

Maximising Hackathon Impact: A Comprehensive Framework for Sustaining Post-Event Outcome

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Abstract: Since 2020, numerous guides and tools have been available for designing, planning, and running hackathons in fields such as software engineering, ICT, and healthcare. However, a substantial gap is observed in the post-event phase of hackathons' life cycle, directly affecting the sustainability of results. This bears significant implications for hackathon events per se, as well as for ecosystem stakeholders, in medium-term and long-term perspectives. This paper addresses the issue of low valorisation of hackathon-derived solutions and assists their direct exploitation. We aim to provide a framework for hackathon organisers, managers, policymakers, and intermediary bodies maximising impact of such events. To achieve this, we investigate the relationship between event-level success and ecosystem-level impact. We draw upon the practices and data from the ENTREPRENEDU project hackathons, a Horizon Europe-funded program coordinated by the E. Amaldi Foundation. This series of hackathons, held in three different countries, helped identify key aspects for further investigation and served as the groundwork to define/frame our research question. We conducted literature review, examining papers and reports to explore how hackathon-derived knowledge is valorised within entrepreneurial and innovation ecosystems. Our research aimed to identify how the already known success factors of a well-designed event contribute to the sustainability of outcomes and assess their relationship. We link hackathon success indicators juxtaposed to relevant factors. While acknowledging the complexity and multifactorial nature of innovation process and knowledge diffusion, we believe that our study advances the potential for hackathons' greater impact by providing a cohesive framework.

Keywords: Entrepreneurial ecosystems, Innovation, Hackathon, Ideation, Impact

1. Introduction

Hackathons have emerged as a prominent strategy to spur innovation and collaboration within entrepreneurial ecosystems. These events serve as dynamic platforms where entrepreneurs, developers, and subject matter experts convene to tackle complex challenges, often with a focus on harnessing the principles of open innovation.

Open innovation has become a pivotal concept in the realm of entrepreneurship, particularly for small and medium-sized enterprises (SMEs). This paradigm shift from closed to open innovation, as articulated by Chesbrough (2003), emphasises the importance of collaborative efforts and external partnerships in driving innovation. SMEs, which constitute approximately 90% of businesses and over 50% of employment globally, face unique challenges due to their limited access to resources such as funding, infrastructure, and specialised knowledge (Chesbrough and Bogers, 2014). Consequently, the adoption of Open innovation practices is crucial for their survival and growth, particularly in times of crises.

Substantial prior research concerning the continuation of hackathon outcomes and abundant overviews provide insights on the different types (Kollwitz *et al.*, 2019; Heller *et al.*, 2023), approaches (Chau, 2023), event structure and design (Kohne, 2019; Pe-Than *et al.*, 2022). The typical event management structure is roughly distinguished in three phases. Preparation, operation and follow-up (Kohne and Wehmeier, 2019).

Despite the wealth of available knowledge, hackathon follow-up phase is often neglected while this is precisely the time where considerable added value can arise (Kohne and Wehmeier, 2019). 35% of projects show some continuation activity post-hackathon, though only 5% of projects continue for more than five months (Nolte, 2020). The importance of sustaining hackathon outcomes has been identified, but it is essential to understand effective approaches and practices to be applied after the event completion (Medina and Nolte, 2020). These remarks raise notable implications on the affecting factors and expected outcomes of hackathons. Our work

aims to offer recommendations to support the organisation and execution of hackathons that achieve sustained success.

To explore our research question, we held a mixed-method study blending multiple sources of evidence as reports, case study analysis and participant observations from the ENTREPRENEDU hackathons to triangulate data and to increase the richness of information (Yin 2017). Qualitative data has been used to gain a more accurate picture of the dynamics of social relations that take place in inter-organisational projects, by examining the phenomenon of interest in its real-life context (Eisenhardt and Graebner 2007; Yin 2017).

We received observations through involvement in the jury committees, facilitation of local events and team coaching. We also conducted informal interviews and took field notes during the events to capture feelings and reactions related to emerging issues (Bertello *et al.*, 2022). Furthermore, the examination of multiple-case studies allowed us to gain significant insights from other relevant events through comparative review and provided a strong basis for theory building (Eisenhardt and Graebner 2007; Yin 2017). All data extracted during the hackathons gave us the opportunity to delve deeper into the participants’ intentions and expected returns. We elaborate on the experience, insights and knowledge gained in the following section.

2. The ENTREPRENEDU Hackathons

The ENTREPRENEDU project launched an ambitious initiative to foster entrepreneurship and innovation in Europe through three hackathons with the brand name ‘HackTheBusiness’. These events, held in Italy, Bulgaria, and Greece from June 2023 to March 2024, were designed as real business challenges to solve issues including DeepTech, space technologies and technologies for sustainability. Participants received live support from mentors and attended a total of 16 workshops, which enabled the 3 ‘HackTheBusiness’ to generate a total of 94 business ideas.

Out of these 94 business ideas 13 winners (4 from the first two events and 5 from the last one) got awarded to participate to an exclusive Mentoring and Business Acceleration Programme of 60 hours, where experts from the ENTREPRENEDU consortium provided entrepreneurial education on several topics (e.g. Business Model Development, Crafting a Unique and Competitive Value Proposition, Investment Pitch, etc.) incorporating best practices from the events to support their continuation.

Participation in the HackTheBusiness and in the Mentoring Programme had the primary goal to equip participants with the necessary knowledge and tools to transform their ideas into successful business solutions. By organising these hackathons in low to moderate innovation countries, the project ensured a diverse mix of participants, stakeholders, and industry sectors, facilitating valuable interactions with innovation experts across Europe.

Table 1: ENTREPRENEDU hackathons per country

Place	Date	Vertical	Business Ideas	Individual Questionnaire Responses
Rimini, Italy	15-17/06/2023	DeepTech	30	9
Athens, Greece	25/11/2023	Space	35	37
Sofia, Bulgaria	26-27/03/2024	Sustainability	29	16

Source: Author’s own processing on available data

The completion hackathons marked the conclusion of the project’s second stage “Cross-Fertilisation and Challenge Generation” introducing the twelve teams to the “Venture Building Program”. Though the format of each Hackathon varied to better fit the context, seize local opportunities, better involve local multipliers and stakeholders and address participants needs, all three hackathons were based on a common structure.

The overall satisfaction from participants of the ENPRENEDU hackathons was high, revealing a generally positive experience. Most participants appreciated the collaborative atmosphere, access to mentors, and the opportunity to innovate. Few participants highlighted the need for better organisation and clearer communication regarding event logistics and expectations. Unique learning experience and the networking opportunities provided were among the deciding factors. Still the prospect of valorisation remained unclear.

Based on the experience gained from the three hackathons and the literature review presented in the subsequent section, we aim to develop a grounded approach that includes the most important factors for

assessing the success of hackathons. More critically, this approach will emphasise the sustainability of the projects generated during these events.

3. Hackathons’ Success and Sustainable Impact

According to Nolte *et al.* (2018), hackathons, data dives, codefests, hack-days, sprints, and edit-a-thons have gained significant attention from both practitioners and researchers. These events, typically lasting between 24 to 48 hours, bring together diverse teams to engage in rapid problem-solving and innovation, often within a competitive framework.

The impact of hackathons on startups can be profound, offering numerous benefits such as networking opportunities, skill development, and the rapid prototyping of ideas. Hackathons serve as a microcosm of the open innovation environment, encapsulating the principles of collaborative innovation, external engagement, and problem-solving under constrained timelines (Hossain and Kauranen, 2016). In their work, Rexhepi, Hisrich, and Ramadani discuss the breadth of cooperation and its impact on startups’ innovation performance. They highlight that engaging with a variety of partners—ranging from customers to competitors—enhances a startup’s ability to innovate. This is because diverse inputs can stimulate creativity and lead to the discovery of novel solutions (Rexhepi *et al.*, 2019). Hackathons embody this principle by bringing together participants from various backgrounds to work on common challenges, thereby broadening the innovation landscape for participating startups.

Startups participating in hackathons often gain exposure to potential partners, investors, and customers, thereby enhancing their market visibility and credibility. The collaborative nature of hackathons enables startups to tap into a wider pool of expertise and resources, which can be instrumental in overcoming their inherent limitations. Furthermore, the intensive, goal-oriented atmosphere of hackathons can accelerate the innovation process, leading to the rapid development and refinement of new products and services (Huang *et al.*, 2013).

To further elaborate on the matter of impact we must provide a definition of the term within the hackathon setting. In general, ‘results’ are defined as the top three elements of the result chain: outputs, outcomes and impact (Belcher and Palenberg 2018). However, while outcomes and impact are distinct concepts, they are interconnected. Outcomes describe the objective changes resulting from a planned intervention. Impact, on the other hand, captures the stories, experiences, and feelings of people or society because of these changes. Table 1. displays the main differences.

Sustainable outcome means something that goes on for an extended amount of time, rather than peaking and then waning. Hence, for success to be sustainable, it must have a longer time horizon. A successful hackathon might be just hacking, just training, or both hacking and training (Tauberer, J. 2017). In this regard, success might refer to short-term goals, solely like the successful implementation of the hackathon. Of course, the completion of the event alone does not guarantee lasting impact of the outcomes generated within it. This is clear, since hackathons are not destined to provide complete solutions rather than test assumptions and quickly advance to conclusions (McIntosh and Hardin, 2021). Meanwhile, impact is a dynamic concept which presupposes a relationship of cause and effect. Impact can be measured through the evaluation of the outcomes of actions, be that an initiative, a set of initiatives forming a policy, or set of policies which form a strategy (Fedorciow L. and Bayley J., 2014).

Table 2: Distinction between event success and impact

Outcome	Success	Impact
Level	Event	Ecosystem
Effect	Short-term	Mid-and-Long-term
Scope	Focused	Broader
Measurement approach	Objectively and subjectively	Objectively and subjectively
Evaluation	Measures activity and satisfaction	Measures activity continuation and spin-off, new activity, and behavior

Source: Authors’ elaboration

In measurement terms, outcomes are typically predefined and can be objectively measured using quantitative metrics. Impact, on the other hand, can be quantitative, qualitative, and subjective, often based on people’s

feelings or experiences, making it more challenging to quantify. Impact can be measured for all activities and in its simplest terms refers to the long-term effects of an individual, organisation, or policy actions/interventions on stakeholders, such as customers, beneficiaries, sponsors and society at large. Therefore, measuring impact refers to the process of evaluating the effects of the activities/interventions of an individual/organisation on people, the environment, society or the economy (Fedorciov L. and Bayley J., 2014).

3.1 Hackathon Success

Hackathons are recognised as a strategy for open innovation and entrepreneurial intention, highlighting the importance of open data and investments for the success of hackathons, particularly in aiding startup development (Schaedler *et al.*, 2022). In a study conducted by Juell-Skielse *et al.* (2014), it was found that only one-third of developers who participated in open data hackathons reported completing their projects. To address this issue, open data hackathons should involve entrepreneurs and venture capital firms as jurors. These jurors would be aware of the motivations driving the participating developers. Consequently, at the end of digital competitions, developers could engage in open discussions about their apps, pitch them to investors, and potentially secure funding (Lee *et al.*, 2016).

According to Soltani *et al.* (2014), six critical factors contribute to the success of hackathon contests. Firstly, problem definition is crucial. A well-defined problem area ensures that participants understand the challenge they need to address. If organisers fail to explain the problem clearly, participants may struggle to develop the desired solutions. Secondly, the type of return offered to contest winners serves as a significant motivator. The rewards influence the types of participants who sign up and their commitment throughout the contest. Thirdly, team diversity is essential for success. Collaboration among team members with diverse competencies and skills enhances the development of appropriate digital solutions. Fourthly, effective mentorship plays a vital role. Clear communication of expertise from mentors to participants positively impacts project outcomes. Fifthly, jury knowledge is important for ensuring a fair evaluation process. Jurors with sufficient subject matter knowledge can provide informed assessments of the projects. Lastly, entry requirements need to be clearly defined. These requirements set the tone for the hackathon and help participants prepare adequately for the contest. Together, these factors create a structured and supportive environment that fosters innovation and effective problem-solving during hackathons.

Furthermore, interdisciplinary collaboration is essential for successful hackathons. Teams with members from different backgrounds have an advantage in developing innovative solutions, as explained by Yoo *et al.* (2009). Additionally, the success of the event depends on having a jury composed of individuals with strong academic and professional backgrounds. Organisers must carefully select the best solutions to achieve their desired outcomes.

Rosell *et al.* (2014) emphasised the importance of ideas and team formation in hackathons. They observed that teams were formed either before or during the hackathon, often using social media platforms like Facebook. Participants could post their hackathon ideas and connect with others to form teams. This collaborative approach ensured that everyone contributed to one or more ideas, forming teams around specific concepts. The flexibility to form teams even on the day of the event allowed for dynamic collaboration and idea exchange.

3.2 Key Factors Affecting Hackathon Impact

Nolte *et al.* (2018) conducted a detailed study focusing on the outcomes of corporate hackathons, which have unique characteristics compared to their collegiate or civic counterparts. The study investigated five teams from Microsoft's One Week hackathon, one of the largest corporate hackathons globally, involving over 18,000 employees and 4,700 projects. The researchers aimed to understand how activities before, during, and after the hackathon influenced the continuation of projects and the perceived impacts on participants' skills, careers, and networks. In their study, Nolte *et al.* (2018) identified several critical factors that influence the continuation of projects initiated during hackathons. These factors are essential for understanding how to sustain the momentum and ensure the long-term success of hackathon projects.

Firstly, meticulous preparation is crucial. Teams that engage in thorough preparation before the hackathon, such as defining clear goals, assembling the right team, and understanding the problem space, are more likely to continue their projects post-event. Pre-hackathon activities like team-building exercises, preliminary research, and stakeholder engagement contribute to a stronger foundation for the project. Secondly, having a clear and shared vision among team members ensures that everyone is aligned with the project's goals and motivated to see it through. Projects with well-defined objectives that resonate with all team members are more likely to be pursued further. Effective leadership is another vital factor. Teams led by individuals who are committed to the

project and possess strong leadership skills tend to perform better. Effective leaders can inspire team members, delegate tasks efficiently, and navigate challenges. Leaders who see the hackathon as an opportunity for career advancement often invest more effort and resources into the project, increasing the likelihood of continuation. The composition of the team also plays a significant role. Recruiting team members who are passionate about the project and eager to learn new skills contributes significantly to the project’s continuation. Teams with a diverse mix of skills and expertise are better equipped to handle the various aspects of project development and implementation.

Post-hackathon dissemination is critical. Actively promoting the project within and outside the organisation after the hackathon can attract additional support and resources, facilitating its continuation. Leveraging networks and connections made during the hackathon to secure further collaboration and investment is crucial. Aligning the project with existing product lines or the strategic goals of the organisation increases the likelihood of continued support. Ensuring that the project fits within the broader organisational context and addresses relevant business needs enhances its chances of being adopted and scaled. Engaging relevant stakeholders, such as potential users, customers, and internal champions, early in the process helps validate the project and secure buy-in. Establishing mechanisms for regular feedback from stakeholders ensures that the project remains relevant and adaptable to changing needs. Finally, structured follow-up activities, such as mentorship programs and incubation support, are vital for maintaining project momentum. Ensuring that teams have access to necessary resources, including technical infrastructure, financial support, and expert advice, is crucial for the project’s continuation.

Hackathons also face several challenges. A significant issue is the disparity of intentions to continue projects after a hackathon and their actual continuation. Factors contributing to this gap include the lack of follow-up activities, insufficient stakeholder involvement, and the difficulty in maintaining momentum post-event. Ensuring the long-term sustainability of hackathon projects requires addressing these challenges through strategic planning and support from organisations hosting the events. Despite their growing popularity, the factors of projects continuity from the Hackathons organisation perspective receive limited attention from the research community.

In Table 3 we summarise the outcomes or success indicators on both event level and ecosystem level. We distinguish the most significant indicators to be considered in planning a hackathon (note that there is not a direct correspondence between factors in the two columns of Table 3).

Table 3: Outcomes/success indicators

Hackathon event	Hackathon sustainability/impact
Technical artifacts (Medina, 2020; Chau, 2023)	Projects continued (Kohne, 2019)
Non-technical artifacts (Medina, 2020; Chau, 2023)	Collaborations continued (Medina, 2020; Chau, 2023)
Number of participants (Kohne, 2019)	Teams continued (Kohne, 2019)
Number of teams (Kohne, 2019)	Number of jobs created (Kohne, 2019)
Number of Press mentions (Kohne, 2019)	Inquiries for solutions (Frey F.J., Luks M., 2016)
Money raised (Kohne, 2019)	Accelerated innovation process (Lifshitz- Assaf, 2020)
Participant satisfaction (Heller <i>et al.</i> , 2023)	VC investments (Kitsios and Kamariotou, 2023)
Entrepreneurship (Medina, 2020; Chau, 2023)	IP out licensing and Patent selling (Rexhepi <i>et al.</i> 2019)
Awareness about theme (Medina, 2020; Chau, 2023)	
Learning (Medina, 2020; Chau, 2023)	
Networking opportunities (Medina, 2020; Chau, 2023)	
Ideas generated (Medina, 2020; Chau, 2023)	
Fostering existing enterprise (Medina, 2020; Chau, 2023)	

Source: Elaborated from Kohne and Wehmeier (2019), Rexhepi *et al.* (2019), Medina and Nolte (2020), Chau (2023), Heller *et al.* (2023), Kitsios and Kamariotou (2023)

In Table 4 we provide a summarised depiction of factors contributing to events success or greater sustainability/impact. The factors are listed independently of stage of the event lifecycle, including planning, execution, and post-event follow-up, offering a comprehensive overview to guide future hackathon organisers

and researchers. The selection of factors accomplished by reviewing the most relevant papers discussing the deciding factors in a systematic approach.

Table 4: Success factors in literature

Factors	Hackathon event	Hackathon sustainability/impact
Dissemination	✓	
Entry requirements	✓	
Problem definition	✓	
Compensation/award	✓	
Team composition/Skills diversity	✓	✓
Organisers' support	✓	✓
Mentoring	✓	✓
Jury engagement	✓	
Stakeholders' engagement	✓	✓
Career-promoting ideas		✓
Project feasibility		✓
Post-event incentives		✓
Follow-up program		✓

Source: Elaborated from Soltani *et al.* (2014), Nolte *et al.* (2018), Kohne and Wehmeier (2019), Pe-Than *et al.* (2020), Heller *et al.* (2023)

In order to cater for these factors key decision must be taken at the appropriate time. In Table 5 we show when these decisions should be taken and how they relate to the success factors outlined above.

4. Discussion and Propositions

Building on the experience gained throughout the implementation of the three ENTREPRENEDU hackathons, we propose a framework that contributes significantly to the ongoing conversation on enhancing hackathon outcomes and sustaining their impact over time. This framework extends the success factors identified by Soltani *et al.* (2014), emphasising the critical importance of the follow-up period in maximising the impact of solutions generated during such events. By incorporating considerations for relevant criteria from the planning phase onwards, this updated classification aims to optimise both the immediate outcomes and the long-term viability of hackathon-generated innovations.

The findings of this study underscore the multifaceted role of hackathons in fostering innovation within entrepreneurial ecosystems. By integrating existing literature and analysing the outcomes of the ENTREPRENEDU project, we have identified critical factors that influence the sustainability and impact of hackathon-generated projects. Our study clearly delineates the distinction between immediate success and medium- to long-term impact, emphasising the necessity of considering both aspects in the planning and execution of hackathons.

The disparities between immediate success and long-term impact, as outlined in our study, call for a re-evaluation of how hackathons are perceived and organised. Success should not only be measured by the immediate outputs but also by the enduring impact on the broader ecosystem. This broader perspective encourages organisers to adopt a more holistic approach, integrating sustainability considerations throughout the hackathon lifecycle.

Our findings also contribute to the ongoing discourse on the role of temporary organisations, such as hackathons, in fostering innovation. By highlighting the importance of follow-up activities and sustained support, our study suggests that hackathons should be viewed not as isolated public relations, promotional or encouraging events but as integral components of the innovation ecosystem. This perspective is supported by recent studies that emphasise the need for ongoing engagement and support to ensure the long-term success of innovation initiatives (Adamczyk, Bullinger, and Möslein, 2012; Briscoe and Mulligan, 2014).

Table 5: Key decisions in designing a hackathon

Key Decisions	When and How (methods/tools)			Factors affected and level of impact	
	Before	During	After	Event	Ecosystem
Goal / Objectives	Pre-hackathon survey			Problem definition, Dissemination, Stakeholders' engagement	
Theme	Theme definition			Problem definition, Stakeholders' engagement	
Type and Approach	Competitive/ cooperative, Physical/ Virtual/ Hybrid, Open/ Closed/ Dedicated			Dissemination, Compensation/award	
Stakeholder involvement	Involve sponsors, speakers, coaches, mentors, jurors, co-organisers			Dissemination, Problem definition, Stakeholders' engagement, Project feasibility	
Specialised preparation	Warm-up sessions, tutorials, training, specialised hardware, access to licenses and team meetings			Dissemination, Entry requirements, Stakeholders' engagement	
Duration / breaks	Overall timeline including dates and times (start, end and potential overnight breaks) for each day.			Organisers' support	
Ideation	Brainstorming, targeted questions and idea clustering			Mentoring, Organisers' support, Project feasibility	
Recruitment and team formation	Website with basic information about the event. Pre-event registration form. Promotion and advertising carefully select participants.			Dissemination, Entry requirements, Career-promoting ideas, Team composition/Skills diversity	
Agenda	Agenda that outlines which activities will take place at which point in time.			Organisers' support, Mentoring, Stakeholders' engagement	
Judges and Mentors	Organisers create a mentoring strategy, recruit mentors and support them to execute the developed strategy. Mentors support participating teams based on this strategy.			Mentoring, Jury engagement, Project feasibility	
Continuity Planning	Provide an environment for participants that fosters the desired outcome.			Post-event incentives, Follow-up program, Career-promoting ideas, Project feasibility	

Source: Adapted from Kohne and Wehmeier (2019), Nolte, A., et al. (2020), Chau et al. (2023) and Heller et al. (2023)

4.1 Practical Implications

For practitioners, the proposed framework offers actionable insights into how hackathons can be designed and managed to maximise their impact. Hackathon organisers can use this framework as a guide to ensure that both immediate outcomes and long-term sustainability are considered from the outset. This approach can lead to more successful hackathons that not only generate innovative solutions but also contribute to the development of a vibrant entrepreneurial ecosystem.

Policymakers and funding bodies can also benefit from the insights provided by this study. The identified success factors and sustainability metrics offer a valuable tool for evaluating the potential impact of hackathon projects. By considering these factors, policymakers can make more informed decisions about which projects to support and how to allocate resources effectively.

Educators and academic institutions can leverage the findings of this study to enhance their curricula by incorporating hackathons as experiential learning opportunities. By doing so, they can foster entrepreneurial thinking and collaboration among students, preparing them for success in innovation-driven environments.

4.2 Future Research Directions

While this study offers valuable insights into the factors that influence the sustainability and impact of hackathon-generated projects, further research is needed to validate and refine the proposed framework. Future studies could focus on testing the framework in different contexts and with different types of hackathons to assess its generalisability. Additionally, research could explore the specific mechanisms through which post-hackathon support influences long-term outcomes, providing a deeper understanding of how to optimise these activities.

Another promising area for future research is the role of stakeholder involvement in hackathons. While our study highlights the importance of involving stakeholders early in the process, more research is needed to understand how different types of stakeholders contribute to the success of hackathons and how their involvement can be optimised. Finally, longitudinal studies that track the outcomes of hackathon projects over time would provide valuable insights into the factors that contribute to their long-term success.

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