Measuring the Performance of the Innovative Potential of the Academy on the Example of Algorand WEB 3.0 Hackathon

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Abstract—Hackathons and similar events are becoming very popular ways to supplement academic learning to practice teamwork, coding, and increasingly business skills. With a short implementation time frame of typically up to 36 hours, the hackathon routing process that generates the final code or proof of concept solution is completed after the jury trial is generally concluded at these events. Stakeholder efforts were focused on the design of the hackathon and the organizational aspects of the event. The students' efforts were mainly focused on the hackathon challenge and short tasks. That influence leaves aside the potential that the results of the hackathon could bring to further influence the innovative capacity of stakeholders, especially the academic community in the context of this paper. So, the main dilemma is how to use the potential of the hackathon as a mechanism to strengthen the innovative potential in the academic community. To explore this potential, the first initial step was to identify and measure performance indicators arising from hackathons such as exploring new pedagogical approach and experimental learning, motivation, and satisfaction for the adoption of hackathons as a mechanism for a pedagogical approach to initiating innovations and perceived innovative capacity. These indicators were analyzed on the example of the Algorand Hackathon 2023. These indicators become a foundation for further research and identification of performance indicators that serve as a basis for modelling performance indicators for innovative capacities based on the hackathon.

Keywords - hackathons, outcomes, sustainability, continuation hackathon project, performance indicators, hackathon-based innovation capacity

I. INTRODUCTION

Innovation is now becoming the new "name" [1] of higher education institutions that create new processes for new value propositions to students and industries, through the creation of new models of higher education for global economies. However, small steps should be taken first and HEIs should create an environment for dealing with internal innovation potential and innovation performance, and how faculty activities such as hackathons can ultimately contribute to the internal innovation performance and innovation potential of the faculty with their results. Hackathons are growing and explosion in popularity and that led to impacted by the necessity for researchers to study them more [2].However, most research is in one way similar about how to organize and run a hackathon, how to design a hackathon for a specific purpose, how to deal with different participants, or how to run hackathons that are not solely focused on developing software [2][3][4].

When it comes to the sustainability of results and projects after hackathons, most research work focuses on tangible and technical artifacts. The paper will present the proposed initial indicators that are used to measure and monitor the performance of the hackathon, using the example of the Algorand 2023 hackathon. Following indicators are monitored: pedagogical approach and experimental learning, motivation to adopt the hackathon as a mechanism for initiating innovation at the faculty, and perceived innovative capacity, motivation to participate in the hackathon, the treatment of the hackathon as an opportunity to earn internships, scholarships or starting a startup and starting a business, as well as the post-event indicator of satisfaction with the achieved effects. In the end, on the example of these performance indicators, it is concluded that the organizer, in this case, the academy, begins to monitor and measure the indicators so that the hackathon can have a long-term impact on the internal innovative potential.

A systematic review of guidelines for long-term sustainable outcomes of hackathons is currently lacking. Also, understanding its basic mechanisms and developing support for hackathon organizers, especially regarding the sustainability of hackathon outcomes, monitoring the im-

pact of hackathon outcomes, identifying hackathon performance, and measuring the impact of performance in generating the innovative potential of hackathon organizers and users, has not been deeply explored [4][5].

This paper has approached the hackathon in the context of the perceived hackathon as a mechanism that could bring results and outcomes to motivate participants and organizers to continuously utilize it. Especially in the context of how it could bring value to the academic staff especially innovative potential or how hackathon could serve the academic innovative potential.

This paper provides the initial steps in order to identify the key indicators of the innovative performance of the hackathon, on the example of measuring the performance of the implemented Algorand Web 3.0 hackathon at the Faculty of Organizational Sciences in April 2023. (https://bc.elab.fon.bg.ac.rs/2023/02/01/w3-algorand-hackathon-2023/).

The paper focuses on the possibility of monitoring and measuring the outcome of the hackathon. Especially an initial review of the performance that indicates the contribution of the hackathon to the innovative potential of the hackathon organizer. In addition to monitoring the various dimensions of the hackathon and numerous recommendations for the successful organization of the hackathon, conducting research before, during and after the hackathon, through questionnaires and observations, the question of what happens after the hackathon is still open and insufficiently open. How and whether the outcomes and results of the project are monitored, and whether and how the organizers and participants relate to the hackathon in terms of the sustainability of the project. Additionally important is how stakeholders could benefit from hackathon results to impact innovative potential.

II. LITERATURE REVIEW

Hackathons and similar so-called codefest, time-based, themed events or extracurricular events have become very popular and recognized ways for boosting open-minded and innovative thinking in business and at the University of computer science learning. Additionally, hackathons are placed in different domains for corporate and educational purposes and shifted focus from generating innovating ideas or software products to covering an abundant variety of different contexts ranging from corporations to higher education and civic engagement[6].

Hackathons are set to aim to tap a variety of achievements such as getting and practicing specific business skills like problem-solving and critical thinking also creating startups, innovative prototypes of products and services, and generating new project ideas or improvements in existing communities. They also aim to boost connectedness among specific domains, teach specific skills and deliver recognizing and enhancing existing talent[6][7].

Most hackathons have a main goal to focus on a specific problem, develop solutions, present solutions to participants, gain quick feedback, and rapidly change prototype designs. Over and above that, the hackathon is also a identified as model of crowdsourcing with the goal to utilize and stimulate innovation among groups with diverse backgrounds that learn from each other, share knowledge and work toward a common goal[4].

Some of the implications indicated are that hackathons are a very practical concept for capturing the values of students (initiators, organizers, participants) and that balancing the values that participants can capture becomes the focus of hackathons in the context of a shared win-win situation. If the initiators can, in addition to valuable prizes, determine and more precisely present the capture of value for users of the hackathon, the hackathon becomes more attractive for a larger number of students and encourages more effort from each of them [1].

According to the proposed classification from the literature, [2][4] hackathons might be differentiated per value that is generated, so they are categorized as communal (towards community nurturing), contributive (issue-oriented), or catalytic (towards the search for innovation).

Research of hackathons is focused on the identification and classification of outcomes or how to relate hackathon design aspects (duration, team size, stakeholder connection, and participants' skills) [8] with hackathons' tangible and nontangible outcomes. Under hackathon's tangible and intangible outcomes researchers observed code, excitement, learning, networking, interdisciplinary collaboration, and ideas, fostering awareness about hackathon themes[8]. A full list of all references considered in is available here: https: https://bit.ly/2CDIezF and whose relative merits are unclear [7]. For instance, code is very often abandoned after the hackathon competition had finished, or what outcomes bring value to participants, organizers, and stakeholders[5].

A. Elaboration of Hackathon Status and Process after Hackathon

Various hackathon design factors (name, date, duration, initiator sector, initiator type, objective, key drivers, themes, format, number of participants, gender, team composition, participant skills, problem statement, generated ideas, prizes) determine the success of the hackathon. The diversity of the participants, and the degree of openness, according to [5]especially contribute to the generation of a large number of ideas and the solution of problems, which is the richness of the hackathon.

A study conducted at the Aga Khan University (AKU) in Karachi, Pakistan tracked the progress of hacking and post-hack incubation teams. Data was collected from applications, from applications, through evaluation forms and tracking incubation team milestones. A list of factors such as the sectors the winning projects deal with, and the

grants received was made. Ratings given by participants were positive, with a mean rating of 4.00 (SD = .78) out of 5 on the Likert scale. The suggestions (n = 69, 68%) from 109 participants were divided into 5 categories: workplace, access, quality, safety, and design. 15 teams were formed, 5 of which were accepted for incubation. All teams had a minimum viable product for one year. Hackathons are a reliable way to come up with effective solutions to targeted problems in various fields and using the Hackathon methodology can create a set of low-cost, innovative solutions. [5]

The literature provides recommendations for designing and setting up the "anatomy" of a successful hackathon, whether and how to implement an online, onsite or hybrid hackathon model, what are the advantages and fewer different hackathon formats. In the analysis (through questionnaires and observations, which are carried out before, during and after the hackathon), the focus is on the teams during the hackathon and tech artifacts. Additionally, for hackathon organizer seemed very important to set up the right tools such as Hackathon Platform (for instance https://devpost.com/), that enables organizer to:

- Publicize hackathon
- Define eligibility criteria and rules
- Register attendees
- Distribute critical competition updates
- Collect and record app submissions
- Mentor, Check and judge apps
- Award prizes
- Showcase projects

and Attendees also want a single destination for:

- Finding teammates
- Rules, deadlines, and competition information (data sets, developer tools, etc.) Managing submissions
- Proof of submission, so they can link to it permanently
- A forum to ask questions, get help, and engage with organizer
- The platform has to accommodate sponsors, mentors/ judges, attendees, press, voters, and the public at large.

The after-effects are measured by interviews according to the principle of whether the students are satisfied with the participation, whether they have achieved the desired technical knowledge, whether was fun during the hackathon, how would they describe the experience at the hackathon and whether they would recommend the hackathon to longtime students. The given insights do not bring deeper recommendations for what to do after the hackathon and how to provide the conditions and incentives for the motivation of the organizers and participants to continue the projects after the hackathon.[1], [2], [5]–[7], [9], [10].

Motivation for the continuation of hackathons is boosted by fostering a competitive, yet cooperative, culture for talented individuals to showcase their knowledge. There are examples where hackathon organizers (academy and faculty) and partner companies create key benefits for students to motivate stakeholders and students' further engagement in hackathon projects. They provide an internship or employment also students can be recruited from hackathon events for specific research assistantships, create valuable mentorship connections with alumni, and chose to work on staff-suggested projects. This allows university units to leverage the hackathon as a source of creativity for those who need help specifically developing apps or web interfaces to augment their domain-specific research. It also allowed participants to connect with faculty, labs, centers on campus, and most importantly, with each other. [1], [4], [10], [11].

Additionally, organizers of academy and stakeholders sponsoring students to attend other hackathons, and funding-related events, and solicit greater partnerships with industry. These initiatives focus on fostering inclusive and higher levels of engagement.

In order to sustain the development of technical artefacts that were created in the hackathon, organizers have offered: Coaching and mentoring to the winning teams a showcase of technical artefacts developed during an event at a forum], post-hackathon prizes the release of the productive version of technical artefacts recruitment of new team members and grant writing However, little is known about the long-term impact that these post-hackathon activities had on outcome sustainability[2].

All teams put in a lot of effort, given the variety of projects and the limited time, not only for the winning team but for all teams, there should be a process of connection and support. Although, according to [4] it is recommended that stakeholders stay in touch with projects, there is no clear process and description, and everything is left to stakeholders to do voluntarily. This further suggests that organizers and stakeholders should provide the environment and conditions for projects to continue after the hackathon ends and that teams or projects should reach the right organizations and the right people. That is, along with networking, organizers and stakeholders should provide support for incubation and organizational changes in public and private organizations to use the solutions from the hackathon.

The most far-reaching tangible impacts of hackathons occur through follow-ups, and activities carried on by an individual or a team after the event. Follow-ups may include developing a communication (blog, poster, meeting presentation), convening the team for further work, or seeking funding[12].

There is a noticeable tendency and need for hackathons to be scaled in terms of the time dimension. That is the transition from a duration of two or three days to a longer one, all with the aim of maximizing outcomes and results, longer engagement of participants in solving more complex projects and creating the potential for the continuation of the project after the hackathon [13]. Existing research points towards a disparity between the intention

to continue projects after a hackathon and their actual continuation[6]. Continuation intentions might be directed at different follow-up activities, includes technical continuation activities as well as activities related to expanding the reach of a project by attracting funding[5].

This paper gives a literature overview of the open innovation concept and the role of hackathon in its implementation. The question that will be further pursued through future research will focus on the continuation of the hackathon projects and its utilization in corporate setting. The data analysis showed us a rising interest in hackathon participation by students and companies' involvement in organization of the hackathon. This lays the foundation for future research that will have a twofold focus: on participants: reasons for participation, expectations, hackathon impact on further development, future/current employment, etc. on companies: reasons for involvement, continuation of the hackathon projects, impact of generated ideas, etc.[14].

B. The power of hackathons as a specific manner to run innovation.

Hackathons are successfully used as a new form of organizing product innovation in response to new business needs and technical changes due to their ability to create prototypes and evaluate their feasibility in a relatively short period of time. However, designing a hackathon involves careful planning ahead and considering the goals that the organizers and participants have set for the event and for themselves.

Based on the studies on hackathons and the review of the presented literature, the different goals that organizers and participants can achieve with hackathons, showed how such events can be designed to achieve specific goals and identified potential design compromises. According to the results, in addition to product innovation, hackathons can be used with great success as a tool for enriched networks within the company and preparation of employees for future changes and positions[10].

Overall, it could be summarized that hackathons bring a lot of benefits for all participants. For participants and team members it refers to team engagement and teamwork, working together on a project, playing specific roles in a team and a creative way of approaching problem-solving, learning technology together, but also business and management skills, (soft skills), developing a common understanding of software development, quickly visible results, getting feedback, acquisition of new competencies, acquisition of relationships with real problems and tasks from practice, noticing the potential for further personal and project development. On the other hand, organizers and sponsors realize benefits such as recognition and visibility, a source of innovation, community building and engagement, corporate branding, recruitment, IP development [3] [15].

However, the following disadvantages are also identified from participants point of view, such us short project time, focus on the development of software and tangible artefacts, such as programs and code, high intensity of events and uneven workload and exhaustion, limitation of use of tools and technologies, variable motivation, unequal level of training of team members, lack of output usefulness and the unpredictability of further development of created solutions. Additionally, from organizers and sponsors it could be in mainly from costs side, output usefulness as potential of hackathon to generate an innovation [3][16].

III. MODELLING PERFORMANCE INDICATORS FOR HACKATHON-BASED INNOVATION CAPACITY

The main research questions in this research are:

1. What hackathon results could be measured and set as an innovation performance indicator of an academic institution?
2. How to identify and measure the indicator of innovative performance of an academic institution?
3. How to set foundation for modeling performance indicators for hackathon-based innovation capacity?

Innovative performance of an academic institution can be measured through various indicators such as[17]–[19]:

1. Research output: The number and quality of research publications, patents, and other intellectual property generated by faculty members.
2. Teaching effectiveness: The development and implementation of innovative teaching methods, curriculum, and technology-enhanced learning tools that improve student learning outcomes.
3. Industry collaborations: The extent of partnerships and collaborations with industry, government, and community stakeholders to solve real-world problems and transfer knowledge to society.
4. Entrepreneurial activities: The extent of faculty engagement in entrepreneurship activities, such as founding startups, licensing technology, or consulting, that have the potential to generate economic and social impact.
5. Reputation and recognition: The extent of national and international recognition and awards received by the faculty for its innovative activities, research, and teaching.

In addition, the innovative performance of teaching staff refers to their ability to develop and implement new teaching methods, tools, and approaches that improve student learning outcomes, engagement, and retention. It can be measured through various indicators, such as[13][17], [20]–[22]:

1. Teaching effectiveness: The extent to which teaching staff can engage students in active learning, promote critical thinking, and use feedback to improve their teaching practice.
2. Curriculum development: The development and implementation of innovative curricula, such as project-based

learning, service learning, and interdisciplinary courses that integrate different fields of study and prepare students for real-world challenges.

3. Technology-enhanced learning: The use of technology to enhance the teaching and learning experience, such as the use of learning management systems, flipped classroom approaches, and gamification.
4. Educational research: The extent to which teaching staff engage in educational research, such as assessing the effectiveness of their teaching methods, evaluating student learning outcomes, and exploring new pedagogical approaches.
5. Professional development: The extent to which teaching staff engage in ongoing professional development activities, such as attending conferences, workshops, and training sessions, to stay up to date with the latest teaching practices and technologies.

According to the literature review [2], [3], [7], [9], [10], [13], [17], [20]–[22] some specific performances derives from hackathons result are captured to analyze. Possible factors that impact to innovative performance of an academic institution were identified in Category Faculty/ Hackathon Organizer:

1. Explore new pedagogical approach & Experimental learning.
2. Motivation & Satisfaction to adopt hackathon as mechanism for pedagogical approach to drive innovation at Faculty.
3. Perceived innovation capacity.

and Category Hackathon Participants/Team such as:

1. Motivation to join hackathon and Motivation to repeat (keep) participation.
2. Hackathon as opportunity (Route to start Idea business development, Self-Employability, Employability, Assistantships, fellowships)
3. Post work: Satisfaction with post hackathon events.

Overall, innovative performance at the faculty level is essential to maintain the competitiveness and relevance of academic institutions in today's fast-changing world. It requires a supportive environment that fosters creativity, risk-taking, and collaboration, as well as adequate resources and incentives to reward innovative efforts.

IV. ANALYSIS OF PRELIMINARY RESEARCH RESULTS

The data used in this work was collected during the W3 Algorand Hackathon 2023 – W3AH'23, implemented at Faculty of organizational science in April 2023. Participation in hackathons was voluntary and everyone can propose innovative Web3 projects based on blockchain technologies and the development of smart contracts on the Algorand platform. Projects proposed new e-business ecosystems and models (for health, education, industry, banking, commerce, smart cities, etc.). W3 Algorand Hackathon 2023 – W3AH'23 was organized by Blockchain Laboratory & Student Blockchain Club, Faculty of Organizational Sciences, University of Belgrade and Blockchain Lab at UF, University of Florida, and sponsored by Algorand Foundation.

In that first stage, 33 students from Serbia provided data in the proposed survey. Results show that among 33 students, 40% are in undergraduate studies, 28% are in postgraduate studies - currently on master, 22% are graduate students, 10% are in high school. Referring to the hackathon topic, among these 33 students, 27 students provided Blockchain solutions, and 6 students were engaged in the NFT hackathon projects.

Further, 82% of participants didn't have any previous experience in the hackathon competition and 12% did.

Figure 1. shows how students rate the importance of hackathons at the faculty level. On the Likert scale (from 1 to 5, where 1 stands for unimportant and 5 stands for essential), students rate hackathons with avg rate 4.36.

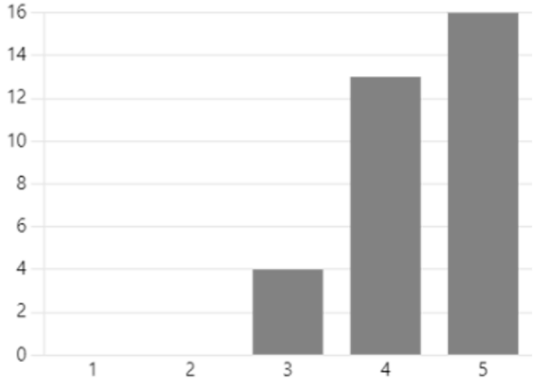

Figure1. Distribution of hackathon importance for students at the faculty level

Figure 2. shows how students rate the importance of hackathon as an opportunity to get an internship/apprenticeship? On the Likert scale they could rate from 1 as very unimportant to 5 as very important. Results show that the Average Rating is 4.26.

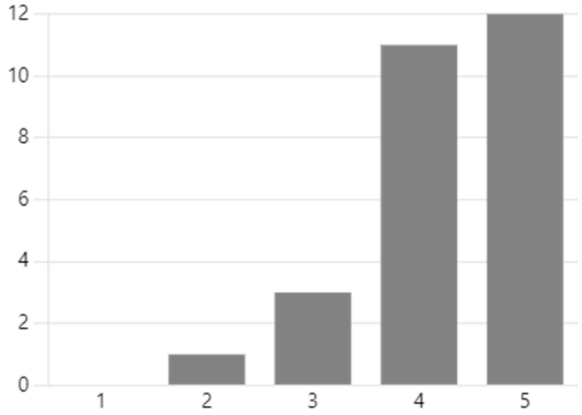

Figure 2. Distribution of importance of hackathon as opportunity for internships or apprenticeships.

Figure 3. shows how students rate importance that hackathon organizer should provide post hackathon event (Post hackathon events engagement in the community. It could be perceived as additional mentorship, sponsoring students to attend other hackathons, funding related invents, soliciting partnership with industry.) (1 Very unimportant, 5 Very important). Results show that the Average Rating is 4.2 and 67% of students rated it as "High" importance.

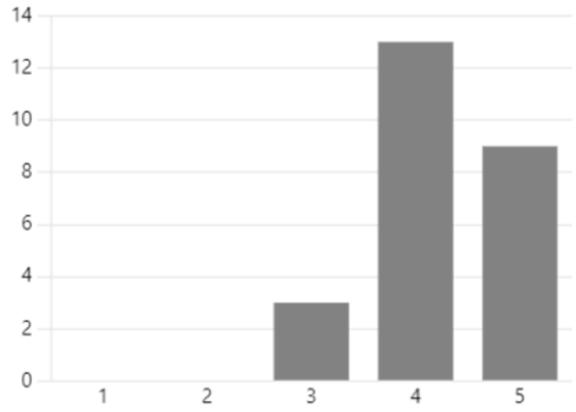

Figure 3. Distribution of how important is that organizer provide post hackathon event.

V. CONCLUSIONS

This paper aimed to foster an understanding of how useful joint scientific efforts would be to improve the performance of value creation and value capture for innovation in hackathons. It analyzes who organizes hackathons, who participates in them, for what purpose and in what context, and how to motivate a continuation of hackathon projects and implicate boosting internal innovative academic performance. The obtained results have yet to be confirmed by quantitative studies using a larger and more diverse data set. This is just an initial step, and the findings form the basis for future research on this topic and demonstrate the utility of the concepts for understanding the phenomenon of discovering and measuring the innovative academy indicators of hackathon-based innovation capacity.

This paper tries to present how the innovative potential can be improved by the results of the hackathon and set the first steps into modelling performance indicators for hackathon-based innovation capacity.

It is a challenging area and will be continued and used as a basis for further research.

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