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12. Quasi-successful and Quasi-failing academic spin-offs: The role of technological and commercial alliances

Paolo Gubitta, Alessandra Tognazzo, Diego Campagnolo, Martina Gianecchini

1. INTRODUCTION

Fostering spin-off firms, with a view to commercializing university research, is at the core of today's many economic policies (Kroll and Liefner, 2008; Rasmussen 2008; Shane 2004). In Europe, one major reason for such attention is due to what is called the *European paradox*, according to which Europe plays a leading world role in terms of scientific excellence, but lacks the entrepreneurial capacity of the US to transform this excellent performance into commercialized innovation, growth, and jobs. This weakness also depends on the performance of technology transfer process. With respect to license agreements for the use of academic research results, some scholars show that there are not substantial differences between Europe and US in terms of number of granted licenses, while the difference in license revenue remains significant (Conti and Gaule, 2011).

In this context, science-industry connections have a particular strategic relevance, because they can accelerate and address the technology transfer process toward the most promising markets. These connections are highly significant in the development of academic spin-offs, which tend to remain small. The design of effective policies supporting the growth of these new ventures requires an in-depth knowledge of the characteristics of these firms at the time of their founding and their development. The present chapter aims at helping review and developing such knowledge.

We focus attention on academic start-ups, defined as new technology-based firms (NTBFs) established by academics, i.e. full-time or part-time personnel of public research organizations and Ph.D. students who were actively involved in academic research immediately before founding the firm.

What makes these firms special is that, since they are created by academics, they inherit from their founders *genetic characteristics* that clearly differ from those of other NTBFs (Colombo and Piva, 2008). NTBFs can use different strategies to enlarge initial competence endowments and thus enable growth, and alliances with third parties can be one of such strategies. Among all kinds of alliances, technological and commercial ones are those less explored (Colombo and Piva, 2012): we explore how and why these collaborations in the years after foundation can be a driver of academic spin-offs success.

The chapter proceeds as follows. In the second and third section, we provide an overview of the theoretical background, with particular attention to the role of collaborations and on how they affect innovation process and innovation outcome. The methodology of the empirical analysis is briefly described in the fourth section. Then, we analyse two Italian NTBFs: one spin-off that established a commercial alliance in the founding phase and another that did not. In the last section, we discuss the main findings and their implications, and indicate some theoretical propositions for future research.

2. TYPES OF ALLIANCES AND STRATEGY OF ACADEMIC SPIN-OFFS

As a result of the characteristics inherited from the founders at the time of their foundation, academic NTBFs have competence endowments that are different from the ones of non-academic spin-offs. NTBFs have higher scientific and technological competencies than their non-academic counterparts. The star scientist's network of academic contacts is a strategic asset that fosters the creation of NTBFs, because it increases their level of legitimacy and the likelihood of receiving financial resources (Gubitta, Destro and Tognazzo, 2015).

Nevertheless, these firms have less experience in cooperating with other organizations or companies. To enlarge the initial competence endowments, the establishment of collaborative relationships with third party organizations is one straightforward approach. Intuitively, since NTBFs are generally small, resource scarcity favors the acquisition of external competencies rather than their internal development.

Alliances can take different forms. Here, following Colombo and Piva (2012) we differentiate four typologies on the bases of two dimensions: type of partner and type of goal of the alliance. Technological alliances can reduce innovation-related risk, which is shared among several firms, and can favor access to complementary knowledge useful to accelerate or complete innovation processes. Commercial alliances may be explorative or exploitative. The former ones aim at inter-organisational learning and internationalization of partner competencies, while the latter ones may simply allow a firm to use the services of partners' competencies (or assets) with no further learning involved. In this

study, such distinction is negligible because both forms of alliances allow firms to enlarge the set of competencies on which they rely (Grant and Baden Fuller, 2004).

Table 12.1. Technological and commercial alliances
<INSERT TABLE 12.1 ABOUT HERE>

Public research organizations are key external sources of information for new ideas and innovation completion (e.g., Cohen *et al.*, 2002) and may potentially bring to a technological alliance knowledge seldom available in the private sector (Leyden and Link, 1999). NTBFs have low costs of partnering with public academia and of managing these alliances because they already belong to the same social network (i.e., trust is likely to be high). Moreover, academic spin-offs find it easy to identify and develop promising scientific results that have been developed by partner public research organizations and to make joint plans on further use of research for commercial objectives.

International research that compares NTBFs with non-academic spin-offs supports the previous arguments (Colombo and Piva, 2012). However, no clear results that explore public-commercial alliances are yet available. In accordance with Colombo and Piva (2012) we can argue some competing arguments. On one side, partnership and management costs of this type of collaboration are low for academic NTBFs, for the reasons just mentioned above. Nonetheless, the characteristics of academic NTBFs might reduce the benefits of this type of partnerships. These alliances mainly aim at bringing technological products and knowledge developed by partner research organizations to the market and selling them, but the lack of commercial competencies and assets of academic NTBFs reduces the likelihood of success of this kind of collaborations. People involved in this kind of relationship (whose motivations are generally research-oriented, rather than market-driven) might also feel, that they are artificially altering the nature of the alliance and thus underperform (Hess and Rothaermel, 2011).

It is a common belief that NTBFs have great propensity to establish collaborative relationship with private firms, but there are also reasons to sustain the opposite. On one hand, some scholars have emphasized the synergistic advantages that alliance partners can obtain by combining complementary assets and capabilities (Teece, 1986; Gans and Stern, 2003). It is easy to detect the existence of considerable gains in combining the superior scientific, theoretical and technological expertise of academic NTBFs with the practice-oriented, industry-specific technological competencies possessed by private firms.

On the other hand, the costs of this type of collaboration are likely to be great for academic NTBFs. In particular, NTBFs are more likely to possess state-of-the-art technological knowledge and this knowledge is likely to be their only (potential) source of competitive advantage. Partner firms' opportunistic behaviors and misappropriation of this knowledge can be very detrimental for NTBFs, especially if the partner possesses the complementary technological and commercial assets that are needed to commercially exploit the technological knowledge of the academic NTBF (Colombo, Grilli and Piva, 2006).

Also, academic NTBFs might have high partner-search and alliance-management costs because of the existing gap between the public research system and the private sector. In the next section, we will focus on commercial alliances with private firms. Before that, we summarize the main arguments discussed above and identify some main factors that might prevent NTBFs from establishing alliances.

It is believed that spin-offs generally benefit from collaboration, mainly because they can expand their resource endowment, which is a necessary condition to grow. Alliances may not be an option if spin-offs are not attractive or do not have the resources to interact with and learn from the partnership itself. When alliances are an option (spin-offs are neither unattractive nor too resource-constrained), they may choose not to collaborate when the organizational costs associated with such alliance outweigh its benefits. These costs are associated with: searching the "right" partner; disclosure, which might lead to misappropriation of knowledge by the partner; perceived loss of control over the innovation paths; 4) the need for intensive collaborative interactions with partner' employees to get benefits from the collaboration (Eisenhardt and Schoonhoven, 1996).

3. COMMERCIAL ALLIANCES: THE IMPACT ON SPIN-OFFS' INNOVATION OUTCOMES AND PROCESSES

For a NTBF, an alliance with a private commercial partner since its early founding stage might be either an advantage or a disadvantage.

Such alliances are especially valuable for NTBFs, as they allow these firms to obtain access to specialized market-knowledge and commercial assets and competencies (e.g., a trained sales force, marketing competencies, distribution channels and a brand reputation) that are complementary to their internal technical and scientific competencies and knowledge (Colombo and Piva, 2012). Gentlemen's agreements between the two parties do not usually guarantee access of NTBFs to the commercial assets and competencies possessed by private firms. More often than not, time and financial constraints may prevent NTBFs from acquiring or enhancing them in isolation (Teece, 1986; Gans and Stern, 2003; Colombo, Grilli and Piva, 2006).

Again, the costs that academic NTBFs incur when establishing commercial alliances with other firms are likely

to be very high. First, searching for suitable partners in commercial alliances is likely to be more difficult for the founders of academic NTBFs, as they seldom have a well-developed network of commercial contacts. Second, the costs of managing a commercial alliance are also high due to the lack of commercial and managerial work experience of the academic founders.

In short, commercial alliances may affect NTBFs in many respects, in particular on *innovation process* (team composition and functioning; team decision-making processes and strategic goal setting; financial and resource investment, destination and quantity) and on *innovation outcomes* (quality and quantity of products; market target; branding).

4. METHODOLOGY

In the study we aim at exploring how and why private commercial alliances can or cannot be a driver of NTBFs success in the years after foundation. We adopted a qualitative, longitudinal and comparative case study method, in order to discover contrasts, similarities, or patterns between the cases.

We follow Yin's (2013) principles about case study design for what concerns logics, data collection techniques and data analysis. In particular, data about the company have been collected from many sources: we interviewed the NTBFs' scientists/founders using a semi-structured interview protocol and triangulated the information with data from the company's websites, from other internet sources and magazines.

To reach this aim, we selected two Italian NTBFs: one spin-off that established a commercial alliance in the founding phase, and one that did not. We have systematically analyzed the two firms from their establishment up to their present situation, through periodic meetings with the members of their founding teams.

In order to prepare and present the case studies described in the following sections, supplementary interviews were carried out between June 2015 and September 2015. The summarized transcripts were sent to the interviewees for review. Partial authorization to disclose collected data anonymously has been obtained. To enhance limited generalizability inherent in the case method of inquiry, the two cases were selected in such a way that the difference in their success outcomes was maximized: the first firm is close-to-success and the other one close-to-failure.

5. CASE DESCRIPTION AND ANALYSIS

5.1 A close-to-success case study and the role of a private commercial alliance

NewFood is an academic spin-off, founded in 2009 thanks to the collaboration with the University, which holds a stake of 5% in the company equity. The founding team included one academic (the star scientist), two post-doc fellows, and the RandD manager of a private company operating in the food industry.

The business idea of NewFood is the development and application of new processes and materials in the food sector, through the transfer of existing technologies as well as new ones developed in biotech research. The company's business is the transfer of innovative biotech technologies and prototypes designed to optimize and improve the chemical and physical properties of food products for improving human and animal health.

The founders' aim is to fill the gap between innovation processes and production processes for SMEs operating in the food industry, matching the distinctive scientific focus to its business potential.

The company operates in a niche segment of the food sector and aims at becoming a provider of innovation for SMEs. The primary source of competitive advantage is the company's patent, which grants the role of *first-mover* with regard to the products currently in development. For the company, however, is very difficult both to innovate before competitors and to defend that advantage over time: in this sector, not fully covered by intellectual property rights due to the *knowledge transfer*, imitation occurs quite frequently.

Compared to other small biotech firms, this academic spin-off has been able to preserve its advantage, since it has the capability to evaluate the feasibility of projects thoroughly, under a triple point of view: economic, commercial and industrial. Often, smaller competitors focus only on the scientific part, neglecting to assess the costs and financing, and especially the commercial issues. Compared to larger competitors, the spin-off can sustain its competitive advantage thanks to the direct link with SMEs: the company opts for a customized solution, suitable to the customer's actual requirements (this is not possible for companies that act globally). Furthermore, it aims at achieving that solution quickly, while maintaining quality and cost standards as agreed with buyers.

Since its foundation, pushed by the industrial partner, NewFood has been actively exploring opportunities for establishing collaborative strategies, particularly to cover skill gaps and market knowledge. From the scientific point of view, the company developed several upstream vertical alliances. The star scientist, using its scientific network, started numerous collaborations with research centers, which allowed the firm to integrate its scientific expertise portfolio and to expand the number of portfolio products. The industrial partner, on the other hand, has made available its sales network, in order to improve contacts with distributors and manufacturing companies.

These decisions have decidedly influenced the innovation process, which has been focused on a few projects,

in order to gain quick results and reach the market equally fast, with beneficial impact on the available economic and financial resources. At the same time, access to the network of market relations of the industrial partner has supported a rapid market entry.

Notwithstanding its innovative technology, NewFood has not rapidly grown, and has gradually reduced its *strategic autonomy* over time. It has almost become the research and development unit of the industrial partner, by delegating all future plans and forsaking the development of commercial skills and first-hand knowledge of the market and customers. In 2015, due to a series of events concerning the industrial partner, NewFood's activities have suffered a setback.

Today the firm is going through a very delicate moment, because of the lack of a clear strategic direction and dearth of internal managerial resources. These are the unintended consequences of the fact that the star scientist has delegated the day-to-day management of the business to the industrial partner while he continued to focus exclusively on technology development and research of new applications.

5.2 A close-to-failure case study and alliance avoidance

NanoLife is an academic spin-off, founded in 2007 thanks to the collaboration with the University, which holds a stake of 5% in the company equity. The founding team included one academic (the star scientist), one post-doc fellow, one Ph.D student, and one business consultant.

This spin-off was founded to commercially exploit the results of a scientific discovery in the biotechnology industry. The firm developed technology regards the generation of nanoparticles, whose composition and preparation process are protected by an international patent held by the firm. By exploiting the property of such technology, NanoLife develops, produces and commercializes innovative reagents and kits for high sensitivity diagnostics, which are a more effective alternative to those currently on the market and sold by other international competitors. Today, the firm has optimized the preparation process of the nanoparticles, but does not yet have a precise commercial strategy. NanoLife operates in a sector controlled by some big players, who sell a kit for diagnostics integrated with analysis devices. This makes it particularly difficult for new comers to entry the market to sell their own products. In the last few years, NanoLife has tried to develop a broad product portfolio to increase the probability of entering the market, through different channels. Some products are sold on a catalog; others are tailor-made according to specific clients' requests.

According to this commercial model, different agreements regulate the sale of the products. They can be used exclusively by the client's labs, they can be commercialized with a brand chosen by the client, or in co-branding with the spin-off. In this segment, the competitors use pharmaceutical sales agents who are in contact with intermediary commercial firms. NanoLife might license their product portfolio to an intermediary firm that can easily sell these products to the client labs. The firm's strategy also foresees agreements with the producers of nanoparticle-activated diagnostic kits. In this regard, firms that sell diagnostics kits and that can integrate their products with the technology developed by NanoLife, represent another target of clients. All these opportunities are described in detail in the business plans, which NanoLife has prepared from its start-up to the present day. Actually, none of these strategic options has ever been implemented, for lack of financial and human resources.

In 2008, NanoLife won an international award, consisting in a sizeable amount of money. In 2009, NanoLife had the chance to grow, when a seed capital fund proposed to finance the firm with a big financial backing necessary to complete the development of technology, deliver the first products and reach the market. With this operation, the seed capital fund would have become the main shareholder of NanoLife. In spite of the tempting offer, the star scientist of the team preferred to continue independently, to reduce the risk of conditioning the uses of the scientific discovery on which the company started operations. The missed golden opportunity to take the big step into growth has damaged relations between the star scientist and the younger researchers, who leave the firm about a year later. This unforeseen event starts a vicious circle: the two researchers are not replaced with new ones, for lack of financial resources. Finally, this situation has slowed down the research and development of the first products, hampered the commercialization process and changed the company's strategy, which begins to look for commercial alliances with both public and private

In 2011, Nanolife signs the first commercial agreement with a public partner, interested in using the diagnostics kits in its sector, one in which NanoLife has no experience. After the first, not fully satisfactory experiments, the collaboration loses intensity and is quickly terminated. At the end of 2011, the company established a formal collaboration with a public organization operating in the same industry and focused on technology development.

In 2012 and in 2013 the Board of Directors, in the face of growing difficulties, has repeatedly discussed the possibility to close the firm. The availability of the star scientist and of the business consultant to finance with own resources the company has avoided the default. Recently, NanoLife has changed the strategic plan and started looking only for private industrial partners. In spring 2015, the firm has signed the first cooperation agreement for the use of the patent for a specific application in the pharmaceutical industry.

5.3 A comparison between the two cases

In both NewFood and NanoLife, a star scientist is the leader of the enterprise, and the NTBF represents the conclusion of a multi-year research project, conducted in different international contexts and protected by a precise patent strategy. In both cases, the services and facilities made available by the University have been critical to start the activity (Fini *et al.*, 2011). Finally, the top management team also includes some non-academic people who were able to fill the gap between scientific and practical knowledge about firm strategy and organization (Visintin and Pittino, 2014).

However, the similarities between the two cases stop here, while the differences refer to the general strategy, the innovation paths and the human and relational capital development, as illustrated above.

Since its inception, NewFood involved an industrial partner in the firm's management and governance, starting a close strategic cooperation. This choice was made because the commercial dimension has been considered strategic. The industrial partner brought its relational network (*market target*) and filled the reputational and legitimacy gap of the academic spin-off (*brand*). Moreover, since its foundation, research activities have been geared toward the most promising applications in terms of sales and the firm was able to reach the market without direct investments in marketing activities (*strategic goal setting* and *quality and quantity of products*).

Overall, this process proved successful to overcome the problems associated to early stage, because access to complementary resources has bridged the gap of knowledge and relationships of the star scientist and has reduced market risks. However, by delegating all decisions concerning relations with the market to the industrial partner, NewFood has not acquired internal knowledge for independent development and new clients (*team composition and functioning*). Currently it is structured as a service provider of research and development and this situation creates several constraints against a robust growth.

NanoLife founding members chose a stand-alone strategy, to maintain scientific control of the development of a high-potential scientific discovery, even though it was in its initial phase. The top management team refused the proposal from a seed capital fund to enter; instead, it invested all the resources in RandD to complete the development of the technology (*financial and resource investment, destination and quantity*). This has postponed the start of relations with the environment, also preventing to build up reputation and legitimacy for the spin-off (*brand*). The result is a fully developed technology without an available market (*market target*).

By selecting a stand-alone strategy, NanoLife's choice has not proved effective. With a very innovative technology still in an early stage of development, the lack of an industrial or financial partner has prevented the star scientist to focus on investment in research (*team composition and functioning*). The continued focus on improving technology has made it possible to discover new applications that exploit the intrinsic versatility of the technology (*quality and quantity of products*), but at the same time it did not create strong ties in the industrial and financial system. This missing element became apparent when the available resources were short (*team decision making process and strategic goal setting*).

All in all, NanoLife has not yet passed the early stage, and its survival can be explained only by the existence of reliable networks. Namely, the University, which supplied the equipment for research activities, the national and international scientific network of the star scientist, which has allowed the consolidation and development of the technology and the strong ties between the partners and the Board of Directors, who have renewed confidence in the star scientist, in spite of the absence of satisfactory economic performance.

6. DISCUSSION AND CONCLUSION

The analysis of the first years of business life of NewFood and NanoLife indicates that collaborative strategies play an important role for the development of NTBFs, and particularly of academic spin-offs, but that such partnerships do not necessarily have a positive impact on the growth and managerial development.

6.1 Public-Commercial alliances

The University is a founding partner of both cases. This institutional link creates an implicit collaboration with the technology transfer office (TTO) of the University.

According to Phillips (2002) and Maskus (2003), technology transfer is the process that enables ideas and concepts to move from the laboratory to the market place and where one party gains access to another's technical information and successfully learns and absorbs it into the production function. Therefore, the more successful the technology transfer process is, the more thorough and extended knowledge accumulation becomes (Ratinho and Henriques 2010), and this explains the real success of new ventures. When spin-offs originate from University research, TTOs have a strategic role. They become the University's main channel to sell academic research that have potential in the market, holding a share of the company and maintaining a strong presence inside the start-up in order to guarantee specific support. High support means that the TTOs actively sustain the spin-off of companies with business and commercial services.

However, in the two examined cases, the role of the TTO was marginal and the two spin-offs have not been

able to benefit from this collaboration. Interviews with the star scientists brought to light their difficulty to understand and apply the TTO's suggestions autonomously, that is the firms' reduced ability to recognize the value of new information, assimilate, and apply it for commercial purposes (Cohen and Levinthal).

According to the above analysis, we propose the following proposition:

Proposition 1 –The effectiveness of technological or commercial alliances with public or private organizations depends on the absorptive capacity of the spin-offs.

6.2 Public-Technological alliances

As to NanoLife, neither the Public-Commercial alliance nor the Public-Technological alliance allowed the spin-off to grow.

However, these partnerships have played an important role in the evolution of NanoLife. Public institutions have a medium to long-term perspective, and are more concerned with effectiveness rather than efficiency. The presence of these partners has legitimized the propensity of the star scientist to continue to experiment with NanoLife's technology in new areas of application, instead of focusing on the most promising products for the market (Rasmussen, 2011). On one hand, this comprehensive approach has concentrated all investments in research and slowed down the commercial development of the firm, but on the other hand it has allowed NanoLife to become aware of the versatility of the technology, which has been fundamental to start its search for industrial partners.

In light of the emerging findings of this case, we put forth the following proposition:

Proposition 2 –In the early life stages of academic spin-offs, technological or commercial alliances with public organizations increase the propensity to invest in research rather than in commercial initiatives.

6.3 Private-Commercial alliances

The quasi-successful strategy of NewFood is due to the choice of the industrial partner, which immediately accompanied the spin-off in the market through its own commercial network.

Shortage of commercial attitudes may lead academic spin-offs to failure, so it is very important to provide technical support both in research labs and in managerial skills (Clarysse and Moray, 2004). In the case of NewFood, a clear division of roles between the scientists and the industrial partner, and the presence of the latter in the Board of Directors has led to this result. As mentioned in paragraph 5.1, this arrangement has optimized the innovation process and maximized the innovation output in the early stages.

This argument leads us to formulate the following proposition:

Proposition 3 – In the early life stages of academic spin-offs, commercial alliances with private organizations have a positive impact on decision-making process and on strategic goal setting.

6.4 Private-Technological alliances

Notwithstanding its complete lack of commercial results, NanoLife survives and obtains promising scientific results with the application of its technology. As mentioned in section 5.3, the survival of the spin-off is due to the reliable internal and external networks that the star scientist has succeeded in building, which has saved NanoLife from default and supported the star scientist through rocky times (D'Este *et al.*, 2012).

In time, the spin-off has learned from its mistakes and this has allowed it to complete the development of technology and to test its multiple applications, which have been instrumental in the negotiations with the industrial partner, which regards NanoLife as a sort of platform for potential uses in several segments of the biotech industry.

Thus, we develop the following proposition:

Proposition 4 – In the early life stages of academic spin-offs, the reliable internal and external network influences the likelihood of survival of the company

6.5 Contribution to the literature

Most studies on academic spin-offs focus on success stories and very seldom on failures. In this chapter, we analysed

the reasons why quasi-successful spin-offs do not grow and quasi-failing spin-offs do not fail, focusing our attention on the role of commercial and technological alliances.

As a contribution to existing literature, these explorative case studies highlight that 1) commercial alliances with private firms are among the factors that affect innovation processes and outcomes, but they also provide market and internal legitimacy to work on research driven by different grounds that are not strictly research-oriented. 2) when academic spin-offs evaluate the opportunity to start an alliance with a private technological or commercial partner, they also assess the impact it may have on the research path of the firm and of the star scientist, who is the *key actor* of all the strategic decisions.