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Journal of Open Innovation: Technology, Market, and Complexity

Provided in Cooperation with:
Society of Open Innovation: Technology, Market, and Complexity (SOItmC)

This Version is available at:
https://hdl.handle.net/10419/274412

Article

Hackathons for Driving Service Innovation Strategies: The Evolution of a Digital Platform-Based Ecosystem

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Abstract: Despite the fact that hackathons and digital innovation contests have emerged as substantial intermediaries in open innovation and entrepreneurship, knowledge about how hackathons and digital innovation contests impact innovation in cities is restricted. There is also a scarcity of models that aid in the organization of digital innovation contests. Based on the existing frameworks for contest organizations, the aim of this article is to present a case study which develops a framework for hosting and evaluating open data hackathons. The hackathon framework is developed from the organizer's viewpoint, and it has been executed in three digital innovation competitions in Thessaloniki. The suggested scheme adds new knowledge to the field of open data and digital innovation competitions while also providing practitioners with opportunities to host digital contests. Moreover, this framework offers hackathon organizers with regulations and resources to help them plan innovation contests that contribute to the betterment of an open data ecosystem.

Keywords: service innovation; digital services; open innovation; hackathon; ecosystem

1. Introduction

The popularity of open data hackathons and digital innovation competitions is growing continuously. Digital innovation contests and hackathons have become popular and improve the increase in open innovation and entrepreneurship [1]. Hackathons are organized to stimulate the development of services using open data that will increase the added value for governments and citizens. The purpose of hackathons is to engage citizens and developers to collaborate to develop open data applications that are launched in the market through contests [2–5]. Hackathons are gatherings of people who come together to work on designing and promoting a new or completed application to the public [6,7]. Hackathons are short-term events in which developers generate ideas and turn them into applications. The ideas and prototypes are then evaluated by an expert jury, and winners are chosen [5]. Even though hackathons are a frequently used method to enhance the generation of new ideas and the development of prototypes, only a limited number of prototypes developed during digital innovation competitions are launched on the market and used by end-users [2–5].

Additionally, hackathons are designed by organizations to generate ideas for new products or services and evaluate existing ones. Many organizations promote intra-entrepreneurship by motivating employees to participate in innovation contests and to develop their own ideas in order to make suggestions for improvement to existing services [6]. An essential component of open innovation is making use of various outside bodies of information in order to bring about the improvement or transformation of particular aspects of reality. In a similar vein, open innovation seeks to investigate a wide variety of already existing sources and opportunities in conjunction with the firm's capabilities and resources, and to exploit those opportunities widely through resources, capabilities, and multiple channels [7].

Many hackathons are based on open data, but the developed services fail to satisfy the needs of the open data market due to obstacles faced by participants in contests. Although hackathons have grown in popularity, the rate of finalized applications that attract the market is low. The development of services using open data has failed to meet the expectations, and findings indicate that the applications which have been developed during these contests and have been transformed into services using open data to reach the market are limited due to obstacles faced by developers [8–10]. Although innovation contests and hackathons are popular topics in academic research, findings regarding the functions and actors involved in this process and how they affect the digital service innovation process are limited [5,11–13]. This occurs as a result of the processes of organizing hackathons and how they affect the development of innovative services as well as the fact that it is still uncertain who the actors are [5].

Therefore, effective management tools and new models for digital innovation competitions and hackathons are required in order to better manage digital services and open data applications as well as increase innovation and the impacts of competitions. Hackathon organizing committees should follow a set of principles to ensure that hackathons are properly managed and that they become a driving force of innovation in a city's economy [12].

Thus, scholars are trying to develop models and tools that support the organization, implementation, and evaluation of these competitions to improve the efficiency of digital services and the benefits of digital innovation competitions [8]. Scholars have concluded that a model is necessary to support the organization, execution, and evaluation of digital innovation competitions, taking into account the role of organizers during the organization and execution of hackathons to increase the generation of new ideas and the development of new services. This model can help us understand how hackathons affect the innovation ecosystem in greater depth [8,9].

The aim of this article is to present a case study which develops a framework for hosting open data hackathons in Thessaloniki based on previous models for hosting hackathons. The following are the key questions in this survey: What are the stages for organizing digital innovation competitions? What are the challenges for organizers? The focus of this paper is the hosting of contests, which is analyzed through the prism of the experiences of three digital innovation competitions in Thessaloniki. These applications improve the city's efficiency as well as the daily lives of its residents. When it comes to constructing a "smart city" in Thessaloniki, organizers must provide open innovation platforms that can be used by all municipal bodies interested in developing new apps. When public data are made available and entrepreneurs are encouraged to use them, new opportunities are created for people in the ecosystem to work together.

The remainder of the article is organized as follows. Section 2 analyzes the research conducted concerning hackathons. The methodology for the paper is presented in Section 3. Section 4 describes the evaluation of the proposed model in three hackathons. Section 5 presents directions for further research.

2. Open Data Innovation Hackathons

2.1. Motivations and Benefits

Public organizations distribute data to support citizens and developers to participate in innovation contests in order to create applications using open data. Organizers host these hackathons in order to inform citizens of the significance and the usage of open data and to support developers to create new applications. These innovation contests are a predominant strategy for boosting openness and economic growth through the use of open data [11,14].

Open data receive much attention from public organizations, but the market is still immature. Although innovation contests and hackathons have become a popular method to develop service innovation based on open data, their surveys are limited. The market of open data is still in its infancy because organizers of hackathons do not take into consideration the benefits and the motivations of the digital contests for both sponsoring

governments and hackathon participants. Moreover, the organizing of digital innovation contests is not implemented strategically. Organizers of hackathons have to educate, motivate, promote, and persuade developers to use open data in the creation of apps for citizens or businesses (such as tourism) that will meet market requirements [11]. Organizing a digital innovation contest or a hackathon, then, is the biggest challenge in encouraging developers to come up with new ideas that can be turned into applications for citizens. Organizers offer money to winners in order to persuade developers to participate.

Developers in eight European cities were interviewed by Lee et al. (2015) [14], who found that money is a major driver for developers, giving them the foundation they need to grow their digital service application portfolios. Another motivation for developers is the distribution of data by public organizations. Governments are obligated to make open data available freely and easily in order to support developers to utilize them and develop digital services and applications [11]. Other motivations for developers which persuade them to participate in hackathons are the opportunities for training, collaboration with other developers, and new knowledge and the fairness of the judgment system [2,7,15–17]. These motivations encourage developers to participate in hackathons because they can explore their ideas, transform them into digital services, and face high market competition and technical uncertainties. Organizers of previous digital innovation contests distributed open data to help participants develop new skills and create new applications [11]. Furthermore, participants are drawn to hackathons for a variety of reasons, including intellectual stimulation, a chance to demonstrate their abilities, a chance to gain professional and personal recognition, a chance to learn new skills, a chance to have some fun, and a chance to reciprocate in some way [5,18].

Furthermore, many companies promote intra-entrepreneurship by motivating employees to participate in innovation contests and to develop their own ideas in order to make suggestions for improvement to existing services. They aim to develop new products, increase business value, and look at business opportunities by sharing knowledge, competencies, and technological resources [7,19]. Open innovation, which acts as a driving force for effective internal and external flows of knowledge and technology, is unable to capture the value of these flows unless it is first harnessed by essential internal resources [1,19,20].

Open business models make it possible for an organization to be more efficient in the processes of value creation and value capture.

They also make it possible to extract a greater amount of value from a company's key asset, resource, or position by allowing it to be used not only in the company's own operations but also in the operations of other companies' businesses. When it comes to open business models, collaborating with other partners in the ecosystem is one of the primary means by which value is produced. Companies that pursue an open business model actively seek new ways of working together with suppliers, customers, or complementors in order to open up and expand their business opportunities. Therefore, developing a business model that takes into account co-creation is essential to open innovation and the appropriate dynamics that go along with it [21–23].

2.2. Digital Innovation Contests and Hackathon Preparation

Organizers of a hackathon explain the contest's main goals and encourage people to take part in it. Once the contest starts, they are in charge of everything that goes into making it happen, including the timings, location, technology, and logistics. Next, attendees develop their apps, which the jury committee evaluates [6,24,25]. According to scholars, successful digital innovation contests can be organized using one of the models listed in Table 1. Despite the fact that the stages in each of these models differ, they are all very similar. It is, however, important to plan digital contests carefully because organizers must provide funding and support as well as the technological tools they need in order to run the competition [12,26].

Table 1. Models for organizing hackathons.

Phases	Activities	References
1. Leadership support	An outline of the hackathon's aims and priorities	[6]
2. Publicizing the event	Invitations and announcements to get people excited about the event	
3. Timing	The date of the hackathon	
4. Social media and team building	Participants can communicate with one another in an online forum	
5. Preparing the participants	Technical infrastructure	
6. Hackathon day infrastructure	Preparation of small breakout conference rooms and networking facilities	
1. Ideation and team building	Collection of ideas	[16]
2. During the hackathon	Technical infrastructure	
	Coffee and food	
3. Post-hackathon	It is up to the attendees to decide how their idea can be advanced further	
1. Outlining the basis	An outline of the hackathon's goals and objectives	[3]
2. Planning and organizing	An outline of the hackathon's challenges	
	Logistics	
	Sponsorship	
	Promotional effort	
3. Hackathon execution		
4. Post-event follow up		
1. Preparation	Goals	[27]
	Skills	
	People	
2. Hackathon	Problems	
	Solution alternatives	
	Prototypes	
	Pitch and feedback	
3. Decision		
4. Follow-up activities	Product readiness	
	Rollout	
	Sales	

There are three main stages that coordinators use to broadcast a hackathon or a digital innovation contest, per the published literature. The first step in planning an event is to determine its aims and targets. To increase participation, they will need to let people know about the contest via social media, email, posters, and other means. The competition's preparation is the focus of the third stage (for example, technical resources, APIs, software libraries, WiFi access, physical space, networking facilities, small breakout conference rooms, and the logistics of the competition). In order to win a hackathon, a prize and a set of criteria must be established. As a final step, members of the judging panel and the sponsors who will back the winners must be invited [28–31].

To design a hackathon, Longmeier et al. (2022) [6] proposed a framework that involves six activities. Defining the hackathon's aims and objectives is the subject of the first. Advertising and publicizing the event are included in the second activity. The event's

timetable is discussed in the third activity. The fourth and fifth activities revolve around the use of technical resources. The final step is to set up conference rooms for small breakout sessions and other networking opportunities. Alternatively, organizing a hackathon can be broken down into three steps, but the final step was left out of the previous model by Komssi et al. (2016) [16]. To begin, participants are asked to sign up for the hackathon and provide a brief description of their entrepreneurial ideas. To help with the hackathon, the second activity refers to resources. The last activity involves post-hackathon activities where participants must seek funding to expand their ideas and develop new products or services. In addition, Pe-Than et al. (2022) [3] presented a framework that is similar to the previous one, where they stress the importance of defining the hackathon's aims and objectives in the first activity. Promotion of the event is referred to as the second activity. Processes for the hackathon's actual execution are covered in the third activity, as are events for participants to attend following the hackathon.

The applications that are developed during digital contests or hackathons can be provided to citizens through a market launch. For example, in Helsinki, developers can use online market sales channels (e.g., Ovi Store and iTunes) in order to distribute their developed services without significant distribution costs, which allows for practically unlimited upscaling of the services' utilization [24]. In Amsterdam, participants in digital contests use municipal websites in order to inform citizens of the civic applications and they make available their services [14].

When Juell-Skielse et al. (2014) [5] surveyed developers participating in open data hackathons, only one-third of the participants had completed their projects, even though they had planned to do so. To solve this problem, open data hackathons should include entrepreneurs and venture capitalists as juries who are aware of the motivations of the developers participating. As a result, developers could engage in real-time discussions about their applications, present them to potential investors, and secure funding during the closing ceremonies of digital contests [14].

3. Case Study and Suggested Framework

The organization of hackathons and other digital innovation contests is an important part of the growth of the city of Thessaloniki by the local government there. Organizers motivate developers to generate new ideas and create new applications. Moreover, organizers encourage developers to develop digital services, expand their applications further, and create innovative startups. Hackathons are an opportunity for them, because these competitions provide information, tools, consultancy, and funding to developers in order to develop digital services. The city of Thessaloniki should host hackathons and innovation contests strategically to maximize the benefits for both participants and citizens. Figure 1 depicts the suggested framework for organizing themed hackathons, which is based on existing models that have been implemented in digital innovation competitions and analyzed in Section 2 [3,6,16].

The model consists of four phases. The purpose and the objectives of the hackathon or digital innovation contest are defined in the first phase. As these events are themed, each one has a different concept, and developers have to create applications according to it. In the second phase, the organizers have to develop a plan for the execution of the contest. Thus, they have to obtain sponsors to finance the hackathon, the venue and IT requirements, and the catering. Furthermore, the organizers have to plan the registration platform, decide who the juries are, and develop a marketing strategy in order to promote the event. The third phase involves the activities required for the execution of the hackathon. On the day of hackathon execution, the organizers are obligated to support developers with technical infrastructure in order to create their applications and to provide them with food. After many hours of programming, the developers present their applications to the jury committee, and they select the best ones, which win prizes. The fourth phase is the last phase of the hackathon preparation process. In this phase, the participants give feedback to the organizing committee in order to improve the hosting of hackathons in the future.

Based on this feedback, the organizers can evaluate the outputs of the hackathon and focus on the activities which have to be improved in the next years. Unfortunately, when organizers prepare hackathons, they often ignore the importance of this phase. Figure 2 summarizes the activities included in each phase.
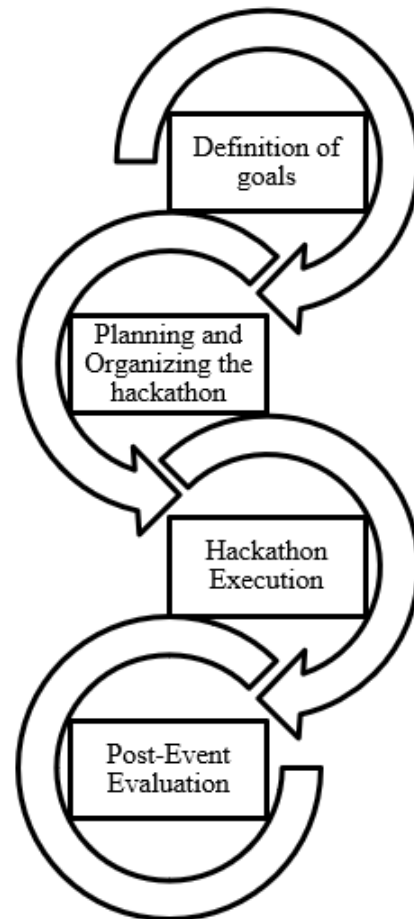

Figure 1. The suggested framework for organizing hackathons.

Definition of goals	Planning and Organizing the hackathon	Hackathon Execution	Post-Event Evaluation
• Definition of the purpose and the objectives of hackathons or digital innovation contests	• Finding sponsors to finance the hackathon Planning the venue, IT requirements, the catering, the registration platform • Finding juries to evaluate the applications • Promotion of the event through the development of a marketing strategy	• Supply of the technical infrastructure and food to developers • Development and evaluation of applications	• Evaluation of the event • Planning activities to improve the outputs • Supporting developers to create startups

Figure 2. Phases and activities.

Organizers should further support the developed applications after the end of the event. Developers who participate in hackathons aim to develop applications which will be useful for citizens, and they should have the opportunity to expand their applications and create innovative startups by finding funding and mentors to support the establishment of startups. Unfortunately, the organizing committee often does not help developers find consultants to support them to start a new business and marketplaces to promote these applications. Therefore, organizers could involve entrepreneurs and consultants in the judgement committee in order to support developers to create startups and obtain funding for them.

The grounded theory method, which aims to present an understanding of the dynamics based on a singular setting, can be referred to in this study. This method can involve a single case or multiple cases, and it can combine qualitative and quantitative approaches to data collection. As so little is known about the design strategies that are utilized during hackathons and other innovation competitions, this approach has been put into practice [32–34].

In this paper, the case study approach aimed at selecting cases that vary from context to context includes hackathon organizers in Thessaloniki. This allowed the authors to evaluate the execution process within each hackathon as well as how design choices impact the participants' overall performance. The evaluation of these competitions was based on both primary and secondary data. In addition, interviews were conducted with the organizers of innovation competitions and hackathons that were held in Thessaloniki. The average length of time spent on each interview was 53 min, with an overall range of 45–60 min [8]. The interviews were conducted with the organizers of three digital innovation contests that were held in Thessaloniki.

Conducting interviews makes it possible to gain an understanding of the activities and events taking place within particular settings. According to the existing research [6,16], the questions were connected to the goals and design choices that influence the performance of hackathons or digital innovation competitions. Organizers were asked to provide details about the process and activities of hosting hackathons as well as the challenges raised during hackathons, for example: What are the main activities for organizers? What are the organizers' goals? What are the participants' goals? How do developers create applications? What are the prices? Who participates in the jury committee?

Three digital innovation contests in Thessaloniki used and evaluated the proposed model. A digital innovation contest has been held by the city of Thessaloniki every year since 2014. These competitions were held with the intention to come up with new ideas and bring them into existence. It started with a contest called "apps4Thessaloniki", which aimed to assist developers in creating web and mobile applications that improved various aspects of the municipality and city. The second competition was called "Hackathess", and the goal of this hackathon was to develop new applications based on open data to improve city life in Greece. The third digital competition, "apps4thessaloniki tourism edition", was aimed at developing web and mobile applications that would help the city's tourism industry grow.

These applications will make new paths available for the development of digital narration, which in turn will allow for the creation of new experiences for tourists who come to the city. The objective of the hackathon was to provide application developers with access to open data gathered from organizations in the city that are associated with tourism. Residents of Thessaloniki were also invited to submit their ideas for potential applications, which served as inspiration to the programmers who created the final products. Finding cases that are different from one another contextually and that involved groups that represent different roles in the ecosystem of Thessaloniki and have a variety of skills was a primary focus during the case selection process so that each competition's execution could be compared.

The municipality's initiative was not just for those with programming skills. Citizens, institutions, organizations, and companies throughout the city were asked to register on

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their platform to share their ideas for new digital applications and services. This effort included engaging the entire city. Organizations, institutions, businesses, and citizens will thus work together under the umbrella of the municipality to develop a network to address current issues by harnessing the power of new technology.

The mind mapping technique has been used describing the central problem to visually represent the issues of the competitions [35]. Mind maps are used to record all of the important concepts in a topic and to focus on the relationships between them [36,37]. Conceptual maps encourage the generation of ideas, the rapid production of results, the visual representation of ideas in a graphic manner, and the interrelationships between concepts [37]. The appearance of mind maps in digital form is often significantly more consistent than mind maps in paper form [38]. A subject tree that can be expanded and collapsed to organize information or thoughts is an example of what is known as a digital mind map [39].

4. Results

The events took place in teams of up to three people, with 50 participants. Open datasets provided by the municipality of Thessaloniki were used to develop 12–14 new applications during each hackathon. Transportation, energy, food, water, structures, infrastructure, governance, tourism, etc., were among the topics addressed in the applications. Registration for each hackathon or digital innovation contest was completed. To collaborate and create applications, the participants then established their teams. To encourage teams to create new applications, the organizers set up a platform where citizens could sign up and submit their ideas. Participants on this platform were encouraged to share their ideas. People's needs were taken into consideration by those who participated. A panel of judges evaluated the applications created by the developers after 32 h of programming.

4.1. Definition of Goals

Participants and citizens alike were encouraged to use open data and applications developed based on those data as part of the goal of hackathons in Thessaloniki's innovation contests. Using only open data sources provided by the municipality, participants were required to build an app for the municipality. In this instance, attendees were free to create any application that fits within the selected topic areas selected by the organizers (such as crowdsourcing, public data, etc.). Sometimes, participants are compelled to build applications using open data.

The first hackathon's goal was to develop web and mobile applications that would help the municipality and the city in various ways. The second hackathon's goal was to create new applications that would improve the lives of citizens by utilizing open data. The third hackathon focused on tourism. Thus, its purpose was the development of applications that will provide new experiences and benefits for tourists.

4.2. Awareness Strategy

Contests were promoted through a mix of public announcements and personal invitations. The scope of hackathons was made clear via websites built to inform participants and the general public. In addition, there were posters all over the city. To encourage students to participate in contests, emails were sent to undergraduate and graduate students at all of the city's universities. Digital contests mainly attract software developers and the technical community with technical skills. Technical staff members are encouraged to come up with new ideas during the competition, and other businesses or organizations are encouraged to help the winners establish their startups. The executives of the Open Knowledge Foundation in Greece and the Urban and Regional Innovation Research Unit were also asked to participate in the jury committee of the contests.

4.3. Planning and Organizing the Hackathon

As digital contests are usually attempting to engage developers and juries who have work or academic commitments during weekday business hours, these contests are most often conducted on weekends. Furthermore, it would not be feasible to remove juries from their normal work duties, and as a result, the organizers decided that a typical weekend schedule would likely be successful in this case. Another important aspect of timing is the planning of the agenda and schedule of events during the contest. The organizers had to balance the amount of time given for idea pitches, team formation, development and presentation of applications, evaluation of applications, and closing remarks to maximize the amount of time available to developers. The 32-h time limit for each contest necessitated that the organizers maximize the time available to the attendees for application development. An online platform was set up where citizens could register and submit ideas that sparked the creation of new applications. Using the needs and problems of citizens, participants were able to create solutions for transportation, social services, economic conditions, and local government administration. No teams could be formed, and no questions could be asked. There were also awards, closing remarks, and judging after the competition was over. Thus, teams had more time to develop their applications.

The organizers had to provide all the technical tools necessary for the developers to develop their applications because they were paying attention to developers with different levels of experience and knowledge. APIs and software libraries could be used with the help of a software development kit. Additional considerations included the size of the room, the logistics of each competition, and the availability of Wi-Fi access. Small breakout rooms were also provided for teams. Based on the ideas that were voted on by the public on the previous two days, participants formed teams. As soon as the groups had been formed, they got to work on building their solutions. After 32 h of coding, the developers prepared for the presentation. Participants had limited time to present their application to the jury committee. Following the end of the competitions, the winners were announced, and closing remarks were given. The websites were also mentioned. The applications were posted on the contest websites to entice participants to join future hackathons.

4.4. Hackathon Execution

According to the event planners, these competitions are expected to last anywhere from 1 to 3 days. The competition must be organized by the organizers (e.g., physical venue, scheduling, logistics, and technical resources). Jury members then look over the applications created by the participants. The most important part of each competition is the final pitch in front of the jury to select the most innovative prototype. Toward the end of each contest, a jury panel selects the most innovative prototypes that should be developed into viable products for clients and presented to the public. There were a variety of people on the jury, including industry experts, potential clients, mentors, academics, investors, and members of the Thessaloniki municipal government. Other stakeholders can also be invited to participate in the iterative approach at the beginning of the decision-making process.

The participants were judged by a panel of experts as well as by the general public, who cast their votes for their apps on an online voting system. Academics, mentors, potential customers, experts, senior managers of local businesses, investors, and members of the municipality of Thessaloniki were on the panel to choose the winners. The audience's votes accounted for 30% of the score, while the jury's votes accounted for 70%. The deposited ideas could also be graded by the public on a scale of 1 to 5 points. At the awards ceremony for the winners of the contest, the person who came up with the best idea talked about it. Criteria such as innovation, scalability, usefulness, and the design of the user interface (the experience of the user of the app) were used to evaluate the applications by the juries. Some other considerations included multilingual support, the availability of data, and technical expertise. The winners of the competition were given various prizes, such as money and tablets.

4.5. Post-Event Evaluation

The following provides brief summaries of the contests' outcomes. More than 85,000 people have visited the contest's website. More than 80% of visitors came from Greece, while 20% came from around the world, with the majority coming from the United States and Europe. In addition, 220 people came forward with ideas, and around 3000 people weighed in on them. As a result, 14 of the contestants' submissions were deemed particularly valuable and applicable. The organizers of these competitions did not obtain any feedback from the people who took part, even though the competitions were successful and new apps were made. As a result, the organizers did not encourage the winners to expand their applications and create startups. Mentors who can help attendees obtain funding and get their applications off the ground should be sought out. This can be a new step in the suggested framework [3,6,16].
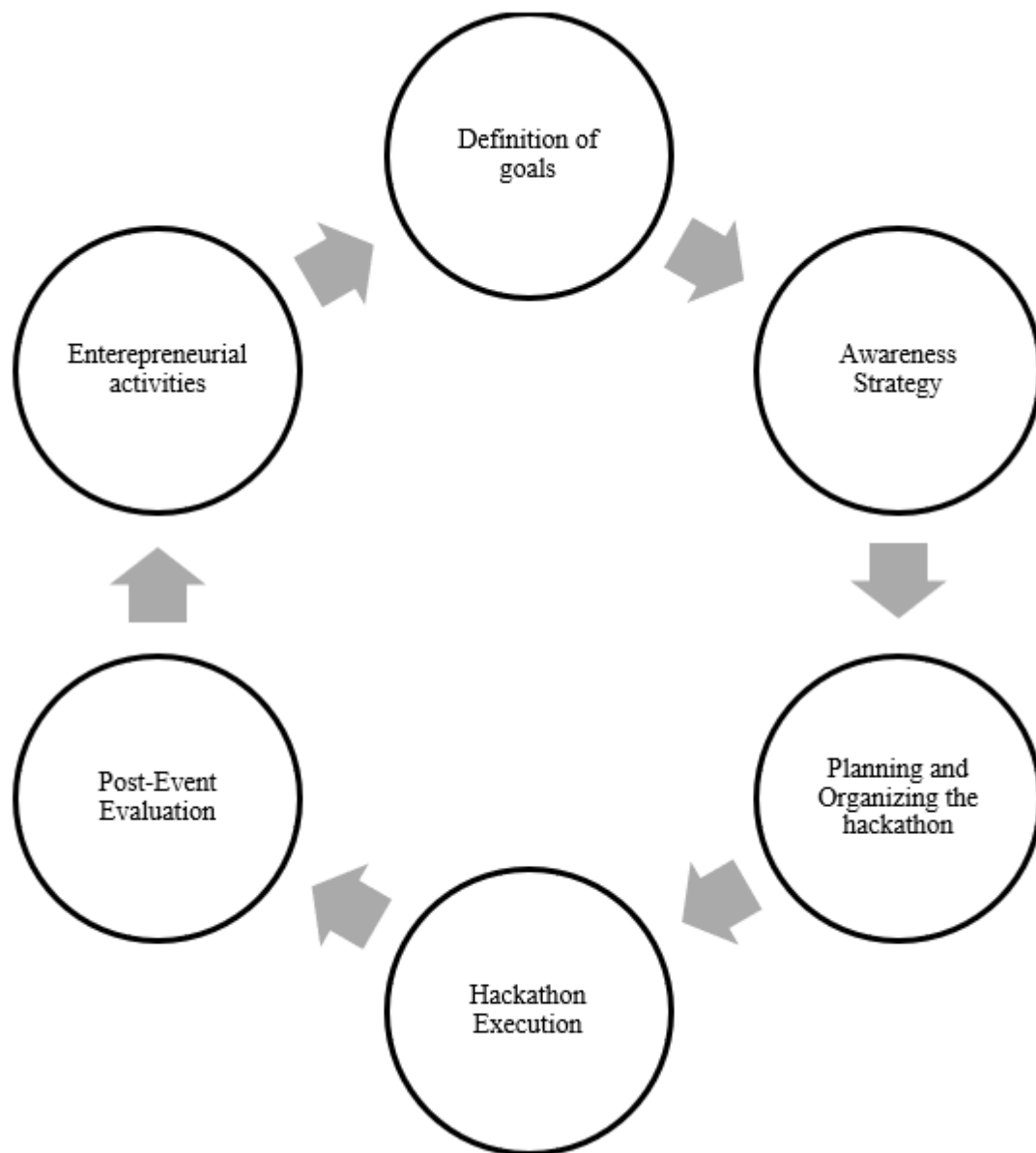
Figure 3 presents the updated model.

Figure 3. The updated model for organizing hackathons.

4.6. Challenges for Organizers

Organizers have to face many challenges. They should provide more open datasets to developers to support them to develop new and innovative applications, which will

improve internal city processes, provide citizens with better public services, and support government-to-citizen contact. During hackathons, web-based APIs can be used to achieve rapid arrangements and use on common platforms. This is a way to guarantee value capture. Another challenge was that the organizers were not informed of the motivations of participants so as to increase their engagement. The organizers reasoned that prize money was a significant motivation for developers, but they ignored other motivations for developer participation such as networking, new knowledge, training, fun, and support for the creation of startups. The amount was limited to support developers. Organizers could include entrepreneurs and venture capitalists as jury members in order to support developers to start a business from their applications. Although external funding is significant for the development of their applications, developers aim to capture value through launching applications to the market. Municipal sites should promote the applications which have been developed in innovation contests to citizens. Thus, developers can aim to obtain more subscribers at the beginning of their startups so that they can continue with the development. They need increasing awareness through the municipal platform to be able to grow. The use of app stores such as those of Apple and Android is not effective because they do not categorize city applications and it makes it difficult to create awareness. Furthermore, during innovation contests, workshops on business modeling should be run to support developers to create business models for their applications. Figure 4 represents these challenges.
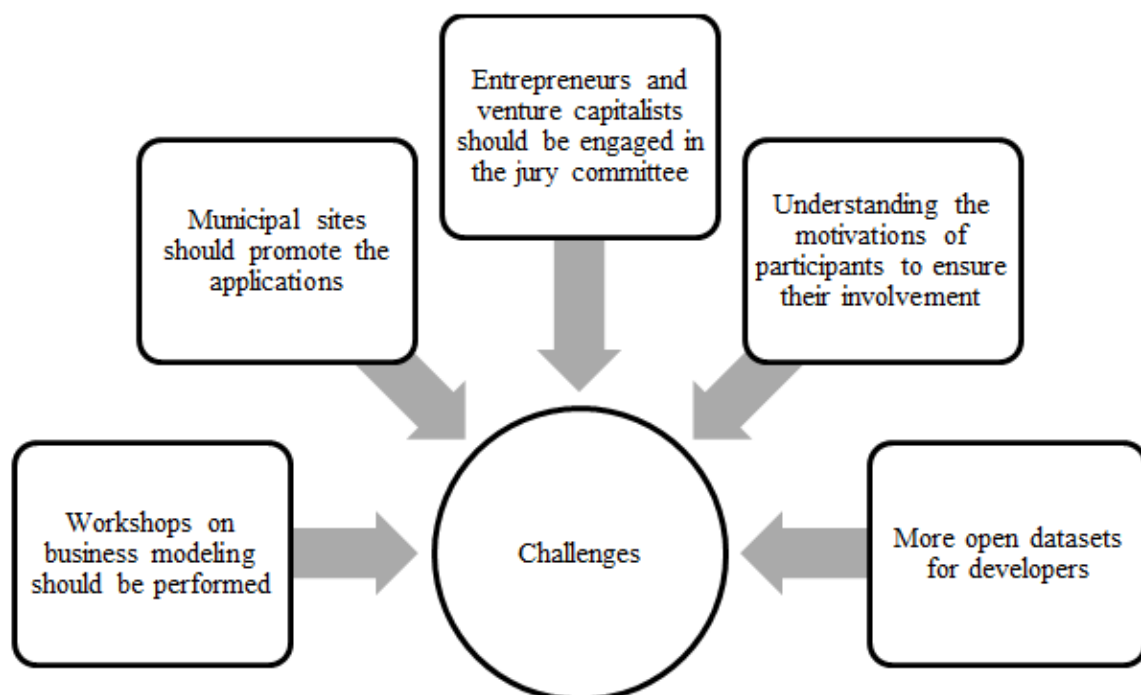

Figure 4. Challenges in Thessaloniki's digital contests.

Using the free tool mindmap.com, a mind map depicting the stages for arranging open data hackathons as well as organizers' challengers (Figure 5) was developed. A mind map is a visual depiction of thoughts or concepts that can be used to better comprehend the relationships between them. Every node in a mind map has the capability of spawning a new one. The mind map was constructed using the paradigm of hosting open data hackathons as a starting point. The technique was expanded to connect the thoughts based on their importance.
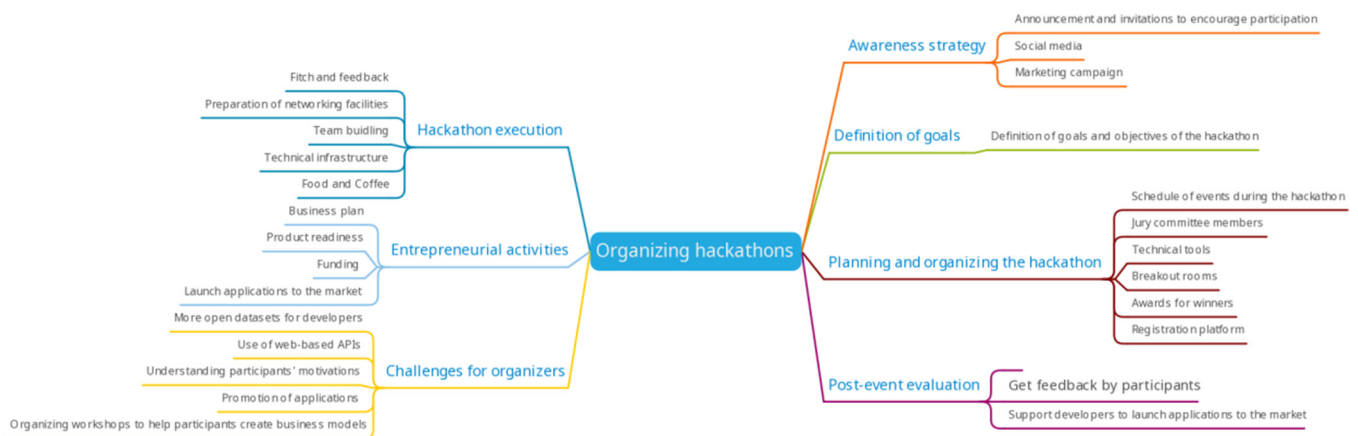
Figure 5. Mind map visualization for organizing open data hackathons.

5. Grounded Theory

5.1. Hackathon for Service Innovation with Digital Platform

The evaluation of the proposed model gives us a better chance of meeting the goal of improving the city's quality of life through collaboration and commitment from all of the city's different groups. Models such as this one aid in the design, execution, and evaluation of digital innovation contests. A hackathon or competition cannot be organized in a single way, but each public institution's needs must be defined specifically, and the set-up should be tailored to each specific use case [40]. When the goal of an event is clearly communicated, it can be good for both the organizers and the people who show up. Clear objectives and plans for follow-up activities help a viable product to be developed and launched for the customer base [3,6,41–43]. An innovative product or service cannot be developed, launched, or marketed without the help of sponsors such as small venture capitalists [44]. As a result, participants may be unable to overcome the barriers to technological development and commercialization. This is a significant problem.

There is a chance that the follow-up work will not get completed at all. After a hackathon, it is critical to follow through with the next steps in a methodical manner. An initial concept or prototype necessitates additional software development activities to develop a solution (at least with a minimum set of features) and provide it to clients [27].

The results of the evaluation of the framework indicate some challenges for organizers in designing hackathons. The main challenge is to integrate hackathons into the city's ecosystem culture and motivate participants, businesses, investors, public organizations, mentors, and citizens (as application users) to be involved. Another significant challenge concerns how to transform the prototypes into services which create revenue and value. In fact, the main purpose of innovation contests is to produce services for the market. Therefore, hackathons should be supported by decision makers such as businesses, R&D managers, or venture capitalists who invest in developing applications or ideas further. A further challenge concerns the adoption of hackathons by actors in the city's ecosystem and whether they fit in the smart city's entrepreneurial culture [45–49]. The results of this study indicate that hackathons are well accepted by stakeholders in the Thessaloniki municipality, especially developers. However, both the designing and the execution of hackathons require enthusiastic people and appropriate ideas in order to be applied. Therefore, hackathons must not become a tiring routine but instead must be a way to generate and expand new and innovative ideas.

5.2. Hackathon with Digital Platform and Its Relationship with Open Innovation

Thessaloniki's efforts to organize competitions have raised many obstacles in their management efficiency. Mechanism coordination is the main problem. Beyond the development of the applications, there are no effective diffusion channels. Software applications also restrict access to data because they are not available as open standards or for free. Fur-

thermore, the data are not available in their original form, are not updated, and are not in a format that people can use. This means that people cannot check the quality of the data and use them. Hackathon participants cannot make apps because many businesses do not want to share their data, making it impossible for them to participate. In order to publish useful data, provide funding, educate citizens about open data-driven activities, share knowledge and technical tools, and create networking opportunities that will support the launch of more platforms based on open data, services, and startups in the city, collaboration with universities, research institutes, businesses, consultants, and other public organizations is necessary [31].

This is similar to what previous research has found. For example, Rys (2021) [50], Juell-Skielse et al. (2014) [5], Kitsios and Kamariotou (2019) [28], and Pope and Greene (2003) [51] stated that the most important challenges faced by hackathon organizers and participants are the lack of external support, collaboration with partners for technical development, and access to technical expertise and innovation experience. The lack of good data sources, data quality, accessibility to local data sources for application development, time or funds, promotional integrity, and data are all issues that they bring to light. They also bring attention to other concerns, such as legal issues.

Many companies promote intra-entrepreneurship by motivating employees to participate in innovation contests and develop their own ideas in order to make suggestions for improvements to existing services. They aim to develop new products, increase business value, and look at business opportunities by sharing knowledge, competencies, and technological resources [7,19]. As a driving force for effective external and internal flows of knowledge and technology, open innovation dynamics cannot capture the value of these flows unless it is harnessed by key internal resources [1,19,20]. Open business models enable an organization to be more effective in creating and capturing value. They also allow greater value to be captured by using a firm's key asset, resource, or position not only in its own operations but also in the businesses of other companies. In open business models, collaboration with partners in the ecosystem becomes a central source of value creation. Companies that pursue an open business model actively seek new ways of working together with suppliers, customers, or complementors to open and expand their business. Therefore, the essence of open innovation and its appropriate dynamics is to create a business model that considers co-creation [52–55].

6. Conclusions

In this article, we presented a case study on the evaluation of a model for organizing hackathons in Thessaloniki based on previous models for hosting hackathons. The focus of this paper was the hosting of contests, analyzing it through the prism of the experiences of three digital innovation competitions in Thessaloniki. These applications improve the city's efficiency as well as the daily lives of its residents. When it comes to constructing a "smart city" in Thessaloniki, organizers must provide open innovation platforms that can be used by all municipal bodies interested in developing new apps. When public data are made available and entrepreneurs are encouraged to use them, new opportunities are created for people in the ecosystem to work together.

By sharing practical experiences with scholars and practitioners, this paper provides new insights into the design, implementation, and evaluation of digital innovation competitions. This article helps practitioners prepare competitions that meet the goals of the organizers and encourage participants to start their businesses. Hackathons are a great way to give citizens a sense of how their involvement can enhance their city's quality of life through the development of new apps. As the number of open data hackathons in Thessaloniki increases, the need for organizers to work with the city's universities, government, app users, and other ecosystem actors is also increasing. This collaboration is essential. A hackathon requires careful strategic planning and an understanding of the goals that have been set.

This article presented an analysis of three hackathons held in Thessaloniki. A limitation of this article is that the results cannot be generalized because they refer only to one case study. Therefore, the proposed model should be examined in greater detail to see how it can be applied to different hackathons, as they all have different goals, preparation, implementation, and follow-up activities. Future researchers can use similar cases from other cities or countries to create a holistic planning process for planning digital innovation contests and hackathons and generalize the outcomes of this paper.

Another limitation is that there is a lack of research studying the motives that stimulate developers to take part in hackathons and the advantages and obstacles from the usage of open data. Although scholars have analyzed how to design competitions, the motivations and understanding of open data's significance as well as the advantages of their usage have not yet been established or investigated. Thus, future researchers can investigate whether developers opt to keep the apps or abandon them.

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