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INITIAL FACTORS' INFLUENCING THE ROMANIAN ACADEMIC SPIN-OFF'S LONG-TERM SURVIVAL

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Abstract: *In emergent economies like Croatia, Czech Republic, Romania, and Bulgaria, academic spin-offs have a slow evolution. These are new firms created by individuals affiliated with research institutes or universities to exploit the scientific results. This paper improves the assessment mechanism of the main initial factors influencing the development of academic spin-offs in the Romanian context following Vohora's five-stage model. From a resource-based view, the initial factors that influence the venture following four stages of development are outlined: research, opportunity phase, phase of pre-organization, phase of reorientation, and phase of venture sustainability. Using a qualitative research method, the paper highlights the two important key factors in the stages of development: team heterogeneity and university resources. The university's implication starting from the inception venture phase influences positively the formation of the academic spin-off especially in the reorientation phase.*
Keywords: *academic spin-off, factors, stages of development, spin-off survival*

1. INTRODUCTION

In the past years, in European countries, research institutes and universities showed a significant rise in interest in accessing European funding for the creation of spin-offs, incubators, and clusters of innovation. Some consider that academic spin-offs can generate economic growth because they are growth-oriented which makes them risky ventures in contrast with other types of innovative firms [1]. Shane [2] concluded that American academic spin-offs are 100 times more likely to have an impact on regional development by creating jobs than the average new ventures.

Likewise, some research papers on academic spin-offs are trying to give a complete definition [2, 3, 4, 5, 6]. For instance [5] defines spin-offs as ventures "founded by employees of the university around a core technological innovation which had initially been developed at the university", while [7] sees them as new firms that need to use the institution's intellectual property for the development of the product or service, which will be launched in the industry.

Studying the literature, we found studies that analyze the development of academic spin-offs as mechanisms having a stage-based model from a resource-based perspective [2, 8, 9]. Some studies reveal that an academic spin-off follows four [8, 9] or five stages [5] of development, due to the initial phases of the endowment of the academic spin-off. Each stage of development is influenced by the spin-off's access to capabilities and resources, especially from the parent organization. Therefore, there are not so many studies analyzing the impact of the initial factor on the survival rate of the spin-off, especially in emergent economies [7].

The pursuit of understanding the relationship between the venture's initial factors and the survival of academic spin-off most of the time includes links to a variety of capabilities and financial resources that firms can access, depending on the type of core technology and innovation stage of the patent. According to [10] and [11] initial conditions impact long-term performance. [12] showed that in the first stage of development academic spin-offs are a part of the research unit or university, but there is still

not enough information regarding the influence of research unit structures and the role of multidisciplinary research teams on the development of the academic spin-off.

Taking into consideration this aspect, our research provides new insights into the field of academic entrepreneurship and brings as a novelty new factor that can contribute to the increase of the survival rate and performance of this atypical research venture.

In this context, the present study analyzes the influence of the initial factors on the academic spin-off survival, with a focus on the 9 Romanian spin-offs. The paper performs a qualitative investigation over the period 2010 to 2023 and we focus on the academic spin-offs (ASP) which were financed by the European Union for two reasons. On the one hand, Romania has been a part of the European Union (EU) since 2007 and the phenomena of spin-offs started to rise because grants of 200.000 euros were offered to beneficiaries. In the period 2007-2013, 120 innovative ventures were financed by the UE through the program POCCE (Sectoral Operational Program Increase of Economic Competitiveness). In the new program POC, Competitiveness Operational Program (AP 1/P1.2/OS1.3) until 2020, 104 innovative ventures were financed and finalized. According to Order MCID - MIPE no 20300-23.03.2022, the European Union allocated a budget of 2,43 million euros for 2021, 9,88 million euros for 2022, and 0,48 million euros for 2023. On the other hand, there is no evidence of a database of spin-offs in Romania, and the research institutes and universities do not publish the list of spin-offs on their website.

2. THEORETICAL BACKGROUND FOR INITIAL FACTORS FROM A RESOURCE-BASED PERSPECTIVE

In the papers scholars identified different initial factors impacting the development of academic spin-offs: *previous entrepreneurial experience of the manager* as a driven survival factor for spin-offs [13,14,15,16,17], *heterogeneity of the team* [18, 19, 20, 21, 22], *networking ties with university* [7,18, 23, 24] *the maturity of the research result* [18, 25, 19, 26, 27]; *shareholders of public research institutes and firms* [7, 28, 29, 30, 31].

Starting with the pioneering work of [32] underlining the importance of *team heterogeneity* to provide the right capabilities required to address organizational complexities, some researchers highlight that the horizontal or vertical heterogeneity of the team can increase the economic performance of new ventures in later stages of development [21, 22].

Aspelund [18] highlighted that the survival rate of new ventures is influenced by team heterogeneity and the maturity of the research result. Also, a study on 8,300 academic spin-offs in 24 European countries [33] outlined that team heterogeneity increases the survival rate of academic spin-offs. However, there are studies, that mention either technological capabilities [26, 27], or the previous entrepreneurial experience of the team [16], as the main factor that increases the firm survival.

[34] studying 43 companies argued that available and free infrastructure offered by the university or research institute was a key element for the survivability of the spin-off. Meanwhile, others [7, 31] argue that the financial involvement of the parent organization (university or research institute) improves the success of the academic spin-off in the first stage of development. The point of observation in the study of [28] on aerospace industry spin-offs from Japan is the condition of providing a validated prototype and the efficient collaboration between public research institutes and private companies. [19] argue that the degree of innovativeness is the most important survival factor. Figure 1 presents the key factors that influence the phases of development according to [5].

To generate sustainable returns, the academic spin-off must succeed in passing each of the five phases as seen in Figure 1, encountering the following “critical junctures”: opportunity recognition, entrepreneurial skills, firm credibility, and sustainability. Furthermore, the study of Vohora [5] defines a critical juncture as a barrier that prevents the firm from moving to the next level. Each critical juncture is characterized by the firm's ability in a matter of social, human, and financial resources to overcome this obstacle [35].

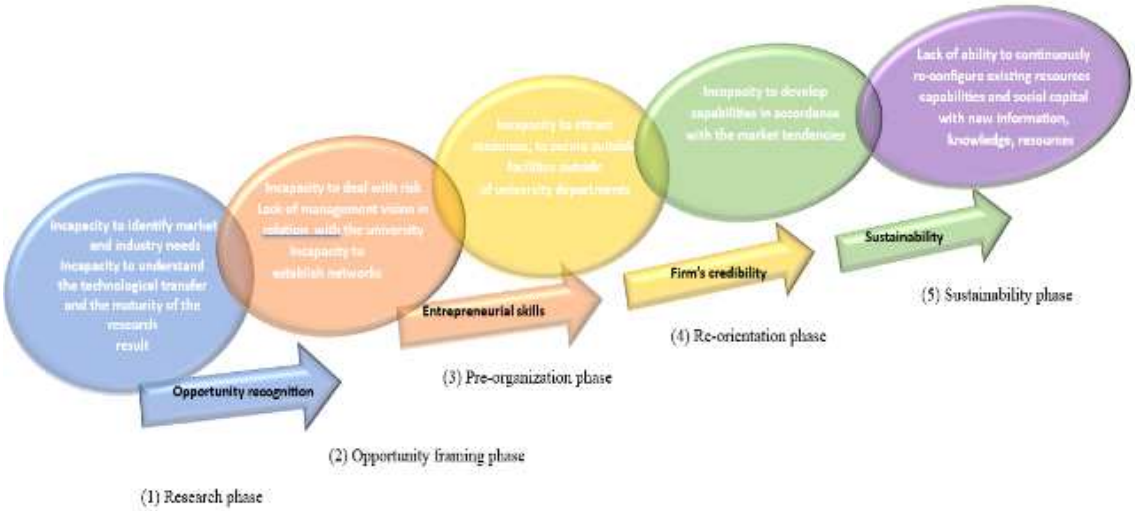

Fig. 1. Factors initiating critical junctures (adapted after [5])

For the venture to pass from the research phase to the opportunity phase, it must pass the critical point, namely the recognition of the opportunities. Entrepreneurs need to have the ability to: identify markets and industry needs; understand the technological transfer and the maturity of the research result.

When entering the third stage of development the spin-off must overcome a critical juncture, namely entrepreneurial skills and the entrepreneurs need to have the following capabilities: capacity to deal with risk; management vision about the university; capacity to establish networks.

In the stage four re-orientation phase, the spin-off must overcome a critical juncture, namely the firm's credibility. Due to this, entrepreneurs need to attract resources, to secure suitable facilities outside of university departments.

When entering stage five, the sustainability phase, passing the critical juncture of sustainability, the firm needs to prove the capacity to develop capabilities per the market tendencies. For the academic spin-off to remain in the sustainability phase, entrepreneurs need to have the ability to continuously adapt their own resources, capabilities, and financing resources with new market tendencies.

3. RESEARCH METHODOLOGY

The purpose of this paper is to find new initial factors that impact the long-term survival rate of academic spin-offs, following the five stages of development after Vohora's model [5] on a sample of 9 spin-offs taking into consideration a survival rate of more than 11 years, even though other researchers took into consideration as firms' survival, a period of more than 7 years [10, 26]. Only Aspelund [18] who studied 80 Norwegian and Swedish technology-based start-ups found that the ventures survive in average 3.8 years.

To identify the factors that can influence the survival rate of academic spin-offs qualitative methods were used involving interviews and realization of case studies/presentations. Official lists of European funding have been identified of beneficiaries, published (www.poc.research.gov.ro) in the period 2007 to 2023, covering 141 spin-offs. Given that most spin-offs went bankrupt, we have retained into analysis only those ventures with sustainable and profitable survival rates and the some that went bankrupt. To evaluate the financial situation of the academic spin-offs up to 2023, we used public data from www.m.finante.ro. By accessing the database from www.listafirme.ro we obtain data regarding the administrator and the structure of the stakeholder.

As seen in Figure 2 out of 141 spin-offs, 80 companies survived between 8-11 years. In our research, we observed that there is no database regarding the number of spin-offs at a national level. Since November 2022 out of 141 academic spin-offs, 20 spin-offs have a longevity of more than 11 years, the target population remained 13 spin-offs that had contact information. Of these, only 9 spin-offs answered all the questions from the interview. The interview, which took place between October 2020 and May 2023, was chosen as the method of collecting information because it offers the possibility of studying some successful cases of spin-offs in the Romanian context.

In the literature, several authors have used interviews such as [9], who states that this type of interview is much more productive in terms of the information collected. Through the interview, an attempt was made to find out what is the role of management in increasing the survival rate of the company; what is the role of external resource providers in supporting the company; what is the role of research centers in supporting these companies; and, if the technology transfer was successful. Throughout the interview, the interviewees were allowed to speak freely about their involvement in the creation/development of the innovative company with minimal interruptions (to guide the interviewees towards the issues we wanted to address).

This type of narrative approach was chosen to allow closer observation of the events that took place over time, given that the firms were established in the period 2006-2012, and to avoid the personal and theoretical views of the researcher influencing data collection.

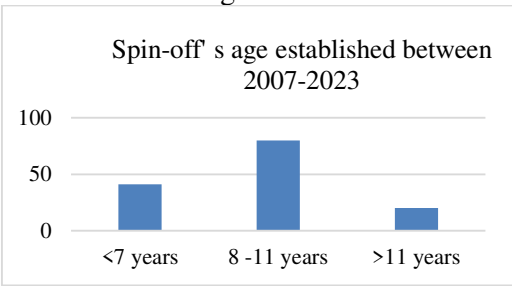

Fig. 2. The survival rate of spin-offs financed by the POSCCE and POC in the period 2007-2023

During the research, a large volume of data/information is obtained that must be processed. According to the conclusions mentioned by [9], this type of narrative approach can lead to - death by data asphyxiation, which is why data must be processed at many levels.

Following specialized literature, Table 1 presents the structure with the stages that must be completed for data collection.

Table 1

Summary of the main steps in data collection

Steps in data collection	Information sources, data analysis
Analysis of the national context in terms of technological transfer within research and development units	- At the national level, participating in conferences; - Meetings with teaching staff, and researchers; - Visits to universities, research institutions, and business incubators.
Selection of case studies	- Identification of projects financed through the POS CCE and POC program.
Initial investigation of the case	- Consulting web pages, linkedin, Twitter, and Facebook; - Informal conversations with people from research and development units.
Data collection	- Obtaining support from the respondents via e-mail; - Consulting websites, and mass media releases; - Obtaining the description of the submitted project; - Visiting organizations.
Data transcription	- Transcribing interviews (most recorded), focusing on revealing the spin-off development process.
Interview construction	- Semi-structured with two parts.
Recording the main events that took place during the interview	- Recording the main events that took place recording the narratives of the spin-of-formation process.
Correlation with theoretical concepts	- Using empirical data in the analysis phenomena.

To analyze the initial factors influencing the Romanian academic spin-offs a semi-structured

interview was developed, and the interview guide for this type of interview includes two parts:

- One with general, predefined questions regarding information about the founder of the company and the field of technology, the source of the business idea, and the type of research result that was the basis of the establishment of the company;
- Another with some basic questions regarding information about the company's management and unstructured questions that give the autonomy for the interviewer to explore the topic in depth, as he considers more appropriate, depending on the interviewee's answer.

The questions in the first part of the interview focus on the field of technology; the source of the business idea; the status of the founders; the type of research result, which was the basis of the establishment of the company; the experience of the management team; the existence of management strategies; initial resources for the opportunity recognition phase; the number of employees coming from the research environment; additional funding sources.

The processed data consisted of tracking the identification of key points that impact the stages of the life cycle of the atypical ventures [5], such as technological transfer and business start-up, human resources, the relationship with the academic environment, and the relationship with the business environment.

The criteria for the selection of the 9 spin-offs were:

- More than 11 years of survival;
- Organizations from different industries.

The innovative spin-off companies that participated in the interviews are activating in the following fields:

- ASP1 (Bucharest Ilfov Region) is engaged in electronics.

- ASP2 (West Region) is engaged in general mechanical operations;

- ASP3 (Bucharest Ilfov Region) and ASP8 (West Region) are engaged in research and development in other natural sciences and engineering;

- ASP4 (South West Region) is specialized medical assistance;

- ASP5 company (Bucharest Ilfov Region) is engaged in renewable energies;

- ASP6 (Bucharest Ilfov Region), ASP7 (Nort-West Region), and ASP9 (South Region) are engaged in information technology service activities.

4. RESULTS

Following the 5 stages of [5], we tested new factors from the literature that could influence the spin-off survival as the degree of heterogeneity of founders/ team, the maturity of the research result, networking, material resources at your disposal in the incubation stage and shareholders of public research institutes and firms as seen in Table 2.

Table 2 presents the main characteristics of nine successful academic spin-offs in the research phase and opportunity framing phase, taking into consideration the new factors from the literature.

It is noticed that successful academic spin-offs had as shareholders other firms, with financial capacity to sustain the venture.

Of all the companies studied, over 70% of them were based on a patent, because they were in the advanced phase of designing the product/service/technology (TRL5 and TRL 6, respectively).

Another observation refers to the fact that all successful companies have a management team with technical and entrepreneurial skills.

From the described data (Table 2) it can be observed that in seven cases out of nine, the research unit got involved with resources in supporting the spin-off, except for the ASP5 and ASP6.

To understand the initial factor’s influence on the long-term survival rate, we chose to present a successful academic spin-off (ASP7) following the five stages of development described by Vohora [5], because out of the nine investigated the ASP7 maintained constant the number of employees (also in the pandemics) and the turnover.

The ASP7 spin-off, established in 2010 in the Nort-West Region (Oradea), has as the main

activity: custom software development activities (customer-oriented software).
The firm is experiencing growth in terms of turnover and number of employees, while still managing to be profitable year after year and in the period 2019-2022 the turnover increased constantly.

Table 3 presents the main factors of influence but follows the five stages of development defined by [5].

Following the life cycle of the company ASP7, we can see that in the sustainability phase (starting with 2014) the company provided computer systems design and related services industry.

It can be observed from the table above that in the first stages (research phase and opportunity framing), the company had 5 employees and in the other third stages, the number of employees increased to 15. Also, the heterogeneity of the team (an entrepreneur researcher and an entrepreneur) in the two stages of development influenced the survival rate of the spin-off for more than 11 years.

In the sustainability phase during 2014-2022, the company offered personalized IT applications according to the needs of the customer.

Analyzing the data in Tables 2 and 3 we find that the main factors influencing the survival rate of spin-offs are the degree of heterogeneity of founders/ team, networking, and material resources at your disposal in the incubation stage.

Table 2

The main characteristics of the 9 spin-offs in the research phase and opportunity framing phase

Firm / Variables	ASP1	ASP2	ASP3	ASP4	ASP 5	ASP6	ASP7	ASP8	ASP9
Location	**Bucharest**	**West**	**Bucharest**	**South-West**	**Bucharest**	**Bucharest**	**North-West**	**West**	**South**
Foundation year	**2008**	**2010**	**2007**	**2010**	**2009**	**2009**	**2010**	**2010**	**2006**
No of employees 2022	**16**	**11**	**3**	**1**	**3**	**1**	**15**	**7**	**21**
The field of technology	electrical and electronic engineering	general mechanical operations	zeolitic materials for agriculture	medical	renewable energy	information technology service activities	customer-oriented software	analysis of soil, chemical fertilizers, analysis of water	developing trading platforms, applications for mobile and websites
The source of the business idea	the inventor wanted to capitalize on the result of his work	a researcher from a public institute saw the potential of the product	the manager had entrepreneurial experience	the inventor wanted to bring a new technology to market	the researcher (university teacher) saw the potential of the product	an economist saw the potential of the PhD thesis.	The entrepreneur had two firms.	the research center in Hungary came up with the idea	an innovation patent
Degree of heterogeneity of founders/ team	seven professors , four SMEs, and an NGO	entrepreneur and researche	entrepreneur with managerial experience and technical skills and two	a researcher, professor, without managerial experience	professor and economist	an entreprene ur professor and an economist	entrepreneur, researcher, and economist	a researcher, a research institute from Hungary	a teacher, a firm from Denmark with 5 entrepreneur s
The maturity of the research result	invention patent TRL 6	invention patent TRL 4	Public Research Grant results TRL 6	Public Researc h Grant results TRL 6	invention patent TRL 4	PhD thesis result TRL 4	Innovation patent TRL 5	Innovation patent TR 5	Innovation patent TRL 5
The entrepreneurial experience of the team	2 years	12 years	10 years	2 years	14 years	2 years	15 years	3 years	10 years

Networking, and material resources in the incubation stage	research institute offered access to resources	a university offered access to resources	the company accesses research projects together with the research institute	the university offered access to resources and free internal space	no	no	the research institute offered access to resources and free internal space and financial support	the research institute from Hungary offered access to the equipment's	the university offered access to the social network the firm from Denmark offered financial support
Shareholders of public research institutes and firms	no	no	12% - firm	15% - firm	45% - firm	no	no	45% - private research institute 25% -firm 30%- researcher	45% - firm

Table 3

ASP7 spin-off development stages

Phase / Resources	Research phase (2010)	The opportunity framing (2011)	The phase of preorganization (2012-2013)	Reorientation phase (2014)	Sustainability phase (2014-2022)
The technological transfer	custom software development activities	4 innovative solutions: (Monitoring and control solutions, Heat pump monitoring equipment, Payment system for parking)	building the model through collaboration with the industry	the services offered were scaled	IT application according to the needs of the customer
Human resource	founding members: one scientist with technical and entrepreneurial skills	the management team consists of an entrepreneur researcher and an economist	11-14 employees	14 employees	14-16 employees
University context	a research institute gave the scientific result from a European project to an entrepreneurial scientist	5 employees and 3 are from the research institute	3 scientists as employees	4 scientists as employees	4-5 scientists as employees
Industry ties	The public research institute offered free space for the firm	The public research institute gave access to social networking	The public research institute promotes the company	-	-

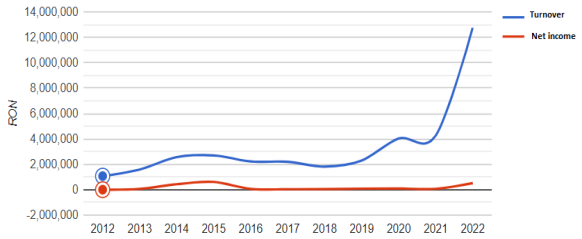

Fig. 3. The evolution of the economic performance in the period 2012-2023

5. CONCLUSION

An adequate source of financing is crucial in the first stage of business. Therefore, [36] outlined that managers with previous experience in management can gather more funds in contrast with those without experience. Our findings mostly address another key aspect of this survival puzzle- the implications of a heterogenous team and the social and financial support of the research institution. The paper's findings provide practical and policy implications for the university and research institute management departments in establishing new strategies for preparing multidisciplinary teams for the development of academic spin-offs.

Also, research units and universities should get involved as shareholders in the academic

spin-offs to strategically integrate the spin-off into the academic environment.

Another important limitation was imposed by the fact that the reconstruction of the events that took place in the company's development process is subjective (large time interval from the establishment of the company to the moment of the interview). Further studies should focus on analyzing the economic performance of academic spin-offs financed in the period 2007-2013 and those financed in the period 2014-2023.

The findings of the qualitative study offer clarification and bring a new vision of the spin-off life phases to the management of public organizations, universities, and government units.

In the future research and initiatives, a special attention will be paid to the digitalization of the entrepreneurial processes [37-39].

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Influența factorilor inițiali asupra ratei de supraviețuire pe termen lung a spin-off-urilor academice din România

În economiile emergente precum Croația, Cehia, România, Bulgaria, spin-off-urile academice au o evoluție lentă. Acestea sunt firme noi create de persoane fizice afiliate unor institute de cercetare sau universități cu scopul de a exploata rezultatele cercetării științifice. Această lucrare îmbunătățește mecanismul de evaluare a principalilor factori inițiali care influențează dezvoltarea spin-off-urilor academice în contextul românesc după modelul prezentat de Vohora. Dintr-o perspectivă bazată pe resurse, sunt subliniați factorii inițiali care influențează afacerea urmărind cele cinci etape de dezvoltare: cercetare, faza de încadrare a oportunităților, faza de pre-organizare, faza de reorientare și faza de sustenabilitate. Folosind o metodă de cercetare calitativă, lucrarea evidențiază cei doi factori cheie importanți în etapele de dezvoltare: eterogenitatea echipei și resursele universității. Implicarea universității cu resurse începând din faza de inițiere influențează pozitiv dezvoltarea spin-off-ului academic mai ales în faza de reorientare.

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