate also how the matrixes that do not show any polarity can be used for enriching the literature as it may be that some academic paper identifies some behaviors that are not present in hackathons.

The division of the building blocks into the macro variables engagement and expertise was made with the intention of finding results that would be a combination of two building blocks that belong to the same macro variable and provide the same result. From a first quick look at table 24 and at the matrixes of the results, it is possible to appreciate how this is difficult for the performances of participation and community building. As a matter of fact, it was possible to identify polarities only on one building block and the results appear to be only consistently dependent on the choice of involving a community or not.

As far as the usefulness of the output is concerned, the results are a combination of the decision taken over five building blocks. As a matter of fact, from an analysis of the results it is possible to state that those promoters that decide to involve a community, ask a third-party organization to help in the organization of the hackathon, provide a monetary reward, and set precise rules on the formation of the teams are able to organize a hackathon that generates a useful output. Of course, the popularity of the promoter was left aside as it is not something that possible to decide. In other words, if a promoter follows these indications it will use the investment made on the hackathon as a way to gather innovative ideas and prototypes that it will reuse in the future.

8 Discussion

This chapter shows the results of the field research as well as explaining how this thesis enriches the literature. First the results are going to be reviewed in order to show them in detail, making considerations that go beyond the mere looking at the result and explaining the reasons behind each one. Simultaneously, the results will be compared to the literature analyzed in the first part of the thesis and a discussion will be carried on, understanding how this enriches the current literature. In addition, the validation of the integrated definition of hackathon is presented.

8.1 Theoretical contribution

The contribution to the theory is divided in two parts. The first one shows the results extracted from the literature review, the second shows the ones that were found with the field research.

From the literature, it was discovered that hackathons are a sourcing method to perform Open Innovation (Almirall, Lee, Majchrzak, 2014), (Hjalmarsson, Johannesson, Jüll-Skielse, Rudmark, 2014), (Chesbrough., Bogers, 2014), (Chesbrough, Crowther, 2006), (Chesbrough, Rosenbloom, 2002), (Chesbrough, 2003), (Dahlander, Gann, 2010), (Nerkar, 2007). This was both found during the review of the literature and during the comparison of the events. Another result is that hackathons appear to be a specific subset of innovation contests, which are a sourcing method to open innovation (Bullinger, Neyer, Rass, Moeslein, 2010), (Bullinger, Moeslein, 2010), (Carvalho, 2009), (Kastelle, 2013), (Olson, Walsh, Garg, Steel, Mehta, Data, 2016), (Terwiesch, Xu, 2008). The fact that hackathons are a subset of innovation contests is also a confirmation to the fact that hackathons are a way to perform Open Innovation. In addition, it was found that in hackathons, teams work as temporary groups organization. This is clear because when comparing the characteristics of temporary group organizations to hackathons, they resulted to be the same (chapter 3.5) (Bakker, 2010), (Lundin, Söderholm, 1995), (Nisula, Kianto, 2015), (Nisula, Kianto, 2016).

The second part, the one that deal with the results from the empirical research, is presented in the following. The results are going to be presented following the

dimensions of the performances. In particular, for each performance, it will be described the decisions of the building blocks that affect the performance and those that do not. In addition, some results found in the empirical research enrich the current literature. The way they do so is explained in the following paragraphs. Concerning the participation, it appears that the decision taken on the building block "involvement of a community" is the only one that affect this performance. There are some building blocks that were expected to influence the participation such as the popularity of the promoter and the type of reward but apparently, they did not. However, the information coming from the building block are of great importance. This is mostly important as these factors affected the performances of Innovation Contests. It appears that hackathons are a such a particular way to run Innovation Contests that some of their mechanism do not work in hackathons. First, involving a community appears to be the only decision that improve the chances of performing well over the three dimensions. Concerning the participation, it seems that communities are quite sensitive to the theme of hackathons as those hackathon that involved a community reached the target of the number of participants. Also, communities might see in the hackathon an occasion to foster their shared principles that make the community and to make the community grow, both in number and in passion. (Briscoe, Mulligan, 2014), (Irani, Vertesi, Dourish, Philip, Grinter, 2010), (Johnson, Robinson, 2014), (Lara, Lockwood, 2016).

Secondly, the literature analyzes rewards as one of the main driver of participation. Since all the hackathon offered a reward the analysis was done on the type of reward – monetary or non-monetary. It appears that participation is not influenced by the type of reward as both hackathons that offered monetary and non-monetary rewards performed well and vice versa (Girotra, Terwiesch, Ulrich, 2010), (Masters, Delbecq, 2008), (Adamczyk, Bullinger, Möslein, 2012), (Bullinger, Moeslein, 2010).

As far as the usefulness of the output is concerned, there are different building blocks that, if performed in the right way, allow for the generation of an output

that the promoter will use after the hackathon. These are: the involvement of a community, the popularity of the promoter, the involvement of an organizer, the type of reward, and the rules on the participants background in team formation.
As for the first performance, also other building blocks were expected to be influential for this performance like the specificity of the challenge and the selection of the participants but were not.
It appears how involving a community does not only mean quantity but also quality as most of the hackathons where communities were involved generated a solution useful for the promoter. As a matter of fact, communities are groups of people that are interested in a specific topic. Advertising the hackathon to a community of people interested in computer, technology and coding means to address a preselected group of people that is likely interested in participating and likely have the skills needed for the hackathon.
Also, the promoter's popularity has a significant impact on the usefulness of the output. This can be related to two reasons: one is that the more a promoter is popular, the more capable people it attracts, the other is that popular promoters are able to shape the challenge in a way that is easier for the participants to generate a useful output. It is still to define if the reason is one of the two or a combination of both. Papers that deal with how the promoter's popularity impacts on a hackathon performance were not found. Most papers on this matter were found in the commercial and advertising field. However, the result of how promoter's popularity affects the hackathons' performances is new to the literature.
In addition, the involvement of an organizer improves the chances of the hackathon to generate an output useful to the promoter. It might be that the promoter involved an organizer as it is the one that hold the contacts with most of the communities and to exploit the use of communities.
Moreover, the type of reward seems to impact the usefulness of the output. In particular, hackathons that offered monetary rewards are the ones where the output was useful. It seems that monetary rewards play a relevant role in driving the effort of participants. This enriches the literature as the papers so far had addressed the issue of the reward based on its presence, not on its typology

(Girotra, Terwiesch, Ulrich, 2010), (Masters, Delbecq, 2008), (Adamczyk, Bullinger, Möslein, 2012), (Bullinger, Moeslein, 2010).

Finally, making mixed teams compulsory plays a relevant role. As a matter of fact, this brings what was discussed in the literature even beyond. The literature analyzes how hackathon function as a way to bring together people of different fields and make them work to solve a complex issue (Angelidis, Berman, dela Luz Casas-Perez, 2016), (Artiles, Wallace, 2013), (Briscoe, Mulligan, 2014), (Depasse, Carroll, Ippolito, Yost, Santorino, Chu, Olson, 2014). This result shows how hackathons that enforced the creation of mixed teams actually generated a useful output while those that did not were not able to generate an output that the promoter could utilize after the hackathon.

Regarding the performance of community building, the building block that was found to impact this performance was the involvement of communities. Involving a community in a hackathon improves the chances of making the hackathon an opportunity for community building. This is very straight forward and has already been analyzed by the literature (Lara, Lockwood, 2016), (Munro, 2015), (Bullinger, Neyer, Rass, Moeslein, 2010), (Ebner, Winfried, Leimeister, Krcmar, Helmut, 2009), (Füller, Hutter, Hautz, Matzler, 2014), (Hallerstede, Bullinger, 2010), (Palazzuolo, 2013). However, the results found on the involvement of a community are important as they not only shed light on the reasons why involving a community is beneficial to the community itself but also, and more importantly, to the promoter.

8.2 Validation of the integrated definition

The definition provided in 3.1 represents a great enrichment to the literature on hackathon. However, if not validated with the field research, it cannot serve its purpose. In 3.1 it was left to do during the field research to understand if the definition applied to every hackathon. In the following the definition is divided in parts to see whether if the observed hackathons differ from it.

- *"Hackathons are events that last between 8 to 48 hours":* all the hackathon observed respect this statement. Therefore, this part is validated.

- *"in which participants are challenged to generate a technological innovation in the form of a functioning software or hardware prototype.":* all the teams had to present a façade of their service to a jury. This was usually done in the form of an elevator pitch in which teams showed how the prototype worked.
- *"The best idea, selected by a jury, is rewarded with a prize. This could have the form of a monetary or non-monetary (e.g.: access to online or offline courses, incubation or acceleration programs, technological gadgets) reward.":* every hackathon promised a reward. In particular there were four promoters that promised a monetary reward and four that promised a non-monetary one.
- *"Hackathons are open to different categories of participants such as business-related figures, designers and computer experts. Also, the participation of experts, in hackathons that require expert knowledge, is welcomed.":* most hackathons welcomed different kind of participants. In two cases the promoter was only looking for tech experts but in one case (Vipera Hackathon) participants with a business profile showed anyway. The case of hack.developers can be considered a outliner for its specific promoter and the specific conditions under which it was organized.
- *"Every hackathon follows a structure: team selection, creative problem solving, coding and preparation of the presentation. In the initial phase of every Hackathon participants are required to create a team. In the second phase participants engage in creative problem-solving activities, in the third phase the program gets written and in the last one the pitch is created.":* the reasoning that could be made here would be very similar, if not the same, done few paragraphs before, where it was explained that hackathons follow the four phases beside few exceptions.
- *"Hackathons are an effective way to literally "hack" existing problems and find creative and tangible technological solutions.":* this mirrors the objectives of the hackathons. As a matter of facts hackathons are ways to challenge people to think around problems to solve with technology.

The integrated definition is validated as it is safe to consider those hackathons that did not fit into the definition as outliers. As a matter of fact, the definition provided is fruit of the analysis of many papers that deal with hackathons. This definition identifies hackathons as it both differentiate these from other forms of running an Innovation Contests and is loose enough to consider all the different ways that are present to run hackathons.

9 Conclusions

This thesis provides a comprehensive literature review on hackathons analyzing hackathons per se and providing an integrated definition of these event taken from all the papers that provide a definition of hackathon. Also, during the literature review, a comparison between hackathons and other events that are aimed at providing innovative ideas to the promoter was carried on. From the analysis of the literature it was defined how hackathons function as a sourcing method to perform Open Innovation and it was noted that in hackathons, teams work as temporary groups.

From the literature, a model that shows 22 building blocks that compose the hackathon was built to analyze these events. In addition to the building blocks also four variables have been created to assess how each hackathon performed. The model has been used to observe with an ethnographic research, eight hackathons ran in Italy from April to November 2017. The data collected served as an input to the cross-case analysis from which two typologies of results have been derived. First, from the building blocks that have been performed in the same way by most promoters (all of them or seven out of eight), the characteristics of hackathons have been extracted. Even though this was merely a verification of what was found on the literature, this passage also served to validate the integrated definition of hackathon.

Secondly, in addition to the general characteristics of hackathons, the results on how a decision over a building block affects the performances of the hackathon are showed in the following:

- The involvement of communities is beneficial for all the dimensions of performance;
- The more a promoter is popular the more the output of the hackathon will be useful to it;
- There are greater chances of generating a useful output for the organizer with the involvement of a third-party organizer;

- Among two typologies of reward – monetary and non-monetary – if the hackathon promises a monetary reward, there are more chances that the hackathon will generate an output useful to the promoter;
- Enforcing participants to create teams of mixed backgrounds increases the chances that the hackathon generates a useful output.

The model built can be used as a guideline to organize, run and analyze a hackathon; therefore, the last section deals with managerial implications that the thesis holds.

9.1 Managerial implications

In order to provide organizations that want to run hackathons with guidelines and advices to run the best one for their needs, this section shows the reinterpretation of the results in the form of advices to managers.

Results show that hackathons function as a way to solve problems of different nature. Managers should know what problem they want to face with the hackathon knowing that also more than one can be faced at a time. Great importance must be put in the creation of the challenge. As a matter of fact, shaping the challenge in the right way is the best way to actually solve the problem and have useful results from the hackathon.

Results show how great the importance of communities is. These should always be involved. If the organization that runs the hackathon is actually running to create a community from nothing and does not have any contacts, the best way to solve this problem is to contact an organizer and ask him to recruit participants. Hackathons can be of different dimensions starting from a small group of people to gatherings of hundreds of people. The target should always be consistent with the budget available (place, food, gadgets, rewards and so on).

As far as the reward is concern, results indicate that monetary rewards call for a higher effort in generating a useful result. As a matter of fact, organizations that run a hackathon to collect innovative ideas, should not waste their money. It is better to spend more, offering a monetary reward, than to offer a gadget.

Also, mentors must be present throughout the whole duration of the hackathon. It is advised the presence of mentors of different background to help teams on all

the typologies of problems they might face. On the same wave length one of the most important result reside in the discovery that if participants are forced to create teams of different backgrounds, they will generate an output that is useful to the promoter.

Organizing and running a hackathon is not a difficult operation but there are certain decisions that may make the event a waste of money from the promoter. Following these advices, derived from a consistent research on the field, promoters could use hackathon as ways to solve multiple problems at once.

9.2 Limitations and further work

This thesis covers different gaps left from the literature. In particular, it covers the need of an empirical research on hackathons and indicates new direction open to investigation for further works.

However, it holds some limitations that have to be acknowledged and does not cover some gaps left from the literature.

The main limitation of the thesis is the small sample of analysis. As a matter of fact, a larger sample would have allowed for the calculation of some indexes of statistical value as well as more clear relationships between the building blocks and the performances. The sample was mainly limited due to the Italian environment where hackathons are not as popular as in certain tech district as Silicon Valley and London, where more than 200 hackathons are run every year.

The model built would produce some meaningful results from its application to a much broader number of cases.

Also, the limited number of cases did not allow for the empirical study of all the typologies of objectives that the literature identifies. In particular a deeper study of promoter that organize hackathons with recruitment purposes and the study of the recruitment process itself, would add some meaningful information to how really hackathons are useful for recruiting. The same study should be carried out with those hackathons that have an educational intent. The actual learning potential that participants get from hackathon is yet to define.

The thesis aim was the creation of a model for the use of promoters and no deep study was made for understanding the role of participants inside the hackathon.

A question that remains unanswered is the one on gender inclusivity. In the hackathons visited, the percentage of females in hackathons remained consistent with the ones found in the literature and this issue was not addressed.

Also, a possible direction of further work might be to understand how participants interact with each other during the hackathon and how different ways of interaction generate different performances.

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