

Nicoleta CRISTACHE, PhD

nicoleta.cristache@ugal.ro

Dunărea de Jos University of Galați, Galați, Romania

Oana PRICOPOAIA, PhD (corresponding author)

oana.pricopoaia@ugal.ro

Dunărea de Jos University of Galați, Galați, Romania

Cristian BUSU, PhD

cristian.busu@man.ase.ro

Bucharest University of Economic Studies, Bucharest, Romania

Camelia Mădalina BELDIMAN, PhD

madalina.beldiman@ugal.ro

Dunărea de Jos University of Galați, Galați, Romania

Teodora Odett BREAZ, PhD

teodora.breaz@uab.ro

“1 Decembrie 1918” University of Alba Iulia, Alba Iulia, Romania

Ioana LĂZĂRESCU, PhD

ioana.lupasc@ugal.ro

Dunărea de Jos University of Galați, Galați, Romania

Eduard Mădălin DINU, PhD

eduard.dinu@cig.ase.ro

Bucharest University of Economic Studies, Bucharest, Romania

The Role of Business Incubators on Entrepreneurial Ecosystem Development in a Dynamic Environment

Abstract. *In an increasingly competitive and dynamic entrepreneurial environment, the role of business incubators is important. Business incubators are characterized by high innovation, reducing the risks associated with starting new businesses and promoting sustainable economic growth. We started this research from the question: what are the implications of business incubators for the development of the entrepreneurial ecosystem in a dynamic environment? We used the questionnaire to collect responses and the Smart PLS software for data processing. Business incubators are not promoted so much, so even the people who would need the specialized support offered in these entities do not know much about the role, importance and implications on the entrepreneurial ecosystem. So through this research we aim to present how business incubators contribute to the development of entrepreneurship, analyzing their main functions, their impact on start-ups and the challenges they face. In this research we start by presenting the main impacts and functions of business incubators, and then focus on entrepreneurial skills development, ecosystem performance, adaptability and resilience, technological and innovative opportunities, access to finance and the state of financial markets.*

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1. Introduction

The entrepreneurial ecosystem is made up of a wide variety of participants, including entrepreneurs, investors, educational institutions, governments and business incubators, and is becoming increasingly complex. The economic environment is dynamic, characterized by rapid and unforeseen changes, so business incubators have become fundamental elements of this ecosystem. Business incubators support the development of the entrepreneurial ecosystem in a dynamic environment. Business incubators provide the necessary infrastructure and support for start-ups to grow and thrive, mitigating risks and increasing the chances of success.

They create an enabling environment for the development and growth of new businesses by providing education and mentoring programs. In doing so, they contribute significantly to the development of entrepreneurial skills of the participants. Business incubators not only provide logistical and financial support to start-ups, but also have direct implications in developing entrepreneurial skills, stimulating innovation and adaptability to risks and market changes. By providing training, advice and mentoring programs in business incubators, participants can develop their entrepreneurial skills. Business incubator programs can help both managers and founders of start-ups to benefit from access to experts in various fields such as business management, marketing, strategy and finance. These programs not only improve theoretical knowledge, but also promote practical skills necessary for effective business management in a dynamic and competitive environment.

Business incubators contribute directly to improving performance by facilitating new business start-ups, supporting innovation and job creation. Business incubators promote the flexibility and agility of the entrepreneurial ecosystem by facilitating collaboration, the exchange of ideas and stimulating continuous innovation. Business incubators should be characterized by resilience and adaptability to different risks or unexpected changes in the economic environment.

The originality of this study lies in its integration of multiple dimensions of business incubators and entrepreneurial ecosystem development into a single conceptual model. Although the literature analyzes various relationships between business incubators, entrepreneurial competencies, innovation, access to financing, and entrepreneurial ecosystem performance, this study proposes an integrative approach by simultaneously examining these dimensions within a dynamic entrepreneurial environment. The conceptual model includes the risk adaptability and resilience of business incubators, their organizational culture, the development of managers' entrepreneurial competencies, the flexibility and agility of the

entrepreneurial ecosystem, the intensity of competition, innovation and operational efficiency, financial market conditions and access to financing, as well as entrepreneurial ecosystem performance.

The novelty of the study lies particularly in examining business incubators not merely as providers of infrastructure, mentoring, or financial support, but as actors whose organizational and adaptive characteristics are associated with the development of managers' entrepreneurial competencies, ecosystem flexibility and agility, innovation, and entrepreneurial ecosystem performance.

By simultaneously testing the proposed relationships using PLS-SEM, the study offers an integrated empirical perspective on the mechanisms through which the organizational and adaptive characteristics of business incubators are associated with managerial competencies and entrepreneurial ecosystem outcomes. Therefore, the study contributes by connecting these dimensions within a unified conceptual and empirical framework and by examining their interrelationships in the specific context of the entrepreneurial ecosystem analyzed.

2. Literature Review and Research Hypotheses

Access to resources such as state-of-the-art infrastructure, networks of experienced mentors, and funding opportunities is vital to the success of early stage entrepreneurs. Mentors are an integral part of business incubators that interact intensively with entrepreneurs to support the growth of their businesses (Hackett & Dilts, 2004). Business mentors can be successful entrepreneurs, investors or experts in particular fields. Prior literature has documented that business mentoring is an important predictor of business incubation performance, as mentors can provide valuable experiences for entrepreneurs (Hackett & Dilts, 2004).

Business incubators are equipped with technology labs, co-working spaces, and prototyping facilities, all of these resources allow start-ups to develop and test new technologies without high costs. Business incubators are characterized by risk adaptability and resilience.

Resilience is closely associated with individual personality characteristics and can be understood as a dynamic process that develops over time (Braes & Brooks, 2010). Walker (2002) describes resilience from a systemic perspective, emphasizing the capacity of a system to continue functioning despite disruptions, while also retaining the flexibility needed to adapt, reorganize, or modify its structure when such disruptions affect its functioning.

The flexibility and agility of the entrepreneurial ecosystem helps start-ups to respond quickly to market opportunities and apply appropriate strategies. Business incubators foster an environment of continuous learning and experimentation, where failures are seen as an integral part of the innovation process. Business incubators are the perfect environment for accumulating the necessary entrepreneurial knowledge through hands-on learning. Knowledge stock is a capital in the form of experience combined with appropriate knowledge to deliver ideas, values, creativity

and profit, aiming at the growth of ideas, innovation, thinking, competence and expertise.

Business resilience can be understood as a firm's capacity to withstand disruptions while adapting to changing circumstances and continuing to develop (Fiksel, 2006). From this perspective, the ability of local businesses to respond effectively to rapid changes and unexpected shocks plays an important role in supporting broader economic development (Dahles & Susilowati, 2015).

The technological and innovative opportunities provided by business incubators are essential for the development of start-ups. Business incubators promote risk adaptability and resilience, contributing to their long-term success. The flexibility and agility of the entrepreneurial ecosystem fosters a culture of innovation and collaboration, essential for navigating challenges and capitalizing on opportunities. Business incubators are an important factor for the development of the knowledge and innovation economy.

2.1 Risk Adaptability and Resilience of Business Incubators, Entrepreneurial Skill Development of Managers, Intensity of Competition, Innovation and Operational Efficiency of the Entrepreneurial Ecosystem

Entrepreneurship is an essential means of employment generation, especially for youth, women, and people in rural areas (Bullough, De Luque, Abdelzaher & Heim, 2015). Modern entrepreneurship is characterized by intense competition, being fueled by rapid technological advances and constant market changes. Thus, business incubators play an important role in the entrepreneurial context as they provide a stimulating environment for start-ups. Innovation dynamics are associated with organizational learning. Start-ups are known for their competitive ability, fast learning processes, rapid decision making and intense tacit knowledge sharing. Business incubators promote competition through competitions and accelerator programs that inspire the innovative spirit and support the development of effective solutions. To survive and succeed in a potentially austere environment, firms must effectively deploy and combine their physical, human and organisational assets (Cicea et al., 2019).

According to Xiao and North (2018), technology training programs and services of business incubators aimed at training entrepreneurs have a very high level of success. Business resilience refers to an organization's capacity to respond effectively to disruptions, adapt to changing circumstances, and ensure the continuity of its operations while safeguarding its employees, assets, and overall brand value. Resilience is cultivated by providing emotional support and practical resources, which allows entrepreneurs to recover quickly from failures and learn from them, thereby strengthening start-ups' ability to cope with change and continue to innovate.

Through the training and mentoring programs offered the focus is on improving leadership skills, strategic management, effective communication and negotiation. Start-ups need mentors and advisors to understand and survive in the market. Moreover, the participation of people from the same industry with experience could

help a new venture to endure in the market. A competency indicates the possession of knowledge, necessary skills, and a favorable attitude that enables a person to act effectively in a wide variety of situations or jobs.

Recent research increasingly views business incubators as an active part of entrepreneurial ecosystems, rather than merely as isolated support structures for startups. Yuan et al. (2022) analyze the performance of technology incubators from the perspective of the entrepreneurial ecosystem and highlight the importance of the interaction between resources, capital, infrastructure, technology, and human capital.

Along the same lines, Bouncken and Kraus (2022) emphasize the interconnected and dynamic nature of entrepreneurial ecosystems, in which interactions among various actors and forms of governance contribute to the ecosystem's evolution. More recent research on the incubation context also highlights the dynamic nature of the relationships between entrepreneurs, incubator managers, and other actors involved in the incubation process (van Erkelens et al., 2024).

For the long-term success of start-ups managers need to develop their entrepreneurial competencies, which can be achieved by participating in educational and mentoring programs offered by incubators. Thus, business incubators are considered necessary elements of innovation and economic growth in a changing society.

Given these results, the paper proposes the following hypotheses:

H1: Risk adaptability and resilience of business incubators (RAR) significantly positively influence managers' entrepreneurial competence development (DEC);

H2: Risk adaptability and resilience of business incubators (RAR) significantly positively influence competitive intensity, innovation and operational efficiency of the entrepreneurial ecosystem (ICI);

H3: Development of entrepreneurial competence of managers (DEC) significantly positively influences competition intensity, innovation and operational efficiency of the entrepreneurial ecosystem (ICI).

2.2 Flexibility and Agility of the Entrepreneurial Ecosystem, Organizational Culture of Business Incubators, Development of Entrepreneurial Skills of Managers

Digital transformation allows organizations to adapt to rapidly changing environments and technological advancements. entrepreneurial ecosystem's need for flexibility and agility (Banciu et al., 2023). However, it require new entrepreneurial skills, which need to be developed as much as possible for start-ups to be as sustainable as possible. By offering educational and mentoring programs focused on various aspects of leadership and strategic management, business incubators play a central role in developing the entrepreneurial ecosystem. By participating in the programs offered by business incubators, managers can benefit from improved leadership skills.

Incubators need to develop a performance-oriented culture in a short period of time that is centered on the intellectual capital of the enterprise. Knowledge is the essential resource of an enterprise for organizational learning. Acs et al. (2009) highlighted the role of incubators in fostering knowledge development, which can strengthen entrepreneurs' capacity to recognize and capitalize on new opportunities.

Experience cannot come from formal education, potential entrepreneurs can only gain experience by working in a business. Learning how to run a business is almost impossible without prior experience. The provision of mentoring is an important way in which business incubators help the development of start-ups. Coaching can be referred to as the provision of training or instruction, seminars, educational workshops or programs to individuals to improve skills and knowledge (Bhabra et al., 2003). In the context of business incubation, coaching is closely related to the concept of mentoring. Coaching is the dissemination of knowledge and support to entrepreneurs in business start-ups.

Recent literature highlights the importance of resilience and adaptability in entrepreneurial ecosystems. Khurana et al. (2022) show that resilience and adaptability are important for the response of organizations and ecosystems to changes in the entrepreneurial environment. The development of entrepreneurial skills is also an important component of the ecosystem. Andriani et al. (2023) highlight the role of entrepreneurial education, incubators, and ecosystem support in developing these skills.

At the same time, innovation is supported by connecting entrepreneurs to resources, technologies, and ecosystem actors. Bhat (2023) highlights the role of technology incubators in supporting innovation and the development of entrepreneurial ecosystems. These contributions support the inclusion of resilience, entrepreneurial competencies, and innovation in the analysis of this study.

Business incubators contribute to the development of innovative products by providing targeted support and facilitating the timely integration of emerging technologies. The organizational culture of business incubators takes into account innovation, collaboration and mutual support. In addition, business incubators promote an atmosphere of continuous learning and experimentation, where failures are seen as opportunities for learning and improvement. Entrepreneurial ecosystems involve a set of individual, organizational, industry and environmental elements, leadership, dynamic capabilities, culture, capital markets, networks, and customers, which combine in complex ways (Isenberg, 2010). So inexperienced entrepreneurs need guidance and support to meet the challenges of the increasingly dynamic entrepreneurial environment.

Given these results, the paper proposes the following hypotheses:

H4: The organizational culture of business incubators (OCB) significantly positively influences the flexibility and agility of the entrepreneurial ecosystem (FAE);

H5: Organizational culture of business incubators (OCB) significantly positively influences managers' entrepreneurial competence development (DEC).

2.3 Development of Entrepreneurial Skills of Managers, Performance of the Entrepreneurial Ecosystem, State of Financial Markets and Access to Finance

Today's entrepreneurial ecosystem is complex and dynamic, characterized by rapid innovation and competitive intensity. Its performance can be significantly influenced by the contribution of business incubators, which serve as engines of start-up growth and development. Some elements of the entrepreneurial ecosystem can proactively provide help to start-ups (Audretsch & Belitski, 2017). In order to promote regional entrepreneurial performance, local governments can provide start-ups with legal advice, entrepreneurial mentors, business training, tax incentives, etc. (Isenberg, 2016).

These resources can provide help in the value capture process for start-ups that lack experience and competitive capacity (Estrada & Dong, 2020). Business incubators are hubs of innovation and technological experimentation, thus they provide start-ups with access to state-of-the-art infrastructure, advanced technology labs and specialized expertise in various fields.

Through the resources made available by business incubators entrepreneurs can test and develop new ideas, often without the high costs associated with initial technology investments. Moreover, connections to networks of investors and strategic partners facilitate access to finance and to different markets, accelerating the cycle of development and commercialization of innovative products.

Innovative small businesses often face the greatest difficulties in obtaining finance. Access to finance is one of the biggest obstacles faced by SMEs, especially in developing countries, where financiers typically avoid lending to micro and small enterprises due to lack of collateral (Beck & Demircug-Kunt, 2006). Business incubators not only support individual start-ups, but also contribute to the overall performance of the entrepreneurial ecosystem. For start-ups, achieving an appropriate balance between exploration and exploitation can contribute to improved business performance. However, developing and maintaining this organizational ambidexterity remains a significant challenge.

Flexibility and adaptability are important characteristics of entrepreneurial ecosystems. Rosado-Cubero et al. (2023), in their analysis of business incubators in Spain, highlight the importance of the regional context, innovation, and the support provided to entrepreneurs for the development of the entrepreneurial ecosystem.

Furthermore, Leal, Leal, and Silva (2023) emphasize the importance of cooperation among incubators, universities, local authorities, and business organizations for the development of entrepreneurial ecosystems and the stimulation of local growth. These interactions highlight the role of organizational and relational characteristics in ecosystem development. Additionally, Chen, Yan, and Wang (2023) show that the development of the digital economy is associated with entrepreneurs' performance, and the services provided by incubators, such as access to technology, capital, and knowledge, can support their development. These

contributions underscore the importance of flexibility, organizational culture, and skills development in the analysis of the entrepreneurial ecosystem.

By attracting talent, stimulating innovation and creating jobs, business incubators support economic development and regional or national competitiveness. Successful start-ups in incubators serve as examples of best practice and encourage other entrepreneurs to implement their ideas and grow their businesses in a supportive and resourceful environment. By organizing events, workshops and mentoring programmes, the exchange of ideas between start-ups, universities, research centres and the private sector is encouraged. Given these results, the paper proposes the following hypotheses:

H6: Managers' entrepreneurial competence development (DEC) significantly positively influences entrepreneurial ecosystem performance (EEP);

H7: The state of financial markets and access to finance (SFM) significantly positively influences entrepreneurial ecosystem performance (EEP).

Although the individual relationships analyzed in this study are grounded in the existing literature, the contribution of this research lies in integrating these dimensions into a single structural model and in the empirical examination of the interrelationships among them within the context of the entrepreneurial ecosystem under analysis. Furthermore, the study simultaneously analyzes organizational culture, risk adaptability and resilience, the development of managers' entrepreneurial competencies, financial market conditions, and the outcomes of the entrepreneurial ecosystem, providing an integrated empirical perspective on these relationships.

3. Research Methodology

Starting from the literature review with the help of which we established the research hypotheses, we derived a list of items that we used in the research. In Table 1 we have detailed the items included in the questionnaire, the data collection instrument. The items represent suggestive questions for the variables used in this research. We collected responses using the questionnaire, the respondents were entrepreneurs, incubator managers, policy makers and investors.

After establishing the theoretical framework by analyzing the literature, we tested the variables that represent influencing factors of business incubators on the development of entrepreneurial ecosystem in a dynamic environment. Thus, after confirming the issues through empirical findings, it became necessary to test the hypotheses for conducting the primary research. In this research, we opted for structural equation modeling using SmartPLS4 software. This method is suitable for this research as it involves a complex conceptual model. Moreover, by modeling structural equations using SmartPLS4 software can give practical value for applied research.

The study of the impact of business incubators on the entrepreneurial ecosystem is oriented towards practical and applied results. This study aims to identify the extent to which business incubators influence business success, business survival

rates and innovation. By studying incubators, we can understand their interactions with other actors and how they contribute to an innovation-friendly environment. The choice of partial least squares structural equation modeling over other correlational analyses is justified by the ability to simultaneously analyze the relationships between these variables, providing insight into direct and indirect influences. Moreover, SmartPLS4 software is well suited in exploratory research that seeks to validate new conceptual models or test emerging theories.

Figure 1 shows the structural model, which highlights the relationships between variables through the seven hypotheses detailed in section 2. The items used in the research, referred to as items, represent the directly measured variables, comprising the results of the questionnaire-based analysis. The survey items are represented as rectangles, and the relationships between variables, respectively between variables and associated indicators, are illustrated by one-way arrows, and are assessed as predictive or causal relationships. The variables are represented as blue circles, being reflected by several items in the questionnaire.

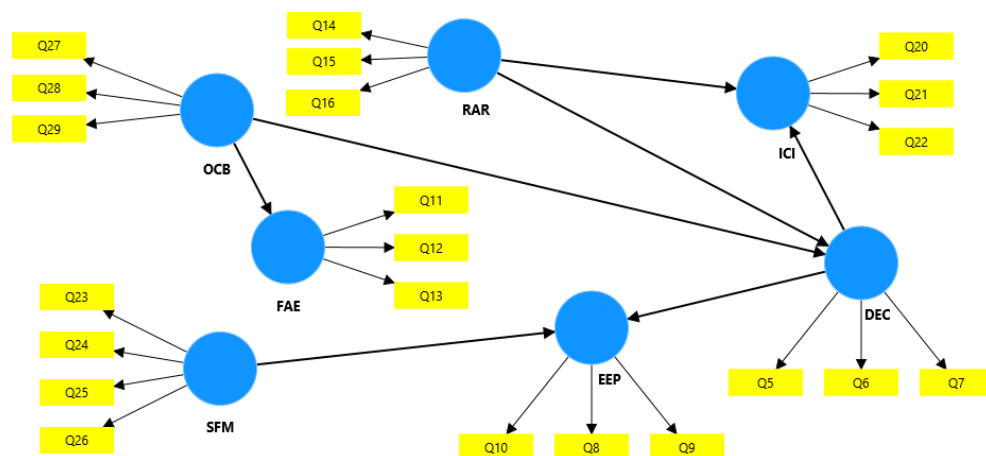


Figure 1. Conceptual model developed for the structural equation modelling analysis

Source: Author's processing using SmartPLS 4 software.

Between 02.09.2025 - 02.11.2025 data were collected using the questionnaire. The questionnaire consisting of 29 questions and structured in two sections was completed by entrepreneurs, incubator managers, policy makers and investors. Section 1 of the questionnaire contains questions related to the respondent's profile, while the second section contains five-step Likert scale type questions that address the research variables. Respondent profile questions include background, age, education level and gender.

The study focused specifically on the entrepreneurial ecosystem in rural areas, and the sample was selected using convenience sampling, in line with the research objective and context. Consequently, all 212 respondents are from rural areas and include entrepreneurs, business incubator managers, decision-makers, and investors involved in or familiar with the entrepreneurial ecosystem in these areas. The

selection of respondents from rural areas was intended to ensure their relevance to the entrepreneurial context under analysis. Thus, the composition of the sample directly reflects the study's objective, namely the analysis of the rural entrepreneurial ecosystem.

Section 2 consists of five-step Likert scale questions focusing on seven concepts central to the objectives of this research. These concepts refer to: managers' entrepreneurial competence development (DEC), entrepreneurial ecosystem performance (EEP), entrepreneurial ecosystem flexibility and agility (FAE), risk adaptability and resilience of business incubators (RAR), intensity of competition, innovation and operational efficiency of the entrepreneurial ecosystem (ICI), state of financial markets, interest rates and access to finance (SFM), organizational culture of business incubators (OCB). It is considered as a general rule, the sample size should exceed 200 cases in most situations (Boomsma & Hoogland, 2001). We obtained responses from a total of 212 individuals which shows that the sample is adequate for our research objectives and the structural model we wish to test.

According to the methodological recommendations formulated by Reinartz et al. (2009), the sample of 212 respondents is adequate for applying structural equation modeling using the PLS-SEM method and for testing the proposed structural model. Therefore, the sample size provides a basis for conducting the empirical analysis and evaluating the relationships included in the model. At the same time, the results are interpreted in light of the specific characteristics of the analyzed sample and the rural entrepreneurial context under investigation.

In the present research, 52% (n=110) males and 48% (n=102) females participated, all the respondents were from rural areas. The majority of the respondents are aged between 30 and 45 years and have a higher education.

4. Analysis of Research Findings Through Structural Equation Modelling

Figure 2 illustrates the relationships among the latent variables included in the research model. The arrows reflect the direction of the relationship, starting from the independent latent variable, considered as a predictor, to the dependent latent variable. This diagram presents the measured variables in a reflective approach, where the arrows are directed from variables to indicators.

From the structural model we can understand that between (1) OCB (organizational culture of business incubators) and FAE (flexibility and agility of the entrepreneurial ecosystem) there is a strong relationship, the path coefficient is 0.809.

Moderate relationships are found between (2) SFM (state of financial markets and access to finance) and EEP (entrepreneurial ecosystem performance), the coefficient of relationship is 0.478, (3) DEC (development of entrepreneurial skills of managers) and EEP (entrepreneurial ecosystem performance), for which the coefficient of relationship is 0.460, (4) RAR (risk adaptability and resilience of business incubators) and DEC (entrepreneurial skills development of managers), the coefficient of relationship is 0.455, (5) RAR and ICI (intensity of competition,

innovation and operational efficiency of the entrepreneurial ecosystem), the coefficient of relationship is 0.429, (6) DEC (development of managers' entrepreneurial skills) and ICI (intensity of competition, innovation and operational efficiency of the entrepreneurial ecosystem), the coefficient of relationship is 0.420 and (7) OCB (organizational culture of business incubators) and DEC (development of managers' entrepreneurial skills), for which the coefficient of relationship is 0.415.

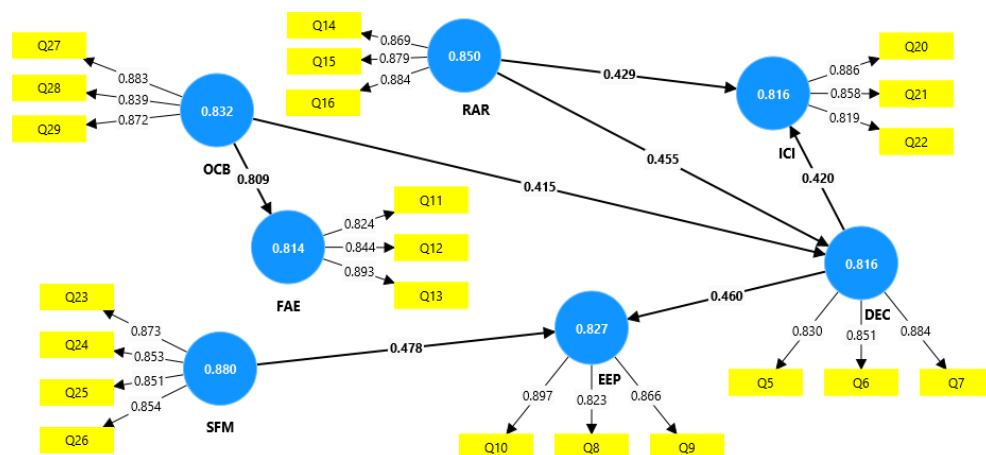


Figure 2. Effect sizes and indicator contributions to the reflective latent variables
Source: Author's processing using SmartPLS 4 software.

Table 1 presents the relationship coefficients obtained from the PLS-SEM analysis conducted in SmartPLS 4. The strongest path coefficient is observed for the relationship between OCB and FAE ($\beta = 0.809$), all the others obtaining moderate relationships.

Table 1. Relationship coefficients obtained from the structural model

	Path coefficients
DEC → EEP	0.460
DEC → ICI	0.420
OCB → DEC	0.415
OCB → FAE	0.809
RAR → DEC	0.455
RAR → ICI	0.429
SFM → EEP	0.478

Source: Author's processing using SmartPLS 4 software.

In order to assess the internal consistency of the research instrument, the questionnaire, which includes the 29 items, we determined the Cronbach Alpha coefficient. This coefficient estimates the degree of correlation between the variables included in the structural model. According to Hair et al. (2021), Cronbach Alpha values between 0.60 and 0.70 are considered acceptable. In the present research, all

the variables analyzed had Cronbach Alpha coefficient values greater than 0.70, as shown in Table 2. These results indicate a significant internal consistency of the variables in the analyzed structural model. By internal consistency the items of a questionnaire are conceptually aligned and objectively measure what is intended to be assessed. Internal consistency indicates that participants' answers are consistent and that the results are replicable.

Table 2. Results of the reliability and convergent validity analysis for the reflective constructs

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
DEC	0.816	0.821	0.891	0.732
EEP	0.827	0.827	0.897	0.744
FAE	0.814	0.814	0.890	0.729
ICI	0.816	0.825	0.891	0.731
OCB	0.832	0.833	0.899	0.748
RAR	0.850	0.852	0.909	0.770
SFM	0.880	0.880	0.918	0.736

Source: Author's processing using SmartPLS 4 software.

The internal consistency of the latent constructs can also be assessed using the Composite Reliability (CR). This indicator provides a measure of the reliability and validity of the latent constructs. Unlike the Cronbach Alpha coefficient, the CR is more sensitive to the weights of each indicator, which makes it a more precise tool in analyzing reliability. For the CR the minimum accepted threshold is at least 0.7, very high values, e.g. above 0.95, may however signal redundancy between items, which could indicate that they are repeatedly measuring the same aspect of the construct.

We note that for all variables, appropriate data above the minimum accepted threshold of 0.7 and below 0.95 were obtained, reflecting that the indicators correlate well with the latent construct. Thus, as can be seen, the internal consistency and convergent validity requirements of the model are met. In this research, we observe that the composite confidence level exceeds the recommended minimum threshold for all seven reflective variables (DEC, EEP, FAE, ICI, OCB, RAR, SFM).

AVE (Average Variance Extracted) is an indicator of the convergent validity of a model, assessing how well a set of items explains a latent construct. AVE measures the proportion of the total variance of the items that is explained by the construct, compared to the variance attributed to measurement error. AVE shows how well the items reflect a common construct, confirming whether the variables are adequate to represent the latent construct. The acceptable threshold for AVE is 0.50 (Hair et al., 2014).

Convergent validity measures how well latent variables represent the variability of their indicators. Thus, a higher AVE value indicates a better adequacy of the latent variables in explaining the observed variation in the indicators. We observe that all the seven reflective variables (DEC, EEP, FAE, ICI, OCB, RAR, SFM) have AVE

above the recommended threshold. The AVE values indicate that each construct accounts for more than half of the variance in its respective indicators, thereby providing evidence of satisfactory convergent validity.

The Fornell–Larcker criterion was used to assess the discriminant validity of the measurement model. This criterion involves comparing the square root of the AVE value for each construct with the correlation coefficients between that construct and the other constructs in the model. For this criterion to be met, the square root of the AVE must be greater than the correlations between the construct and the other latent variables (Fornell & Larcker, 1981). In the case of the analyzed model, the square root of AVE values are: 0.855 for DEC, 0.853 for EEP, 0.854 for FAE, 0.855 for ICI, 0.865 for OCB, 0.877 for RAR, and 0.858 for SFM. The results indicate (Table 3) that this condition is met for most of the constructs analyzed. However, an exception is observed for the SFM–ICI pair, as the correlation between the two constructs (0.877) is greater than the square root of the AVE for SFM (0.858). This situation indicates a possible overlap between the two constructs and requires further verification of discriminant validity.

Table 3. Discriminant validity assessment for the reflective measurement model (Fornell-Larcker criterion)

	DEC	EEP	FAE	ICI	OCB	RAR	SFM
DEC	0.855						
EEP	0.836	0.853					
FAE	0.811	0.842	0.854				
ICI	0.755	0.817	0.793	0.855			
OCB	0.772	0.802	0.809	0.844	0.865		
RAR	0.780	0.826	0.844	0.757	0.784	0.877	
SFM	0.788	0.840	0.846	0.877	0.825	0.834	0.858

Source: Author's processing using SmartPLS 4 software.

In light of this observation, discriminant validity was further assessed using the Heterotrait–Monotrait (HTMT) ratio, an additional criterion used in the evaluation of measurement models. The HTMT values reported in Table 4 are all below the recommended threshold of 0.85, indicating satisfactory discriminant validity among the constructs. The highest values were recorded for the OCB–DEC (0.833), SFM–ICI (0.833), RAR–OCB (0.829), and SFM–DEC (0.827) pairs. Therefore, even for the SFM–ICI pair, for which the Fornell–Larcker criterion indicated a potential issue, the HTMT value of 0.833 falls below the threshold of 0.85. These results provide additional support for the discriminant validity of the constructs analyzed.

Based on the combined evaluation of the two criteria, the results provide favorable evidence regarding the discriminant validity of the constructs. Although the Fornell–Larcker criterion highlights a possible overlap between SFM and ICI, the HTMT analysis does not confirm this issue, as all values obtained fall below the conservative threshold of 0.85. Therefore, the HTMT results provide further support for the empirical differentiation of the constructs included in the model.

Table 4. Assessment of discriminant validity using the Heterotrait–Monotrait (HTMT) criterion

	Heterotrait-monotrait ratio (HTMT)
EEP <=> DEC	0.813
FAE <=> DEC	0.792
FAE <=> EEP	0.774
ICI <=> DEC	0.815
ICI <=> EEP	0.793
ICI <=> FAE	0.771
OCB <=> DEC	0.833
OCB <=> EEP	0.764
OCB <=> FAE	0.780
OCB <=> ICI	0.821
RAR <=> DEC	0.734
RAR <=> EEP	0.782
RAR <=> FAE	0.824
RAR <=> ICI	0.803
RAR <=> OCB	0.829
SFM <=> DEC	0.827
SFM <=> EEP	0.783
SFM <=> FAE	0.799
SFM <=> ICI	0.833
SFM <=> OCB	0.810
SFM <=> RAR	0.764

Source: Author's processing using SmartPLS 4 software.

To assess multicollinearity, the variance inflation factor (VIF) values for the indicators included in the model were analyzed. The values obtained (Table 5) range from 1.611 to 2.511, which is below the recommended threshold of 5 for identifying significant multicollinearity issues. Therefore, the results indicate the absence of significant multicollinearity issues among the indicators used in the model.

Table 5. Assessment of multicollinearity using the variance inflation factor (VIF)

VIF			
Q10	2.421	Q24	2.290
Q11	1.680	Q25	2.243
Q12	1.809	Q26	2.228
Q13	2.284	Q27	2.209
Q14	2.054	Q28	1.643
Q15	2.065	Q29	2.193
Q16	2.107	Q5	1.751
Q20	2.110	Q6	1.744
Q21	1.740	Q7	2.047
Q22	1.748	Q8	1.611
Q23	2.511	Q9	2.128

Source: Author's processing using SmartPLS 4 software.

5. Results and Discussion

The coefficient of determination R^2 was used to assess the explanatory power of the structural model, indicating the proportion of the variation in the endogenous constructs explained by the predictive constructs included in the model. The results (Table 6) show consistent R^2 values for the endogenous constructs analyzed. For the development of managers' entrepreneurial competencies (DEC), the R^2 value of 0.675 shows that 67.5% of the variation in this construct is explained by the predictive variables included in the model.

For entrepreneurial ecosystem performance (EEP), the R^2 value of 0.785 indicates that 78.5% of the variation is explained by the model's predictors. In the case of entrepreneurial ecosystem flexibility and agility (FAE), the R^2 value of 0.655 indicates that 65.5% of the variation is explained by the predictive variables, while for competition intensity, innovation, and operational efficiency (ICI), the R^2 value of 0.642 indicates that 64.2% of the variation is explained by the predictors included in the model. The adjusted R^2 values are close to the corresponding R^2 values, indicating that adjusting for the number of predictors does not substantially alter the model's explanatory power.

Table 6. R^2 values for the endogenous constructs in the structural model

	R-square	R-square adjusted
DEC	0.675	0.672
EEP	0.785	0.783
FAE	0.655	0.653
ICI	0.642	0.639

Source: Author's processing using SmartPLS 4 software.

The effect size (f^2) was assessed to determine the contribution of each exogenous construct to the explained variance of the endogenous constructs. According to commonly used thresholds, f^2 values of approximately 0.02, 0.15, and 0.35 indicate small, medium, and large effects, respectively. The results presented in Table 7 show that the development of managers' entrepreneurial competencies (DEC) has a large effect on the performance of the entrepreneurial ecosystem (EEP), with an f^2 value of 0.373, while the effect on the intensity of competition, innovation, and operational efficiency (ICI) is moderate ($f^2 = 0.193$).

The organizational culture of business incubators (OCB) has a moderate effect on the development of entrepreneurial competencies (DEC), with $f^2 = 0.205$, and a very large effect on the flexibility and agility of the entrepreneurial ecosystem (FAE), with $f^2 = 1.900$. The risk adaptability and resilience of business incubators (RAR) have moderate effects on both DEC ($f^2 = 0.247$) and ICI ($f^2 = 0.201$). The state of financial markets and access to finance (SFM) has a large effect on entrepreneurial ecosystem performance (EEP), with $f^2 = 0.403$. Overall, the results indicate that $OCB \rightarrow FAE$ represents the strongest relationship in terms of effect size, highlighting the importance of the organizational culture of incubators for the flexibility and agility of the entrepreneurial ecosystem.

Table 7. Estimation of the effect size (f^2) in the structural model

	f-square
DEC -> EEP	0.373
DEC -> ICI	0.193
OCB -> DEC	0.205
OCB -> FAE	1.900
RAR -> DEC	0.247
RAR -> ICI	0.201
SFM -> EEP	0.403

Source: Author's processing using SmartPLS 4 software.

The predictive validity of the model was assessed using the PLSpredict procedure. The Q^2_{predict} values obtained for all endogenous constructs are positive, ranging from 0.634 to 0.751, indicating the presence of predictive validity for all constructs analyzed (Table 8). The highest Q^2_{predict} value was recorded for entrepreneurial ecosystem performance (EEP), with a value of 0.751, followed by the development of managers' entrepreneurial competencies (DEC), at 0.663; the flexibility and agility of the entrepreneurial ecosystem (FAE), at 0.649; and the intensity of competition, innovation, and operational efficiency (ICI), at 0.634. The results indicate that the model exhibits good predictive power for all the endogenous constructs analyzed.

Table 8. Predictive relevance (Q^2_{predict}) for the endogenous constructs of the structural model

	Q^2_{predict}	RMSE	MAE
DEC	0.663	0.586	0.422
EEP	0.751	0.503	0.360
FAE	0.649	0.598	0.417
ICI	0.634	0.610	0.434

Source: Author's processing using SmartPLS 4 software.

The bootstrapping technique was applied to determine the statistical significance and robustness of the PLS-SEM model estimates, particularly the path coefficients used to test the research hypotheses. In SmartPLS 4, 5,000 bootstrap subsamples were generated. The analysis was conducted using a two-tailed test at a significance level of 0.05. The bootstrap percentile approach was employed to derive the confidence intervals, with a fixed random-number seed applied to ensure that the analysis could be replicated under the same computational conditions.

The bootstrapping results were used to calculate the t- and p-values associated with the path coefficients and to assess the statistical significance of the relationships hypothesized in the model. Thus, the bootstrapping procedure allowed us to verify the robustness of the estimates and to substantiate the decision to support or reject hypotheses H1–H7.

Following the bootstrapping procedure, the estimated structural model is presented in Figure 3, illustrating the hypothesized relationships between the constructs included in the model. The arrows indicate the estimated path coefficients,

while the corresponding p-values provide information on their statistical significance.

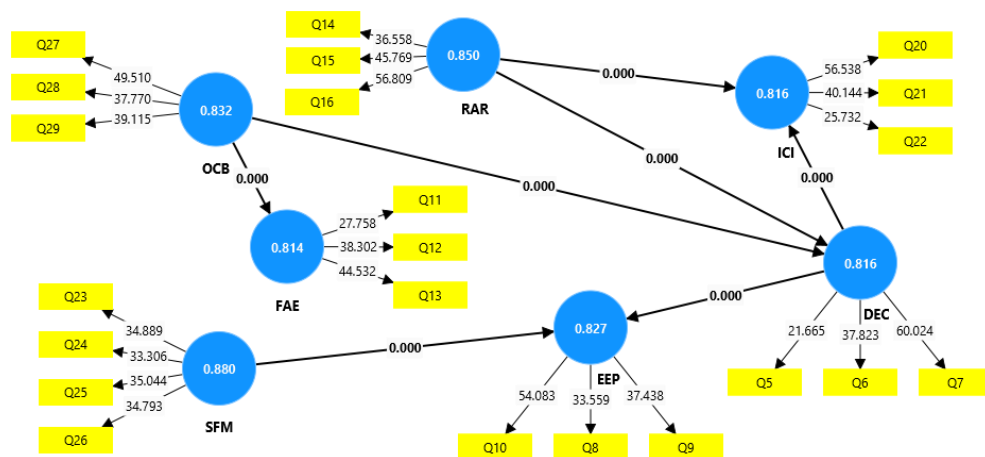


Figure 3. Statistical significance of the relationships between the model variables following bootstrapping

Source: Author's processing using SmartPLS 4 software.

The detailed bootstrapping results, including the path coefficients, t-values and p-values, are presented in Table 9 and are used to evaluate hypotheses H1–H7.

Table 9. Statistical significance and hypothesis testing in the structural model

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
DEC -> EEP	0.460	0.454	0.080	5.744	0.000
DEC -> ICI	0.420	0.414	0.104	4.040	0.000
OCB -> DEC	0.415	0.412	0.089	4.654	0.000
OCB -> FAE	0.809	0.811	0.030	27.194	0.000
RAR -> DEC	0.455	0.458	0.091	4.995	0.000
RAR -> ICI	0.429	0.437	0.105	4.076	0.000
SFM -> EEP	0.478	0.484	0.081	5.896	0.000

Source: Author's processing using SmartPLS 4 software.

Original Sample (O) represents the estimated path coefficients in the model, indicating the strength and direction of the relationship between the variables analyzed. In the present research, the positive values obtained for Original Sample (O) signify a positive relationship between the constructs, thus the increase in one

variable leads to an increase in the other. Sample Mean (M), the average of the path coefficients computed from all the subsamples generated by bootstrapping provides an additional check on the stability of the estimated coefficient.

Standard Deviation (STDEV) measures the variance of the coefficient estimates between subsamples, smaller values indicate higher stability of the estimates, thus the present research is stable. T Statistics ($|O/STDEV|$) is the ratio of the estimated coefficient to the standard deviation. Values of T greater than 1.96 indicate statistical significance at the 95% confidence level. Values $p < 0.05$ confirm that the relationship between the constructs is significant. The lower the p-value, the stronger the statistical support for the relationship. Thus, all seven hypotheses were supported by statistically significant path coefficients. Given the cross-sectional nature of the survey data, the estimated path relationships are interpreted as statistically significant associations rather than as evidence of definitive causal effects. Accordingly, the results are discussed in terms of the strength, direction, and statistical significance of the observed associations.

The path coefficient ($\beta = 0.460$) indicates a moderate positive relationship between DEC and EEP. The t-statistic and p-value indicate that the path coefficient is statistically significant. The results indicate a positive and statistically significant association between DEC and EEP. DEC is positively and significantly associated with ICI with a moderate path coefficient ($\beta = 0.420$). The significance level ($p < 0.05$) provides support for the proposed hypothesis, indicating a positive and statistically significant relationship between DEC and ICI. OCB is positively and significantly associated with DEC ($\beta = 0.415$), t and p values confirm the significance of the relationship. The relationship between OCB and FAE is very strong ($\beta = 0.809$), indicating a strong positive and statistically significant association between OCB and FAE. The high t-value (27.194) and the corresponding p-value indicate that the path coefficient is statistically significant.

The results indicate a positive and statistically significant association between RAR and DEC, the stability of the relationship is confirmed by the t and p values. RAR is positively and significantly associated with ICI ($\beta = 0.429$), indicating that the relationship is statistically significant ($p < 0.05$). SFM has a moderate to strong positive association with EEP ($\beta = 0.478$). The relationship is supported by significant t and p values.

6. Conclusions

In a competitive market there is a greater emphasis on issues such as how quickly and flexibly an organization can react to constant changes in the business environment. These issues are based on an important paradigm that is known as agility (Perker et al., 2015). Agility is considered to be a critical foundation for modern organizations today and necessary for their survival. Thus, business incubators play a very important role in the modern entrepreneurial ecosystem as they provide a conducive environment for the development of start-ups. Good performance, project sustainability and knowledge are the critical factors. Following

the growth of a knowledge-based economy, technology and innovation are considered important components of performance. Innovation can contribute to increased productivity, a high level of competition and wealth generation (Carlson & Wilmot, 2006).

In the practice of knowledge sharing, information technology support has a major influence on knowledge flows that accelerate the knowledge sharing process (Hsu, 2008). Business incubators provide managers with educational and mentoring programs that improve leadership, communication, negotiation, and risk management skills. All these skills are necessary for the effective management and long-term success of start-ups in a dynamic and competitive entrepreneurial environment.

Business incubators directly support start-ups and the creation of a collaborative and innovative environment, contributing to the overall performance of the entrepreneurial ecosystem. Moreover, it can stimulate innovation and contribute to regional or national economic development and competitiveness. By providing access to state-of-the-art infrastructure, advanced technology labs and specialized expertise, business incubators enable start-ups to develop and test innovative ideas and commercialize them quickly, thus contributing to technological and economic progress. Moreover, incubators encourage the exchange of ideas and cooperation between various entities, including start-ups, universities, research centers and the private sector. By participating in business incubators, managers can benefit from innovative solutions and learn to tackle complex problems.

Collaborating in the same building with representatives from other firms can create synergies, integrated relationships and social capital, all of which are believed to strengthen a firm's innovative capabilities and increase the potential for business collaboration. Such interactions can also contribute to the sharing of resources, knowledge and information and, to addressing the problem of novelty that most firms face. Second, businesses can create networks through the targeted support provided by business incubators (Hansen et al., 2000).

Business incubators are fundamental to creating and sustaining a robust and innovative entrepreneurial ecosystem. They enable the development of entrepreneurial skills, improve ecosystem performance, and provide technological opportunities essential for the success and sustainability of start-ups. Given all these benefits, business incubators are seen as engines of innovation and economic growth, essential for the prosperity of a knowledge-based economy and adaptability to rapid market changes.

From an empirical perspective, the present study contributes to a deeper understanding of the relationship between business incubator characteristics and outcomes within the entrepreneurial ecosystem. The study's contribution lies in integrating into a single structural model dimensions related to organizational culture, risk adaptability, and the resilience of business incubators; the development of managers' entrepreneurial competencies; access to financing; and the outcomes of the entrepreneurial ecosystem, and in simultaneously empirically testing the relationships among these constructs. The results obtained by applying PLS-SEM

show that the risk adaptability and resilience of business incubators, as well as their organizational culture, are significantly associated with the development of managers' entrepreneurial competencies and with the flexibility and agility of the entrepreneurial ecosystem.

Furthermore, the development of managers' entrepreneurial competencies, the state of financial markets, and access to financing are positively and significantly correlated with the performance of the entrepreneurial ecosystem. Consequently, the study offers an integrated empirical perspective on how these dimensions interact within the analyzed entrepreneurial ecosystem. These results provide empirical evidence that business incubators are not merely support structures for the individual development of startups, but can play an important role in developing and strengthening the entrepreneurial ecosystem as a whole.

A key aspect of the study is the Romanian and rural context in which the data were collected. The analysis offers an empirical perspective on how the characteristics of business incubators and the conditions of the entrepreneurial ecosystem interact in rural areas of Romania. This context is relevant because the economic and institutional characteristics of rural areas can influence how incubators, managers, investors, and decision-makers interact within the entrepreneurial ecosystem. Therefore, the results must be interpreted in light of this specific context and should not be automatically generalized to other regions or to the entire Romanian entrepreneurial ecosystem.

The main role of business incubators is to support start-ups in their early stages and further development to stimulate the local economy and increase regional or national competitiveness. Business incubators have implications for economic development and innovation in a changing world. Business incubators therefore not only facilitate the launch of start-ups, but also enable the development of a dynamic and adaptable entrepreneurial ecosystem. Through innovation, education and practical support, business incubators turn ideas into reality and shape the future direction of the global economy.

The findings provide empirical evidence of positive and statistically significant associations among the constructs included in the proposed model. However, due to the cross-sectional nature of the data, the results should not be interpreted as definitive evidence of causal relationships.

7. Limitations and Future Research Directions

The sample of 212 respondents was selected in accordance with the research objective, which focused on analyzing the entrepreneurial ecosystem in rural areas. The respondents come from rural areas and include several categories of stakeholders relevant to the entrepreneurial ecosystem, namely entrepreneurs, business incubator managers, decision-makers, and investors. This sample structure reflects the specific context under investigation and allows for the capture of different perspectives on the phenomenon being analyzed. However, the use of a convenience sample represents a limitation in terms of generalizing the results to

other populations and contexts. Therefore, the results are interpreted in relation to the characteristics of the sample and the rural entrepreneurial context analyzed.

At the same time, the sample size of 212 respondents is adequate for applying PLS-SEM and for testing the proposed structural model. The seven relationships analyzed exhibit positive and statistically significant path coefficients ($p < 0.001$), providing empirical support for the hypotheses formulated within the analyzed context. However, the results must be interpreted in light of the sample characteristics and the specific research context, without automatically generalizing them to other populations or contexts.

Future research could expand the analysis by using larger and more geographically diverse samples, including respondents from both rural and urban areas, as well as by conducting comparisons between different regions of Romania. Such an approach would allow for an examination of potential regional differences in the relationship between the characteristics of business incubators and the outcomes of the entrepreneurial ecosystem and would contribute to assessing the model's applicability in different territorial contexts.

Furthermore, a separate analysis of stakeholder categories, entrepreneurs, business incubator managers, policymakers, and investors, could highlight potential differences in perceptions regarding the role of business incubators in the development of the entrepreneurial ecosystem. Furthermore, the use of longitudinal data would allow for an examination of how the analyzed relationships evolve over time and would provide a more in-depth perspective on the dynamics of the entrepreneurial ecosystem.

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