Crowdsourced Software Development in Civic Apps
Motivations of Civic Hackathons Participants

Kiev Gama
Centro de Informática, Universidade Federal de Pernambuco (UFPE), Recife, Brazil

Keywords: Software Crowdsourcing, Hackathon, Motivation, Civic Apps.

Abstract: Hackathons are intensive events that typically last from 1 to 3 days, where programmers and sometimes people with interdisciplinary backgrounds (e.g., designers, journalists, activists) collaborate to develop software applications to overcome a challenge proposed by the event organizers. Civic hackathons are a particular type of hackathon that gained momentum in the last years, mainly propelled by city halls and government agencies throughout the world as a way to explore public data repositories. These initiatives became an attempt to crowdsource the development of software applications targeting civic issues. Some articles in academic literature have conflicting arguments about factors that motivate developers to create such apps. Claims are mostly based on anecdotal evidence since research is still scarce in the empirical analysis of civic hackathons. Thus, we decided to do a study to gather data under the perspective of hackathon participants, focusing on what motivation factors make them join such competitions. We conducted a survey research where we intended to provide empirical evidence for a diverse audience (e.g., hackathon organizers, open data specialists) interested in civic hackathons as a form of software crowdsourcing. In this work, we present preliminary results.

1 INTRODUCTION

Hackathons are continuous events that engage people in small groups to produce software in a limited amount of time, typically lasting from 1 to 3 days (Komssi et al., 2015). They gained popularity in technology companies in the 2000s as a way to promote exploratory coding, new idea generation, and prototyping with low-risk (Carr and Lassiter, 2017). Leveraged by many government open data initiatives, which aim at the increase of public transparency, civic hackathons or "app contests" became an opportunity for governments to invest in crowdsourced software as a new form of procurement (Johnson and Robinson, 2014). These are issue-oriented hackathons, focused on governance and public life, that go in a different direction of corporate hackathons, which concentrate on specific technologies and business opportunities (DiSalvo et al., 2014).

Initial competitions for "civic apps" development brought the argument that a few thousands of dollars invested in prizes would generate crowdsourced software that altogether would cost millions of dollars to develop (Lee et al., 2015). However, in recent years, the potential of these contests started to be criticized due to numerous issues such as the apps' utility (Carr and Lassiter, 2017) or quality (Johnson and Robinson, 2014), and the hackathons process (Ferrario et al., 2014) or scope definition (Lee et al., 2015).

Apps developed in civic hackathons are said to be quickly abandoned by users because of a lack of focus on the citizen (Townsend, 2013). These claims are in part confirmed by a study(Lee et al., 2015) reporting that developers participating in these competitions have a limited perspective of the city problems and little experience with city services. Therefore, they usually create what they think to be appealing, guided by their personal experience. However, that study also brings into discussion other aspects such the applications being of low quality. Johnson and Robinson (Johnson and Robinson, 2014) also mention the variable quality and highlight that the gap between design and implementation signals the importance of tracking the outcomes of civic hackathons.

Besides these claims about the results of civic hackathons, we also found contradictions in the literature about the motivation of participants to join these events. While some studies say participants join these competitions because of money and prizes (Almirall et al., 2014), others allege that those are the least important motivation factors (Hartmann et al., 2016) (Juell-Skielse et al., 2014). Briscoe and Mul-

Gama, K.
Crowdsourced Software Development in Civic Apps - Motivations of Civic Hackathons Participants.
DOI: 10.5220/0006377005500555
In *Proceedings of the 19th International Conference on Enterprise Information Systems (ICEIS 2017) - Volume 2*, pages 550-555
ISBN: 978-989-758-248-6

ligan (Briscoe and Mulligan, 2014) present the top three reasons for attending a hackathon as learning, networking, and social change, while prizes come in fourth place.

After looking for empirical studies with deeper analysis and evidence to support all of those claims, we found academic research about civic hackathons to be scarce and limited. Johnson ad Robinson (Johnson and Robinson, 2014) mention that fact which is reinforced by more recent work from Carr and Lassiter (Carr and Lassiter, 2017). Even though crowdsourced labor is one of the most common features of civic hackathons (DiSalvo et al., 2014), we still found limited literature on software engineering research focusing on civic hackathons as a way of software crowdsourcing. Currently, studies of crowdsourcing in software engineering (Mao et al., 2016) are rather focused on a perspective where global software engineers are recruited through open calls in online platforms. Concerning motivation in civic hackathons, most of the work is either addressed to more general forms of crowdsourcing (Leimeister et al., 2009) (Hossain, 2012) or brings limited studies sampling the participants of just one competition (Juell-Skielse et al., 2014) (Decker et al., 2015).

We decided to do a preliminary study to gather data under the perspective of hackathon participants, focusing on two points: (1) how they are dealing with software engineering activities and (2) what motivation factors make they join such competitions. Based on that, we did an online survey with civic hackathon participants from different countries. We presented the results around point (1) in another work (Gama, 2017), while the results around point (2) we detail here. What we explore the current article is based on the following research question: **"What are the main motivation factors of participants in civic hackathons?"**. With this study, we want to gain an initial understanding on that topic as well as to verify if our preliminary results can support the claims we found in literature. It also allows us to provide empirical evidence for a diverse audience (e.g., hackathon organizers, open data specialists) interested in civic hackathons as a form of software crowdsourcing.

The remainder of this paper presents related work in section 2, section 3 presents the methodology we employed, section 4 discusses the results of our survey, followed by our conclusions in section 5.

2 RELATED WORK

From a general perspective on crowdsourcing, there are some studies highlighting aspects that motivate people to join such practices. Leimeister et al. (Leimeister et al., 2009) analyze motives and incentives that lead to participation in information technology-based ideas competition. Intrinsic motivation is related to behavior initiated without external incentives (e.g. a hobby). External motivation is activated by external incentives (e.g., direct or indirect monetary compensation, recognition by others). They allege that competitions organizers are not able to influence intrinsic motivation. In a crowdsource competition organized by a large technology company, Leimester and colleagues found that prizes were an important motivation aspect after "Appreciation by the organizer."

These findings go in a different direction from other studies, like (Seltzer and Mahmoudi, 2012) who emphasize that any compensation by money or rewards is less important than more subjective aspects such as the prospect for public recognition or satisfying inner desires. Hossain (Hossain, 2012) performed a study on motivation in crowdsourcing where he mentions intrinsic incentives as the dominant motivational factor in open source software. When analyzing crowdsourcing platforms, the author arrives at the conclusion that extrinsic motivation is more dominant than intrinsic motivation. However, that analysis is limited since it is solely based on the analysis of platforms, without ever collecting opinions of people that participate in crowdsourcing.

If we narrow down the scope to studies focusing on civic apps development on different types of civic app competitions (e.g., civic hackathons), we also see contradiction about the importance of prizes. Almirall et al. (Almirall et al., 2014) support the argument that instead of being motivated by civic engagement, hackathon and application development contest developers are driven by entrepreneurship and the rewards of the contests. There is no data presented by the authors to support those claims. Decker et al. (Decker et al., 2015) found that the social aspect and the community involvement aspect were relevant to some of the participants of a non-competitive hackathon they organized. (Lee et al., 2015) mention that developers go to civic app contests not only after money but also looking for visibility that would help them get investments. In a study of 24 civic app contests (Hartmann et al., 2016), researchers confirmed that civic hackathons are typically centered on the support of open data usage and development of useful services for citizens. Participants are driven by motivation around engaging in the construction of that as well as meeting new people, discussing ideas and improving skills. Juell et al. (Juell-Skielse et al., 2014) performed a survey with participants of a 24-

hour civic hackathon held in Sweden; the authors found that the top three triggers of motivation were all related to intrinsic motivation: fun and enjoyment, intellectual challenge, and status and reputation.

Briscoe and Mulligan (Briscoe and Mulligan, 2014) on a survey with 150 participants from the USA reported that the motivation for these people to participate in hackathons was learning, networking, social change, win prizes, free pizza, build a product, glory, find a team, find employment, and attract investors, in that order.

Hackathons, in general, have been used as a learning platform (Nandi and Mandernach, 2016), where students can teach and learn from their peers. Participating students spawned creativity and enthusiasm. The hackathons established valuable mentorship connections with alumni. The authors mention that students involved in these hackathons tend to have better grades than those who did not participate. We found this related to the different forms of intrinsic motivations, from an interpersonal level, such as cooperation and recognition, which are supported by (Malone and Lepper, 1987) in the context of learning.

3 METHOD

In our study, we used a survey to gain a broad understanding on how participants of civic hackathons perceive the software development practices they employ in the different project lifecycle activities and what factors they consider more important as motivation for joining such competitions.

3.1 Research Question

When performing survey research, having clear research questions is a precondition (Easterbrook et al., 2008). Before defining the questionnaire, we defined our research questions that would be broken down into a more detailed questionnaire. Our research focuses on two concerns: (1) how civic hackathons are dealing with software engineering activities and (2) what motivation factors make they join such competitions. In complementary work (Gama, 2017), we discuss research questions concentrated on the first concern (1) while the second one is depicted below:

RQ: "What are the main motivation factors of participants in civic hackathons?". We try to understand the motivations of people that participate in civic hackathons. For instance, participants of civic hackathons are driven by motivations such as meeting new people, discussing ideas, and improving skills rather than going after money (Hartmann et al., 2016).

Table 1: Motivation factors asked to civic hackathon participants. The answer was measured in a five-point Likert scale, ranging from "not important at all" (1) to "very important" (5).

	Motivation Factor
MF1	Prizes (cash, products)
MF2	Engaging in the resolution of civic problems
MF3	Learning and developing new skills
MF4	Performing teamwork
MF5	Networking (make contacts, meet new people)
MF6	Increase your visibility in the community

3.2 Questionnaire Design

In agreement with the research question, the questionnaire was formulated based on our field observation from previous experiences in the organization of civic hackathons. We validated it with other two hackathon organizers who suggested rephrasing some of the sentences to avoid ambiguity.

In a previous attempt of an exploratory survey employing open questions, we did not get many responses after sending out emails to participants from civic hackathons. Thus, instead of open-ended questions, in the survey instrument described here we focused on multiple choice questions, which were grouped into three sections:

- *Participant profile*: Since teams in civic hackathons may mix people with different backgrounds, we asked about the participant's experience and their roles in the project (developer, designer, project manager, activist).
- *Software Engineering Practices*: This section contained questions about different project activities: requirements gathering, software design, project management, development, configuration management, testing, software release, and maintenance. The results from this section were explored and detailed further in another work (Gama, 2017).
- *Motivation*: In this final section, which is the focus of this article, we used a five-point Likert scale (ranging from "not important at all" to "very important") to ask participants about the importance of different factors that may have motivated them in the hackathon. Table 1 details the motivation factors we asked participants.

3.3 Population and Sampling

Certain scenarios make difficult to gather probability samples from a significant part of the target population. Trying to reach out participants of civic hackathons who were willing to answer a survey

questionnaire was not an easy task. Therefore, our best option was to gather non-probability samples, which is supported by Kitchenham (Kitchenham and Pfleeger, 2008) in situations when the target population is very specific and of limited availability. Responses from a convenience sample might be useful in developing research hypotheses in early stages of research (Fricker, 2008), which is our case.

We use a Google Form as the online questionnaire that collected the data. The sampling was performed by sending the survey to participants of three civic hackathons: Hackacity[1], GovHack[2] and Hacker Cidadão[3]. These competitions were held in May, July and August of 2016, and January of 2017 respectively. The first one took place held in Australia/New Zealand while the other two happened in Brazil.

GovHack is one the worlds biggest annual open data hackathon, attracting over 3,000 participants from 40 different locations in the 2016 in Australia and New Zealand [4]. The access to them was done online during the last day of the hackathon through messages posted on Twitter by one the organizers and through Slack[5].

In the other two of civic hackathons we were the organizers: Hackacity and Hacker Cidadão). The former was a 24-hour event that was held simultaneously in four cities worldwide, focused on solutions that will have an impact in the city. We applied the survey to 45 participants in the Brazilian side. The latter is the official hackathon from the City Hall of Recife, Brazil, which was held in two rounds on two consecutive weekends, involving 46 competitors. The goal was to create civic applications that use data from the city's Open Data Portal as well as from connected sensors. All participants from both hackathons received the survey link by email in the week after the event. We sent a reminder email a week later.

We also used the Facebook social network to post the link to the survey in 12 civic hackathon communities and also sent it to some civic hackers mailing lists. However, the data collected was not representative of any demographics (e.g., region, country) therefore it was not used in our analysis.

[1]https://www.hackacity.eu/

[2]https://www.govhack.org/

[3]http://hackercidadao.rec.br/

[4]https://accgh16.alan.id.au/wp-content/uploads/2016/11/GovHack-2016-Review.pdf

[5]http://govhackhq.slack.com

4 RESULTS

Our questionnaire had 123 respondents from three civic hackathons: GovHack (55 responses), Hackacity (32 responses) and Hacker Cidadão (36 responses). We used the same set of responses in our analysis of software engineering practices (Gama, 2017), where we decided to consider a subset of responses only from participants who marked "developer" as their role in the team. However, in this study of motivation factors presented here, we examine the responses from all participants, from all roles. We decided to partition our responses grouping them by hackathons. This partitioning approach is useful when one may want to compare responses from different subgroups, reporting it separately, and can also be used to alleviate initial design errors of the survey (Kitchenham and Pfleeger, 2008).

4.1 Motivation Factors

The motivation factors were analyzed for all responses, since we were interested in the motivation of all participants, regardless of their profile or background. A summary of the results is presented in Table 2. We chose to consider the values from the Likert scale as intervals (Brown, 2011), which allowed to use descriptive statistics that helped summarize the data from our sample and understand the central tendencies. A similar approach was used in (Juell-Skielse et al., 2014) to analyze the main motivation factors of participants in a 24-hour hackathon.

4.2 Discussion

This section discusses survey results from the perspective of the research question "What are the main motivation factors of participants in civic hackathons?". The discussion is centered around the data presented in Table 2.

Contradicting claims we found concerning the motivation around prizes (Almirall et al., 2014), our results show it was the least important motivation factor for the civic hackathon participants we surveyed, as illustrated in the answers of MF1. If we look at the top three motivation factors for respondents of those competitions, learning and developing new skills (MF3) was rated as the most important factor by respondents of two competitions (GovHack and Hackacity) and as the third most important in Hacker Cidadão. This reinforces the perspective of a hackathon being also a learning environment (Nandi and Mandernach, 2016). Networking (MF5) was considered as the second most important

Table 2: Mean, standard deviation, mode and median of the results about motivation factors (see Table 1) in civic hackathon participants.

Motivation	GovHack (*N=55*)				Hackacity (*N=32*)				Hacker Cidadao (*N=36*)			
	Mean	SD	Mode	Median	Mean	SD	Mode	Median	Mean	SD	Mode	Median
MF1	2.73	1.08	3	3	3.34	1.1	3	3	3.81	0.95	4	4
MF2	3.85	0.99	4	4	4.47	0.67	5	5	4.75	0.65	5	5
MF3	4.22	0.83	5	4	4.78	0.42	5	5	4.72	0.57	5	5
MF4	4.11	0.98	5	4	4.44	0.8	5	5	4.64	0.68	5	5
MF5	4.05	1.03	5	4	4.56	0.91	5	5	4.75	0.50	5	5
MF6	4	1	4	4	4.22	0.97	5	4.5	4.53	0.77	5	5

factor for respondents from two hackathons (Hackacity and Hacker Cidadão) and as the third most important factor for GovHack respondents. Engaging in the resolution of civic problems (MF2) was the most important factor in the responses from Hacker Cidadão. Performing teamwork (MF4) was the second most important factor in the answers from GovHack but was less important for respondents of the other hackathons.

4.3 Threats to Validity

Like any research, this one poses some threats to validity. Easterbrook et al. (Easterbrook et al., 2008) state that in survey research one of the major challenges is to control for sampling bias. Due to that risk, it is dangerous to draw strong inferences from the samples (Kitchenham and Pfleeger, 2008). It applies to this survey, which has a limited representation of the target population. The samples have only the perspective of participants from three hackathons, which is a limiting factor. The professional background of participants was not collected, which may lead to another bias. For instance, students may be more motivated to learning. According to general estimates from hackathon organizers, the overall profile of GovHack participants is a fairly distributed proportion of both professionals and students, while Hackacity and Hacker Cidadão had a slight majority of students.

The low response rate from GovHack also is a major limitation. Researcher bias also poses threats to validity in the formulation of questions. Our experience in the organization of civic hackathons may have influenced the questions regarding the practices observed in hackathon participants, instead of going to a broader view. The survey has a probability of having responses from members of the same team, however, we intended to measure individual perceptions.

5 CONCLUSIONS

Many government agencies have been exploring hackathons as a way to foster the usage of public open data and as an attempt to crowdsource the development of civic applications. We can find in literature criticism about the resulting applications (e.g., bad requirements definition, lack of quality in the applications, incomplete work) and contradictions about the real motivations of participants in those competitions. However, those claims are mostly based on anecdotal evidence. We collected data in a survey with civic hackathon participants in order to find empirical evidence. Results concerning applications are presented in another work (Gama, 2017), while motivation factors are detailed and analyzed in the current work.

After examining the data collected with participants from three civic hackathons, we could find support to some of the claims reported in the literature. When looking into the motivation of participants, we found that prizes are the least important factor. The top three motivation factors were learning and developing new skills, networking with other people, and engagement in the resolution of civic problems. This is aligned with the findings of (Briscoe and Mulligan, 2014), who reported similar results in another study involving 150 hackathon participants from the USA, where the top three reasons for attending a hackathon were learning, networking and social change.

Among future work to be pursued, we plan to perform a broader study involving more competitions with pre- and post-hackathon interviews, to gather data that can reveal motivation factors we could not find or were not apparent in literature.

ACKNOWLEDGEMENTS

This research was partially funded by INES 2.0, FACEPE PRONEX project APQ 0388-1.03/14. The author acknowledges support from the organization of GovHack (Richard Tubb and Kathy Reid), Hacker Cidadão (Breno Alencar and Eugenio An-

tunes) and Hackacity (Margarida Campolargo and Claudio Nascimento).

REFERENCES

Almirall, E., Lee, M., and Majchrzak, A. (2014). Open innovation requires integrated competition-community ecosystems: Lessons learned from civic open innovation. *Business Horizons*, 57(3):391–400.

Briscoe, G. and Mulligan, C. (2014). Digital innovation: The hackathon phenomenon. *London: Creativeworks London Work Paper*, 6.

Brown, J. D. (2011). Likert items and scales of measurement. *Shiken: JALT Testing & Evaluation SIG Newsletter*, 15(1):10–14.

Carr, S. J. and Lassiter, A. (2017). Big data, small apps: premises and products of the civic hackathon. In *Seeing Cities Through Big Data*, pages 543–559. Springer.

Decker, A., Eiselt, K., and Voll, K. (2015). Understanding and improving the culture of hackathons: Think global hack local. In *Frontiers in Education Conference (FIE), 2015. 32614 2015. IEEE*, pages 1–8. IEEE.

DiSalvo, C., Gregg, M., and Lodato, T. (2014). Building belonging. *interactions*, 21(4):58–61.

Easterbrook, S., Singer, J., Storey, M.-A., and Damian, D. (2008). Selecting empirical methods for software engineering research. In *Guide to advanced empirical software engineering*, pages 285–311. Springer.

Ferrario, M. A., Simm, W., Newman, P., Forshaw, S., and Whittle, J. (2014). Software engineering for'social good': integrating action research, participatory design, and agile development. In *Companion Proceedings of the 36th International Conference on Software Engineering*, pages 520–523. ACM.

Fricker, R. D. (2008). Sampling methods for web and e-mail surveys. *N. Fielding*, pages 195–216.

Gama, K. (2017). Preliminary findings on software engineering practices in civic hackathons. In *Proceedings of the 4th International Workshop on CrowdSourcing in Software Engineering*.

Hartmann, S., Mainka, A., and Stock, W. G. (2016). Opportunities and challenges for civic engagement: A global investigation of innovation competitions. *International Journal of Knowledge Society Research (IJKSR)*, 7(3):1–15.

Hossain, M. (2012). Crowdsourcing: Activities, incentives and users' motivations to participate. In *Innovation Management and Technology Research (ICIMTR), 2012 International Conference on*, pages 501–506. IEEE.

Johnson, P. and Robinson, P. (2014). Civic hackathons: Innovation, procurement, or civic engagement? *Review of Policy Research*, 31(4):349–357.

Juell-Skielse, G., Hjalmarsson, A., Johannesson, P., and Rudmark, D. (2014). Is the public motivated to engage in open data innovation? In *International Conference on Electronic Government*, pages 277–288. Springer.

Kitchenham, B. A. and Pfleeger, S. L. (2008). Personal opinion surveys. In *Guide to Advanced Empirical Software Engineering*, pages 63–92. Springer.

Komssi, M., Pichlis, D., Raatikainen, M., Kindström, K., and Järvinen, J. (2015). What are hackathons for? *IEEE Software*, 32(5):60–67.

Lee, M., Almirall, E., and Wareham, J. (2015). Open data and civic apps: first-generation failures, second-generation improvements. *Communications of the ACM*, 59(1):82–89.

Leimeister, J. M., Huber, M., Bretschneider, U., and Krcmar, H. (2009). Leveraging crowdsourcing: activation-supporting components for it-based ideas competition. *Journal of management information systems*, 26(1):197–224.

Malone, T. W. and Lepper, M. R. (1987). Making learning fun: A taxonomy of intrinsic motivations for learning. *Aptitude, learning, and instruction*, 3(1987):223–253.

Mao, K., Capra, L., Harman, M., and Jia, Y. (2016). A survey of the use of crowdsourcing in software engineering. *Journal of Systems and Software*.

Nandi, A. and Mandernach, M. (2016). Hackathons as an informal learning platform. In *Proceedings of the 47th ACM Technical Symposium on Computing Science Education*, pages 346–351. ACM.

Seltzer, E. and Mahmoudi, D. (2012). Citizen participation, open innovation, and crowdsourcing: Challenges and opportunities for planning. *Journal of Planning Literature*, page 0885412212469112.

Townsend, A. M. (2013). *Smart cities: Big data, civic hackers, and the quest for a new utopia*. WW Norton & Company.