

THE ROLE OF UNIVERSITY SPIN-OFFS NETWORK CHOICES IN THE QUALITY OF TECHNOLOGICAL TRANSFER AND CAPITALIZATION OF ACADEMIC RESEARCH

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Abstract:

The research carried out in this article (a synthesis of specialized literature regarding the networks used by academic spin-offs in order to achieve an effective technology transfer) refers to the interaction of academic entrepreneurs with different internal (university) and external (commercial) networks. The research aims to identify in which way the characteristics of both internal and external networks can contribute to the growth and performances of these companies. The main conclusion seems to be the approach pro access to networks outside the university for an increased visibility of university-developed technology and facilitates access to other networks and sustainable technological transfer. Furthermore the visibility of academic research will improve access to other relevant networks, involving at the same time other outputs for university spin-offs such as: reducing parent university dependency, obtaining funding from other sources, increasing market adaptability and agility.

Key words: university spin-offs, academic entrepreneur, technological transfer office, networks, parent university

JEL classification: O32

1. INTRODUCTION

The third mission of the university refers to an additional function of the universities in the context of knowledge society which is next to education and research, entrepreneurship and economic development. The transition to entrepreneurial university is made by engaging in various interactions with the industry in order to transfer the technology developed in universities towards market. Technological transfer is represented by direct research contracts with the industrial environment, transfer of innovative products and services, one of the ways being academic spin-offs and start-ups (Ufuk and Kunday, 2015).

Even if universities are conducive environments for the creation of high-tech ventures, they are generally unsuitable for developing new companies due to potential conflicts of interest in their traditional research and teaching roles. Academic spin-offs (based on intellectual property or knowledge and skills) are considered to be a specific form of academic entrepreneurship. They are essentially a vital part of technology transfer, one of the extremely important tasks of academia nowadays. (Meek and Wood, 2016; Etzkowitz, 2017).

Spin-offs are special cases of entrepreneurship due to the fact that they are usually initiated in a scientific environment, while business opportunities arise in a business environment (Scholten et al., 2015). The university's perspective regarding the creation of spin-off companies with which it can transfer the technology developed through its own research has two main arguments. The first argument regards the direct economic impact triggered by new technological ventures (spin-offs) and can be mentioned as an argument of economic growth. From this perspective, spin-offs are practical examples that investing public money in universities can generate direct economic benefits such as new business activities at the national and regional level. Thus universities help create new

jobs, tax revenue, and technology ventures that can compete at international level. The second argument is that these companies can act as technology transfer mechanisms that transform new scientific knowledge into products and services applicable in society. Spin-offs creation can be seen as a method to improve the dissemination of the results obtained through university research (Rasmussen and Wright, 2015).

In the context of a successful technological transfer at the university level, knowing the industry, market requirements, having specific knowledge of marketing research results, as well as links with networks outside the university are equally important aspects. Many studies refer to the fact that academics have a specific training that brings them closer to research and technology and less close to the market, which prevents them from seeing aspects that would serve an effective commercialization of technology. Many time they work on the development of technologies that do not have a correlative in the needs of the market, which sometimes makes the research work almost pointless. In order to avoid this from happening, it is very important for academic researchers to be supported on the one hand by the incubation structures within the parent university, and on the other hand to connect to external non-university networks that allow them access to knowledge and valuable opportunities on the market. In this way, the valorization of research can be done efficiently and taking into account a series of vital aspects for a good performance on the market.

2. METHODOLOGICAL APPROACH

The present article is the result of a theoretical approach on specialized literature in the field of spin-offs access to internal (university) and external networks whose consultation you can find in the mentioned bibliographic sources. The synthesis is based on a number of 16 articles from which 11 strictly address the issues faced by university spin-offs regarding the support received from the parent university and access to both internal and especially external networks. The target groups investigated in the research articles are shown in table no. 1.

Table no. 1. The situation of target groups investigated in the research articles

Main topic	No of articles	Cumulative target group for the topic	Localization	Interval of article publication years
The interaction of academic entrepreneurs with different internal (university) and external (commercial) networks	11	470 – academic spin-offs 30 – CEO spin-offs 1 – technological transfer offices 82 – academic entrepreneurs 45 – academic researchers	Netherlands, Belgium, Ireland, UK, USA, Italy, France, Spain	2006 - 2022

3. THE INTERACTION OF ACADEMIC ENTREPRENEURS WITH DIFFERENT INTERNAL (UNIVERSITY) AND EXTERNAL (COMMERCIAL) NETWORKS

University spin-off companies develop their technology in the academic environment, but their aim is to transfer it to the economic environment in order to effectively capitalize the true potential of the invention for sustainable growth in the field. University spin-offs and their entrepreneurs face different influences depending on the environment they come in contact with. In this sense, the internal environment is represented by the academic context, the supporting infrastructure, know-how and the networks developed by it, while the external environment is represented by the main market stakeholders in the industrial field targeted by the technology developed by the spin-off (independent entrepreneurs, major investors, external environmental networks) as it is shown in figure no. 1.

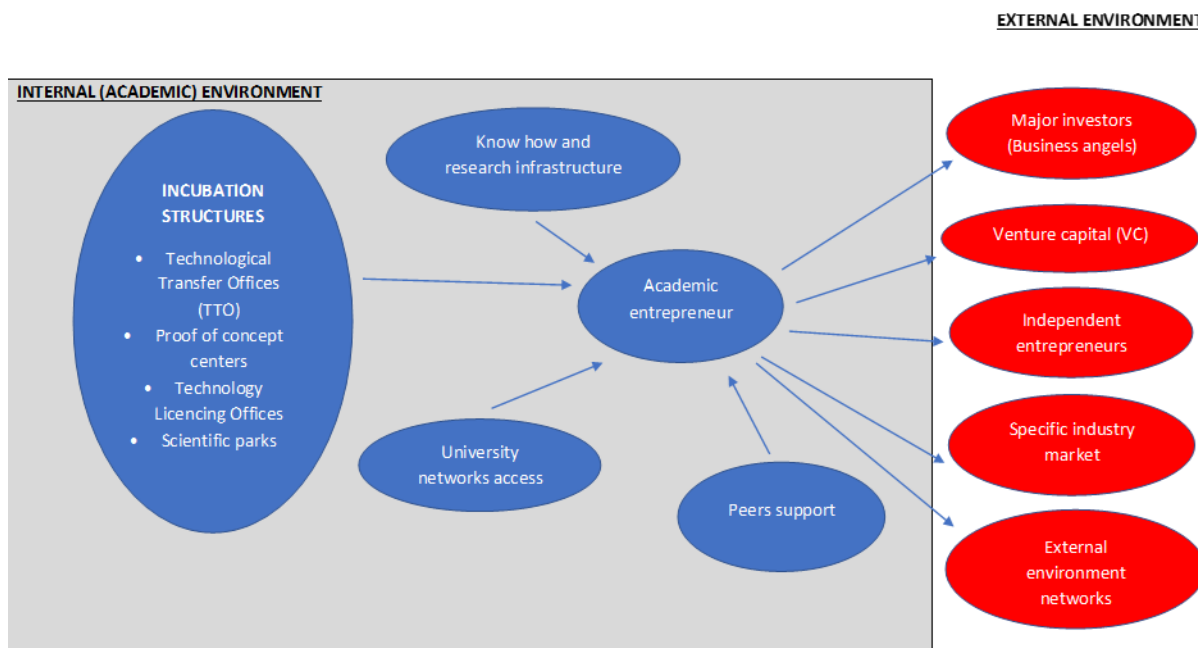


Figure no. 1. The internal and external environment of academic entrepreneurs

The advantages and disadvantages of the interaction with the two types of environment and of the networks associated are synthesized (Scholten et al., 2015; Vanacker et al., 2014, Hayter, 2015; Sanjay et al., 2009; Baroncelli and Landoni, 2019) in table no. 2.

Table no. 2. The advantages and disadvantages of networks used by university spin-off companies

ADVANTAGES AND DISADVANTAGES ON TYPES OF NETWORKS ACCESSED BY UNIVERSITY SPIN-OFF COMPANIES		
	Internal network (academic environment and parent university network)	External network The market (big investors, business, angels, research clusters, customers)
Advantages	<ul style="list-style-type: none"> • Support in the business creation and incubation process (TTO, CTT) • Technological support given the fact that the research result was developed within the university • Financial support provided through access to the university's research and development funds (own or attracted) • The trust and stability provided by the university context and the networks verified and developed by it • The opportunity to collaborate with other academic entrepreneurs and access funds through joint research projects, but also to obtain support for technology development, prototyping, product design, testing and market potential of products 	<ul style="list-style-type: none"> • Access to new information of great value, to knowledge other than related to technology • Access to business mentality and identification of new business ideas • Access to market requirements and the ability to adapt technology accordingly • Marketing know-how • Recognizing the value of the business opportunity • Willingness to assume the risks triggered by investing in new research results based on previous experience and a good knowledge of the market • Increasing the degree of visibility and the opportunities provided by the new technology (through the relationship between these networks and other networks) • Access to new industries, new markets (use of technology in various fields)

Disadvantages	<ul style="list-style-type: none"> • Informational redundancy (access to information of the same kind as an effect of the narrow academic circle of the university environment) • Attempting to commercialize scientific results that do not have the necessary technological maturity due to ignorance of market requirements • A certain rigidity in terms of protecting the invention, the desire to achieve the technological transfer using as little as possible external resources (only in-house activities) • The prevalence of the approach with a strong academic output (peer recognition - recognition of the merits and value of the invention) at the expense of a commercial one (making a profit) • The constraints imposed by the university environment through culture, norms, specific procedures • The fear of risk manifested at the level of the university management against the background of the development of innovative technologies whose applicability, however, they are not familiar with • Given the fact that they rely heavily on the support provided by the parent university, academic spin-off companies have a lower ability to adapt to the market (lower agility) 	<ul style="list-style-type: none"> • The large amount of available information and the need to systematize, prioritize this information, to extract only the information that can be helpful in the context of the commercialization of new technologies • External entrepreneurs who have solid market knowledge and who could invest in the research output, are not familiar with the technology and the benefits it can bring (need the researcher's involvement) • Ownership of the invention, and therefore control over how it is used, can be lost through assignment to new companies
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In the process of creating and developing university spin-offs, the orientation towards the external environment, especially towards the market requirements, is essential. In this sense, a good entrepreneurial start and the identification of potential commercial barriers represent important conditions that must be treated with mindfulness. In terms of overcoming barriers to commercialization, academic entrepreneurs approach this aspect taking into account (O'Gorman et al., 2006): the commercial value of new knowledge when knowledge related to the market is included in the context of their research and/or when they develop external contacts with that market knowledge; scientists' deliberate efforts to obtain market information materialize in learning (deepening) market knowledge and new market skills for scientists.

The ways in which universities could increase their capacity to create successful spin-offs/start-ups are (Elco van Burg et al., 2008): creating university awareness of entrepreneurial opportunities, stimulating the development of entrepreneurial ideas and then filtering entrepreneurs and ideas into programs targeting students and academic personnel; supporting start-up teams, both in the process of building and in learning the right combination of skills and knowledge by providing access to advice, training and coaching; help start-up teams gain access to resources and develop social capital by creating collaborative networks of organizations and investors, managers and advisors; establishing clear rules and procedures to regulate the spin-off creation process, improve the treatment of the parties involved and separate the spin-off creation process from university teaching and research.

Another very important aspect throughout the life cycle of a university spin-off concerns the influence of the two types of networks on each spin-off development stage. Thus, the following issues need to be addressed: 1. the involvement of the university in the activity of creating university spin-offs, 2. the predominant contacts that university spin-offs have during the development phases, as well as 3. the structure that the network must have according to the experience of academic entrepreneurs in running university spin-offs. The involvement of the university in the activity of creating university spin-offs takes place through the business incubation and support structures at the university level (Hayter, 2015; Elco van Burg et al., 2008), as well as through human resources (valuable academic know-how) (table no. 3).

Table no. 3. University involvement in technological transfer activity through academic spin-offs

THE INFRASTRUCTURE PREPARING PHASE FOR THE CREATION OF SPIN-OFFS	Technological transfer offices Technological transfer centers Proof of concept center Technology Licensing Offices
SUBSEQUENT PHASE OF SUPPORT FOR SPIN-OFFS	Incubation support provided by Technology Transfer Offices, Technology Transfer Centers, Proof of Concept Centers, Technology Licensing Offices Access to science and technology parks Access to university networks Support from university researchers who are involved in entrepreneurial activities and have the business mentality necessary to support technology transfer under market conditions Attracting independent/surrogate entrepreneurs to support academic spin-offs

The predominant contacts that university spin-offs have during the development phases are human resources (academic researchers and graduates) according to Aerts, 2022 and Hayter, 2015 and can be presented as a matrix in which they stand out according to the targeted goal and the development phase (table no. 4).

Table no. 4. Matrix of university spin-offs contacts through the development phases

	Spin-offs development phase name	Pursued targets	Predominant contacts of spin-offs according to development phase (in order of importance)
PHASE I	PRELIMINARY TO THE SPIN-OFFS CREATION	ENTREPRENEURIAL COMMITMENT	Academic researchers of the parent university Graduates TTO
<i>PHASE I.1</i>	<i>brainstorming and research output</i>		
<i>PHASE I.2</i>	<i>ideas are transformed into a specific project</i>		
PHASE II	SPIN-OFFS CREATION	CREDIBILITY	Academic researchers of the parent university Full-time managers Researchers' companies Investors Graduates
PHASE III	VENTURE DEVELOPMENT	SUSTAINABILITY	Academic researchers of the parent university Graduates Consulting firms TTO Researchers' companies Investors

In order to survive in the market and be successful university spin-offs must be able to convince different stakeholders of their legitimacy. Therefore, they must obtain legitimacy (credibility) from as many stakeholders as possible, both internal (the research center, business incubators, the university's governance system) and external (clients, investors, business angels). The more diverse the interests of these groups, the more complex the search for credibility becomes (Francois and Philippart, 2017). As the academic spin-off develops, it is observed that it is necessary to achieve sustainability. This is achieved most of the cases by accessing the university's external networks, increasing the visibility of technology and gradually reducing the dependency on university support. The structure that the network must have depends also on the experience of academic entrepreneurs according to Mosey and Wright, 2007 and is presented in table no. 5.

Table no. 5. Network structure depending on the experience of entrepreneurs

NASCENT ENTREPRENEURS	More experienced academic colleagues Firms dealing with intellectual property rights (IP) and legal issues	These entrepreneurs sought advice from the TTO but concluded that the value of the advice they received was not up to the advice obtained from other stakeholders. This aspect is also generated by the fact that TTO has little commercial experience. TTO also believes that academic scientists should not be directly involved in the commercialization of research results.
NOVICE ENTREPRENEURS	TTO IP companies SMEs and large enterprises	They give credit above all to the assistance received from the TTO They are open to proof of concept funding from universities and government grants They are open to the help offered (proof of concept knowledge, other facilities) by large enterprises Identifying potential customers
HABITUAL ENTREPRENEURS	SMEs and large enterprises Business angels and VCs Colleagues from academia	The most valuable relationship was considered the one with suppliers of industrial knowledge, developers of business and technical knowledge

The success of a spin-off can be influenced by a multitude of factors, both positive and negative, and the way in which entrepreneurs pay attention to these factors can represent the effort to achieve a successful technological transfer or the failure in the commercialization of a state-of-the-art technology. By capitalizing social networks an entrepreneurial team can adjust its capabilities which will improve its ability to access different types of external sources of capital (Huynh, 2016). Among the factors that have been shown to positively influence the success of a spin-off can be mentioned (Hayter, 2015): the non-academic contacts outside the region that the spin-off develops, VC support received is directly proportional to the type of network used (spin-offs using non-academic networks have higher chances of obtaining VC), the extra-regional networks to which the spin-offs have access, the ability of the academic entrepreneur to go beyond the traditional academic networks to which he is connected through the parent university and to access non-academic networks and contacts (investors, industry researchers, consulting firms that are sometimes located outside the region where the spin-off is located). On the other hand, among the factors that have been shown to negatively influence the success of a spin-off the one with significant input are: strong academic contacts and orientation mainly towards them to the detriment of non-academic ones, the constraints that universities exert on spin-offs in terms of focusing mainly on the academic environment and little attention given to industry, which makes it very difficult to access other relevant resources outside of academic ones (spin-off success may be attenuated by the strength and relatively closed nature of traditional academic research networks, a phenomenon known by sociologists as homophily), the fact of being connected exclusively or mainly to academic networks to the detriment of non-academic ones means that the degree of distribution of knowledge is also reduced, which causes regional economic development to suffer (this is how the position of the State of New York in the ranking regarding innovation and jobs created in the field of high tech).

4. CONCLUSIONS

The support received from the parent university (incubation structures, research infrastructure, academic networks) in the first stages of development is vital in the early stages of university spin-offs. The success of these companies is also dependent on the type, location and size of the support network used. While university networks give access to knowledge that are often redundant, extra-regional networks of non-academic contacts allow university spin-offs to access a

wider range of knowledge and other important resources for their success thus contributing to regional economic development.

Access to networks outside the university increases the visibility of university-developed technology and facilitates access to other networks and sustainable relationships outside the university. In this way occur phenomena such as: gaining financial independence through access to funds from other sources thus reducing dependency on the parent university and its support structures, as well as increasing adaptability on the market and agility as a result of conscious adjustment to challenges and market opportunities. Thus, the technological transfer of the research results can be effectively carried out at an optimal level of performance and addressability and the true potential of university-developed technology can be better capitalized.

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