University Fourth Mission. Spin-offs and Academic Entrepreneurship: a theoretical review through the variety of definitions

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Structured Abstract

Purpose of this paper: Universities are now considered to be vital players in the process of the transferring of knowledge, innovation and technology from the academic to the commercial/productive sector. If in the past universities covered this role by granting patents to outsiders, the situation has deeply changed. Today academic institutions are also dedicated to the creation and promotion of spin-offs and start-ups, as a response to the social pressures on accountability and dialogue with economic world through the sharing of scientific research results. This paper analyzes the existing definitions of University Spin-offs (USOs) in order to systematize them and to identify the possible criteria for classifying the different aspects of this multi-headed concept.

Plan/methodology/approach: The research will present a review of existing national and international literature on the subject in order to outline the theoretical framework within which the whole survey will then be placed, using a qualitative methodology.

Findings: The different definitions of USOs, which are not explicitly clarified by the authors, cover a big variety of phenomena and this is a problem for the comparability of the different researches.

What is original/value of paper: Define a typology of the different USOs.

Keywords: Fourth Mission, Spin-offs, Academic Entrepreneurship, Definitions.

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Universities are now considered vital players in the process of the transfer of knowledge, innovation and technology from the academic to the commercial/productive sector. If in the past universities covered this role by granting patents to outsiders, the situation has deeply changed. Today academic institutions are also dedicated to the creation and promotion of spin-offs and start-ups, as instruments for responding to the social pressure on accountability and dialogue with economy through the sharing of scientific research results (Geiger 2006; Laredo 2007). This paper analyzes the existing definitions of USOs in order to systematize them and to identify criteria for classifying the different aspects of this multi-headed concept.

A preliminary issue is the difference between the terms “spin-offs” and “start-ups” and the reason why only spin-offs is used in this paper. In particular, the label “start-up” can be applied to any new form of innovative company in its embryonic stage. Once the project has launched and has separated itself from the university, it has become its own entity, therefore it can be describe as “university research spin-off”. To be a spin-off could be considered as a genetic condition which continues throughout the life on the business market and that could be mitigated if the spin-off becomes bigger than the original institution.

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Consequently, in this paper, the term “spin-off” has been adopted to describe a new form of entrepreneurship that results from a previous phase of academic research and that is now separated from the original institution and has become an independent entity on the business world, as an instrument of exploitation of academic research. The paper wants to investigate in order to shed light on theories regarding the processes and methods applicable to how this phenomenon continues to spread, whose boundaries of interaction with other fields and disciplinary areas appear to be progressively dilated (Lazzeri and Piccaluga 2012).

The analysis of academic spin-offs needs a preliminary summary, in order to discipline the numerous and different definitions of academic spin-offs that, in fact, are progressively developed by researchers in the various studies on the subject. From the analysis of literature, emerges a substantial absence of a clear notion of the argument and this phenomenon, which eventually lead to the use of the same term to describe totally different phenomena in terms of nature and peculiarities. If, for example, considering the number of companies created by MIT (Massachusetts Institute of Technology) in Boston in a thirty-year period, Roberts and Malone (1996) argue that the annual rate of business creation is equal to 6.4. At the same time, Bray and Lee (2000) estimate this rate around 25 spin-offs of the year; Carayannis et al. (1998) and Steffensen et al. (2000), however, through analysis of data contained in a research conducted by the Bank of Boston, they say that this rate is equal to 140 companies a year. The cause of this lack of homogeneity of the estimates is definitely placed in the lack of a clear, unambiguous and shared definition of the USOs.

Such a plurality of definitions «does not involve only theoretical problems, but especially practical since it determines a strong difficulties in the quantification of the phenomenon and in the comparison of the same in terms of time and space, so that often you have as a consequence a considerable shortcomings from the point of view of supporting policies which should intervene both at the planning stage and in the implementative one» (Grossi and Ruggiero 2008, 58). The definition provided by Steffensen, Rogers and Speakman (2000, 97) allows to demonstrate how simple it is to create confusion, «a spin-off is a new company that is formed by individuals who were former employees of a parent organization, and a core technology that is transferred from the parent organization».

Some authors adopt an expanded definition of the phenomenon, generally including all enterprises established by a person who studied or worked within the university (Roberts 1991), not allowing in this way to be able to develop in-depth and operational analysis of the phenomenon. A narrow definition, however, considers the academic spin-off companies as born from the exploitation of a codified knowledge from the university (i.e. the use of a patent or intellectual property), but so it will exclude all those initiatives that are based on unpatented knowledge (Piccarozzi et al. 2013).

One of the first definitions of academic spin-offs, also called university spin-offs (USOs), is due to McQueen and Wallmark that identify three distinctive elements of the phenomenon: «[...] in order to order to be classified as a university spin-off, must be checked three criteria: (1) the founder or founders must come from a university (faculty, staff, students); (2) the company’s activities must be based on technical ideas generated in the university; and (3) the transfer from universities to industry must be directly and not through an intermediary» (McQueen and Wallmark 1982, 307).
The definition introduced by Klofsten and Jones-Evans (2002) emphasizes how the academic spin-offs can be identified through four aspects described as follows: a new business (autonomous entity from the university, with its own legal identity); created by the university (thus excluding all other entities or research institutions); for use of the results deriving from academic (not only all the patentable results, but also all those technical and scientific knowledge acquired during the academic activity); the purpose of which is to obtain a gain (for then exclude all non-profit activities).

University Spin-offs: a Typology

In Italy, the spin-off of the research have appeared in the first half of the 80’s, when in other contexts – such as the US – the phenomenon appeared to be already widely spread, having found early forms of application since the early years of ’900. Italy, moreover, has always been characterized by a smaller number of spin-off companies, when compared to other European countries – such as, for example, France, Germany and Britain. There are those who explains this aspect with the fact that it has tended to focus on quality rather than quantity, aiming thereby to create realities that had a real growth potential (Cesaroni and Piccaluga 2003; Rostan and Vaira 2010).

At the same time, however, this can also be linked to the traditional university idea, which generates a widespread mistrust on the part of academics to do all that is economic finalization of the research (Boffo and Moscati 2015). In Italy, that of the exploitation of research is therefore a recent phenomenon, especially if it is considered that the Italian universities have started to deal with the technology transfer only at the end of the past century, by means of appropriate structures (Algieri et al., 2011; Chiesa and Piccaluga 2000; Piccarozzi et al. 2013) and that remains in many academics the cited inclination to avoid any commingling between research and economic sphere.

The overall picture of the Italian academic spin-offs is well defined by Chiesa and Piccaluga (2000): in Italy, according to the authors, it has been a very dynamic environment albeit often characterized by small realities dedicated to consultancy and research and development, with a limited number of employees and a rather small initial capital. Moreover, it is important to note that «the phenomenon in question is very grew from what may be considered his date of birth in Italy, and that is the end of the 80’s, although some companies have also been established in previous periods, representing the made of the spin-offs before its time. In general, the importance of spin-off companies has progressively increased with the emergence of so-called “knowledge economy”, characterized by a competitive process based on the opportunity and the need to continuously introduce new products and services with a high technological content» (Lazzeri and Piccaluga 2012, 43-44).

In particular, just the variety of needs related to financing is a first criterion in relation to which it is possible to classify the academic spin-offs in three different categories (Salvador 2006). In the first, there are companies operating in consulting, design and applied research: in this case, to the small initial investment corresponds a wealth of knowledge and skills acquired directly from the university of origin, which it is necessary to implement a reduced number of instrumental resources. The spin-offs of this type therefore tend to consolidate itself as a consulting firm, thus avoiding switching to the material production phase – if not for the realization of software – and opting for the creation of partnerships with similar companies or industrial groups to whom the production and marketing processes are assigned. The second category
includes enterprises that require higher funding: the founder searches for a lender that is already well established on the market and that has a big liquidity, so as to become the promoter of the project’s promoter and to check materially the spin-off on the market. In the third and final category of spin-offs, there are firms established with public fundings.

The mortality rate of the three types of spin-off companies appears to be rather small in Italy and the geographical location denotes a greater presence of these initiatives in the North, with a notable spike that is registered in the universities of Tuscany. As for the areas of activity, most of the companies has been activated in the field of Information and Communication Technologies (ICTs), a sector that is characterized by the need of reducing investments in the process of entry into the market and which in the past included about half of the spin-off companies, «many of these initiatives that provide consultancy services on a local and regional basis have gradually improved the level of specialization and scientific-technological content. In recent years, however, the weight of ICT companies has gradually decreased, while have increased companies involved in the sector of life sciences, companies operating in sectors characterized by high initial investments in R&D, and that often include industrial and financial partners whose model business is characterized by ambitious growth plans; cases in the energy and environment sectors and in electronics have increasen too» (Piccarozzi et al. 2013, 4-5). In the international literature, it is possible to distinguish three different analytical strands (O’Shea et al. 2005) about the academic spin-offs:

- the first explores the nature of the proponents;
- the second analyzes the impact of university policies and procedural steps that must be followed in the implementation phase;
- the third, finally, focuses on the factors that contribute to the success of spin-offs, such as, for example, the presence of adequate facilities, national law and the possible forms of financing.

The areas of study in the literature help locate different types of academic spin-offs. Shane (2004) divides the USOs into two categories considering the financing for which the business initiatives require at the startup phase of the project: the first includes the spin-off that require minimal funding (as predominantly self-financing) as those that operate in the software industry; the second, instead, encompasses spin-offs that, in order to produce a product or to provide a service, need higher funding, as in the case of biotechnological companies.

In turn, Clarysse and Moray (2004) identify three different models of university spin-offs, that are defined according to the policies adopted during the creation process. The first is called “select-low” and is the result of policies that aim to create the largest possible number of spin-offs, which are not necessarily able to achieve concrete objectives: these are mainly companies with a low level of capitalization and characterised by a management structure often poorly consolidated, and that operate on the local or national market. The second model is founded on the “support” and refers to companies that are born with the specific goal to expand their market boundaries: USOs of this type generally have a patentable technology; in this case, the number of business initiatives tends to be lower than the previous model. The third group, finally, is defined as “protective” and suggests to consider the spin-off as a means to commercialize the
results of the research activities: it is therefore appropriate to start a business project only if it is clear and certainly a growth path, structured and based on a patent.

Yet, the promotion and support policies are the basis of the proposed distribution by Degroof and Roberts (2004), which identify four models: the first does not require an active policy for the spin-offs, which are only supported by the initiative of individual researchers; the second is based on a minimum level of support and selectivity; the third, however, provides for an intermediate level, resulting in a greater involvement by universities both in terms of selection and financing; the fourth model, finally, is characterised by a high support and selectivity level, with emphasis placed on the transfer of technology with high business potential. Similarly, even the European Commission (2002) has developed its own classification, dividing the academic spin-off companies in relation to the type of intervening link between them and the institutions of origin, thus distinguishing between:

- primary spin-offs, arising from projects related to the original institution’s research activity;
- secondary spin-offs, those whose institution does not appear interested in (or is not able) to exploit the intellectual property produced.

The different types contribute to develop a more organic and structured vision of the phenomenon, as they provide classes designed to classify the composite reality of academic spin-offs (Declich 2006). The definitions of university spin-offs so far processed tend to flatten the complexity that characterizes the phenomenon in question and, for this reason, it is appropriate to consider two main dimensions in relation to which researchers tend to build their own particular definitions of the generic concept of university spin-offs (Pirnay et al. 2003). These dimensions are:

- the status of the individuals involved in the new venture creation process: while some authors (Steffensen et al. 2000) exclusively consider researchers as possible promoters of university spin-offs, other (McQueen and Wallmark 1982; Bellini et al. 1999) adopting a more inclusive pattern, consider as potential founders of spin-off companies also teachers, staff members and students;
- the nature of the knowledge transferred from the university to new business: while some authors (Steffensen et al. 2000) have focused mainly on the spin-offs created from specific products arising from academic research – such as, for example, publications, technical artifacts, computer software, equipment –, thus referring to a form of knowledge “codified”, others (McQueen and Wallmark 1982; Rappert et al. 1999) include, among those potentially exploitable in the creation process of the spin-offs, also forms of “tacit” knowledge, thus related to the background and know-how of consultants (eg. personal skills, experience and expertise).

In particular, it is precisely in relation to this second dimension which is a further subdivision of academic spin-offs can be made, that can be considered as oriented “to the product” (“product-oriented spin-offs”), for the transfer of codified knowledge, or “to the service” (“service-oriented spin-offs”), in case of transmission of tacit knowledge. To this point, it seems useful to report that Pirnay and colleagues (2003) propose a third factor to classify the different types of USOs. Specifically, the authors (Pirnay 1998; Pirnay et al. 2003) refer to the attitude of the university towards the new business reality. It is therefore possible to distinguish between:
spin-offs created *without* the university’s support (“pull spin-offs”), resulting from the initiative of individuals induced to go out from the university upon potential market opportunities.

- spin-offs created *with* the active complicity and support of the university (“push spin-offs”), arising from academic environments that play an active role in the promotion of an entrepreneurial culture among researchers, thus encouraged to create and launch to market new forms of innovative companies.

From the combination of the dimensions described above, different types of spin-offs arise, each of which will present specific characteristics in relation to the prevalence of one or other variable progressively considered. In this work, it is intended to add an additional level of complexity to the set of criteria commonly adopted at the international level for the classification of academic spin-offs. In particular, from the literature analysis, it was found that, regardless of the disciplinary area, the long term survival rate of USOs, once they have been launched on the market, depends on the degree of technological investment reached under development. According to this scheme, it is here also proposed the adoption of a new variable to describe the spin-offs of the university research: the investment in technology (see Fig. 1). Thus, it is possible to distinguish between:

- “low-tech spin-offs”, with the use of low-grade of advanced technology;
- “high-tech spin-offs”, with the use of high degree of advanced technology.

**Fig. 1 – A Typology of University Spin-offs**

Source: Pirnay *et al.* (2003); Cocorullo (2017); own elaboration.

**Conclusions**

So far, the analysis of the literature produced in the field of the university spin-offs has allowed to construct a comprehensive and multidimensional synthesis of the phenomenon, highlighting strengths and weaknesses related to the process of creating new enterprises by universities. The issue of the USOs definition is very interesting and
complex at the same time, because of the heterogeneity of definitions of the different researches. In particular, to involving multiple dimensions of the phenomenon — such as, for example, the composition of the founding members group, the type of activity delivered from the spin-off, its orientation towards the market, the relationship with the university of foundation and the potential investors, the nature of the subject area of origin —, it also interfere with the analytical and mapping efforts of these entrepreneurial initiatives promoted by the higher education institutions.

It has been shown that the divergence of the theoretical definitions corresponds to a disorganized overview of the phenomenon by individual universities. In particular, as a consequence of the absence of a single theoretical paradigm, the different higher education institutions adopt different criteria for the identification and the characterization of the spin-offs, even if situated in the same geographical area and at national level, as it is evident for the Italian case. At the same time, the university regulations about the subjects who founded the spin-offs and the accreditation procedures are also uneven and divergent. For this reason, it would be desirable to have a wider homogeneity to make different researches more easily comparable. Different opinions were also recorded among researchers about the steps in creating an academic spin-offs process, the identification of the different support measures, the classification of the many factors of facilitation and obstruction that characterize the process.

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