

Article

Developing a Digital Business Incubator Model to Foster Entrepreneurship, Business Growth, and Academia–Industry Connections

Roberto Vaz * , João Vidal de Carvalho and Sandrina Francisca Teixeira 

CEOS.PP, ISCAP, Polytechnic of Porto, R. Jaime Lopes Amorim, 4465-004 Porto, Portugal

* Correspondence: rifv@iscap.ipp.pt

Abstract: The roles and positive impacts of business incubators, including virtual ones, in promoting entrepreneurship and innovation in multiple industries, and their consequent contributions to fostering sustainable economic growth and social development, have been highly advocated in the extant literature. Nonetheless, several authors highlight the urgent need to further carry out research concerning these structures' operation models by involving end users, since knowledge related to this phenomenon remains scant. This study sets out to convey the third phase of a broader research and development project following a design science research methodology. Ultimately, this contributes to the field by proposing a new virtual business incubator model with immediate practical applicability. This model was cocreated and validated with 23 incubator managers and startup founders from 15 business incubation centers during focus group sessions and organized into 8 dimensions concluded as fundamental in future digital incubation programs. Moreover, this study offers knowledgeable guidelines to support academics, practitioners, organization managers, or other professionals interested in building and running virtual business incubators. The main strengths and weaknesses of the proposed model are also highlighted, and several recommendations are provided to surpass the expected challenging stages of its implementation.

Keywords: incubator model; entrepreneurship; digital transformation; digitalization; framework; information and communications technology; virtual incubator; business incubation; startup; guidelines



Citation: Vaz, R.; de Carvalho, J.V.; Teixeira, S.F. Developing a Digital Business Incubator Model to Foster Entrepreneurship, Business Growth, and Academia–Industry Connections. *Sustainability* **2023**, *15*, 7209. <https://doi.org/10.3390/su15097209>

Academic Editors: Rui Alexandre Castanho and Daniel Francois Meyer

Received: 17 March 2023

Revised: 6 April 2023

Accepted: 23 April 2023

Published: 26 April 2023



Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Business incubators are recognized as essential for promoting social development and sustainable economic growth across a range of industries [1,2]. These structures hold the ability to increase entrepreneurship, technology, and innovation, as well as create new employment opportunities that lead to wealth generation [3,4]. They allow a variety of support and offer a range of services to bolster new ventures, established companies, or entrepreneurs, safeguarding their survival and expansion during challenging times.

In fact, business incubators' contributions to support the entrepreneurial process are stressed as vital tools that promote better survival prospects of incubated companies compared to nonincubated ones, even after tenants have graduated from incubator programs [5]. Examples of provided services include, among others, access to consultancy, networking opportunities, training sessions, and venture capital [6], entering new markets [7], and assistance with the development of products or services [8]. Considering these aspects, it is clear why several business incubators worldwide have been receiving not only private but also governmental funding, which has considerably aided their growth over the last decade [3,9].

However, it is essential to note that business incubators' facilities, support, and services supplied did not remain static throughout generations, and several shifts in their operation models were registered [10]. For instance, first-generation incubators models prioritized providing tangible resources to their tenants (e.g., physical spaces and facilities) [11,12]. In

contrast, new-generation ones focus more on supporting innovation and creativity through intangible resources (e.g., mentoring, business advice, coaching, and networking) [10,11,13].

Moreover, several universities around the globe have understood the impacting role that incubator programs can offer in improving the learning system, encouraging the growth of entrepreneurial spirit, and fostering their students' innovation competencies [14,15], in addition to contributing to strengthening collaborations with the industry. On the other hand, universities' two primary contributing functions and their impacts on serving the industry should also be underlined. One, academia is responsible for training new students that will enter the industry, and two, it fosters the flourishing of ideas that can potentially turn into new business ventures [16]. Despite the clear benefits linked to industry–academia collaboration and “the potential to contribute to the betterment of both—the industry and universities” (p. 1), the path to creating connections, developing incubator programs, and realizing operationalization is full of challenges and failed attempts. As explained by researchers focusing their work on this particular subject, there are diverse factors in the genesis of this problem. Some examples are linked to extended delays between the dissemination of research findings and their implementation into practice [17], the lack of incentives to address the issue that the expected gains should be higher than the costs, the inexistence of mature mechanisms to access the market and facilitate technology transfer, problems related to ethical issues of the collaboration to establish, and the lack of facilities to enable entrepreneurship development and the incubation of projects [18,19], to name a few.

Additionally, notwithstanding the growing and evolving phenomenon around business incubators' typologies, several authors stress that there is no literature consensus concerning the used nomenclature and definitions attributed to them [14,20], and that research encompassing their many business models has only lately begun to show some progress [14,15,20–23]. Despite this lack, it is widely acknowledged that understanding incubator models is crucial to enable improved support to entrepreneurs' ventures, further their missions, and create and capture value [23,24]. This problem is particularly significant for the case of virtual business incubators—which mainly operate through information and communication technologies to support their tenants [25]—given the ongoing digital transformation of organizations, which is expected to result in improved and more sustainable business processes, enabling enhanced competitive advantages [26].

Thus, this study sets out to explore the research question, “Which dimensions should be integrated into a new virtual business incubator model to support the entrepreneurial process of digital business or startups creation?”. It is the result of the third iterative stage of a broader research project following a design science methodology, which aims to contribute to the field in several ways: (i) extend previous research by providing new knowledge and perspectives to the significant existing literature gap; (ii) propose a new framework cocreated and validated with primary stakeholders to generate knowledge, namely, centered on empirical research with incubator managers and startup founders; (iii) inform guidelines that should be taken into account when implementing virtual business incubators following the proposed model; and (iv) provide practical guidance to support academics, practitioners, researchers, organization managers, or other professionals aiming to implement and run similar virtual business incubators.

The forthcoming section provides a background on research concerning previously-proposed virtual business incubator models in the literature and the Portuguese entrepreneurial ecosystem, followed by an explanation of the materials and methods for conducting the research. The article proceeds with the presentation, description, and explanation of the main findings, including the proposed digital business incubator model. Then, the study's main findings and contributions to the field are discussed, including the proposed model's strengths and challenges. The article finishes with the conclusions, outlining the study's limitations and suggesting future research directions.

2. Background

The first virtual business incubator model found in the literature [27] was proposed based on a case study of a small business community linked to the software industry in California. It aimed to provide information about good practices for business development and management experience, as well as resources to improve international business projection, while allowing for sustainable competitive advantages. This model operated in nine dimensions, namely: integrated human resources and capital; focus on strategic alliance formation; intellectual capital valuation and management; internet-based; for-profit; private sector playing the leading role; formalized management control systems; national and international business and market; and work with physical incubators when needed.

On the other hand, the virtual incubator DYEKO focused on a case study methodology linked to promoting women's entrepreneurship in the social economy [28]. It proposed four dimensions for digital incubation: provision of initial capital; knowledge and training; mentoring; and support services, such as accounting, marketing, taxation, legislation actions, insurance, and banking and finances.

Another incubator model, structured as a knowledge management system, was proposed to support emergent economic agents in Romania [29]. It operated under three additional dimensions to allow collaborative work between tenants and a team of experts who periodically validated the ongoing entrepreneurship results: three-tier client-server architecture; segmentation of tenants based on their needs; and content, support, and networking adjustments or restrictions, depending on the incubator fee.

Guetl and Pirker [30,31] proposed an immersive incubator model implemented in a 3D virtual world, developed by following an iterative methodology with end users to evaluate their incubation experience and to establish interactions within the system. This model allowed tenants to access three incubator dimensions when entering different virtual rooms: knowledge acquisition about specialized subjects, alone or in collaboration with other peers; social networks to discuss ideas and activities with experts; and resources and infrastructures to enable virtual presentations and marketing events.

A similar incubator model from Romania was proposed to enhance business, research, and academic opportunities focused on environmental and eco-innovation issues concerning electrical and electronic equipment waste recycling [32]. Although this model did not encompass 3D virtual spaces for its operation, it was organized in four dimensions: knowledge and training; local, national, and international events; innovation, knowledge, and technology transfer; and access to funds.

The incubator model developed by Unal, Afsarmanesh, and Angelov [33] was based on a literature review, and aimed to support small and medium virtual organizations and enterprises from the Netherlands by following an agile framework encompassing five dimensions: innovation process, competence matching, trustworthiness evaluation, negotiation support, and performance evaluation.

Additionally, two other models grounded in literature review were concluded to support virtual organizations from Portugal, Greece, and Spain [34], and to provide business training and networking opportunities to local entrepreneurs from Malaysia [35]. The first one highlighted six dimensions for its implementation: market sensing, unified digital enterprise, financing, team building, product support, and mentoring. On the other hand, the Entreportfolio Malaysian model operated through four interconnected dimensions: entrepreneurs, agencies, and enterprises' profiles; online business simulation; access to funding opportunities; and the incubator provider.

More recently, two additional incubator models were proposed to promote and support tenants' entrepreneurship on technological projects. The entrepreneurial information system eGosystem [36], from Italy, implied four dimensions: actors in the ecosystem, activities performed, knowledge assets and flows, and environment containing the services available. Meanwhile, the Finnish university incubation program Oulu EduLAB [37] had as its target audience bachelor's or master's students and unemployed professionals with entrepreneurship projects in the education technology industry. This model operated

through five dimensions: participants' selection; demo path and second lab; knowledge and training; mentoring; and networking.

Finally, Luik, Ng, and Hook [38] concluded as to several dimensions that creative virtual hubs operating in the United Kingdom should entail during incubation processes, concluding the following: participants' selection, virtual incubator business model, key qualities, program organization, the support offered, duration of support, digitalization strategies, and information and communication digital tools.

Although the virtual incubator models found in the literature are mostly grounded in findings from case studies, literature reviews, or questionnaires for their conceptualization, user-centered research underlying the cocreation and validation of theoretical models with incubator stakeholders remains urgent [25]. In this sense, before proceeding with the presentation of the materials and methods followed in the present study, it is critical to briefly mention that the Portuguese incubation ecosystem is moderately young compared to other countries in Europe, Asia, and the United States of America. According to the last report from the International Data Corporation, there are more than 160 incubators and accelerators in the country [39], a number which has grown by 40% between 2016 and 2020 [40]. It is estimated that there are 2039 startups and scale-ups running in the country, with more than 49,000 employees and a valuation of EUR 34.5 billion in 2022, placing the country in 28th position of the Global Startup Ecosystem Index, and the 32nd position of the Global Innovation Index [39]. In line with these factors, Portugal has seven unicorns representing 86% of the valuation of all founded startups. The national entrepreneurial ecosystem is also characterized by 63% of startups focused on a business-to-business (B2B) model, primarily operating in enterprise software (14%), health (13%), and marketing industries (9%). However, about 62% of startups are still in the seed stage, while 28% are in early growth, and 10% are in late growth. In addition, the regions of Lisbon and Porto together represent about 64% of the distribution of startups with headquarters in the country [39].

3. Materials and Methods

This study relied on focus group sessions [41] with startup founders that were tenants in national incubators and managers of national incubators as the primary data source to validate the virtual business incubator model, further discussed in this article.

This conveys the third phase of a broader ongoing empirical research and development project (project name anonymized for the blind-review process), following a design science research methodology [42–44]. This method was adopted from the initial phase of the project due to its recognized applicability in research focused on problem-solving [45], by following a rigorous six-step process [44] that helped investigate, understand, and design new solutions (e.g., models [43]) while involving both academic and organizational standpoints [42,46]. Therefore, the final objective of this methodologic process “is to provide a mental model for the characteristics of research outputs”, in which outcomes “are clearly expected to differ from those of theory testing or interpretative research” [44] (p. 52). Figure 1 presents a schematic organization of the various iterations of the research, aiming to clarify the research design developed to the present stage.

The virtual business incubator model was initially conceptualized in two steps. First, a systematic literature review on existing incubator models was conducted, identifying the demanding gap of developing a unified model by actively involving different stakeholders and considering their various experiences during its design (particularly those of startup founders) to further support digital businesses' and startups' creation. The main results of this phase were published in a previous article [25]. Next, a study focusing on startup founders' daily-lived incubation experiences was developed to understand which aspects they perceived as creating value or limiting their venture development, and their recommendations for enhancing future virtual incubation programs. The final results of this stage, published in an earlier article [47], allowed us to redefine and detail the dimensions of the virtual incubator model to validate during the next research phase.

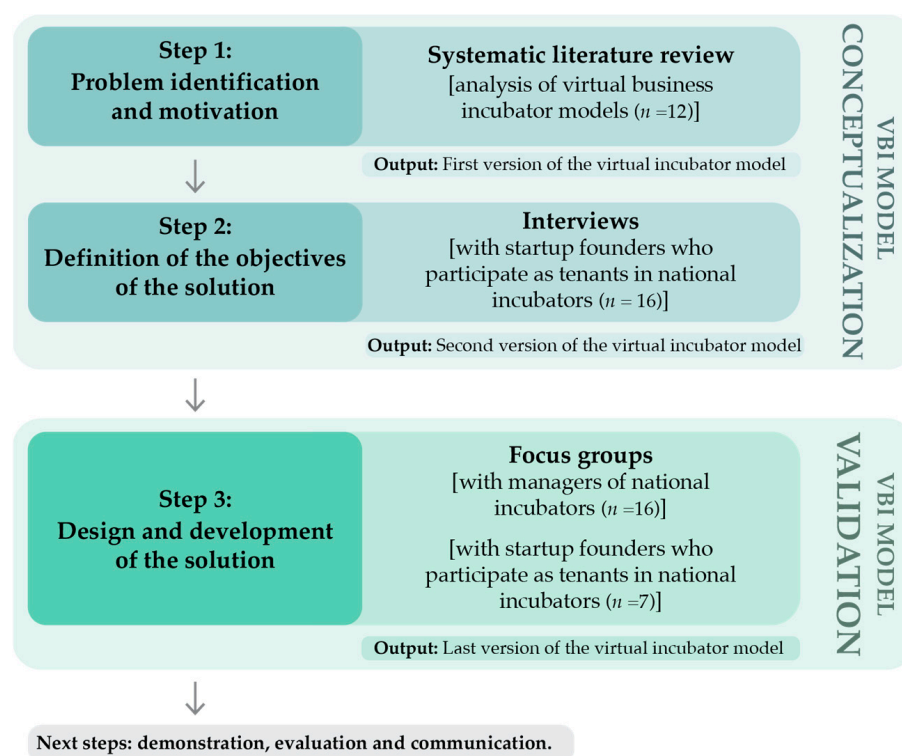


Figure 1. Schematic organization of the study phases and activities conducted by adopting a design science research methodology.

As already mentioned, the present study reports the third stage of the project, presenting the validation of the final virtual business incubator model, designed and developed iteratively during focus group sessions organized with managers of national incubators and startup founders who participate as tenants in national incubators.

The next subsections describe the process of sampling participants for the study, the research instrument and procedure, and the methods followed for data treatment and analysis.

3.1. Participant Sampling

For sampling participants for the research, the National Network of Incubators (RNI) platform [48] was first consulted to identify the existing business incubators in the country ($n = 99$)—from a total of more than 160 incubators and accelerators [39]—and to gather the respective contact information. After this process, a random test with small sample data was conducted to verify the accuracy of the contact information, during which it was compared with the information presented on the institutions' official websites and social media platforms. Since it was concluded that some contact details previously gathered were not up to date, it was decided to proceed with a manual verification of this information to guarantee its accuracy and, consequently, improve the success rate of the participant sampling for the research. Moreover, it was found that some incubators were subdivided into different incubation hubs located in distinct places in the country. From this process, a database containing a total of 110 email contacts of incubator centers was accomplished.

Next, the coordinators of the 110 incubator centers were contacted individually via email, and were requested for collaboration for this research and to extend the participation invitation to their incubatees. A total of 16 incubator managers and 7 startup founders expressed their interest in voluntarily collaborating with the study. Finally, the eight focus group sessions were agreed upon and scheduled individually with each participant: three sessions including only the startup founders, and five sessions with the incubator managers.

At this point, it is worth mentioning that it was initially expected to have the participation of a higher number of startup founders than incubator managers in this study,

mainly because the last available data estimated that there were 2039 startups registered in the country [39]. However, several authors called attention to the fact that accessing entrepreneurs who participate as tenants in incubators can be a challenging task [49,50]. This argument is in line with the Portuguese reality concerning developing research involving these entrepreneurs, since (i) no national online database is available to search for active startups in the country, to the best of the authors' knowledge; and (ii) there are only a few examples of incubators that the names of the incubated startups publicly available on their websites and social media platforms. Furthermore, research involving startup founders participating in incubation programs can be susceptible to exposing unsatisfactory incubation practices and experiences [47,51,52], which increasingly contributes to obstructing access to them, making research involving these persons somewhat complex.

3.2. Research Instrument and Procedure

A discussion guide was prepared to be used as the instrument to promote the group discussion about the development and validation of the digital incubator model under analysis. This instrument was based on the results of the previous phases (systematic literature review and interviews with startup founders), and was designed to help promote a 90 min debate per session. It included open-ended questions to probe the discussion and to allow for more precise responses [41,53] from participants from each focus group concerning the various dimensions of the virtual business incubator model. As advised by Hennink [41], the discussion guide was not used as a static instrument during the entire process of data collection; it was moderately refined at the end of each focus group, as more was learned about the study topic, and new conclusions helped to enhance the conversation of the subsequent focus groups.

Data collection occurred during January of 2023 via eight video conferences arranged with the twenty-three participants, and each session included between two and four individuals. A document was previously sent to each participant by email when arranging their focus group session, explaining the research objectives; why the research was being conducted; the research protocol; the collection of data, including how they would be used, its anonymity, and its confidentiality; and if there were any risks associated with their participation. Additionally, the informed consent to participate in the study was briefly discussed with all participants before the start of their respective focus group sessions, in which they gave their verbal and written consent to audio record the corresponding conference.

The focus group sessions were moderated by one researcher responsible for presenting the last version of the virtual incubator model, delivering the questions, providing clarifications, and probing the discussion. Moreover, all participants had online access to the most current version of the virtual incubator model—shared by using the Miro collaboration platform [54]—and their contributions were registered iteratively and consentingly during the sessions.

3.3. Data Treatment and Analysis

The average duration of the focus group sessions was 1 h and 26 min, excluding the initial protocol, ranging from a maximum of 1 h and 39 min to a minimum of 1 h and 2 min.

The eight recorded sessions were transcribed verbatim in the original language of conversation (Portuguese), and only relevant quotes included in the Section 4 of the present article were translated into English. The artificial intelligence transcription plugin of Microsoft Office 365 was used initially to produce the text transcripts, given the substantial audio-recorded total time resulting from the data-gathering (11 h and 27 min). Then, while reviewing each transcript compared to the original audio-recording file, several pieces of information were manually corrected to ensure the high quality of the transcriptions. For the sake of privacy and to prevent cross-information matching, this research anonymized the participants by attributing to them a random code, as well as to their respective business incubator centers.

The thematic analysis method [55,56] was adopted to identify, systematize, analyze, and report the qualitative data resulting from the focus group sessions. The thematic coding process was conducted by following an inductive approach based on the explicit meaning of the data linked to the diverse dimensions of the virtual business incubator model. One author was responsible for systematically conducting the coding process and iteratively categorizing the qualitative data into refined themes and subthemes. Then, all authors analyzed and discussed the categorization to resolve any disagreement until the final version's revised structure was concluded.

Lastly, a database was created containing the participants' answers as to their demographic information, educational background, and their role in their respective business incubator center, among other information. Descriptive statistics and exploratory data analysis were performed to analyze these topics under study.

4. Results

This section is organized into three subsections, presenting and describing the main results of the research as follows: (i) participants' profiles; (ii) mapping of iterations to the virtual business incubator model; and (iii) proposal of the virtual business incubator model.

4.1. Participants' Profiles

The sample's demographic characteristics are organized in Table 1, presented according to the distribution of the twenty-three participants into the eight focus group sessions: three sessions (E, G, and H) saw the participation of four individuals in each; two focus groups (A and D) involved three participants per session; and three (B, C, and F) occurred with two participants in each, given three individuals were unable to attend their scheduled focus group.

The participants' ages ranged from 27 to 61 years ($M = 41.2$; $SD = 9.7$), and the predominant age group was 35–44 (47.8%), followed by 27–34 (21.7%), 45–54 (17.4%), and 55 or more years old (13%). Concerning gender, the nine female participants represent 39.1% of the sample, while the fourteen males correspond to 60.9%.

Regarding their educational level, all participants had completed higher education. More than half held a master's degree ($n = 12$), six had a bachelor's degree, three completed a post-graduate degree, and two individuals had a Ph.D. degree. Their fields of education were diverse, but mostly related to the areas of economics, management, or innovation ($n = 8$), followed by engineering or technology ($n = 6$), human sciences ($n = 6$), natural sciences ($n = 2$), and mathematics ($n = 1$).

The seven entrepreneurs who participated in the research (coded with the abbreviations F-1 to F-7) founded their startups and occupied top management positions, five as Chief Executive Officers (CEO) and two as co-CEOs. In the case of the sixteen incubator managers (coded as M-1 to M-16), ten were responsible for top positions in leading the incubators in which they worked (four board advisors, three directors, two coordinators, and one CEO), and six participants were in charge of senior management positions (three managers, two technicians, and one technical advisor and consultant). Additionally, it is mentioned that the incubator managers had 9 years of experience on average ($SD = 7.07$) in managing incubators, and entrepreneurs had 2 years of experience on average ($SD = 1.53$) as tenants in their current incubators.

Furthermore, the incubator managers and startup founders were linked to fifteen different incubator centers (i.e., they represent 13.6% of the total number of national incubators asked for collaboration for this research), located in seven districts and two islands of Portugal: Porto ($n = 3$), Lisbon ($n = 3$), Bragança ($n = 2$), Évora ($n = 2$), Portalegre ($n = 1$), Setúbal ($n = 1$), Vila Real ($n = 1$), Autonomous Region of Azores ($n = 1$), and Autonomous Region of Madeira ($n = 1$). As already mentioned, the official names of the incubators represented by the participants were coded to ensure data anonymity (i.e., I-1 to I-15).

Table 1. Demographic characteristics of the participants.

Focus Groups by Participants	Focus Group Code	Participant Abbr. *	Age Group	Sex	Educational Background	Incubator Code	Role in Incubator
Focus groups with startup founders (<i>n</i> = 3)	Focus Group A	F-1	35–44	M	Post-graduation in photography	I-1	Startup co-CEO
		F-2	35–44	F	Master’s degree in theater studies	I-1	Startup co-CEO
		F-3	35–44	F	Ph.D. in food technology	I-2	Startup CEO
	Focus Group B	F-4	27–34	M	Master’s degree in informatics engineering	I-2	Startup CEO
		F-5	27–34	M	Master’s degree in mathematics	I-2	Startup CEO
	Focus Group C	F-6	35–44	F	Ph.D. in cellular biology	I-2	Startup CEO
		F-7	27–34	M	Master’s degree in entrepreneurship and innovation	I-1	Startup CEO
Focus groups with incubator managers (<i>n</i> = 5)	Focus Group D	M-1	35–44	F	Bachelor’s degree in architecture	I-3	Director of economic development
		M-2	35–44	M	Master’s degree in educational technologies	I-3	Senior technician of economic development
		M-3	35–44	M	Bachelor’s degree in mechanical engineering	I-4	Director of marketing and innovation
	Focus Group E	M-4	35–44	M	Master’s degree in entrepreneurship and innovation	I-5	Manager of administration
		M-5	35–44	M	Master’s degree in information and enterprise systems	I-6	Project manager
		M-6	35–44	M	Bachelor’s degree in business management	I-7	Chair of the Board of Directors
	Focus Group F	M-7	45–54	M	Bachelor’s degree in informatics engineering	I-8	Incubator CEO
		M-8	45–54	F	Master’s degree in business management	I-9	Chair of the Board of Directors
	Focus Group G	M-9	27–34	M	Master’s degree in economics	I-10	Project manager
		M-10	55+	F	Master’s degree in management	I-10	Chair of the Board of Directors
		M-11	55+	M	Post-graduate in public management and administration	I-11	Incubator Director
		M-12	55+	F	Bachelor’s degree in sociology	I-11 & I-12	Technical advisor and consultant
	Focus Group H	M-13	45–54	M	Master’s degree in educational sciences	I-13	Board advisor
		M-14	35–44	M	Bachelor’s degree in civil engineering	I-11	Senior technician
		M-15	27–34	F	Post-graduate in human resources management	I-14	Incubator Coordinator
		M-16	45–54	F	Master’s degree in business management	I-15	Incubator Coordinator

* Participants’ abbreviation: “F” means startup founder, and “M” means incubator manager.

4.2. Mapping of Iterations to the Virtual Business Incubator Model

Before proceeding with the detailed explanation of the final version of the virtual business incubator model, this section aims to objectively present the results concerning the several iterations introduced during its validation and codesign with the 23 participants.

A mapping of the iterations introduced to the virtual business incubator model under analysis is organized in Table 2 as an effort to convey the rich dynamics registered during the eight focus group discussions, clarifying the modification and removal of existing topics and the inclusion of new ones.

Table 2. Summary of the iterations of the virtual incubator model discussed in each focus group.

Focus Groups by Participants	Focus Group Code	Participants	Topics Modified	New Topics Included	Topics Removed
Focus groups with startup founders (<i>n</i> = 3)	Focus Group A	F-1, F-2 & F-3	<ul style="list-style-type: none"> • Mentor–participant matchmaking before starting the incubation process. • Some networking moments should also be in person. • Learning resources must define the goals to attain during the different phases of the incubation. • Digital tools should be simple and efficient to use. 	<ul style="list-style-type: none"> • A stage to assess new incubatees’ immediate needs. • Provide new tenants a welcome kit for initial guidance with important information (e.g., how to register their startup). • Consultancy services should include intellectual property advice. • Assess the incubatees’ needs to select topics of interest for the next events, and communicate funding opportunities directed to their businesses and development stages. • Promote the exchange of services between incubated startups. 	No topics were removed during the focus group session.
	Focus Group B	F-4 & F-5	<ul style="list-style-type: none"> • As criteria for participants’ selection, contemplate businesses with market traction. • New applications should fit already incubated projects. • Assess the needs of new tenants before the pre-mentoring stage. • The kit for initial guidance should include answers to recurring questions, information about the existing perks, and what to do to start using them. • Select potential investors aligned with the incubator’s mission. 	<ul style="list-style-type: none"> • The key qualities and purpose should specify the business sectors. • Provide an initial moment for matchmaking between new and old tenants. • Seminars and workshops based on current economic challenges, needs, and priority sectors for investment. • Connect incubated startups to potential clients as a perk. • Promote job opportunities by helping incubatees search for new human resources among university students, and vice versa. 	No topics were removed during the focus group session.
	Focus Group C	F-6 & F-7	<ul style="list-style-type: none"> • New applications should fit already-incubated projects in a short-term phase. In the long-term horizon, the diversity of businesses can benefit the incubator ecosystem. • Learning resources should include courses about how to register a brand, how to open a startup, intellectual property issues, and how to complete accountancy tasks. • Mentors must be experienced and assist tenants in searching for funding opportunities. • Networking events should also invite older and former tenants to share their experiences and success stories. • The spread of information about funding opportunities should also include community, national, European, and other international calls. 	<ul style="list-style-type: none"> • Program operation should specify the weekly scheduled time for incubation. • Accept individual applications, since forming a team during incubation can be beneficial. • The challenge is making the virtual incubation experience similar to a physical incubation one. Face-to-face moments should be ensured, even if only once a year. • Consultancy and support services should ensure competitive prices during and after incubation. • Develop partnerships with external entities to assist tenants regarding funding applications. • The incubator can offer a support service for funding for applications, and retain a percentage of the money if approved. • Digital tools: learning management system with multimedia content; shared online page with access to entrepreneurship and personal development books and videos; group messaging; and forums and online group channels. 	No topics were removed during the focus group session.

Table 2. Cont.

Focus Groups by Participants	Focus Group Code	Participants	Topics Modified	New Topics Included	Topics Removed
Focus groups with incubator managers (<i>n</i> = 5)	Focus Group D	M-1, M-2 & M-3	<ul style="list-style-type: none"> The purpose and key qualities dimension should specify the incubator's target audience. Recruit experienced mentors. The role of the mentor should be clearly defined, including if they will have any stake in the startup's profits. Develop partnerships with R&D centers and universities, so tenants can access their structures if needed. Strategies to create and promote a sense of community between the stakeholders should provide online and face-to-face social events. 	<ul style="list-style-type: none"> Communication strategy for the incubator should be defined to reach a broader audience (e.g., events directed to the target audience). Calls for the selection of new applications should be vastly disseminated. Allow for having a physical address (important to startups receiving correspondence). Promote connections with other incubators and share experiences with other entrepreneurs. 	No topics were removed during the focus group session.
	Focus Group E	M-4, M-5 & M-6	<ul style="list-style-type: none"> The mission should include the main sectors of specialization of the incubator. Consider both individual and group applications to the incubator. Stipulate a pre-incubation stage to assess tenants' needs, promote mentor-participant matchmaking, and give access to the welcome kit. Include preparatory content in knowledge transfer and offer services to help entrepreneurs with specific cases. Provide the support service of preparing submissions for funding opportunities, and charge a fixed price. 	<ul style="list-style-type: none"> Charging tenants a symbolic amount as a fee is important to ensure the incubator's sustainability. Charge competitive amounts to external companies according to the used services. Candidates should answer an online questionnaire to apply. Applications can be reviewed and selected by professors and researchers. Offer a comprehensive correspondence service to notify, forward, digitize, or collect mail. Email and newsletters are still very relevant to inform tenants about several initiatives, including events and funding opportunities. Organize pitch and demo day events. 	<ul style="list-style-type: none"> Remove very specific and sensitive topics from knowledge transfer (e.g., legal, accountability, intellectual property registration) that can lead to future legal problems. Remove the incubator support to prepare funding applications and retain a percentage of the money if approved.
	Focus Group F	M-7 & M-8	<ul style="list-style-type: none"> The communication strategy should also include the dissemination of the incubator during university entrepreneurship classes; hackathons organized with students and external persons. Mention in the program operation that the weekly scheduled time for incubation is defined with each tenant individually, according to their expectations and available time. The set of perks and partnerships should be built gradually and according to the tenants' needs. Promote business exchanges between tenants by including new perks and services offered by incubated startups. 	<ul style="list-style-type: none"> Develop objective evaluation criteria to filter applications and select new tenants. Design a feasible incubation plan with tenants based on their needs and expectations. Provide an onboarding kit with a constantly-updated knowledge base with recurring questions. Build an extensive partnership network and charge partners a percentage of the revenue from tenants using their services to support the incubator's long-term sustainability. Existing platforms can help manage projects, keep in touch with tenants, incubators, investors, and partners, and manage content. 	<ul style="list-style-type: none"> Remove from program operation the specification of the weekly scheduled time for incubation. Remove information about registering a startup from the welcome kit to avoid legal problems with external entities. Remove the subject if mentors should or should not have any stake in the startup's profits.

Table 2. Cont.

Focus Groups by Participants	Focus Group Code	Participants	Topics Modified	New Topics Included	Topics Removed
Focus groups with incubator managers (<i>n</i> = 5)	Focus Group G	M-9, M-10, M-11 & M-12	<ul style="list-style-type: none"> Develop partnerships with other incubators to exchange experiences and share contacts from national and international mentors. Making seminars and workshops accessible to the general public can support the incubator's communication strategy. Develop a broad and multidisciplinary network of persons and organizations to serve the tenants' needs better. 	<ul style="list-style-type: none"> Arrange meetings for interviewing entrepreneurs during the application stage to better understand their expectations and intentions. During the onboarding process, organize a welcome event so new tenants can present their projects to the entire ecosystem. 	No topics were removed during the focus group session.
	Focus Group H	M-13, M-14, M-15 & M-16	<ul style="list-style-type: none"> Accomplishing the certification of the incubator can also enhance the incubator's communication strategy. Ensuring mentors are available for regular meetings with entrepreneurs is important. Expect some flexibility when defining deadlines with the entrepreneurs. 	<ul style="list-style-type: none"> No new topics were recommended for inclusion during the focus group session. 	No topics were removed during the focus group session.

A total of 35 new topics were included, 33 were modified, and 5 were removed from the model during these sessions, until the final version was achieved. It is also important to note that during the last session, it was not recommended to add any new topics or remove existing ones, and only slight modifications regarding three cases were suggested to be addressed.

4.3. The Digital Business Incubator Model

Figure 2 presents the final conceptual virtual business incubator model validated during the focus group sessions. It is organized into eight main dimensions, which will be individually explained next: key qualities and purpose, program operation, communication strategy, application stage, participants' selection, onboarding process, incubation process, and digital tools.

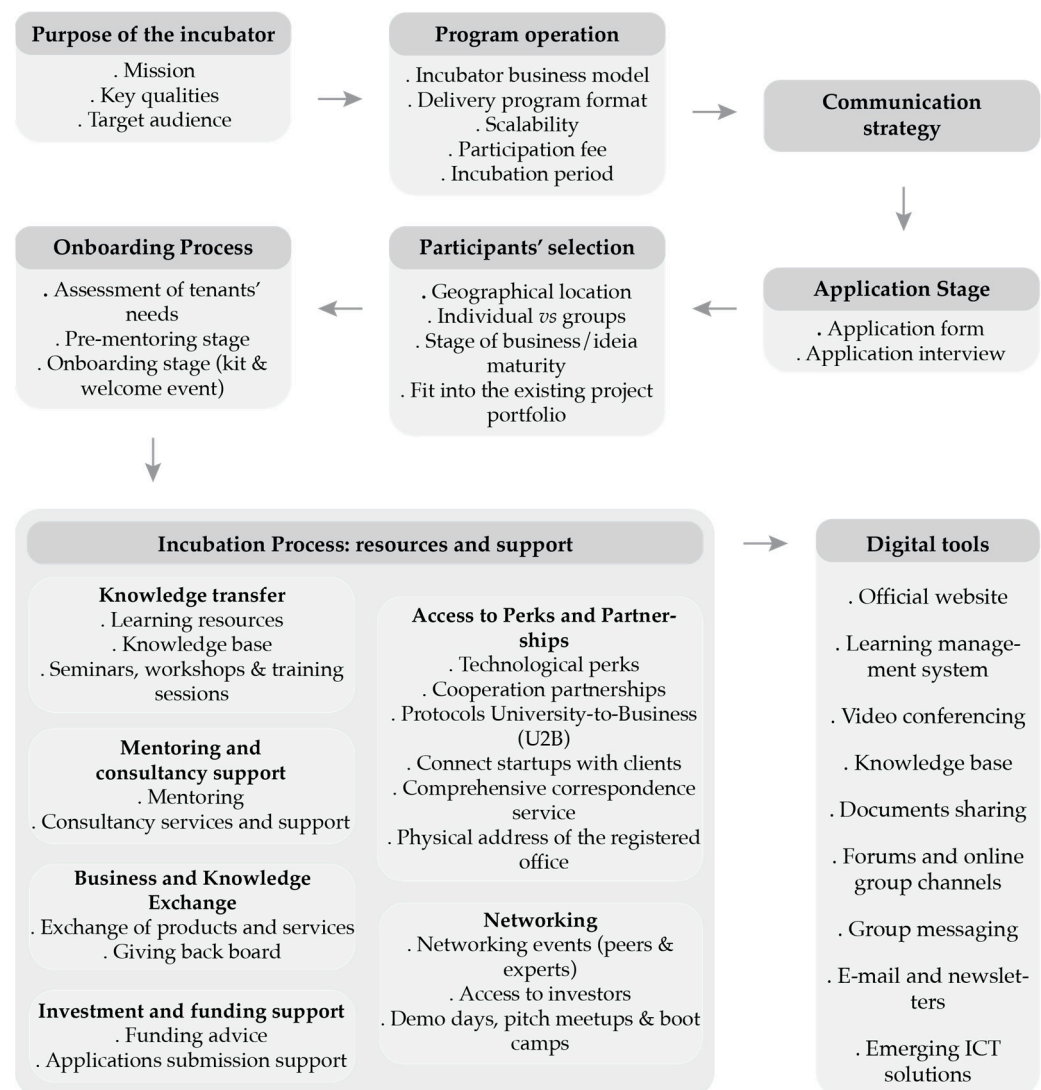


Figure 2. Schematic organization of the proposed digital business incubator model.

Before proceeding with the presentation of each dimension, it is important to additionally stress that this model was codesigned as an attempt to convey several perspectives previously identified as lacking a unified integration in virtual incubator models [25], i.e., business organization and management, information and communication systems, and user experience and engagement. Furthermore, this model provides a set of guidelines to

take into consideration when starting a virtual incubator to bring together and effectively establish links between entrepreneurs, the university, and the industry.

4.3.1. Purpose of the Incubator

According to the participants, this dimension should clearly convey the purpose of the incubator by including the mission statement of the virtual business incubator, the key qualities it reflects on meeting identified demands, and the target audience it aims for, as illustrated in the left block of Figure 3.

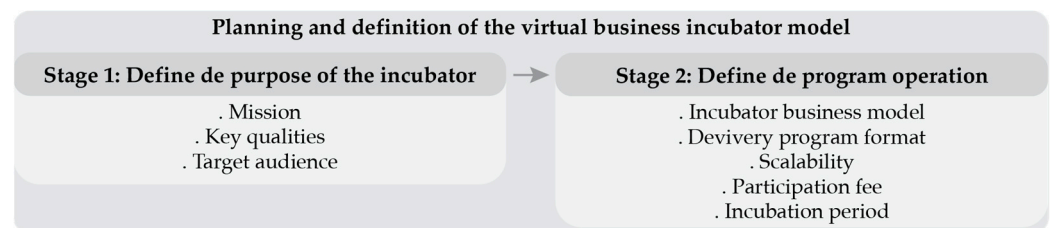


Figure 3. The two dimensions concerning the planning and definition of the digital business incubator model.

When defining the mission statement, first, it is important to consider if the incubator will have one or several specialized activity sectors as to the ideas or companies it seeks to incubate, or if the incubation is open to any sector. During the focus group sessions, it was concluded that having only one or a few areas of specialization would benefit the operation of incubators during their initial years because “it makes everything much easier to collaborate” (M-7), and “we support projects as long as they meet the areas of knowledge where our University partner and we operate so that we can better support entrepreneurs with what they need” (M-13). However, the specialization areas can be broader with time, provided the management team and the ecosystem are developed enough to support entrepreneurs from diverse backgrounds.

Moreover, the key qualities should also reflect the incubator’s purpose; for instance, contributing to the development of the local or national economy, supporting the growth of small and medium enterprises, promoting innovation, supporting the development of specific sectors or industries, stimulating the entrepreneurial spirit of their tenants, developing the social capital value and knowledge exchange, among others.

Lastly, it is recommended to unequivocally explain the target audience of the incubator:

“A digital incubator has the potential to reach a global audience, so by defining it, you can filter from the beginning applications coming from entrepreneurs from whom the ecosystem is not interested and to whom the incubator is not aimed” (M-2)

Additionally, it was also advised that the definition of the target audience should consider that it “must have a certain type of characteristics, need a certain type of support for a certain period of time, to achieve a certain type of results” (M-3). Some examples of target audiences include, for instance, students and alumni with research projects with the potential to turn into a business, unemployed persons, and entrepreneurs with developed business ideas that need extra support.

4.3.2. Program Operation

This dimension defines how the virtual business incubator works and operates, and takes into consideration: the business model, the delivery program format, the scalability, the participation fee, and the incubation period, as illustrated in the right block of Figure 3.

Concerning the incubator business model, participants mentioned that their incubators tend to follow business-to-customer (B2C) models to sell their programs and services directly to their tenants. They agree that this business model seems more appropriate to the main objective of the proposed incubator.

The program format should also be specified, i.e., if it will be delivered through an entirely virtual approach or in a combination of virtual and in-person (hybrid format), which resources will be offered to incubatees, and by which digital tools. These aspects will be examined and discussed in detail, contextualized with other dimensions of the proposed model.

The scalability concerns the number of participants, which can be configured to be limited or to reach a more extensive user base progressively. Incubator managers advised that, based on their experiences, a virtual incubator in an initial phase should consider a low number of participants to start their operation. Firstly, it will allow for testing the model and making small adjustments whenever needed so, over time, it can progressively open to many participants. Secondly, it will enhance the development of a cohesive ecosystem:

“The relationship between these types of structures and the entrepreneurs has to do with points of connection between both sides: the more these connections are, the stronger it makes the relationship and easier it is to support tenants, which is generally not an easy relationship to develop” (M-7)

Another aspect to consider is the cost of participation and access to services (e.g., free, fixed fee, or variable fee based on the tenants’ necessities). As advised by the incubator managers, although the final objective of an incubator may not be linked to generating profit, “it still aims to fulfill its mission, and for that, the incubator has to be sustainable” (M-6). In this sense, it is fundamental to guarantee the economic and financial sustainability of virtual business incubators as well, and several approaches were recommended to follow: (i) charge incubatees a symbolic monthly participation fee to maintain the incubator operation; (ii) charge fixed values for specialized support services, including consultancy with professors and researchers; (iii) build an extended network of partners and use it as another revenue stream, for instance, by recommending entrepreneurs in exchange for a 10% referral fee on the invoiced amount.

Finally, the incubation period outlines the duration of the entire incubation program, including access to the offered resources and support services. This period was highlighted by the founders participating in this study as typically between 1 and 3 years. Still, all participants advised that it should be defined directly with entrepreneurs, since several variables can influence the support needed to develop tenants’ businesses.

4.3.3. Communication Strategy

Incubator managers stressed the need to define an effective communication strategy for the virtual incubator to reach not only the target audience but also to boost its visibility among the general public. This dimension is illustrated in Figure 4.



Figure 4. The dimension concerning the communication strategy of the digital business incubator model.

The focus group sessions outlined several procedures successfully followed by these participants to communicate with their incubators. In order to reach the target audience, virtual hackathons can be organized with specific challenges:

“It is a good way to create a problem-solving mindset and can be excellent to evaluate entrepreneurs’ ideas generation capacity, build a rapport with them, and select candidates to join the incubator later” (M-7)

Also, information about the incubator could be disseminated among students during classes, and events could be organized to encourage their active participation.

Moreover, calls for new applications should be meticulously disseminated, according to the target audience. Social media—more specifically, Instagram and LinkedIn—can offer significant contributions to reach the desired audience, apart from promoting the brand while constantly interacting with stakeholders, as explained by M-13:

“Social media have helped us a lot growing and reaching other geographies and contexts. It helps with the brand activation and boosts the incubator’s visibility”.

Another piece of advice is building proximity with external entities, such as entrepreneurship offices, city councils, social innovation entities, employment promotion entities, and social action councils, among others. Moreover, accomplishing a national or international certification of the incubator can also support the overall communication strategy.

4.3.4. Application Stage

The application stage dimension should encompass the two steps illustrated in the left block of Figure 5: filling out an online form and interviewing the candidates.

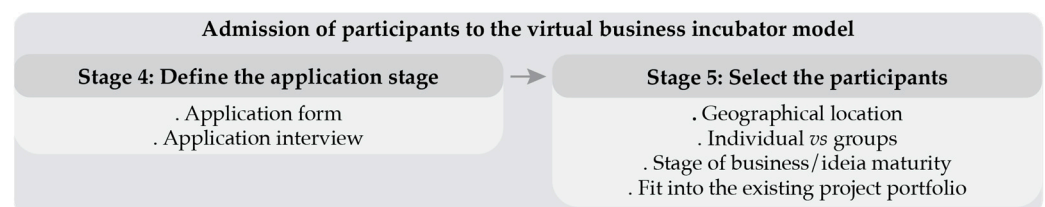


Figure 5. The two dimensions concerning the admission of participants to the digital business incubator model.

The application form should be designed to allow entrepreneurs to answer a group of questions related to their project, for instance: why they consider it innovative, the company name, the team background, and other relevant information. Additionally, they should also send a motivation letter explaining their reasons for entering the incubator. According to the managers, the answers to this form help them make an initial screening of the development stage of the idea, project, or business, and also to have a first impression of the entrepreneur. As explained by M-15:

“We want to receive good applications, so people must think in advance about particular questions related to their projects, at least about the basic things of running a business. Therefore, our form is already developed in this sense”.

Next, an online call with the applicants should be organized, typically lasting 30 min, to allow entrepreneurs to present themselves, explain their projects, and discuss their expectations regarding how the incubation would help them develop their businesses. For two reasons, incubator managers highlighted these application interviews as extremely useful. The first reason is to evaluate some personal characteristics and verify if applicants have an entrepreneurial profile that would contribute to the success of their projects:

“We have to encourage entrepreneurship, of course, but not everyone can be an entrepreneur. If a person does not have the right profile and characteristics, we are contributing to the failure and another company that will go bankrupt. If they do not have resilience and the skills, no matter how good the project is, there is a huge risk that it won’t go anywhere” (M-10)

The second reason is to try to understand the real intentions for the application, i.e., if entrepreneurs are effectively looking for support during incubation or if they only wish to be able to change the tax headquarters where they may have tax benefits, leave their countries, or obtain a visa:

“Sometimes it is really difficult to understand who has a business project that will effectively have the capacity to develop and scale, and who is using the

incubation program for leaving their country, to have tax benefits, or getting a visa, among other issues” (M-8)

4.3.5. Participants’ Selection

Both managers and founders collaborating in the focus group sessions agreed that virtual incubators should expect to have suitable and motivated tenants joining their programs. Apart from that, other aspects were highlighted to be considered when selecting the participants for incubation: their geographical location, whether they were individual applications or groups, the stage of maturity of their projects, and the fit of the projects into the existing portfolio. The block on the right of Figure 5 aims to illustrate this dimension.

The geographical location was identified as an advantage for recruiting national and international talent through a virtual incubator, which promotes diversity, cross-border cooperation, and the development of a multidisciplinary ecosystem. As stated by M-7 and M-13, respectively, “The potential for diversity and having different projects is greater, given the opportunity to reach a larger audience and recruit better talent, and this diversity is very important”, and “this diversity is very welcome and ends up influencing the incubator community”. However, incubator managers also stressed that considering a broader geographical location of tenants leads to some problems. One of them, already mentioned, regards the challenging screening process of the applicants who intend to take advantage of the incubator for tax benefit reasons or to enter another country. Additionally, linguistic and cultural barriers were identified, apart from issues related to running a business: “Besides the language issues, the organization of society can be completely different, the laws are different, and extra support is needed to overtake them” (M-11), and “there are accounting, tax, and market issues that the incubator can be no longer able to deal with after a certain point” (M-8).

Focus group participants also advised that, during the tenants’ selection, the number of team elements should not be limited, i.e., if applications are made individually or in a group: “If the idea is sufficiently developed or if the individual or a team is qualified or not, it is not the responsibility of the incubator” (F-5), and “The incubator should not limit applications to be in group or individual, this is up to entrepreneurs. The role of the incubator is providing them an appropriate support” (M-4).

Another aspect to consider with regards to the stage of maturity of the projects (i.e., initial idea, product development, testing, finding a viable way to start their business, or business expansion, for instance). During the initial years of the incubator, incubator managers advise selecting applicants with similar project development stages because it will be easier to support them. If possible, business projects in the embryonic stages should also be prioritized:

“It is during that stage that people tend to lose motivation most easily because they have the ideas and the whole concept. They can visualize the project and put it in the right context but do not know where to go next, how to open a company, and so on” (F-3)

Nevertheless, after the incubator has been operating for a while and has a well-tested model, both founders and incubator managers agreed that an ecosystem including entrepreneurs with initial stages and others in more advanced stages of their business is advantageous for the entire ecosystem. As explained by M-16:

“Incubating entrepreneurs with business ideas and startups already in advanced stages promotes a very informal network, which is extremely fruitful and allows the sharing of innumerable experiences, that ends up being very enriching for everyone”.

The last suggestion when selecting the incubatees concerns the project’s fit into the existing project portfolio. This aspect is especially important for an incubator in an initial stage which is starting to build its portfolio: “This is more interesting to match the interests of all entrepreneurs in an early stage” (F-7), and “having startups in similar busi-

ness areas helping each other would enhance the incubation process and maximize the success” (F-4). On a long-term horizon, having a diversity of businesses can benefit the incubator ecosystem.

4.3.6. Onboarding Process

During the focus group discussions, participants agreed that an onboarding process would help integrate new tenants into the ecosystem and facilitate them to get to know other peers and the incubator staff. This process, illustrated in Figure 6, should include the assessment of tenants’ needs, a pre-mentoring stage, and an onboarding stage.

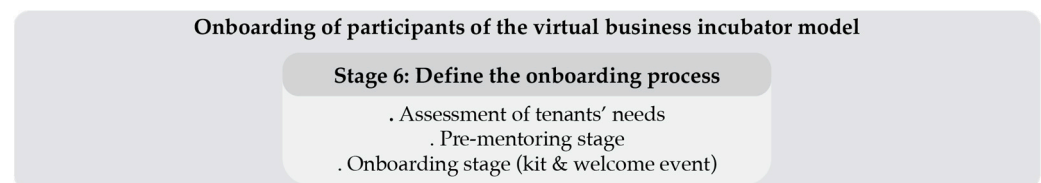


Figure 6. The dimension concerning the definition of the onboarding process of the digital business incubator model.

It was suggested to schedule an individual meeting with the new tenants after the signing of the incubation contract to assess their most urgent needs to develop their business, discuss their expectations, define a strategic schedule for the incubation process, and design a feasible incubation plan aligned with their goals (typically for a one-to-two-year period). As informed by incubator managers, this initial moment is crucial:

“Not all entrepreneurs have the same type of needs to launch the same type of business. Each project and each entrepreneur has her/his own path” (M-3)

After this meeting, a pre-mentoring stage should be organized to promote mentor–participant matchmaking. This aims to offer tenants and potential mentors, previously selected, the possibility of getting to know each other and discussing the project during a meeting to conclude if their collaboration is suited. Startup founders agreed that a match-making moment would improve the chances of tenants’ business development success:

“It makes perfect sense that the mentor is someone who fits well with the project and the company being created” (F-6)

Both founders and incubator managers highlighted that defining the role of mentors and their support is crucial. Still, these aspects must be directly agreed upon between entrepreneurs and mentors: “It is important to make it clear what the mentor’s activities are and with what she/he can or cannot offer support; this relationship should be discussed between them” (M-3) because “if this is not well defined between the two, you end up not taking much advantage of mentoring” (F-6).

Lastly, it was suggested that new tenants could receive an onboarding kit containing a knowledge base with answers to frequently asked questions that is constantly updated; a dedicated area with details about how to start using the perks; a complete list of the incubator’s partnerships and applicable discounts, if applicable; and the respective links for accessing these elements. During the onboarding stage, a general welcome event with all stakeholders of the incubator should also be organized, so a new tenant can present their project to the entire ecosystem, get to know peers, and, ultimately, start a matchmaking relationship with other incubated entrepreneurs or startups.

4.3.7. Incubation Process

Among the set of resources and support the virtual business incubator offers to its tenants, the proposed model highlights some aspects agreed upon as vital ones, organized in six subdimensions: knowledge transfer; mentoring, and consultancy support; access

to perks and partnerships; exchange of services and knowledge between incubatees; networking events; and investment and funding support. These, illustrated in Figure 7, will be explained in detail next.

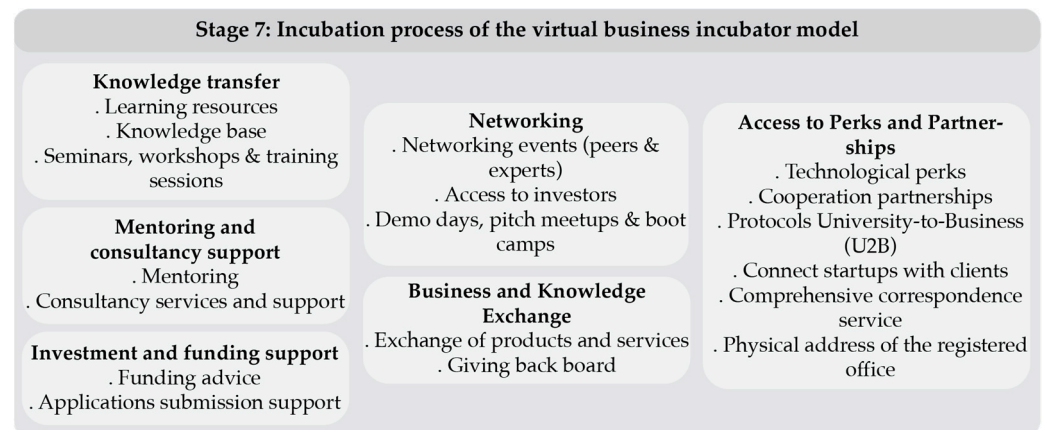


Figure 7. The dimensions concerning the resources and support of the incubation process of the digital business incubator model.

Knowledge Transfer

Knowledge transfer regards the entrepreneurs' professional and personal skills development during their incubation through several resources. Focus group participants agreed that knowledge transfer should be provided by combining synchronous and asynchronous strategies, and should take into consideration interactive and gamified approaches to enhance tenants' incubation experience:

- Learning resources directed to tenants' skills development (e.g., business structure and business plan, minimum viable product, marketing, sales, finance, tax, accounting, and how to pitch, among others) can be provided asynchronously. They can be structured into specific modules to be completed during a certain period of time, including expected goals to attain at the end of each one. These resources should also be combined with meetings with mentors to validate new developments and progress to the following stages. This way, "everyone can be more or less aligned throughout the incubation process" (F-6). Specifically concerning the content related to entrepreneurial development, incubator managers state that the aim of these should be educational, but should not substitute professional assistance required for very specific and sensitive topics to be accomplished (e.g., trademark or patent registration, legal and accountability, among others). As advised by M-5: "Sensitive topics can lead to legal responsibilities, so it is benefic to provide information about them to a certain point, and then entrepreneurs should consult a professional";
- Several founders and incubator managers agreed that a knowledge base should also be made available. It was suggested that the incubator should allow a cooperative curatorship of content, such as videos, podcasts, books, series, and documentaries, to encourage and support tenants' professional and personal development. As explained by F-7: "Having access to this type of content enriches us a lot on a professional and personal level. It gives us many extra tools that are complementary to what we are trying to do";
- Additionally, incubator managers showed interest in having access to a knowledge base like this one, given the remarkable potential to share good practices, "because together we are stronger and if everyone shares what they have, it can be much faster to help each other" (M-10);
- Seminars, webinars, training sessions, and workshops should also be promoted by involving the various incubator stakeholders during virtual or hybrid sessions, and made available to be watched asynchronously afterward. Focus group participants

mentioned the importance of assessing tenants' needs and expectations before organizing these sessions so that they can be more fruitful: "Because we all expect different things, and it should be understood what the majority of incubatees need at a certain time. In my case and many others, this assessment was never done, and then people do not attend the events because there are things that do not fit our entrepreneurial journey" (F-3);

- Another suggestion was to promote problem presentation seminars—i.e., invite representatives of several economic sectors to talk about the challenges, trending needs, and their current investment agenda—so entrepreneurs could adapt their products or services to other businesses that they did not know about: "Our products can have an almost immediate and super useful application in a sector area that we simply do not know and have a Eureka moment" (F-5);
- Still, regarding these events, participants called attention to the fact that several entrepreneurs have parallel jobs when starting their businesses, so it is also important to consider this aspect when organizing synchronous events.

Mentoring and Consultancy Support

The second subdimension—mentoring and consultancy support—was stressed as fundamental for the development of incubated business ideas and providing support during the operational stages of business or startups:

- By having dedicated mentors (previously matched), experts can regularly supervise and advise tenants' work development. Focus group participants recommended that virtual incubators should invest in progressively building a private network of mentors from multidisciplinary fields, "aiming at the best source of information, support, and qualification of incubatees" (M-12). This aspect is of extreme relevance given that tenants "have different needs in different moments" (M-9), but it is also central to keep the mentor–entrepreneur matchmaking as a focal mechanism during the entire incubation process because "Mentors must be aligned with entrepreneurs and have interest in their projects to help them" (M-10);
- Accessing complementary consultancy services and support (such as legal and accountancy, technological, marketing, intellectual property, brand registration, communication, risk management, and product or services development support, for instance [47]) should also be facilitated through the virtual incubator. It was stressed by founders and incubator managers that, depending on the incubator team dimension and expertise, offering several consultancy services in-house over outsourcing them has advantages, such as facilitating and speeding up processes and benefiting the internal ecosystem, while helping to contribute to the economic and financial sustainability of the incubator. According to M-8's experience: "We rely on professors and researchers to offer some consultancy services and only subcontract services from external partners when we are unable to do it";
- Nonetheless, a usual practice followed by incubator managers concerns recommending tenants to contact external partners, which, according to founders, "do not offer any price advantage for incubatees" (F-3), which "for a company that is starting, without the capacity to spend so much money, it is an unaffordable financial burden" (F-6). Thus, our model proposes that virtual incubators should consider this aspect and try to negotiate ways to offer competitive and accessible prices for their tenants.

Access to Perks and Partnerships

Another subdimension of the proposed model includes providing incubatees access to perks and partnerships. It was recommended that new incubators should build the set of offerings gradually and according to the tenants' needs:

- Technological perks are important for the development of digital businesses. Some examples include Amazon services, Stripe, Miro, Microsoft for startups, and Google services, among others. It was mentioned that a strategy of offering a growing number

of perks would benefit entrepreneurs entering the incubator since “The fee they pay is nothing compared to the set of perks they have access to. We started with 5 perks, and at the moment, we offer more than 40” (M-7);

- Cooperation partnerships should also be progressively developed based on tenants’ needs, such as with research units and FabLabs, and with other incubators. Participants also suggested that developing partnerships with other incubators would benefit the entrepreneurial ecosystem in which the virtual incubator is inserted, and allow the exchange of experience and contacts with other players;
- Protocols focused on a university-to-business (U2B) approach were identified by participants as furthering knowledge exchange, technology transfer, professional internships, and promoting employment. However, incubator managers participating in this study informed us that their incubators lacked offering similar protocols. Founders also explained their interest in U2B protocols: “There are several opportunities to develop interesting university projects in startups, and students and graduates can work on several tasks” (F-5), and “this link would benefit both incubated companies and university students and graduates” (F-4);
- The connection of potential clients with startups should also be considered a perk included in the fee. This subdimension was proposed to help startups succeed, especially during their initial stages. This could be accomplished by trying to facilitate important contacts that entrepreneurs cannot complete, and also by promoting incubated startups’ services or products in online contexts;
- Offering a comprehensive correspondence service to notify, forward, digitize, or collect company mail was another recommended aspect agreed upon by participants. This is remarkably important in the case of virtual business incubators because “It is the first thing that our tenants look for in a virtual incubation because they need to access important mail that arrives through physical correspondence” (M-4);
- Lastly, virtual incubators should allow tenants to use a physical address for the registered office. This perk is fundamental to “entrepreneurs being able to establish their companies legally” (M-3), but “they could only use the address officially after signing the incubation contract” (M-4).

Business and Knowledge Exchange

The fourth subdimension to consider in order to enhance the overall incubation process in virtual incubators regards promoting business and knowledge exchange between incubatees. Both founders and managers agreed that this could be accomplished through two means:

- Including the perks and services offered by the incubated startups as part of the general incubators’ set of resources would promote business exchanges between tenants. A practical example of this exchange was provided: “If I want to make a website, I’d rather pay another incubated company than an external one that no longer needs this leverage. Providing other entrepreneurs will offer a competitive price is a win-win exchange” (F-6). Concerning this aspect, some managers advised that “the role of the incubator is to promote and foster these business exchanges, but not determine rules” (M-8), meaning that business details and deals should be treated directly between incubatees;
- Making a “giving back board” available, where volunteer tenants can list their areas of expertise or subjects in which they believe they can help other entrepreneurs and become reference persons to provide specific help and support. Having this dimension in a virtual incubator is considered to be extremely useful because “some problems that new incubatees have at the moment were already overtaken by senior entrepreneurs” (M-16), and also given that “My experience showed me that there are several people who are interested in giving back to the community and helping other entrepreneurs” (F-4).

Networking

All participants stated that networking is one of the most enriching benefits of being part of an incubator, which is also vital to stimulating the community. In the case of virtual business incubators, the potential to enable the fast creation of local, national, or international relationship networks was highlighted. However, it was advised that encouraging only virtual events does not allow the development of strong relationships between stakeholders:

“Direct contact between people, even if it is sporadic, is what allows the creation of durable bonds between entrepreneurs and other actors that can support their ventures” (M-3)

This situation was hugely felt and observed by participants during the COVID-19 pandemic, which forced a scenario of online events: “Despite being more convenient, our community is always looking for presentational moments” (M-15), and “after a face-to-face event that happened almost one year later, everyone became much more active in online events and online communities, the virtual engagement increased a lot after that moment” (F-7). Based on these considerations, our virtual incubator model proposes that face-to-face events should happen at least once per year to foster connections and enhance the overall incubation experience:

- For networking events with a particular focus on socialization and promoting access to peers and experts, it was suggested to invite incubated entrepreneurs and recognized founders of startups outside the community to share their experiences. Moreover, inviting experts from several business areas is also important to “Foster connections with specialists in specific areas, who can help us to reconsider specific points of our businesses” (F-6);
- In this case, it was suggested that tenants’ needs at the moment should be assessed so that the events could be most fruitful to them;
- The same applies to events directed to access potential investors. These persons or funding organizations must be selected in accordance with the business sectors and development stages of the incubated startups because “I receive multiple calls for events with investors, but when I start reading them, they are rarely directed to my business area. And this also happens to other founders I know. We are all very busy, and wasting time on useless events is exhausting” (F-3);
- Promoting demo days, pitch meetings, and boot camps involving various stakeholders can allow for expanding the network and enabling new business opportunities. It was agreed that the organization of these types of events should not only be directed to the incubators’ community, but some should be open to the general public as well, so entrepreneurs can communicate their products and services while sharing knowledge and fostering possible collaborations.

Investment and Funding Support

The last subdimension anticipated during the incubation process regards access to investment and funding opportunities. Offering this kind of information and support was concluded as essential to the sustainability of recently created businesses or startups. If possible, tenants should be provided direct funding opportunities, although participants mentioned this is an uncommon and privileged aspect. Notwithstanding, other support services and information related to fundraising can be offered by virtual incubators to their tenants:

- Inform and advise tenants about public and private funding opportunities aligned with their business sectors and the development stage of their startups. Providing this kind of curated information was highlighted as extremely positive by the founders: “Otherwise, there will be multiple entrepreneurs interested in discovering more about a funding opportunity and then realizing that it does not fit their company, which is a waste of time and energy for everyone” (F-7);

- However, both founders and managers recognized that this curation requires extra effort and is time-consuming, although some managers informed that their incubators follow a similar approach: “We help founders to understand which program is most recommended for their specific cases, to understand the steps they have to follow, and we clear up to a certain extent any questions they have” (M-15);
- Support for applying to funding opportunities was also suggested as an additional service that virtual incubators could provide. According to the focus group participants, this practice is not usual in their incubators, given the multiple resources and particularities it entails. However, they recognize it can benefit tenants while contributing to the economic and financial sustainability of the incubator itself, apart from its market positioning. The only participating manager whose incubator provides this kind of support advised that it also requires a very knowledgeable and dedicated team, and even so, “It is difficult to match a startup in a certain stage and to operate in a determined sector with the incentive programs. It is much information, and the diversity is huge, so we feel this is one of the most difficult parts to add value” (M-7);
- Given this reason, a suggestion to offer tenants this kind of support without overloading the incubator team is to subcontract this service to specialized companies.

4.3.8. Digital Tools

The last dimension of the proposed virtual business incubator model concerns information and communication technologies (ICT) needed to manage and operate the entire framework, as illustrated in Figure 8.



Figure 8. The dimensions concerning the digital tools to run the digital business incubator model.

Depending on their primary objectives, several digital solutions can be used across the various incubator stages using (mostly) standardized and widespread ICT, or a unified digital platform can be developed to support the incubator operation. However, several participants advised that it is usual for them to “adapt to the platforms that incubatees have a good command of”, as explained by M-11, and that technology use should be simplified to facilitate interactions, even though “there are different dynamics of using digital tools depending on the persons or groups” (F-6). Based on these results, the present model proposes that virtual incubators should encompass the following:

- An official website to allow potential tenants and other stakeholders to learn about the incubator’s purpose and the program operation’s dimensions. This website can also support the incubator’s application stage dimension by making available an online application form to be filled out by entrepreneurs aiming to apply to incubation;
- Learning management systems enable great resources to help in knowledge transfer through synchronous and asynchronous possibilities by integrating multimedia content and facilitating sharing and collaboration. Participants agreed that asynchronous content should consider interactive and gamified approaches to enhance tenants’ knowledge acquisition and overall experience during this stage;
- Video conferencing tools could also be used to: conduct applicants’ interviews; during online and synchronous knowledge transfer moments, such as webinars, workshops, and training sessions; to facilitate meetings with mentors and consultancy activities; to promote online networking events, demo days, pitch meetups or boot camps;

to provide support related to investment and funding; to facilitate business and knowledge exchange between tenants; and during the incubator's communications to the external community. Participants identified that the most common video conferencing tools they use for these purposes were Zoom, Google Meet, Skype, and Webex;

- As already discussed, a knowledge base would facilitate a cooperative curatorship of content (videos, podcasts, books, series, and documentaries, among others) and their sharing to encourage and support tenants' professional and personal development. The Notion tool was suggested to easily allow management of and access to this information by tenants, incubator managers, and other interested stakeholders;
- A shared folder with documents should also be provided. As stated by participants, during the incubation process, it is important that entrepreneurs can access financial- and business-related documents that are transversal to support their ventures' development;
- Forums and online group channels were recommended for facilitating communication, sharing experience, and providing mutual support, among other possibilities, in addition to helping tenants grow networking connections and new development opportunities. For instance, forums could be used to build and constantly update the knowledge base with answers to frequently asked questions. Moreover, this can be used to implement the "giving back board", where volunteer entrepreneurs can list their areas of expertise and subjects to help other entrepreneurs. It was suggested that the most active volunteers could receive a badge recognizing their effort and that other tenants could recommend them based on a start voting approach, for example, as ways to improve the users' overall experience. Digital platforms such as Slack and Discord were referred to as preferential ones based on participants' experience;
- Group messaging for instant contacts was stressed as crucial by founders and managers during the entire incubation process. It facilitates stakeholder communication, event scheduling, and the solution of urgent issues, to mention a few examples. WhatsApp and Telegram were mentioned as the most-used by participants in this study;
- Using email for sending newsletters was highlighted as an appropriate tool to communicate important information to the broad community, including forthcoming events and news sharing. It can also be used, for instance, as a way to spread assessment surveys to evaluate tenants' needs and expectations regarding experts, peers, or topics they would like to know more about in future events;
- Additionally, emerging ICT solutions could also be explored to run virtual incubators. Metaverse [57] is a hot topic regarding further research on its impact on business and society, which still lacks understanding as to how it can support incubation processes, and what new interactive and gamified approaches could be adopted to influence users' experiences and enhance the overall incubation process, among other subjects.

5. Discussion and Conclusions

5.1. Theoretical Contributions

Although the undeniable potential of virtual business incubators to promote innovation and entrepreneurship across various industries and on a global scale, the phenomena surrounding these incubators, the value they provide, their effects, and, particularly, their economic models are still in an underdeveloped stage of scholarly study. The literature identifies the urgent gap concerning virtual business incubator models [14,15,20–23] and how they should be operated to support entrepreneurs during the creation and development of their ventures [23,24] as needing further elaboration. Additional scientific knowledge concerning the contributions of industry–academia collaboration is also urgent [16–19].

Thus, this study aimed to explore the research question, "Which dimensions should be integrated into a new virtual business incubator model to support the entrepreneurial process of digital business or startups creation?", and to extend previous research by proposing a new model and discussing the theoretical framework for the implementation and management of future digital business incubators.

This study contributes manifold results and valuable insights to the existing knowledge, by proposing a digital business incubator model through a design science research approach involving 16 experienced managers and 7 startup founders under incubation to codesign and validate the proposed digital incubator model. It included numerous guidelines and advice that should be considered by those who aim to implement similar models from scratch or in their organizations, covering eight incubator dimensions concluded as fundamental for future digital incubation programs, namely, key qualities and purpose, program operation, communication strategy, application stage, participants' selection, onboarding process, incubation process, and digital tools. Several theoretical contributions follow.

First, this provides new knowledge and perspectives to the significant existing literature gap that several authors have indicated concerning research on business incubator models [14,20–22,58]. Additionally, the proposed framework is centered on empirical research with primary stakeholders to generate knowledge collectively, also considering the perspectives of incubated entrepreneurs and their daily-lived experiences; numerous academics called for in-depth qualitative studies incorporating these understandings [10,59–64]. Previous virtual business incubator models were proposed by other researchers based essentially on case studies [27,28,37], literature review [33–35], questionnaires [30–32], website analysis, and semi-structured interviews [38].

Second, the proposed model informs several guidelines that should be considered when implementing virtual business incubators from scratch while combining three main perspectives concluded in earlier research [25] as needing integration: business organization and management, information and communication systems, and user experience and engagement. To the authors' knowledge, the previous literature concerning virtual business incubator models focuses primarily on organization and management viewpoints [27,28,32,37,65], although some examples of models are proposed based on both perspectives of business organization and management, and information and communication systems [29,33,34,36]. Only two models [35,38] were grounded in the three perspectives.

Third, most previous research on virtual business incubator models was mainly concerned with fostering entrepreneurship and growth of specific business areas or industries, such as those linked to technology innovation [27,32,36], virtual organizations [33,34], emergent economic and social agents [28,29], and the creative industry [38]. These models did not encompass the promotion of industry–academia connections and collaboration. One exception is the model of the university-managed incubation program presented by Stevenson [37], which targets the creation and testing of education technology products, offered to students of national and international degree programs or unemployed persons. Despite operating based on knowledge and training, mentoring, demo paths, labs, and networking dimensions, it lacks explanation as to how the industry can benefit from this program.

Fourth, the dimensions linked to the virtual incubator model proposed in the present article offer a more comprehensive approach than existing ones by encompassing key qualities and purpose, program operation, communication strategy, application stage, participants' selection, onboarding process, incubation process, and digital tools. The most common dimension in models proposed in previous research concerned incubatees' knowledge acquisition and training through ICT tools to enable workshops, webinars, lectures, group activities, and learning resources [27–32,36,37]. Then, networking events linking tenants, other incubator stakeholders, and external agents were the second-most common dimension proposed by previous virtual incubator models [27,29,32,37], followed by providing support services to help venture development, charged according to the entrepreneurs' business stages or segmentation [28,29,38]. Other virtual incubator models take into consideration the facilitation of information about financing opportunities through virtual events in which investors are present [32,34,35], and the less common dimension regards the access to mentors to assist entrepreneurs with business creation and development processes [28,34]. In our case, apart from fostering entrepreneurship

and business growth, the proposed model also aims to foster industry–university connections during the entire program operation. Both communication strategies and knowledge transfer activities (seminars, workshops, and training sessions) were proposed to build meaningful proximity with external social and industry entities to attract possible candidates interested in producing innovations in pre-identified market needs. Hopefully, this continuous university–industry involvement would contribute to reducing the delays between innovative solutions and their implementation in practical contexts [17], facilitate technology transfer, and diminish the lack of incentives for entrepreneurs starting or in the early stages of their ventures [18,19].

Moreover, we propose that protocols focused on a university-to-business approach could be established to foster knowledge exchange, technology transfer, professional internships, and promote employment, which has been stressed as an urgent gap to address. This aspect could highly contribute to serving both worlds, and developing solid and trustworthy relationships. Additionally, providing networking moments, to foster the connection of potential clients with startups, and collaborative hackathons (including universities, research centers, and several sectors of industry) could foster the emergence of collaboration between all the stakeholders from the initial stages, and contribute to easing ethical, intellectual property, or other issues typically arising from these collaborations [18]. Finally, it is critical to underscore that the proposed model is theoretical, and still lacks implementation and testing to conclude about its performance and real impacts in fostering entrepreneurship, business growth, and academia–industry connections.

5.2. Practical Contributions

This research carries immediate practical applicability, since the presented unified model was developed to guide and support academics, practitioners, organization managers, and other professionals aiming to pursue the path of creating and running virtual business incubators. However, several strengths and recommendations to enhance the models' weaknesses should be acknowledged, given the nature of the proposed model.

Concerning the strengths, focus group participants outlined the advantages of implementing virtual business incubators by following this model: (i) ecosystems such as this are sorely needed in the current remote work paradigm, promoting access to online support; (ii) these have a much greater reach than incubators with physical structures in attracting talent, and can incubate entrepreneurs in any geographical location; (iii) these are advantageous to promote online events that can be attended by tenants or the broader external community, with speakers from any part of the world; (iv) these promote environmental sustainability, as they substantially reduce unnecessary travel and use of transportation; (v) these overcome tenants' accommodation problems and avoid additional expenses, issues which incubators located in several national regions are facing at the moment; (vi) they can act as virtual collaboration hubs to connect multiple incubators, exchanging experiences and contacts, and forwarding and receiving entrepreneurs with fitting business ideas to and from other incubators. The previous literature corroborates some of these aspects concerning the diversity of incubated entrepreneurs [29,37,38], the virtual events covering national and international scopes [32,36,37], and the focus on strategic alliance formation [27,37,65].

Notwithstanding these strengths, the proposed virtual model is subject to multiple challenges that need to be taken into further consideration during its operation, as stressed by incubator managers grounded in their vast experience: (i) the extended contact between tenants, mentors, and other stakeholders only through virtual means can lead to the loss of human contact and diminish the feeling of proximity and empathy between the ecosystem players; (ii) attracting entrepreneurs during the incubators' initial operation time is not an easy task, especially for virtual incubators that cannot rely on physical spaces to promote themselves; (iii) having a dynamic team at the head of the incubator that knows the entire ecosystem well and has excellent connections with the primary players is a key to successful incubators, but is extremely challenging to accomplish; (iv) creating a network of great

mentors available to support tenants' ventures is exceptionally hard and time-consuming to accomplish with excellence.

Focus group participants mentioned not having concrete answers to surpass most of these challenges during the initial operational years of new virtual business incubators, since these processes require constant improvement, adjustments, and hard work. However, they claim that the first essential step would be to invest time and effort to try to make virtual incubation as close as possible to face-to-face incubation, i.e., by stimulating and nurturing the sense of community within the entire ecosystem by bringing people together, since the social and relational aspects between tenants, and also with other stakeholders, are some of the most important ones during the incubation experience. These last aspects are in agreement with the literature, where it has been concluded that the sense of belonging to the incubator community and the established interactions enrich the potential for entrepreneurial development [11,47,66], and contribute to the mental health of incubatees [10,47,67].

Lastly, but importantly, this study contributes three additional knowledgeable pieces of advice from stakeholders experienced in running and living the process of incubation, which are extremely valuable for individuals starting the path of creating and running virtual business incubators: (i) beginning implementation of the model by taking baby steps and progressively testing it will allow an understanding of which dimensions should be adjusted or redefined before proceeding to implement more complex aspects to support the incubation process; (ii) be cautious when evaluating tenants' applications to understand if they are motivated and skilled entrepreneurs, or if they only seek personal or business advantages through joining the incubator; (iii) adopt an open innovation approach and share implementation results, successes, and failures with other peers to promote collaboration between those starting and those mastering the running of virtual business incubators.

5.3. Limitations and Future Research Directions

This research has several limitations that should be acknowledged. Despite the efforts to involve a high number of national incubator managers and startup founders, the sample size of this study was relatively small. Therefore, its representativeness should also be scrutinized. As mentioned in the Section 3, the random sampling of participants was significantly difficult, and the fact that the seven founders were linked to only two of the fifteen incubators can be interpreted as introducing some bias to the study. For this reason, the findings should be regarded as not representative of other groups, limited as to their generalization, and not appropriate for drawing inferencing conclusions. Moreover, the proposed model was validated based on participating managers' and founders' experiences related to incubation processes and operations with which they were familiar. Despite the small sample size being a key limitation of the conducted study, the authors believe that the vast and knowledgeable experience of participants in managing incubators, and their daily-lived experiences in incubators for years, should be regarded as highly informative and somewhat comprehensive of the Portuguese reality. Therefore, since the proposed model was grounded in these expert stakeholders' experiences, the contributions of this study's findings can be indicative of a relatively reasonable model for other incubators. Furthermore, the proposed model incorporates the views of some participants pertaining to their experiences in international entrepreneurship initiatives and organizations linked to incubation programs. However, it is out of the scope of this research to draw broad conclusions on the applicability of this model in geographical areas other than Portugal.

This last limitation is suggested to be addressed in future research, to validate if the proposed dimensions and guidelines apply to different classical geographies (e.g., European Union, North America, Far East), or with respect to varieties of capitalism, such as liberal market economies, coordinated market economies, and partially non-market economies, for instance. Another particular limitation regards the focus group research, which carries the risk that some individuals can dominate the discussion and stifle the contributions of other individuals [41], and, therefore, we have made an effort to carefully

manage the groups' dynamics to allow all participants to express their points of view concerning each topic under discussion.

Notwithstanding the limitations mentioned, the findings of this research provide practical insights to help and guide academics, practitioners, organization managers, and other professionals interested in building and running virtual business incubators.

Author Contributions: Conceptualization, R.V., J.V.d.C. and S.F.T.; methodology, R.V., J.V.d.C. and S.F.T.; validation, R.V., J.V.d.C. and S.F.T.; formal analysis, R.V., J.V.d.C. and S.F.T.; investigation, R.V., J.V.d.C. and S.F.T.; resources, R.V.; data curation, R.V.; writing—original draft preparation, R.V.; writing—review and editing, R.V.; supervision, R.V., J.V.d.C. and S.F.T.; project administration, J.V.d.C. and S.F.T.; funding acquisition, J.V.d.C. and S.F.T. All authors have read and agreed to the published version of the manuscript.

Funding: This work is financed by Portuguese national funds through FCT—Fundação para a Ciência e Tecnologia, under the project UIDP/05422/2020.

Institutional Review Board Statement: Not applicable. In Portugal, any study in which sensitive topics are not addressed and which excludes tests performed on humans (for example, drugs) does not require prior approval from the ethics board. Even so, ethical procedures generally accepted in social research were applied. The empirical study was anonymous and confidential, and participation was voluntary. Each respondent provided informed consent for data collection and processing, and future publication of results. Participants received information about (1) general study objectives, estimated time, and general participation characteristics; and (2) the right to refuse to participate in the study and to discontinue participation at any time. No personal information was requested, and the data considered to characterize the sample do not allow for the identification of any participant. Thus, we believe that the rights of the respondents were respected.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Acknowledgments: The authors express their gratitude to all entrepreneurs and incubator managers who voluntarily accepted to participate in this research, contributing many insights, without whom this study would not have been possible.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

References

1. Zahra, S.A.; Wright, M. Understanding the Social Role of Entrepreneurship. *J. Manag. Stud.* **2016**, *53*, 610–629. [\[CrossRef\]](#)
2. Sansone, G.; Andreotti, P.; Colombelli, A.; Landoni, P. Are Social Incubators Different from Other Incubators? Evidence from Italy. *Technol. Forecast. Soc. Chang.* **2020**, *158*, 120132. [\[CrossRef\]](#)
3. Ririh, K.R.; Wicaksono, A.; Laili, N.; Tsurayya, S. Incubation Scheme in Among Incubators: A Comparative Study. *Int. J. Innov. Technol. Manag.* **2020**, *17*, 2050052. [\[CrossRef\]](#)
4. Ratinho, T.; Henriques, E. The Role of Science Parks and Business Incubators in Converging Countries: Evidence from Portugal. *Technovation* **2010**, *30*, 278–290. [\[CrossRef\]](#)
5. Schutte, F.; Direng, T. Incubation of Entrepreneurs Contributes to Business Growth and Job Creation: A Botswana Case Study. *Acad. Entrep. J.* **2019**, *5*, 1–17.
6. Aerts, K.; Matthyssens, P.; Vandenbempt, K. Critical Role and Screening Practices of European Business Incubators. *Technovation* **2007**, *27*, 254–267. [\[CrossRef\]](#)
7. Lamine, W.; Mian, S.; Fayolle, A.; Wright, M.; Klofsten, M.; Etzkowitz, H. Technology Business Incubation Mechanisms and Sustainable Regional Development. *J. Technol. Transf.* **2018**, *43*, 1121–1141. [\[CrossRef\]](#)
8. Mian, S.; Lamine, W.; Fayolle, A. Technology Business Incubation: An Overview of the State of Knowledge. *Technovation* **2016**, *50–51*, 1–12. [\[CrossRef\]](#)
9. Grimaldi, R.; Grandi, A. Business Incubators and New Venture Creation: An Assessment of Incubating Models. *Technovation* **2005**, *25*, 111–121. [\[CrossRef\]](#)
10. Nicholls-Nixon, C.L.; Valliere, D.; Singh, R.M.; Chavoushi, Z.H. How Incubation Creates Value for Early-Stage Entrepreneurs: The People-Place Nexus. *Entrep. Reg. Dev.* **2022**, *34*, 868–889. [\[CrossRef\]](#)
11. Theodorakopoulos, N.; Kakabadse, N.; McGowan, C. What Matters in Business Incubation? A Literature Review and a Suggestion for Situated Theorising. *J. Small Bus. Enterpr. Dev.* **2014**, *21*, 602–622. [\[CrossRef\]](#)

12. Bruneel, J.; Ratinho, T.; Clarysse, B.; Groen, A. The Evolution of Business Incubators: Comparing Demand and Supply of Business Incubation Services Across Different Incubator Generations. *Technovation* **2012**, *32*, 110–121. [\[CrossRef\]](#)
13. Pauwels, C.; Clarysse, B.; Wright, M.; Van Hove, J. Understanding a New Generation Incubation Model: The Accelerator. *Technovation* **2016**, *50–51*, 13–24. [\[CrossRef\]](#)
14. Tang, M.; Walsh, G.S.; Li, C.; Baskaran, A. Exploring Technology Business Incubators and Their Business Incubation Models: Case Studies from China. *J. Technol. Transf.* **2021**, *46*, 90–116. [\[CrossRef\]](#)
15. Wardani, S.I.; Widayani, A.; Rachmawati, I.; Widayani, A.; Latifah, N.; Normawati, R.A. Business Incubator Development Model on Campus to Encourage the Growth of Young Entrepreneurs. *Asian J. Manag. Entrep. Soc. Sci.* **2023**, *3*, 294–303. [\[CrossRef\]](#)
16. Ahmed, F.; Fattani, M.T.; Ali, S.R.; Enam, R.N. Strengthening the Bridge Between Academic and the Industry Through the Academia-Industry Collaboration Plan Design Model. *Front. Psychol.* **2022**, *13*, 875940. [\[CrossRef\]](#) [\[PubMed\]](#)
17. Moody, D. Using the World Wide Web to Connect Research and Professional Practice: Towards Evidence-Based Practice. *Inf. Sci. Int. Emerg. Transdiscipl.* **2023**, *6*, 31–48. [\[CrossRef\]](#)
18. Joergensen, M. Working with Industry: Stories of Successful and Failed Research-Industry Collaborations on Empirical Software Engineering. In Proceedings of the 2017 IEEE/ACM 5th International Workshop on Conducting Empirical Studies in Industry (CESI), Buenos Aires, Argentina, 23–23 May 2017; pp. 46–52. [\[CrossRef\]](#)
19. Malhotra, R.; Massoudi, M.; Jindal, R. Na Alumni-Based Collaborative Model to Strengthen Academia and Industry Partnership: The Current Challenges and Strenghts. *Educ. Inf. Technol.* **2023**, *28*, 2263–2289. [\[CrossRef\]](#)
20. Hausberg, J.P.; Korreck, S. Business Incubators and Accelerators: A Co-Citation Analysis-Based, Systematic Literature Review. *J. Technol. Transf.* **2020**, *45*, 151–176. [\[CrossRef\]](#)
21. Indiran, L.; Khalifah, Z.; Ismail, K. A Historical Review of Business Incubation Models. In Proceedings of the 4th International Seminar on Entrepreneurship and Business, Penang, Malaysia, 17 October 2015; pp. 733–751.
22. Bergek, A.; Norrman, C. Incubator Best Practice: A Framework. *Technovation* **2008**, *28*, 20–28. [\[CrossRef\]](#)
23. George, G.; Bock, A.J. The Business Model in Practice and Its Implications for Entrepreneurship Research. *Entrep. Theory Pract.* **2011**, *35*, 83–111. [\[CrossRef\]](#)
24. Amit, R.; Zott, C. Value Creation in E-Business. *Strateg. Manag. J.* **2001**, *22*, 493–520. [\[CrossRef\]](#)
25. Vaz, R.; de Carvalho, J.V.; Teixeira, S.F. Towards a Unified Business Incubator Model: A Systematic Literature Review and Bibliometric Analysis. *Sustainability* **2022**, *14*, 3205. [\[CrossRef\]](#)
26. Kristin, D.M.; Chandra, Y.U.; Masrek, M.N. Critical Success Factor of Digital Start-Up Business to Achieve Sustainability: A Systematic Literature Review. In Proceedings of the 2022 International Conference on Information Management and Technology (ICIMTech), Semarang, Indonesia, 11–12 August 2022; pp. 583–588. [\[CrossRef\]](#)
27. Nowak, M.J.; Grantham, C.E. The Virtual Incubator: Managing Human Capital in the Software Industry. *Res. Policy* **2000**, *29*, 125–134. [\[CrossRef\]](#)
28. Tzafestas, S. The Art and Impact of Physical and Virtual Enterprise Incubators: The Greek Paradigm. In *Open Knowledge Society: A Computer Science and Information Systems Manifesto*; Lytras, M.D., Carroll, J.M., Damiani, E., Avison, D., Vossen, G., OrdóñezDePablos, P., Eds.; Communications in Computer and Information Science; Springer: Berlin/Heidelberg, Germany, 2008; Volume 19, pp. 549–559.
29. Joita, A.C.; Carutasu, G.; Botezatu, C.P. Technology and Business Incubator Centers—Adding Support To Small And Medium Enterprises in the Information Society. In *Economic World Destiny: Crisis and Globalization? Section V: Economic Information Technology in the Avant-Garde of Economic Development*; Lucian Blaga, University of Sibiu: Sibiu, Romania, 2010; pp. 107–115.
30. Pirker, J.; Guetl, C. Iterative Evaluation of a Virtual Three-Dimensional Environment for Start-Up Entrepreneurship in Different Application Scenarios. In Proceedings of the 2012 15th IEEE International Conference on Interactive Collaborative Learning (ICL), Villach, Austria, 26–28 September 2012.
31. Guetl, C.; Pirker, J. Implementation and Evaluation of a Collaborative Learning, Training and Networking Environment for Start-Up Entrepreneurs in Virtual 3D Worlds. In Proceedings of the 2011 14th IEEE International Conference on interactive Collaborative Learning (ICL), Piestany, Slovakia, 21–23 September 2011; pp. 58–66.
32. Ciocoiu, C.N.; Colesca, S.E.; Pacesila, M.; Burcea, S.G. Designing a Weee Virtual Eco-Innovation Hub: The Vision of the Academic and Research Environment. In Proceedings of the 8th International Management Conference: Management Challenges for Sustainable Development, Bucharest, Romania, 6–7 November 2014; Popa, I., Dobrin, C., Ciocoiu, C.N., Eds.; International Management Conference. Editura Ase: Bucuresti, Romania, 2014; pp. 1128–1140.
33. Unal, O.; Afsarmanesh, H.; Angelov, S. An Agile Innovation Framework Supported through Business Incubators. In *Collaborative Systems for Smart Networked Environments*; Camarinha Matos, L.M., Afsarmanesh, H., Eds.; IFIP Advances in Information and Communication Technology; Springer: Berlin/Heidelberg, Germany, 2014; Volume 434, pp. 307–316.
34. Agostinho, C.; Lampathaki, F.; Jardim-Goncalves, R.; Lazaro, O. Accelerating Web-Entrepreneurship in Local Incubation Environments. In Proceedings of the Advanced Information Systems Engineering Workshops, CAISE 2015, Stockholm, Sweden, 8–9 June 2015; Persson, A., Stirna, J., Eds.; Lecture Notes in Business Information Processing. Springer: Berlin/Heidelberg, Germany, 2015; Volume 215, pp. 183–194. [\[CrossRef\]](#)
35. Tawil, N.M.; Halim, A.A.; Ramlee, S.; Arsad, N. Enhancing Small Medium Enterprises Opportunity through Online Portal System. In Proceedings of the 2016 IEEE International Conference on Advances in Electrical, Electronic and Systems Engineering (ICAEEES), Putrajaya, Malaysia, 14–16 November 2016; pp. 631–635.

36. Elia, G.; Margherita, A. A Collective Intelligence Platform for Developing Technology Entrepreneurship Ecosystems. In *Creating Technology-Driven Entrepreneurship*; Carlucci, D., Spender, J.C., Schiuma, G., Eds.; Palgrave Macmillan: London, UK, 2016; pp. 195–220. [\[CrossRef\]](#)
37. Stevenson, B. Oulu Edulab: University-Managed, Interdisciplinary Edtech Incubator Program from Finland. In Proceedings of the 5th International Conference on Innovation and Entrepreneurship (ICIE 2017), Cyberjaya, Malaysia, 26–27 April 2017; Aziz, K.A., Ed.; Acad Conferences Ltd.: Reading, UK, 2017; pp. 140–144.
38. Luik, J.; Ng, J.; Hook, J. Virtual Hubs Understanding Relational Aspects and Remediating Incubation. In Proceedings of the 2019 CHI Conference On Human Factors in Computing Systems, Glasgow, UK, 4–9 May 2019. [\[CrossRef\]](#)
39. International Data Corporation. *Startup & Entrepreneurial Ecosystem Report, Portugal 2022*; International Data Corporation: Lisbon, Portugal, 2022.
40. International Data Corporation. *Startup & Entrepreneurial Ecosystem Report, Portugal 2021*; International Data Corporation: Lisbon, Portugal, 2021.
41. Hennink, M.M. *Focus Group Discussions: Understanding Qualitative Research*; Oxford University Press: New York, NY, USA, 2014.
42. Dresch, A.; Lacerda, D.P.; Antunes, J.A.V. Design Science Research. In *Design Science Research: A Method for Science and Technology Advancement*; Springer International Publishing: Cham, Switzerland, 2015; pp. 67–102. [\[CrossRef\]](#)
43. March, S.T.; Smith, G.F. Design and Natural Science Research on Information Technology. *Decis. Support Syst.* **1995**, *15*, 251–266. [\[CrossRef\]](#)
44. Peffers, K.; Tuunanen, T.; Rothenberger, M.A.; Chatterjee, S. A Design Science Research Methodology for Information Systems Research. *J. Manag. Inf. Syst.* **2007**, *24*, 45–77. [\[CrossRef\]](#)
45. March, S.T.; Storey, V.C. Design Science in the Information Systems Discipline: An Introduction to the Special Issue on Design Science Research. *MIS Q.* **2008**, *32*, 725–730. [\[CrossRef\]](#)
46. Bayazit, N. Investigating Design: A Review of Forty Years of Design Research. *Des. Issues* **2004**, *20*, 16–29. [\[CrossRef\]](#)
47. Vaz, R.; Teixeira, S.F.; de Carvalho, J.V. Comfortable but Not Brilliant: Exploring the Incubation Experience of Founders of Technology-Based Startups. *Sustainability* **2022**, *14*, 15864. [\[CrossRef\]](#)
48. National Incubator Network. Available online: <https://www.rni.pt> (accessed on 2 December 2022).
49. Van Rijnsoever, F.J.; Eveleens, C.P. Money Don't Matter? How Incubation Experience Affects Start-up Entrepreneurs' Resource Valuation. *Technovation* **2021**, *106*, 102294. [\[CrossRef\]](#)
50. Davidson, P. *The Entrepreneurship Research Challenge*; Edward Elgar Publishing Limited: Cheltenham, UK, 2008.
51. Chavoushi, Z.H.; Nicholls-Nixon, C.L.; Valliere, D. Mentoring Fit, Social Learning, and Venture Progress During Business Incubation. *J. Appl. Bus. Econ.* **2020**, *22*, 23–39. [\[CrossRef\]](#)
52. Patton, D. Realising Potential: The Impact of Business Incubation on the Absorptive Capacity of New Technology-Based Firms. *Int. Small Bus. J.* **2014**, *32*, 897–917. [\[CrossRef\]](#)
53. Preece, J.; Rogers, Y.; Sharp, H. *Interaction Design: Beyond Human-Computer Interaction*, 4th ed.; John Wiley & Sons Ltd.: West Sussex, UK, 2015.
54. Miro. Miro: The Visual Collaboration Platform for Every Team. Available online: <https://www.miro.com> (accessed on 15 December 2022).
55. Braun, V.; Clarke, V. Using Thematic Analysis in Psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [\[CrossRef\]](#)
56. Braun, V.; Clarke, V. Thematic Analysis. In *APA Handbook of Research Methods in Psychology, Vol 2: Research Designs: Quantitative, Qualitative, Neuropsychological, and Biological*; Cooper, H., Camic, P.M., Long, D.L., Panter, A.T., Rindskopf, D., Sher, K.J., Eds.; American Psychological Association: Washington, DC, USA, 2012; pp. 57–71. [\[CrossRef\]](#)
57. Kraus, S.; Kanbach, D.K.; Krysta, P.M.; Steinhoff, M.M.; Tomini, N. Facebook and the Creation of the Metaverse: Radical Business Model Innovation or Incremental Transformation? *Int. J. Entrep. Behav. Res.* **2022**, *28*, 52–77. [\[CrossRef\]](#)
58. Reit, T. Knowledge Transfer in Virtual Business Incubators. *Probl. Zarządzania-Manag. Issues* **2022**, *20*, 173–190. [\[CrossRef\]](#)
59. Scillitoe, J.L.; Chakrabarti, A.K. The Role of Incubator Interactions in Assisting New Ventures. *Technovation* **2010**, *30*, 155–167. [\[CrossRef\]](#)
60. Hackett, S.M.; Dilts, D.M. Inside the Black Box of Business Incubation: Study B—Scale Assessment, Model Refinement, and Incubation Outcomes. *J. Technol. Transf.* **2008**, *33*, 439–471. [\[CrossRef\]](#)
61. Hackett, S.M.; Dilts, D.M. A Systematic Review of Business Incubation Research. *J. Technol. Transf.* **2004**, *29*, 55–82. [\[CrossRef\]](#)
62. McAdam, M.; McAdam, R. The Networked Incubator: The Role and Operation of Entrepreneurial Networking with the University Science Park Incubator (USI). *Int. J. Entrep. Innov.* **2006**, *7*, 87–97. [\[CrossRef\]](#)
63. Ahmad, A.J.; Thornberry, C. On the Structure of Business Incubators: De-Coupling Issues and the Mis-Alignment of Managerial Incentives. *J. Technol. Transf.* **2018**, *43*, 1190–1212. [\[CrossRef\]](#)
64. Nair, S.; Blomquist, T. The Temporal Dimensions of Business Incubation: A Value-Creation Perspective. *Int. J. Entrep. Innov.* **2020**, *21*, 38–46. [\[CrossRef\]](#)
65. Harima, A.; Periac, F.; Murphy, T.; Picard, S. Entrepreneurial Opportunities of Refugees in Germany, France, and Ireland: Multiple Embeddedness Framework. *Int. Entrep. Manag. J.* **2021**, *17*, 625–663. [\[CrossRef\]](#)
66. Wenger, E. Communities of Practice and Social Learning Systems. *Organization* **2000**, *7*, 225–246. [\[CrossRef\]](#)
67. Garrett, L.E.; Spreitzer, G.M.; Bacevice, P.A. Co-Constructing a Sense of Community at Work: The Emergence of Community in Coworking Spaces. *Organ. Stud.* **2017**, *38*, 821–842. [\[CrossRef\]](#)

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.