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DOI:
10.1007/978-3-030-50316-1_14

Publication date:
2020

Document Version
Peer reviewed version

Participation in Hackathons: A Multi-Methods View on Motivators, Demotivators and Citizen Participation

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Abstract. Hackathons are problem-focused programming events that allow conceiving, implementing, and presenting digital innovations. The number of participants is one of the key success factors of hackathons. In order to maximize that number, it is essential to understand what motivates people to participate. Previous work on the matter focused on quantitative studies and addressed neither the topic of demotivators nor the relationship between participation in hackathons and citizen participation, although hackathons constitute a promising participation method where citizens can build their own project, amongst other methods such as meetings or online platforms. Therefore, in this study, we examined a specific hackathon organized in Belgium and collected data about the motivators and demotivators of the participants through a questionnaire and in-depth interviews, thereby following a multi-methods approach. This study contributes to the scarce theoretical discussion on the topic by defining precisely the motivators and demotivators and provides recommendations for hackathon organizers to help them bring in more participants. Furthermore, from our exploration of the relationship between participation in hackathons and citizen participation, we suggest a citizen participation ecosystem embedding hackathons to provide benefits for the society.

Keywords: Hackathon · Motivator · Citizen participation · Multi-methods

1 Introduction

A hackathon can be defined as a "problem-focused computer programming event, as well as a contest to pitch, program, and present instances of prototype digital innovations [...]. It brings together programmers and others [...] to collaborate intensively over a short period of time on software projects [...]" [3]. There are different types of hackathons [3], which can serve different purposes. As mentioned in [5], hackathons can be used by organizations looking for a way to innovate within their line of business (company-internal hackathons). Hackathons are also

more and more organized in the academic world and in the public domain (civic hackathons) as a solution to develop new ideas and improve the skills of the participants. In the latter case, hackathons are considered as a way for citizens to participate and to contribute to the improvement of services delivered by governments, for example by exploring public data repositories [7, 4]. For focus-specific hackathons to which anyone can participate (e.g. hackathons about climate, finance, etc.), one critical success factor is the number of participants. Therefore, it is key to understand the factors impacting people's motivation to participate.

While research on the hackathon phenomenon is still scarce, several studies have been conducted on the factors impacting the willingness of people to participate to such events [3, 7, 10, 13, 6]. However, most of the motivators are presented in a vague way and without detailed information. As a result, it is difficult for organizers to leverage these motivators to take concrete actions aiming to increase people's willingness to participate in hackathons. Also, the factors demotivating participation are left aside by the related studies. Finally, the relationship between the participation in a hackathon and citizen participation remains unexplored. A wide variety of citizen participation methods exist (e.g. workshops, participation in town hall meetings, etc.) and hackathons represent one of them where citizens can build their own projects and have a concrete impact on society if the project is implemented [17].

In order to bridge these gaps, this paper presents a study conducted during a focus-specific hackathon organized by a junior enterprise of computer science students in Belgium. We followed a multi-methods approach combining a questionnaire and in-depth interviews to collect insights on motivators, demotivators and on the relationship between hackathons and citizen participation. Then, we compared our findings to previous studies and provided recommendations for hackathon organizers based on the gathered insights. Finally, our findings allowed us to propose a citizen participation ecosystem aiming at generating benefits for society through hackathons.

The remaining of this paper is structured as follows. First, Section 2 presents related studies and the theoretical model used as a basis for the research. Then, the methodology applied to collect and analyze the data is detailed in Section 3. Section 4 presents the findings on motivators, demotivators, and the relationship between participation in hackathons and participation as a citizen. The implications of these findings for research and practice are discussed in Section 5. Section 6 discusses the limitations of the study and provides leads for further research. Finally, Section 7 closes the paper with a summary of its contributions.

2 Previous Studies and Theoretical Model

Previous work has studied the motivators to participate in hackathons. We must here note that we restricted this background evaluation to papers explicitly studying the motivations to participate in hackathons. Indeed, other studies related to motivation to engage in crowdsourcing (e.g. [18, 15]) and in Open Source Communities (e.g. [1]) were not considered as their focus is different.

Table 1 summarizes the previous studies within the scope of the present research and presents the most important elements they identified.

Table 1. Overview of previous work studying motivators to participate in hackathons

Code	Reference	Methodology	Studied motivators
P1	[3]	Questionnaire	Learning, Networking, Social change, Prizes
P2	[7]	Questionnaire	Learning, Networking, Solving civic issues, Performing teamwork
P3	[10]	Questionnaire, interviews (not for motivators)	Fun, Intellectual challenge, Reputation, User need, Career
P4	[13]	Documents, questionnaire, interviews, observations	Professional networking, Fun, Intellectual challenge
P5	[6]	Questionnaire	Recognition, Fun, Financial rewards, Learning

Building up on these sources, we designed a theoretical model represented in Figure 1. First, the model includes the motivators identified in previous work. In order to extract these factors, we listed several individual motivators from the studies and grouped them into overarching categories that can be found in the model. Three additional factors, namely logistics, coaching, and influence from others, have been added following preliminary discussions with 8 hackathon participants. These discussions were open-ended in nature where we first asked the participants about what motivates them to participate to have more fine-grained information about their motivation. We then showed them the theoretical model and asked them if it was complete in their opinion. We also added a general "demotivating factors" element impacting the willingness to participate. Finally, we added the relationship between the willingness to participate in hackathons and the willingness to participate as a citizen, in the broader sense. For each element of the theoretical model, Figure 1 specifies the past studies in which the element was found (see Table 1). The elements that were not found in past studies are indicated as "NEW".

This model constitutes the basis to develop the questionnaire as well as the interview guide we used to collect data for this research. These are also based on previously developed instruments such as [6], authors of which called for the use in other regions of the world than Brazil to compare the significance of the motivators they identified.

3 Methodology

3.1 Context of the Study

In order to collect data for this study, we examined the "Hope For Climate" hackathon that took place in Namur (Belgium) from the 18th to the 20th of

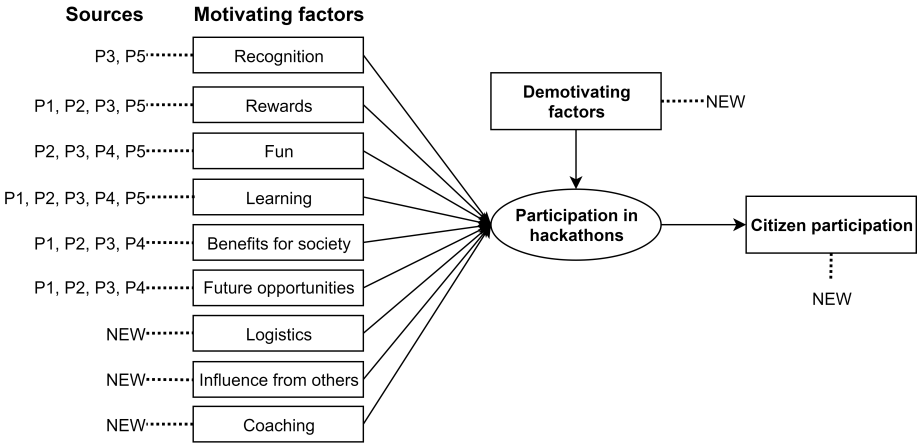

Fig. 1. Theoretical model based on previous studies

October 2019. It is a focus-specific hackathon that did not have requirements in terms of participants profiles, data, or technology to use. This event drew 65 participants. As Namur is a city with one university and several colleges, participants were, to a large extent, students coming from different institutions. They had to form groups of 4-5 to build their solutions. The goal of this hackathon was to envision and implement innovative solutions to address the phenomenon of climate change, with different sub-themes such as agriculture, waste management and green mobility. The ideas and their implementation were, on the last day, evaluated by a jury of professors and domain experts. After that, a number of non-financial rewards were given to the winning teams.

3.2 Data Collection and Analysis

In the present study, both quantitative (through a questionnaire) and qualitative (through in-depth interviews) data were collected. According to Jonhnson et al. [9], a combination of both quantitative and qualitative methods contributes to the identification of informative, complete, balanced, and useful research results. Furthermore, this multi-methods approach combining a questionnaire and interviews was also followed in a study on eliciting participants' motivation to participate in Google's Summer of Code [15] and it allowed the authors to provide a rich view of the motivators.

The quantitative insights helped us understand the importance of particular motivators for the participants and compare the results with related studies. These insights also helped us rework the interview guide to emphasize elements that seemed particularly important as well as elements identified as important in other studies, that however received less interest from the people in our sample. Through the interviews, we were able to to gain a detailed understanding of the motivators and demotivators, which was lacking in most related studies.

Quantitative Data The questionnaire is made of four parts. First, general questions are asked about previous experience with hackathons. In the second part, we refined the nine motivating factors in Figure 1 into 26 individual motivators, each relating to only one higher-level factor. We did this in order to gather information at a more granular level, which is key to have a better understanding of the higher-level motivators. Respondents were invited to indicate to which extent they were motivated by each motivator on a 5-point Likert scale going from "Totally disagree" to "Totally agree". To develop this part of the questionnaire, inspiration was drawn from the one used in [6]. An open-ended question was then asked about what could demotivate participation in a hackathon. Since no previous work details demotivators, an open-ended question appeared as the best option to leave room for creativity in respondents' answers [2]. The third part is dedicated to the relationship between participation in hackathons and citizen participation. Respondents were asked to what extent they participate in hackathons because they feel engaged with the theme and whether participating in hackathons increases their willingness to give their opinion on public matters as citizens. Respondents were also asked on the effect of participating in hackathons on their willingness to exercise citizen participation through the participation methods listed in [17] or through a civic hackathon. All the questions in this part are presented on a 5-point Likert scale. The last part of the questionnaire contains demographic questions and allowed collecting data on respondents' gender, age, education, and background. The full questionnaire is available as supplementary material[3].

A pre-test of the questionnaire was conducted with 8 people, including 4 with experience in organizing and participating in hackathons. These 8 people were the ones interviewed for the preliminary discussions. Feedback was collected on the completeness of the motivators list, on the clarity of the questions, and on the layout of the questionnaire. No issues were raised about the completeness of the questionnaire, and no unclear statement or question was mentioned in the feedback. However, some aspects related to the layout/structure were criticized and the questionnaire was adapted accordingly.

Qualitative Data In order to complement the results obtained in the quantitative analysis, we conducted in-depth interviews with hackathon participants. We relied on the results of the qualitative study to select people to interview according to a diversity criterion. We focused on the participants that had opinions differing from was is typically observed in related studies, as well as participants conforming well to what was observed in these studies.

To define the themes to cover during the interviews, we established an interview guide. It includes questions related to the motivators and demotivators of our theoretical model as well as citizen participation. The interview guide has been refined several times thanks to the feedback received from an expert in qualitative studies and the pre-test conducted with 8 people not being part

[3] `https://www.researchgate.net/publication/338885008_Participation_in_Hackathons_External_Report_Questionnaire_and_Interview_Guide`

of the study. We are aware that presenting a list of motivators to respondents might drive their choice. However, the preliminary discussions and the choice to answer open-ended questions about overall motivations mitigate that risk. The interview guide is available in the supplementary material.

To analyze the data gathered through interviews, we used a coding approach as described in [14]. First, we summarized the interviews by keeping only the interesting parts of the transcripts and we recorded the summaries in a data memo, interview per interview. Afterwards, the coding of the summarized interviews was split between the researchers involved in the present paper. Each researcher coded the data about the factors assigned to him, through all the interviews. To do so, the first step consisted in skimming through all the interviews to get an overall view on participant's answers. After that, important sentences were highlighted and coded using short sentences. The codes were then inserted in a table, allowing to perform analysis for a given theme across all the interviews. As the analysis was progressing, the researchers could write memos to record insights and thoughts. The whole coding phase was conducted in a cloud-based document shared among the researchers who could therefore follow the coding process as applied by the others. This was useful to reach agreement on the codes that were used and to make adjustments as needed.

4 Results

4.1 Sample Description

In total, 50 of the hackathon participants (40 males and 10 females) completed the questionnaire. They are aged between 18 and 25, with an average age of 21. The young age of the participants is a result of the fact that the hackathon attracted mostly students. Whereas the examined hackathon was a first experience for most of the respondents, 14 (all males) reported having participated in hackathons in the past. 9 of them participated in one previous hackathon, the 5 remaining having participated in two or more. Table 2 describes the respondents sample by education level (i.e. highest degree obtained) and background. The larger part of the sample consists of males enrolled in computer science studies. In total, we were able to interview 11 of the 50 respondents. Due to space restrictions, a summarized view of the sample's distribution is provided. The detailed information is available in the supplementary material of this paper.

4.2 Quantitative Analysis

Motivators Figure 2 shows, for each of the 26 individual motivators, the number of respondents who considered it as such. These are the ones who answered "agree" or "totally agree" when asked if their participation in a hackathon was motivated by the motivator at hand. The motivators colored in dark blue motivate at least 75% of the respondents. They mainly cover aspects related to fun, learning, and influence from other people. The motivators colored in light blue

Table 2. Respondents sample description by education level and background.

Education / Background	Computer science	E-business	Other	**Total**
Secondary	25	1	3	**29**
Bachelor	11	4	–	**15**
Master	4	–	1	**5**
Other	1	–	–	**1**
Total	**41**	**5**	**4**	**50**

motivate at least half of the respondents but less than 75%. They mainly concern the benefits of the hackathon for the society, the logistics, and the opportunity to learn about a domain. Finally, the motivators colored in red motivate a minority of the respondents. They cover recognition and rewards for the main part.

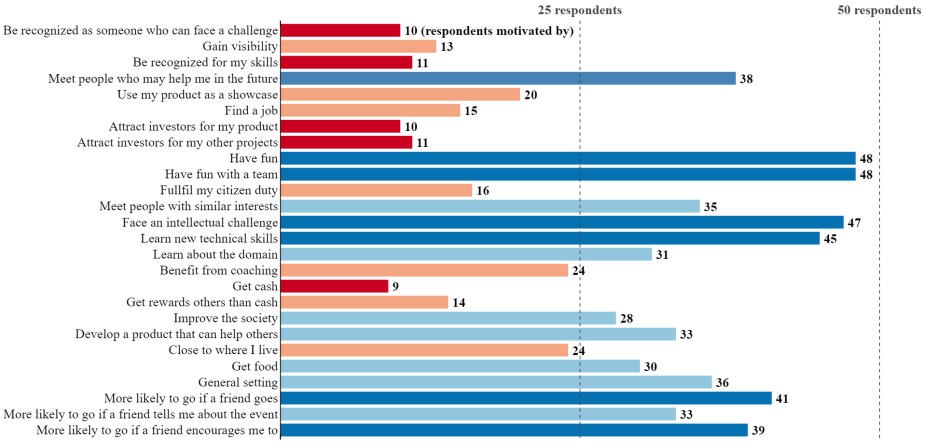

Fig. 2. Number of respondents who are motivated by each motivator. Individual motivators are colored from dark red to dark blue accordingly.

Demotivators Concerning the demotivators, the question was asked in an open-ended way. Although it was not mandatory to answer, 44 of the 50 respondents did provide an answer. In total, 27 distinct demotivators were extracted from the answers. They were aggregated into 12 categories listed in Table 3 and ordered by number of respondents having mentioned them.

Link with citizen participation As for the questions related to citizen participation, 25 respondents reported that they participate in hackathons because

Table 3. Demotivators for participation listed in the questionnaire.

Demotivating factor	Occurrences
Financial aspects (participation fee, no free food)	11
Theme (not interesting, not inspiring)	11
Personal schedule (not enough free time to participate, inconvenient date, already something else planned, laziness)	9
Location (accessibility)	7
Organization (lack of commitment from staff, bad organization)	5
Too high requirements (expectations for the output to produce, level of skill required, fear of lacking skills)	5
Setting (general setting, sleeping conditions, not enough food, not enough activities during breaks)	5
Social aspects (no friends attending, not enough participants)	5
Constraints (not enough freedom, mandatory attendance to talks, mandatory technology)	4
Too much competition	3
No reward	2
Business (no sponsor, too strong emphasis on business)	2

they feel engaged in the theme addressed during the event. Also, 22 respondents indicated that participating in a hackathon increases their willingness to give their opinion as citizens. Pearson's correlation coefficient between the answers to these two questions reaches 0.54. This suggests that participants whose participation is motivated by the theme could be good candidates for citizen participation initiatives on the same subject. Regarding the questions on whether participating in a hackathon increases respondents' willingness to exercise citizen participation through various methods, no striking finding could be extracted. For each method, approximately half of the respondents gave a neutral answer. Nonetheless, a slight preference toward offline methods can be observed. Figure 3 shows the answers distribution, going from "Totally disagree" in dark red to "Totally agree" in dark blue. It can be observed that the workshop and the civic hackathon received more positive answers than the others. Another interesting observation is the high correlation between the answers for the "learn about the domain" motivator and those for the questions on participation methods (ranging from 0.38 to 0.48 for most methods). This suggests that participants attending talks on the domain at the hackathon may be interested to extend their engagement on the theme through citizen participation.

4.3 Qualitative Analysis

Overall motivators As introductory question, interviewees were asked about their motivators to attend hackathons in general. The most important motiva-

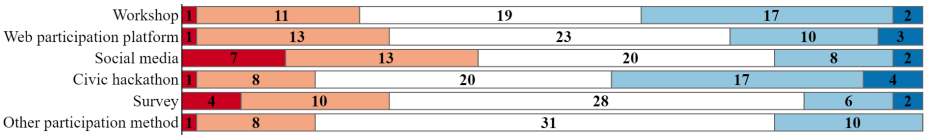

Fig. 3. Answers distribution for the questions on whether participating in a hackathon increases respondents' willingness to exercise citizen participation through various methods, going from "Totally disagree" in dark red (left) to "Totally agree" in dark blue (right).

tor is fun, mentioned by 9 out of 11 informants. The motivators that came next are the opportunity to learn (8), the influence from others (7), the theme (4), the proximity of the hackathon location (3), the opportunity to test one's development skills (3), the conviviality (2), the rewards (2), the opportunity to work on new projects (1), the prestige (1), the convincing communication by the organizers (1), the opportunity to meet sponsors (1), and the professional recognition (1). The two interviewees who had participated in hackathons in the past indicated that their motivations evolved since their first hackathon.

Rewards The rewards were not considered as a major motivation by the interviewees. This finding is consistent with the quantitative insights. Depending on the interest of the interviewees, the preference was set on non-financial rewards (for the pleasure of receiving a "gift" and part of the fun experience) or on financial ones. This latter interest on financial reward was revealed by an interviewee with a high number of participation in hackathons. He now makes a balance between the efforts necessary to win the hackathon and the amount of money to be won. One interviewee mentioned he would like hackathons to offer a more diverse set of prizes to soften competition during the event.

Recognition Most of the interviewees do not participate in hackathons hoping to get some recognition. Rather, they view recognition as a nice side-effect. Those who are looking for recognition want to be recognized for their technical skills, but not only. They also want to be recognized for their way of thinking, their determination, their engagement in societal issues, etc. For other interviewees, participating in hackathons is a way of feeling proud of themselves and building up self-confidence, thus as a form of self-recognition.

Future opportunities This motivator was elicited as heavily linked with recognition. Indeed, recognition is sought either from peers (e.g. other participants, fellow students) or from companies. Some participants have a prior interest in specific companies. In this case, the presence of these during the event can be a motivator as the hackathon represents an opportunity to be recognized by these companies. Those participants would seek recognition by getting in touch with

the companies, demonstrating their abilities during the event, or promoting their participation in a hackathon on their resume.

Fun One of the elements that was mentioned multiple times is the general atmosphere of the hackathon and the fun associated with it. There are a number of elements contributing to the creation of the atmosphere, making the fun a complex yet essential motivator to define. A first element is the freedom left to the participants. Besides the final deadline, participants of the examined hackathon had no obligations and had complete freedom around what they were doing and how to manage their time. A number of training sessions and conferences where organized but attendance was not mandatory. Participants seemed to like this ability to walk freely and "do whatever they want". Another element contributing to the atmosphere is the fact that participants were barely sleeping and had the possibility to sleep on premises, which was fun for some of the interviewees.

Besides this, a number of elements related to the social context created in the hackathon were identified as contributors to the fun. These include the fact that people are programming with friends, interacting and meeting with other people with similar interests, being among "geeks" to code for fun and finally, engaging in distracting activities such as playing cards during breaks.

Another recurrent element is the competition spirit of the participants. The examined hackathon was centered around conviviality rather than competition. While it was mentioned as a positive aspect by some, others would have liked more competition.

In addition to these elements, the ability to learn and to challenge oneself to create something concrete in a short time frame to solve issues faced in a problem domain was also mentioned as part of the fun. The social dimension of the hackathon came to reinforce the fun that participants found in these aspects.

Learning Learning was one of the motivating factors identified by past studies which applied also in our case. Through the interviews, we gained insights about the elements participants expected to learn. They can be grouped into three categories. First, there are technical skills such as programming languages and libraries. Second, there are skills related to project management and particular soft skills such as time management, the ability to work under pressure, the efficient coordination and collaboration with freshly met people, and communication about a project idea and about a product. Finally, there is knowledge about the theme of the hackathon (e.g. climate change). Based on the interviews, it appears that hackathons could be a good way to raise awareness on particular problems. Most of the interviewees were interested in more than one of the learning categories previously mentioned, to a different extent. Some expected learning more about technical elements while others had more interest for soft skills.

Interestingly, one interviewee mentioned he was participating in hackathons to put his prior knowledge into practice rather then learn new skills. For him,

the hackathon contributed to the learning of previously acquired skills, thereby building up experience rather than acquiring new knowledge.

Coaching In the examined hackathon there were coaches with limited technical knowledge but able to help participants with soft skills, project management, idea development, and communication. Overall, the presence of coaches was well received by the interviewees and considered useful. We found that coaches should help participants mostly regarding soft skills and idea development. Technical assistance is nice to have but less important and it should not be the main aspect of coaching. Coaches should be present without disturbing the participants. According to the interviewees, coaches should provide short trainings on specific soft skills and come to check on them 1-2 times a day.

The quantitative findings show that coaching is not a motivator. However, some interviewees mentioned that the presence of coaches to support them and to challenge their ideas was a source of motivation and stimulation. We believe that the discrepancy between the quantitative and the qualitative findings is due to the fact that we discussed coaching in detail during the interviews and defined with the interviewees what would be an appropriate coaching. The questionnaire did not provide any detail about how the coaching would be done.

Benefits for society The quantitative analysis showed that improving the society and developing a product that can help others are important motivators. However, the findings from the qualitative analysis temper this result as most interviewees do not think hackathons can have a concrete impact on society. They believe that the ideas are not innovative enough as they have probably been tested elsewhere already. Another criticism linked to the theme is that the problem to address is complex and will not be impacted by simple solutions. One interviewee mentioned that if he wanted to help with climate (theme of the examined hackathon), he would "go out and clean the streets". A possible solution proposed by two interviewees is to invite investors at the beginning of the hackathon so that they can express their needs and later invest in the projects with high potential or provide them incubators to develop their idea. Another solution is to develop a wiki where all ideas developed in the hackathon can be gathered for others to build upon them.

Providing benefits to society is considered as a nice side-effect of hackathons but the majority of the informants do not view it as a part of their civic duty to participate in such events. However, four interviewees mentioned that it is the responsibility of students to suggest ideas, learn about different topics through hackathons, and that it was a way for a different audience to "bring something on the table" without being interested in politics. These interviewees underlined that the positive impact of hackathons on society does not reside in the ideas themselves but rather in the brainstorming exercise, the raising of awareness about a theme, and the sensitivity it could raise in people about a specific issue.

Logistics The interviewees mentioned that wifi, food, tables, and working rooms are must haves. Showers and beds are considered as nice to have. Furthermore, several interviewees noted that the pizza they received was a motivator.

Influence from others The influence from the social environment was considered as a key motivating factor by the interviewees. Out of the 11 interviewees, 7 stated they would never have participated without friends coming with them. This reluctance to go alone is due to the additional difficulties it induces (working with freshly met people, getting out of one's comfort zone). However, one interviewee mentioned that this could constitute a nice challenge as well.

Demotivators When asking the interviewees which elements would drive their decision not to participate in a hackathon, several elements were cited. The most important demotivating factor is the theme, mentioned by 6 of the 11 interviewees. Other demotivators include a high fee to join the hackathon (5), a too basic setting (3), a too strong competition spirit (3), the location and bad accessibility (3), the technical skills of the team (1), the lack of reward (1), the jury evaluating only the idea (1), the lack of learning opportunities (1), the lack of networking opportunities (1), and vagueness in the information published by the organizers when advertising the hackathon (1). These demotivators and their importance are consistent with the results of the quantitative analysis.

Link with citizen participation Among the interviewees, 4 mentioned that they were not interested in being involved in a citizen participation activity whereas 7 stated they would like to. The reasons for non-participation mentioned by the interviewees were a lack of interest, a lack of experience, a lack of skills, the distance to the participation activity, shyness, and a selfish personality. Among the reasons to participate in public life, the most important driver was that the political representatives should not be in charge of everything (4), that every citizen has something to add in the discussion, that some groups such as students can be underrepresented in political discussions (2), and the possibility of getting out of one's comfort zone and suggest ideas (1).

Regarding the preferred participation methods, the quantitative analysis showed a slight preference for offline methods (workshops and civic hackathons). This is consistent with the insights obtained from the interviews. Participating through social media and online platforms was dismissed by the interviewees because it is not a real-life setting and it could foster extreme or non-constructive opinions. Furthermore, social media force participants to share their opinion publicly. Interviewees' opinion toward offline methods was more favorable. Through a workshop, the direct communication with officials and the consequent possible impact on political decisions was considered as a good benefit. However, the time-consuming nature of this method still remains a barrier. The civic hackathon method was the most preferred by the interviewees. According to them, it allows solving concrete societal issues if they are not too complex, de-

livering practical and usable ideas, meeting real-life stakeholders, and submitting semi-anonymous ideas as they emerge from a team and not from a person.

5 Discussion

5.1 Implications for Theory

Based on previous studies, we devised a theoretical model structuring motivators, demotivators, and the link between participation in hackathons and citizen participation. Compared to previous literature, we included additional motivators and we added the concepts of demotivators and citizen participation. Also, motivators were studied on a finer-grained level. This allowed having a more complete understanding of the meaning of motivating factors. In most related studies, the factors are reported as such, without further explanation of what they actually meant (e.g. what is meant when mentioning the fun experienced by participants). By splitting each motivating factor into individual motivators, we were able to understand which aspects of learning, fun, and the other factors were motivating for participants.

The results we observed are, to some extent, similar to those reported by previous studies. For instance, the fun and the learning opportunities were identified as the most important motivators in our study. For other motivators, however, our findings differ. Whereas recognition and networking were identified as prominent motivators by several previous studies, they did not appear as such in our case. We believe this may be due to contextual and cultural differences between our study and previous ones. However, we did not consider these factors in our work, and further research is required to measure their impact.

Regarding the aspects unexplored by other studies, the interviews revealed that coaching was well-perceived by the participants and that, in an appropriate form, it can be a motivator. Second, the influence from others and the logistics were revealed to play an important role, respectively as motivator and demotivator. Our study uncovered several demotivators, some of which are direct counterparts of motivators. However, as a first attempt, their identification remained exploratory. A valuable research work would be the design of a detailed survey instrument for demotivators, that could be completed by non-participants as well. As for citizen participation, we noted that the questionnaire was not sufficient for our research question. Answers to the questions were mostly neutral, and it was thus difficult to formulate insights. We believe this is due to the fact that citizen participation is an unfamiliar topic for many respondents, which were therefore not sure what to answer. The complementary qualitative approach was thus necessary. It showed that the civic hackathon is the preferred participation method of hackathon participants. This opens the way for further research on this method with this audience.

5.2 Implications for Practice

Hackathons within a citizen participation ecosystem Hackathons can be considered as a participation method allowing citizens to give ideas and

concretely build solutions to improve society. These hackathons are referred to as civic hackathons [8]. However, as highlighted by the qualitative insights, hackathons do not necessarily lead to increased benefits for society even though they are the favored participation method for the hackathon audience. Therefore, based on the insights gathered from the interviews and on previous literature [8, 16], we propose to embed hackathons within a participation ecosystem with complementary methods, as illustrated in Figure 4.

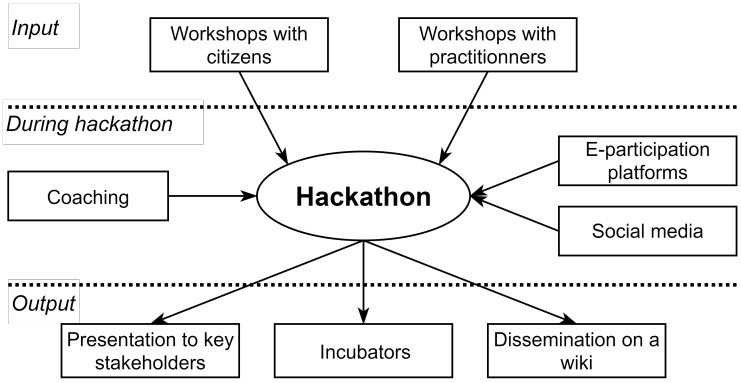

Fig. 4. Hackathons within a citizen participation ecosystem

As input for the ecosystem, workshops with practitioners and citizens can be conducted in order to elicit concrete needs from the population. Then, during the hackathon, other methods could be used to fuel the idea generation. Social media and e-participation platforms could be analyzed using opinion mining algorithms (see [11] for an overview of methods). Furthermore, a strong coaching by knowledgeable experts should be performed to challenge ideas and help refine them. As output of this ecosystem, we recommend the ideas to be put on a wiki to facilitate dissemination. Furthermore, we recommend the invitation of public agents, political representatives or investors to witness the presentations of the top ideas to increase their chance of implementation. Finally, the ideas and the respective teams behind them could be supported by an incubator to help the team going from a prototype to a fully-functional solution.

Recommendations for organizers Based on the insights collected in the in-depth interviews, we list nine recommendations for potential hackathon organizers in order to maximize the number of participants.

1. Provide activities to develop the fun experience (playful activities or interaction between participants).
2. As the main demotivator to attend a hackathon is the theme, find a balance between the relevance and the feasibility of the theme.

3. Since a lot of interviewees would not go alone, especially as first-time participants, provide an ice-breaking activity to encourage people to come alone without fear. Furthermore, organizers should clearly communicate about these activities before the hackathon to encourage the prospective participants to come (even alone if none of their friends is participating).
4. As competition is not a main motivator, plan different rewards to keep a sense of competition but give everyone a chance to win by focusing on different aspects of their solution.
5. Develop the technical training if the focus is on technology and the thematic training to raise awareness on the topic if the hackathon has a specific theme. In both cases, provide training for soft skills such as pitching and ideation.
6. Enroll coaches to support participants in the development of their idea. Coaches should remain non-intrusive and intervene at appropriate times.
7. As the participation fee is an important demotivator, find sponsors or apply for funding instead of charging participants.
8. Be clear on the objectives of the hackathon and provide development opportunities for the ideas (incubators, investors, wiki, etc.) after the event.
9. Plan the basic hackathon requirements (beds, showers, wifi, etc.) and do not underestimate the importance of pizzas.

6 Limitations and Future Work

The study presented in this paper has several limitations. These are discussed below, along with further research leads resulting from them.

As discussed in Section 5, some of our findings differ from what has been reported by related studies. This may be due to differences in contextual (e.g. type of hackathon, characteristics of participants) and cultural factors. Thus, the extent to which our findings can be generalized is limited. However, we developed a new survey instrument which we believe can be applied in other hackathon contexts as well. Conducting different studies with our survey instrument would allow measuring the impact of those contextual and cultural factors. For further studies, we recommend to study a larger hackathon with a more diverse set of participants. Then, by applying random sampling to select respondents, the risk of bias can decrease. Furthermore, we also recommend to interested future researchers to collect data from people that considered going to hackathons and that decided not to go in the end. This would allow a richer analysis of the demotivating factors.

The second limitation stems from the audience of this hackathon, which mostly consists of first-time participants enrolled in computer science studies. This sample was interesting as the previous experience did not influence their motivations. However, the qualitative analysis hinted that the factors impacting a potential participant's motivation evolve as they attend hackathons. Due to its focus on one hackathon and the nature of its participants, our study could not yield detailed insights on this phenomenon. Therefore, we recommend to conduct a longitudinal study to better understand this evolution.

Third, even though we suggest actionable recommendations for organizers as well as a participation ecosystem for hackathons, these are not tested in practice. Therefore, we recommend to follow action research [12] to test these elements in practical cases and validate them over time.

7 Conclusion

One critical success factor of hackathons is a sufficient number of participants. In order to maximize it, it is key to understand what motivates participants to attend hackathons. With this purpose, we conducted a study following a multi-methods approach, involving the collection and analysis of both quantitative and qualitative data, respectively through a questionnaire and in-depth interviews. In total, we collected 50 answers to our questionnaire and interviewed 11 of the respondents. Data was collected from participants of a focus-specific hackathon organized by computer science students on the theme of climate change.

The contribution of this paper is threefold. First, based on existing work on motivations to participate in hackathons, we built a new survey instrument measuring 26 individual fine-grained motivators. The quantitative data collected from the questionnaire allowed us to identify the most important motivators and to compare our findings with previous studies. The fun, the intellectual challenge, the opportunity to learn technical skills, and the influence from others appeared as the main motivators. Through the interviews, further insights were collected to define them more precisely. Second, we studied the demotivators to cast some light on the factors that can deter people from going to hackathons. We observed that the theme and the entry price are the most important ones. Third, as hackathons constitute a citizen participation method, we investigated the relationship between participating in a hackathon and the willingness to engage in various citizen participation methods. We found that participating in hackathons would increase the willingness of participants to engage in offline participation methods, and especially in civic hackathons.

Based on the collected insights, we were able to provide actionable recommendations to hackathon organizers and to propose a model embedding hackathons within a citizen participation ecosystem. These outputs constitute a promising basis for further research.

Acknowledgments

We would like to thank the European Regional Development Fund (ERDF) and the Belgian Federal Science Policy Office (BELSPO) for their support. The research pertaining to these results received financial aid from the ERDF for the Wal-e-Cities project with award number [ETR121200003138] and the Federal Science Policy according to the agreement of subsidy [BR/154/A4/FLEXPUB]. We also thank the members of CSLabs who agreed to integrate our research in the event they organized. Finally, we thank the participants of the hackathon who, despite the tight schedule, dedicated time to our research.

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