PROJECT MANAGEMENT, NETWORKS AND VALUE CREATION IN UNIVERSITY SPIN OFFS

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Abstract:
The paper analyses the operational characteristics of university spin offs and the features of their networks in some territorial clusters. In particular, it observes the system of intangible resources the enterprise manages, then the structure and the impact on the business performances of the applied project management models as well as the features of the network of relations the managers created. The sample consists of 134 enterprises, out of them 105 are located in five clusters of academic spin offs, which have been selected taking into account the territorial density and the most prolific universities in Italy, in improving the of the research by starting up a business. The research questions are expressed in the following way: in a specific business field, what role does the university spin off play within the network of relations with external stakeholders? What intangible resources are essential to success? How does the project management contribute to the efficiency of the business action? The data useful to the empirical analysis are obtained from questionnaires and document sources drawn from national data bases, corporate, ministerial and university sites. Social network and correlation analyses have been carried out on the sample; empirical evidences lead to observations which are useful to understand excellences/critical situations of spin offs in specific territorial clusters, with useful implications for the management of research processes.

Key Words: University spin off, networks, project management, corporate governance, intangible assets

1. Introduction

University spin offs, as a form of technological transfer from universities to the market, represents a very important phenomenon for the economic growth, in particular in those contexts where competitiveness is based upon knowledge and innovation and where capital markets are not very developed and not very dynamic. Given the urgent expectations of development, university institutions and bodies of research are charged with the difficult task to promote and to facilitate local development, in compliance with the national strategic and political priorities. However, in our country different experiences of academic entrepreneurship show problems related to development, unsatisfactory economic and financial performances and an early disappearance from the exchange markets (Piccaluga and Balderi, 2006; Netval, 2012). The inner spin off critical aspects emphasize the difference in development between the excellence of research output, the units of origin provides, and the economic and financial performance resulting from its own application as an output for the market. Literature numbers among the causes the motivational factors driving to start a spin off, the scholars' business skills and the characteristics of those who use the technological applications spin offs execute. However, although academic entrepreneurship has been widely examined, literature points out some research deficiencies which can be expressed in the following way: the observed samples for the quantity surveys are small sized; university social networks and those of the researcher-businessman are poorly studied; it disregards the different environmental influences as well as the heterogeneity of the evolution processes of those enterprises working in not very technologically advanced contexts; the growth and performance courses, the spin off achieves after the end of the parent organization relation, are not very clear. Given that the characteristics of the

economic system have a direct impact on the functioning of the enterprises working there, Italy is described more as a relation-oriented system than as a market-oriented one. (Weimer and Pape, 1999), since we notice a poor dynamism of financial markets that obliges enterprises to make continually use of relations with specific external stakeholders who hold the strategic resources necessary to their working. According to literature, this phenomenon is explained by the *resource dependence theory* (Pfeffer and Salancik,1978), which, together with the *dynamic capabilities vision* (Teece, Pisano and Suen, 1990, 1997), represents the theoretical reference point for this research that focuses on essential factors for the effective management of research projects within spin offs and of strategic resources for a correct business operation. Considering that the dependence on some resources modifies the power relations within the context and starts formal and stable relations, the social networks of some enterprises are also examined in order to understand their impact on spin off performances.

2. The strategic intangible assets for spin offs

The university spin off [219] is undeniably described as a knowledge based enterprise which bases its functioning on knowledge included in processes, in human resources and in relations set up with stakeholders of different kind. Their complex management partially indicates the uncertainties characterizing the management of these resources; as a matter of fact, no theory provides shared scientific interpretation or a consistent composition of studies on intangible assets, showing their characteristics and helping their understanding, even if during the latest decade the effort was made mainly to define the subject matter and the content of the resources at issue. Among the different branches of research, we include the *dynamic capabilities approach*, which develops the *resource based view*; it states that in a dynamic or even complex context, the primary source of survival and of success for the enterprise is its capacity to build, to integrate and to adapt the financial and human resources, intangible and tangible assets, its own ones or its partners', in order to achieve a dynamic consistency with the external environment. In this perspective, the management body of the enterprise is described as the unit charged to allocate and to manage the portfolio of tangible, financial and intangible assets; among them we count the intangible assets, which can be assimilated to commodities, and other resources that the enterprise cannot easily acquire and transfer by interacting with other systems, such as business reputation, leadership style, innovation capacity and relations themselves. If we link this approach to the resource dependence theory, we emphasize the role played by the relations the enterprise management body has established in order to obtain and to strengthen the resources missing within the enterprise. Consequently, the management body plays the role of coordinator of those units where the different resources are allocated, directing them towards a shared growth path, encouraging their internal development and deciding to transfer the relations with those units which are not able to use and to increase the relevant resources. Within spin off enterprises, both knowledge resources typical of the organization, such as patents and information, and above all its human resources' skills are strategically relevant as well as the interaction and relation dynamics with external stakeholders; as a matter of fact, considering the relational nature of the process to establish the enterprise, we think that the network of relations established from the startup phase plays an important role to achieve a dynamic balance for the spin off, but also to establish other social and economic entities in the territory, such as business incubators, consortia, technological parks and alike. Skipping the wide framework of intangibles, this work focuses on some categories which are essential to the functioning of these enterprises: human resources, leadership and communication styles in the research team, external relations. Literature underlines that the human resource within spin offs implies a crucial duality with an impact on its performances: it has to fulfill a business function together with an academic function of research, teaching and sometimes administration as well. On one hand, a researcher's good scientific performance ensures the quality of knowledge applied to operational processes of the spin off; on the other hand, many works underline that the specialty of researchers' individual knowledge requires the recruitment of inter-disciplinary skills and knowledge, both in the academic field and in the business and professional sector, in order to manage the business complexity to protect the different stakeholders' interests. Therefore, the previous human resources' skills become important as well as their technical and scientific quality and, overall, the

[219] In this paper the concept of university is meant to summarize both categories of spin off: university and academic.

level of complementarity of knowledge the business management involves. Many works of the branch of research on entrepreneurship and on innovations study the factors determining the individual business tendency (Lundström and Stevenson, 2005; Davidsson, 2004; Wright *et al.*, 2007); among them, they mention the capacity to acknowledge a market deficiency or a level of suboptimal use of the existing resources, which depends on individuals' sensitivity and also on individuals skills; with this regards, the branch of study with a sociological background ascribes among these factors the need for achievement and the tendency to risk, the attitude for command and the capacity to control, the tendency to be effective and successful, the mastery of additional information and technical skills, the decision making rationality but also creativity and optimism. The Austrian school, instead, considers the ownership of exclusive and complete information concerning business and market as a decisive factor to identify a business opportunity (Hayek, 1945; Kirzner, 1997), both in order to establish the enterprise and to lead it to success. Some studies (Wright et al., 2007) show that the essential information is obtained through the network of social relations the entrepreneur establishes whether he/she is an individual or a collective entity. De Koning reminds, in fact, three cognitive and social processes, which are essential for the entrepreneur during the startup and are developed within a wide network of more or less stable external relations: information gathering, its processing by means of a verbal comparison and resource check. This network has to include long term connections with stakeholders who are not involved in the enterprise, subjects being contacted to obtain the required resources to single out the opportunity, the enterprise members and a remaining group of stakeholders to start weak relations with, although they are necessary to obtain general information. (De Koning, 1999). However, we do not study sufficiently what skills among these allow, over the time, to manage an enterprise effectively; likewise, a poor attention is paid to the literature of the social network of the spin off during the phase following the startup *(*Grandi and Grimaldi, 2003), in particular when the parent organization is not included into the corporate structure anymore. The reason for the gap among the scientific performance of the research unit, the spin off economic and financial performance and the local development is also poorly studied, in particular in contexts which are less vital from the technological and capital market points of view. We consider that it is also possible to identify, among spin off enterprises, networks within the research team, being characterized by interactions based upon the level of heterogeneity of knowledge; therefore we can study the network of relations with external stakeholders both taking into account the scientific collaborations themselves and the relations established within the management body; the latter ones often show again the personal relations of members set up for scientific or professional purposes (Grandi and Grimaldi, 2003; p. 331). According to the studies on corporate governance, the composition of the management bodies shows the requests of stakeholders, who are themselves holders of interests concerning their own asset of more or less formal relations, too. This asset of relations is also connected to the *interlocking directories phenomenon* that, in compliance with the *resource-dependency theory*, represents one of the mostly widespread procedures to manage dependencies on external environment as well as to manage uncertainties and costs related to the acquisition of crucial resources. Some studies show, in fact, that the improvement of business performance depends on the central position of the enterprise within a network of managers (Zona and Gnan, 2009); this network results from the capacity of the enterprise to organize its relations according to the dependencies started in the past. This phenomenon is, however, examined making often reference to the combinations between industries and credit institutions, considering as critical the dependency on financial resources only. For this reason, this work aims to extend the observation to the complex network of enterprises and organizations holding all the strategic assets for a spin off; in particular we take into account that, in this field, as previously stated, the relations established with scholars, who are involved in the management body, show again the previous relations set up for scientific purposes and that they partially depend also upon the expression of roles the founders want in order to develop the research project in the best way. Therefore, not only the enterprises in the financial sector are essential, but also the service enterprises in sectors connected with the spin off and the public and private organizations which work as facilitators of the research applications. Given these remarks, we can formulate some first working hypothesis:

hp1a) the presence of multiple skills within the spin off helps to establish long term relations.

hp1b) the central positioning of the spin off managers within its network of relations has a positive impact on the economic performance of the enterprise.

3. The relationship between spin offs and local development: the dilemma between dependencies and incentives for development

It is essential to understand what resources are necessary for the right operation of spin offs in order to single out the suitable management and development paths for the spin off itself, since it aims to help the social and economic growth of the context. As a matter of fact, the reason why, during the latest decade, the academic entrepreneurship quickly increased also justifies the will to help the development; this is also showed by the *top-down* nature of the process to establish spin offs in Europe, unlike what happened in the States. In fact, the study by Malerba *et al* (1995) underlines that in Italy the main cause for the delay of this phenomenon can be partially found in the national business structure, which is mainly characterized by small and medium enterprises (SMEs) incapable to support significant investments in medium and long term R&D programs; at the same time, they are not very involved by the universities themselves who consider the cooperation with big multinational companies as more prestigious and effective. On one hand, the establishment of an academic spin off is connected with the skills of the promoters of the technological transfer to the facilities of origin, on the other hand we think that the features and the resources available in the reference environment are essential for an effective business action on the local economic growth. As a matter of fact, on one hand, the missing managerial and marketing skills of the members of the technological transfer offices (TTO), the studies often underlined (Whight *et al.*, 2004), lead the universities to prefer the licenses to market their own knowledge, rather than establishing an enterprise, and not to develop appropriate policies and infrastructures to support spin offs. On the other hand, the presence of an active and cooperative business culture in a territory is very important to encourage universities to develop research and to apply, over the time, the technology the spin off has developed. Likewise, an advanced legislative system, the availability of financial resources and the presence of policies supporting business are considered as necessary factors to establish an enterprise and to its survival. It is not by chance whether in Italy most university spin offs are gathered in areas where there is a high concentration of enterprises, which are often connected by facilitators of development such as research consortia, incubators, technological parks; that leads to consider these fields as delimited clusters we can suppose what follows for:

hp2a) a spin off, established in areas with a higher business concentration and resulting from universities with a greater business guidance, achieves better performances and develops a wider network of relations.

Those studies, which focus on the effectiveness of the business action executed by universities, conventionally refer to indicators that are distinguished in terms of input and others in terms of output: the former ones are linked to factors determining the effectiveness of TTOs such as the funds available for investments in R&D, for services supporting technological transfer processes and for the supporting infrastructures, the quantity and the quality of the TTOs staff and the pursued strategy. The data concerning the typologies and the number of executed transfer processes prevail among the output measures together with the earnings gained from their commercial use, the scientific visibility the research unit obtained and the collaborations started with external users (Bozeman, 2000; Debackere and Veugelers, 2005). The latest ones refer to measures applied also to observe the impact the technological transfer processes have on the reference context, which is generally linked with the level of social and economic development, that can be observed in terms of new products or executed processes, in terms of GDP growth, of more skilled technical and scientific staff who is available and the resulting increase of employment, of new enterprises, of development rate for already existing enterprises and alike. (Anderson *et al.*, 2007). However, since this is a widely international research which is carried out among enterprises established with a university spin off, we think that the economic and social externalities of the research have an impact on much wider fields than the territories of origin and above all with very bleared borders; consequently it makes the effectiveness of the business action be detectable marginally only. For the purposes of the local development, it is important to take into account also the impact and the benefit the knowledge which

is generated by the spin off and often coded in *patents*, produces towards the market; the level of use of this technology can be observed in terms of turnover or license contracts signed by the spin off and the users in order to optimize the circulating products or processes, up to achieve output which are difficult to quantify such as local wealth. Often, in order to assess the performance of a research unit we focus on the result the process achieved, which can be translated into the patent, without examining the process effectiveness for the market. The patent and the possession of unique scientific and technical skills represent essential requirements to attract crucial resources, such as financial resources or other human capital, which often determine the spin off dependency on the context where it works. In addition to the application of strategies concerning the interlocking directories, holding these inimitable resources can work as a tool to manage such a dependence, in particular if we consider that the governance of networks based upon knowledge fusion concern those subjects who contribute to the process with the main strategic assets. To appreciate the impact on the development of these enterprises, we also have to take into account their small sizes and their growth rate. Within the Italian scenario, the spin offs are mainly characterized by the SME features from the size and management point of view. As far as the latest feature is concerned, several shared doctrines show that it is possible to single out the nature of SMEs by combining the quantity variables concerning the dimension and those concerning management which show that, within a SME, ownership and management tend to coincide, thus determining the repetition of personal styles in business management. That implies that, within a SME, personal and subjective events of the ownership are absolutely essential during the establishment, even if during the growth they are replaced by a more managerial aspect. As for academic spin off enterprises, this statement is fully accepted; some doubts arose as for the strictly university setting where researcher's personal styles as well as those of the involved staff are faded by the presence of other stakeholders and by the institutional nature itself of the university joining the founders' team. However, even for a university spin off, hybrid styles take shape, where the manager is widely affected by the impacts of the ownership who controls and where there are no formal structures to distribute and to assign tasks. According to some authors, it is actually the fear to delegate the control and the decision making power that moderates the growth of several small enterprises which are still linked to personal motivations of the ownership who wants to keep the small size. That would determine the presence of the so called stable enterprises, anchored to low levels of operational risks, where the manager profile is taken to the extremes and finds within the enterprise a tool to diversify his/her interests and his/her capabilities, unlike other small enterprises which start a quick development by increasing the risk profiles and by evolving towards managerial models; this depends not only on a manager's choice, but also on the structural features of the sector it belongs to imposing this development. At the beginning, the literature on spin offs acknowledged these enterprises' capability to grow quickly by virtue of their highly technological and innovative nature; these enterprises are subject to a quick development in comparison with those working in advanced sectors (Shane, 2004); however, over the time, the empirical evidences have showed some doubts concerning this capacity to grow of spin offs (Wright et al, 2007) which, on the contrary, have proven to achieve weak performances and strong financial tensions hampering growth, in particular in Europe (Autio and Lumme, 1998). An additional factor stopping the growth of university spin offs is linked to the often hybrid nature of the founder team, who thinks it is difficult for the human resource to combine the entrepreneur's role and the scholar-researcher's one. For this purpose, it is essential for this enterprise's core processes to have a clear cut structure and a well-defined assignment of roles, depending on acquired skills, as well as an appropriate in-house communication among the members, a reliable leadership style and a cohesive organizational culture.

4. Spin-offs and emerging strategic networks of knowledge dissemination

Several scholars agree on the fact that *knowledge sharing* can improve an organisation's performance, promote its competitive advantage, strengthen learning processes, stimulate innovation skills and, all in all, protect its survival (Lesser and Storck, 2001; Argote and Ingram, 2000; Argote, *Organizational* 1999; Powell et al., 1996; Baum et al., 1998). At the same time, the vast literature devoted to pinpoint the success factors behind the knowledge sharing process (Burt, 2004; Cross and Cummings, 2004; Cummings, 2004; Hansen, 1999; 2002; Levin and Cross, 2004; Owen and Powell, 2004; Reagans and Mcevily, 2003; Ardichvili et al., 2003; Stenmark, 2000) has highlighted, among

other things, the importance of the position occupied by the node within a network. In particular, some scholars have shown that the diversity of network members can generate particularly positive effects on the *knowledge transferring* process (Cummings, 2004). For instance, a study by Cummings takes into account four specific variables: demographic diversity (i.e. age, genre and working years); geographical diversity; functional diversity (i.e. the tasks assigned to the different working groups) and management diversity (i.e. the type of manager to whom the subject has to respond directly). From the results of this study it is possible to argue that the heterogeneous nature of the members within a network brings positive outcomes to the process related to knowledge transferring. This reinforces the hypothesis of a real and positive correlation between the diversification of knowledge and competencies in a spin-off's board of directors of and the organisation's performance. In addition, it helps to appreciate why spin-off companies get involved more than ever in aggregation and mutual collaboration processes: such strategic conducts are due to the need to develop technological innovation. To this end, action is taken fundamentally on three economic processes: generating knowledge, promoting developed innovations and competencies, exploiting the produced innovations commercially (Huber, 1991). The generation of knowledge represents a critical and significant moment for the competitiveness of a university spin-off (Nonaka, 1991; McCampbell et al., 1999; Snowden, 1998); it results from a process in which there is the simultaneous involvement of both university institutions and companies, which work all together in a number of synergic activities, experimenting and combining techniques and resources, as well as in many other initiatives with a high added value. With particular reference to the academic sector, results greatly depend on both the quality of academic staff and the remaining human heritage, and the available economic resources – if limited, these may preclude the exploration of potentially fruitful avenues, thus forcing the research organisation to focus on projects for which there exists a greater degree of specialisation. Besides being created and developed, knowledge should also be promoted. This process is as important as the generation of knowledge and it is mostly linked to a set of formal and informal organisational conditions that are suitable to optimise and boost in the long run the scientific and technological outcomes achieved.

Several scholars highlight that the process whereby knowledge is promoted cannot be considered from an atomistic perspective with each research unit acting in an autonomous and isolated way. On the contrary, this process must be conceived of as the result of an increasingly widespread exchange between the different networks (Hakansson, 1987; 1990) The more a spin-off unit is located at the centre of a network, the more it will be able to exploit the knowledge produced by the other units, provided that it is equipped with adequate learning skills. Tsai, for example, analysed the impact of *knowledge transferring* on the business units included in an intra-organisational network and concluded that '[…]*organizational units can produce more innovations and enjoy better performance if they occupy central network positions that provide access to new knowledge developed by other units. This effect, however, depends on units' absorptive capacity, or ability to successfully replicate new knowledge' (*Tsai, 2001).

With particular reference to the university sector and the ways in which technological transferring can take place towards the external environment, eight main transfer channels have been defined in the relevant literature: mobility of highly qualified students; scientific publications; interactions between knowledge creators and users; research programmes supported by private subjects; multilevel agreements; consultancy provided by academicians to private subjects; entrepreneurial activities developed by lecturers and students; licensing for enterprises (Academy of Science, 2010).

The exploitation of knowledge is strictly linked to the knowledge promotion process and takes place through the growth and subsequent marketing of inventions. Within the specific context of academic spin-offs, an important function is fulfilled by TTOs, whose main mission can be identified in the promotion of research and the related outcomes, which will be the object of protection, promotion and transfer (Conti et al., 2011). However, alternative means of technological transfer are mentioned in the literature, e.g. publications, patents, consultancy, informal meetings, training, licensing, joint ventures, exchange of human resources, research contracts, and recruitment (Agrawal, 2001; Cohen et al., 2002). Spin-off companies are motivated to establish collaboration relations in order to make up for the impossibility to develop all the possible competencies in an autonomous

way. This situation is well-known, even more so due to globalisation processes and the increasingly faster pace of technological innovation advancement, thus making it necessary to deal with both the rapid obsolescence of research, and the increasing costs of innovation and development (Cainarca et al., 1992). In the era of k*nowledge economy (*Drucker, 1969*),* the production of knowledge is less and less dependent on the processes that a company can put forward on an individual and autonomous basis, and it is increasingly linked to the reticular structures and similar configurations that can be adopted by a spin-off company (Ricciardi, 2003). Therefore, within a company, in addition to the value creation systems that are based on autonomous processes of conception and development of new knowledge and skills, there is the urgent need to implement management procedures as well as harmonisation arrangements of such knowledge and skills, so as to improve their capacity to adjust to possible changes in the relevant environment. This approach is called k*nowledge-based theory* and implies that knowledge transfer takes place both within the company and between different spin-off companies (Grant, 1996). This can be effectively integrated into the perspective of *embeddedness*, which analyses the impact of economic actions in the social context in which they emerge and develop. By analysing the flows that directly unite two actors (*relational embeddedness*) or the flows connecting a number of actors in an indirect or mediated way (*structural embeddedness*) it is possible to ascertain whether the knowledge and skills possessed by other organisations and companies are actually accessible and to what extent; it is also possible to determine the effect of such relations on the production of new knowledge (Levanti, 2008;2010). In this sense companies have devised and espoused the notion of technological transfer, which is intended as '*the movement of technological and technology – related organizational know – how among partners (individuals, institutions, and enterprises) in order to enhance at least one partner's knowledge and expertise and strengthen each partner's competitive position'*. Technology transfer, therefore, consists in an economic and organisational process aimed at the development and marketing of practical applications and products. This must be perceived as the fruit of a knowledge core obtained thanks to R&D activities.In the light of the above, it is possible to suppose that the more spin-off technological transfer is extended on the market, the better the relevant performance will be in qualitative and quantitative terms. In any case, it is important to emphasise that although university spin-offs and companies, with special reference to *corporate spin-offs*, share many characteristics, they also show important differences: on the one hand, *corporate spin-offs* tend to keep research and technologies within the boundaries of the company with an exclusive internal use; on the other hand, university *spin-offs* are encouraged to transfer their results beyond the institutional environment. Hence, when analysing a spin-off's performance it is important to adopt both quantitative and qualitative variables; similarly, together with the traditional economic-financial performance indicators, other indicators of a qualitative nature should be considered, as they can be useful to verify the research outcomes and to what extent these are spread in the wider social context. The indicator 'interdisciplinarity of academicians' has been designed to determine whether the board of directors of a spin-off includes academicians belonging to more fields (in the Italian academic system these are known as 'scientific-disciplinary fields' (SSD). The values 0 and 1 adopted in this dichotomous variable indicate the existence of interdisciplinarity or the lack thereof respectively.

On the other hand, the indicator known as 'composition of the board of directors' has been designed on the basis of the composition of the board of directors of each spin-off: besides retrieving information on the background of each director, it makes it possible to verify the availability of diversified knowledge and skills. Another aim of the study is also to verify the actual existence of a direct correlation between the performance of a spin-off and its ability to transfer the research outcomes into the cluster, and thus to take action on '[...] the development processes of the different national economies against the direct responsibility in the creation activities of ideas and useful knowledge for the entire society'(Cicchetti et al., 2007). The research hypothesis is in line with the observation that '*research knowledge is increasingly considered as the driving force leading to higher productivity, higher and more radical technological innovations, and economic growth*' (Mustar et al., 2007).

5. Research Project Management in University Spin-offs

Following the introduction and development of the concept of complexity, several modern theoretical cornerstone principles have been challenged over the last few decades, including the possibility to base cognitive processes on linear cause-effect relationships and to break down observed phenomena into mechanisms that can, in turn, be broken down, analysed and – if applicable – modified through equally linear technical devices. The establishment of an epistemological scenario whereby reality is characterised by intrinsic uncertainty has required a radically new perspective also in the way projects are understood, as regards both the observation and interpretation stages. Moreover, the analysis of complexity dynamics has highlighted the invalidity of taking one single, overriding assessment approach capable of levelling differences or eliminating any juxtapositions through the co-existence of various perspectives, each resulting from a specific cognitive map. The cognitive paths that intersect in complex environments are interactive and follow circular routes - for many authors they are one of the few viable ways of understanding the numerous and oftentimes juxtaposed logical processes applied. Against this background, the cognitive process no longer consists in a certain, exhaustive definition of the item observed and of the related environment; on the contrary, it may be compared to an analysis of the common aspects, differences and constructive interactions between and among the various logical approaches in place (Ceruti, 1997). In light of the considerations above, the operating process becomes a necessary and vital stage for the implementation of knowledge in highly complex scenarios.

This research stems from the assumption that Project Management can prove to be a valid tool capable of changing and innovating the management of university spin-offs, thereby improving their effectiveness and performances, although it obviously needs to be adapted to the specific features of the project involved, since its application as a mere management tool would be likely bound to failure.

Many authors agree in seeing research as an activity characterised by creativity, innovation and complexity – all aspects that differentiate it from traditional projects, to which the traditional Project Management theory is normally applied. Since research projects are by their nature intellectual, non-routine activities, a key-role is played by the Human Resources involved, who will have to develop concepts like: the cooperation between and among research teams, team building, team climate, team environment, the creation of fruitful relationships with the stakeholders, and the sharing of mental and cognitive models between and among team members. Indeed, being able to create an atmosphere of cooperation by building teams having a high level of responsibility and a shared mental model is described in the literature as the prime task of the leader of a research project.

The goal of this research is to verify how a responsible governance of research bodies can be implemented through an effective and efficient use of Research Project Management (RPM) as a project management innovation tool. As regards R*esearch Project Management*, a truly flexible and incremental approach needs to be defined, capable - starting from the identification of problems – of outlining applicable solutions while allowing, by means of dedicated analyses, to understand how problems and solutions are mutually dependant, so as to contribute to the definition of a coordinated series of decisions taking into account the various stakeholders involved. According to this kind of approach, specifically conceived by Friend e Jessop, the situations characterised by continuous change call for a prompt identification – in line with the ongoing changes – of a constantly new balance between the various aspects of the decision-making process. In this respect, the project manager is faced with a complex, multi-faceted decision-making scenario, where any attempts to maintain stable lines of action clash with both the positions of the other decision-makers and the pressure exerted by complexity, urgency, and uncertainty. The way the decision-making process evolves will substantially result from the outcome of the interactions described above.

6. The Research: Method, Sample, Variables

The assumptions made are tested by analysing a sample of 134 companies, 29 of which formed a control group and 105 belonged to five clusters of university spin-offs promoted or created in those Italian universities recording the highest business-creation rate, taken from the 2012 Netval database. Data were collected through a questionnaire, documentation analysis, and national data banks. More specifically, all information regarding business performance and governance was

obtained from historical files gathered from the Infocamere data bank and from the AidaBvdep system, subsequently adding information on the identity of the scholars-managers working in the various universities and at Miur (the Italian Ministry for Education, University and Research). Additional information regarding project management processes and the provision of intangible resources was collected through a questionnaire.

6.1. Variables and the Research Model

The variables affecting the performance of spin-offs were analysed by Bivariate Correlation Analysis using Pearson's coefficient. The businesses' performance was measured through the Return on Investments (ROI) index obtained from 2011 official financial statements. Other variables included several governance features such as the level of interdisciplinary in the knowledge and competencies of the scholars belonging to the governance body in question (InSSD) and the presence of *interlocking directories* (Indi), all the way to the ability to attract venture capital towards businesses and banks (SogColl) and towards the parent organization (Uni). The relation between business performance and the characteristics of the social network in terms of network centrality and cohesion was also analysed. Analyses were carried out both on companies based in areas considered as more lively from a business and social standpoint and on a control sample, so as to verify how performance is influenced by the "territorial factor" and the spin-off's proximity to enterprises. A first comment is provided on the results of the questionnaire.

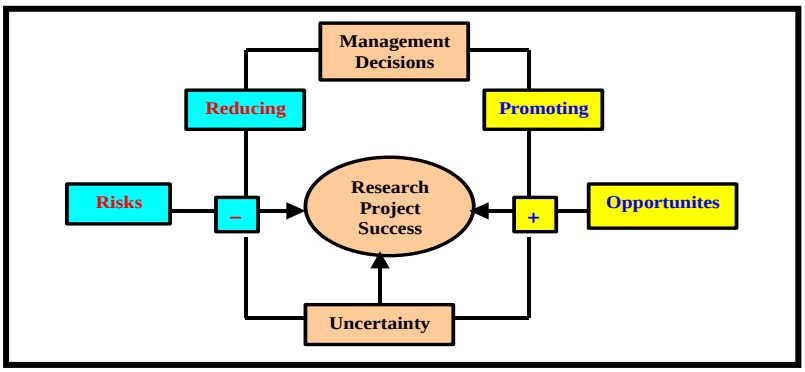
6.2. The questionnaire: Structure and General Aspects

Out of the 21 questions asked to the spin-offs, the first ones (1-4) regard the type of research projects carried out by spin-offs and allow to gather information that will be connected to project complexity indicators to be investigated at a later stage. These questions have been conceived to verify the truthfulness of some data obtained from the literature published in English on the state of the art of Project Management (PM), following some issues arisen by the critical discussion of such results. According to the researches mentioned above, project managers feel a deep dissatisfaction and frustration in relation to PM techniques. Moreover, the projects managed through the above methods are bound to failure in more than half the cases, while the advantages and benefits ensured by the application of planning and control techniques prove to be very limited.

The debate triggered by the considerations above led experts to focus more in-depth on the following issues:

- a critical review of the traditional PM model;
- a detailed analysis of the assumptions and premises on which that model is based;
- a greater focus on the specific features and peculiarities of the projects, which are generally overlooked by the universal approach typically taken in the traditional PM model;
- the identification of critical aspects working as indicators of project complexity.

In particular, questions 3 and 4 aim to verify the actual application of planning techniques and procedures on the part of project managers, while questions 5 and 6 provide information on the criteria applied to measure the success of a certain project and the success-failure ratio of research projects in general. Question 7 assesses the level of satisfaction or dissatisfaction of the managers with regard to the results achieved in their respective research centres. Question 8 uses specific indicators to identify the most frequent reasons for project failure. Questions 9-12 ask the respondents to give their opinion on the relation between the objective pursued by a research project planning and control activity and the actions taken to achieve that objective. The model used is represented in the following logical design.



The third group of questions (13-21) has been conceived to assess project complexity. This value is measured through a series of critical factors that the existing literature has so far analysed and structured in a rather inconsistent way.

More specifically, the following components have been identified:

- project innovativeness (*innovativeness*);
- project technological and epistemological uncertainty (*technological uncertainty, epistemological uncertainty, ambiguity, equivocality*);
- frequency of changes, amendments and revisions that the projects undergo during their implementation (*change management*);
- role played by "soft" aspects, for instance thinking systems, cultural aspects, problem-solving schemes and methods (*creative problem solving, sense-making, shared mental models*, etc.);
- role played by the human factor in the project's success (*human factor, human resources*).

According to the traditional PM model, projects consist in routine, repetitive activities carried out in stable environments that are not subject to any unexpected changes. The research projects typically carried out in university spin-offs, conversely, include activities that cannot be automated nor precisely replicated and that are characterised by great creativity and a powerful drive towards innovation.

6.3. Results: questionnaire

The sample examined recognizes the strategic importance of the implementation of a Project Manager model for the management of research projects. In particular, 86.67% considers as fundamental *defining, in a clear way, the goals to be achieved for a successful research project* against 2.22% *who do not follow any whatsoever planning and organization methodology*. 39.53% of the spin offs believe that *breaking the goals down into sub-goals* is fundamental, 44.44% acknowledge that a strict planning leads to a more efficient *manner to increase the chances of achieving a successful project*. These facts are also confirmed by part A3 of the C-P form, highlighting the well-defined aims and methods. Moreover, the data obtained in connection to the variables which can be traced back to the typical complexity and uncertainty of research projects are clear. In fact, 39.53% of the spin-off companies considered, blame the confusion of defining goals and methodology on the *complexity of the research project* and 25.58% on the *innovative character of the research project*, only 6.98% maintains that said confusion depends on *too ambitious goals that the research program wants to achieve*. In such a context, the percentage obtained with reference to the probabilities of a successful/unsuccessful research program is particularly significant: 97.44% of the spin offs believe that *a better definition of the goals and methodologies during the planning stage* substantially affect the probability of achieving a successful project respecting goals and timings, without exceeding the budget assigned; in effect, 66.67% of the spin offs only concentrate on projects having *clear and well defined goals*. Hopefully, the spin offs will more and more employ a new model of project management aiming at achieving an efficient and successful new RPM approach. Said assertion is confirmed by 42.11% of spin offs that confirm *they often change the goals predetermined during the planning stage*, 97.37% believe they should follow *a circular dynamic model of adaptation and review*. A particularly flexible and dynamic RPM model is fundamental for the management of spin off typical projects because 55.26% believe it is more suitable to make adaptations to the project during its development so as to better face accidental issues, only 5.26% believes not having to alter the original organization plan at all. The RPM also better adapts to a strictly democratic and participative management model believed necessary by 94.59% of university spin offs. As far as the intangibles are concerned, the questionnaire shows that about 40% of those interviewed acknowledge that the relationship with the *end users* and the fact of having the appropriate information are the main factors for guaranteeing the success of the research projects. As far as human resources are concerned, 50% believes the ability of cooperating and coordinating the roles within the team are fundamental, but in particular 64% consider that the person in charge of the projects must have both scientific and strictly managerial expertise. As far as the latter is concerned, marketing expertise, interpersonal skills and the necessary know-how to increase the financial funds coming from outsiders are considered fundamental for successful spin off. Moreover, a democratic and active style, together with a strong organizational culture result in being rewarding.

6.4 Evidence of Statistical Analysis: Descriptive Statistics

The clusters considered concern the spin offs coming from universities in the regions of Piedmont, Emilia Romagna, Tuscany, Lombardy and Fiuli Venezia Giulia. Considering the percentage of answers to the questionnaire, a sample equal to 44% of the people of the spin off companies in the above mentioned areas was acknowledged, to which evidence extracted from 29 companies out of the clusters and considered a control group was added. By 2013, 10% of the sample companies in the clusters are either winding up or inactive. The detailed statistics of the cluster sample (Table 1) highlight an average profitability of the negative investments, even if the value undergoes strong fluctuation, turning out to have, in absolute terms, a profitability over 10% in 28% of the sample within the clusters. Even in the control sample, the average profitability takes on critical values and there is a certain instability within the group.

Tab.1: Descriptive statistics: clusters

	No.	Min	Max	Average	Standard Deviation
ROI	105	-143,55	88,50	-,7523	29,72987
Valid (listwise)	105				

Tab.2: Group Control

	No.	Min	Max	Average	Std. Dev.
ROI	29	-120,44	48,00	-,3210	27,91374
Valid. (listwise)	29				

6.5. Network Structure

About 57% of all the companies studied present cross function managers. That is, in the cluster companies 55% form cross functions between government bodies and other companies; within both groups multiple roles are taken up by the managers who, in almost all the cases, are not researchers with joint assignments. *The Social Network Analysis (SNA),* applied considering the connections among the presence of cross function managers, points out both in the cluster sample and in the control group a network with a poor level of team work, confirmed by very low values of Density[220], by the average number of connections of each manager (AvDegree) and by the great distance observed among the managers, expressed by the geodetic distance index (Table 3). It is gathered that, even delineating the analysis within specific territorial areas characterized by an acceptable business activity concentration, the university spin offs do not create strong networks as far as the relationships made to co-opt the managers c/o partner companies or companies that supply assets are concerned. The analysis underlines that many of said relationships involve companies belonging to the financial sector, whereas involvements in research consortiums, technological parks, research centers or company developers are less frequent. Moreover, many relationships with PMI's belonging to the manager's family network are developed and this confirms the repeating of personal relationships in the spin off collaborations. The *interlocking directories* are less common among the same spin offs, even among those of the same cluster, and this demonstrates the fact that it tends to manage its dependence on the resources, both the human ones and the financial ones, looking for relationships outside the spin off circuits. Even in the control group, made up of companies which are geographically far apart from one another, a weak network and a poor cohesion among the parties stands out.

[220] The density index ranges from a max. of 1 (high cohesion) to 0.

Tab. 3: Network Cohesion measures for both groups

	Geodesic distance	No. Ties	Density	Avg.Degree
Cluster	Avg 4,83	465	0,006	1,58
	StdD 0,02			
Control Group	Avg 9,1	185	0,017	1,74
	Std 2,3			

Substantial datum concerning the positioning of the parties in the network emerge again from the SNA, expressed by the three centrality measures of Freeman: the Degree, the Betweenness and the Closeness of one party to others, which express the efficiency with which a party reaches others in the network. The low value of the degree (Table 4) of the cluster sample stresses a poor inclination of the spin off managers towards the outside (Outdegree) and a poor popularity of the same (Indegree). In the network the centrality measures respectively take on an average value of 4.28% and 2.95%, revealing a poor appeal of the university spin off managers c/o other companies. Furthermore, another fact which comes up is that 53% of the relationships created by the spin offs with other companies present managers who act as homogeneous intermediaries within all the network. If the centralization based on the interposition, equal to 1.55 in the clusters, is connected to the global measure of centralization based on the degree, we can come to the conclusion that a strong and attractant gravity center is lacking in the group. Coherently with the theoretical construct of the research, this phenomenon can explain itself with the fact that among the spin off companies there is a good degree of diffusion of the critical resources, such as technological knowledge and human resources, towards which reliance from the outside is limited even if present, whereas financial requirement and the need to compare one another with *end users* are greater. Even in the control groups the average values of the centrality are limited (Table 4).

In the cluster sample, the SNA stresses the presence of 7 *cliques*, that is, sub-groups of companies more often presenting interactions within the Board of Directors. Examining its structure, we can see that it includes company developers and research consortiums, thus proving that the presence of these parties qualifies for their interaction and the creation of strong relationships among the companies and the spin offs, suggesting a more intense exchange among science, technology and the market. Furthermore, it is important to underline the fact that companies belonging to sub-groups are mainly present in chemical-pharmacological industries, as well as medical and industrial engineering ones.

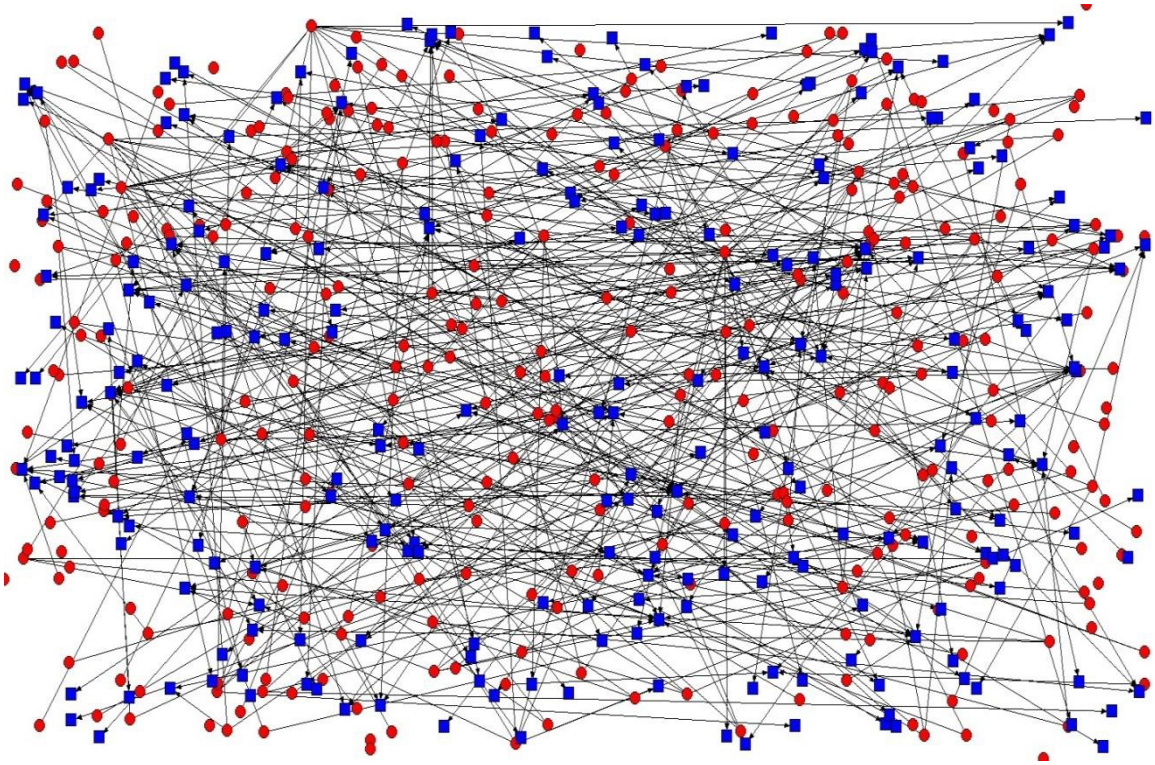


Fig. 2: Diagram of spin offs network into the clusters[221]

Tab. 4: Centrality measures of networks

		OutDegree	InDegree	InClos	OutClos	Betwee
Cluster	Avg	1,54	1,54	0,37	0,37	79,85
	StdD	1,79	1,33	0,05	0,05	159,7
	Network index	4,28%	2,95%			3,50%
Control Group	Avg	1,74	1,75	1,33	1,37	46,89
	StdD	1,90	1,51	1,99	2,18	96,4
	Network index	11,89%	6.07%			4,71%

6.6. The Correlation Analysis

The analysis concerning the companies included in densely populated clusters points out the existence of important relationships between the presence of cross function managers and the one of collective subjects in company structures. We can deduce that the opening of the spin off towards outside is influenced by the nature of the stockholders, confirming the fact that outside networks tend to reproduce the requests of the team of the founding members and partners. The circumstance also comes up in presence of *parent organizations* among the partners and, as a consequence, these events increase the centrality of the companies in the network of relationships with other organizations. No direct connection is deduced between the *interlocking directories* and the profitability of the investments. The latter is instead strongly connected to the centrality expressed by the Closeness measure, in particular by the degree of popularity observed in the network by the manager. That supposes that the presence of capable managers and good levels of profitability the company hold a

[221] In the diagram, the dots refer to spin off companies, the squares refer to the managers. The lines go from the companies towards the subjects.

central role in the network of relationships established on the territory. Satisfactory levels of centrality are also observed in the presence of managers-researchers who basically repeat the great network of technical-scientific relationships made up in the past in their organizations of origin; furthermore, the presence of inside networks of knowledge, expressed by their degree of expertise interdisciplinarity, allows the spin off managers to hold a central role in the network. This also suggests a spreading of knowledge even outside.

Tab.5: Correlation Matrix for spin offs into the clusters

		INDIR	SogCol	Uni	Ammacc	Insdd	Outdeg	Indeg	Inclos	Outclo	Betwee	ROI
INDIR	Pearson Correlation	1	,331(**)	,246(*)	,145	,011	,624(**)	,354(**)	,576(**)	,512(**)	,202(*)	,183
	Sig. (2-code)		,001	,011	,140	,914	,000	,000	,000	,000	,039	,061
	N	105	105	105	105	105	105	105	105	105	105	105
SogCol	Pearson Correlation	,331(**)	1	,331(**)	,071	,075	,328(**)	,222(*)	,188	,175	,155	-,188
	Sig. (2-code)	,001		,001	,471	,447	,001	,023	,055	,075	,115	,055
	N	105	105	105	105	105	105	105	105	105	105	105
Uni	Pearson Correlation	,246(*)	,331(**)	1	,377(**)	,380(**)	,426(**)	,117	,046	,097	,233(*)	,150
	Sig. (2-code)	,011	,001		,000	,000	,000	,235	,640	,324	,017	,128
	N	105	105	105	105	105	105	105	105	105	105	105
Ammacc	Pearson Correlation	,145	,071	,377(**)	1	,749(**)	,246(*)	,077	,223(*)	,248(*)	,128	,120
	Sig. (2-code)	,140	,471	,000		,000	,011	,434	,022	,011	,195	,223
	N	105	105	105	105	105	105	105	105	105	105	105
Insdd	Correlazione di Pearson	,011	,075	,380(**)	,749(**)	1	,250(**)	,010	,107	,210(*)	,146	,066
	Sig. (2-code)	,914	,447	,000	,000		,010	,919	,279	,032	,137	,503
	N	105	105	105	105	105	105	105	105	105	105	105
Outdeg	Correlazione di Pearson	,624(**)	,328(**)	,426(**)	,246(*)	,250(**)	1	,274(**)	,454(**)	,566(**)	,537(**)	,111
	Sig. (2-code)	,000	,001	,000	,011	,010		,005	,000	,000	,000	,260
	N	105	105	105	105	105	105	105	105	105	105	105
Indeg	Correlazione di Pearson	,354(**)	,222(*)	,117	,077	,010	,274(**)	1	,461(**)	,206(*)	,405(**)	,020
	Sig. (2-	,000	,023	,235	,434	,919	,005		,000	,035	,000	,838

	code)											
	N	105	105	105	105	105	105	105	105	105	105	105
Inclos	Correlazione di Pearson	,576(**)	,188	,046	,223(*)	,107	,454(**)	,461(**)	1	,851(**)	,211(*)	,201(*)
	Sig. (2-code)	,000	,055	,640	,022	,279	,000	,000		,000	,031	,040
	N	105	105	105	105	105	105	105	105	105	105	105
Outclo	Correlazione di Pearson	,512(**)	,175	,097	,248(*)	,210(*)	,566(**)	,206(*)	,851(**)	1	,225(*)	,165
	Sig. (2-code)	,000	,075	,324	,011	,032	,000	,035	,000		,021	,093
	N	105	105	105	105	105	105	105	105	105	105	105
Betwe e	Correlazione di Pearson	,202(*)	,155	,233(*)	,128	,146	,537(**)	,405(**)	,211(*)	,225(*)	1	,097
	Sig. (2-code)	,039	,115	,017	,195	,137	,000	,000	,031	,021		,323
	N	105	105	105	105	105	105	105	105	105	105	105
ROI	Correlazione di Pearson	,183	-,188	,150	,120	,066	,111	,020	,201(*)	,165	,097	1
	Sig. (2-code)	,061	,055	,128	,223	,503	,260	,838	,040	,093	,323	
	N	105	105	105	105	105	105	105	105	105	105	105

* The correlation is significant at level 0.05 (2-code).

** The correlation is significant at level 0.01 (2-code).

In the group control, the presence of interlocking directories is evident where other companies or banks in company structures are present, whereas the presence of parent organizations does not seem to make a difference. Even in this case, if there are interlocking directories good levels of centrality in terms of openess and the closeness of other subjects are achieved, but no interpositions are present. No correlations between profitability and other variables are present.

Tab. 6: Correlation Matrix control group

		INDI	Sogg Coll	Uni	Amm acc	Insd d	Outd eg	Indeg	Inclo s	Outcl o	Bet wee	R OI
INDI	Pearson Correlation	1	,368(*)	,186	,306	-,005	,557(**)	,432(*)	,788(**)	,738(**)	,122	-,207
	Sig. (2-code)		,049	,333	,107	,977	,002	,019	,000	,000	,528	,280
	N	29	29	29	29	29	29	29	29	29	29	29
Sogg Coll	Correlazione di Pearson	,368(*)	1	,589(**)	,133	,205	,440(*)	-,020	,295	,267	-,019	-,290
	Sig. (2-code)	,049		,001	,491	,285	,017	,918	,121	,161	,921	,126
	N	29	29	29	29	29	29	29	29	29	29	29
Uni	Correlazione di Pearson	,186	,589(**)	1	,386(*)	,287	,522(**)	-,118	,023	,200	-,062	-,271
	Sig. (2-code)	,333	,001		,038	,130	,004	,541	,904	,297	,748	,155
	N	29	29	29	29	29	29	29	29	29	29	29
Amm acc	Correlazione di Pearson	,306	,133	,386(*)	1	,424(*)	,385(*)	,286	,148	,253	,217	-,134
	Sig. (2-code)	,107	,491	,038		,022	,039	,133	,443	,186	,258	,488
	N	29	29	29	29	29	29	29	29	29	29	29
Insdd	Correlazione di Pearson	-,005	,205	,287	,424(*)	1	,064	-,016	-,156	-,100	,034	-,125
	Sig. (2-code)	,977	,285	,130	,022		,740	,935	,418	,605	,863	,518
	N	29	29	29	29	29	29	29	29	29	29	29
Outdeg	Correlazione di Pearson	,557(**)	,440(*)	,522(**)	,385(*)	,064	1	,386(*)	,536(**)	,665(**)	,143	-,239
	Sig. (2-code)	,002	,017	,004	,039	,740		,038	,003	,000	,459	,212
	N	29	29	29	29	29	29	29	29	29	29	29
Indeg	Correlazione di Pearson	,432(*)	-,020	-,118	,286	-,016	,386(*)	1	,540(**)	,261	,195	-,132
	Sig. (2-code)	,019	,918	,541	,133	,935	,038		,002	,172	,310	,495
	N	29	29	29	29	29	29	29	29	29	29	29
Inclos	Correlazione di Pearson	,788(**)	,295	,023	,148	-,156	,536(**)	,540(**)	1	,595(**)	,303	-,220
	Sig. (2-code)	,000	,121	,904	,443	,418	,003	,002		,001	,110	,252
	N	29	29	29	29	29	29	29	29	29	29	29
Outcl	Correlaz	,738(	,267	,200	,253	-	,665(	,261	,595(	1	,101	-

o	ione di Pearson	**)				,100	**)		**)			,117
	Sig. (2-code)	,000	,161	,297	,186	,605	,000	,172	,001		,603	,546
	N	29	29	29	29	29	29	29	29	29	29	29
Betwe e	Correlazione di Pearson	,122	-,019	-,062	,217	,034	,143	,195	,303	,101	1	-,013
	Sig. (2-code)	,528	,921	,748	,258	,863	,459	,310	,110	,603		,947
	N	29	29	29	29	29	29	29	29	29	29	29
ROI	Correlazione di Pearson	-,207	-,290	-,271	-,134	-,125	-,239	-,132	-,220	-,117	-,013	1
	Sig. (2-code)	,280	,126	,155	,488	,518	,212	,495	,252	,546	,947	
	N	29	29	29	29	29	29	29	29	29	29	29

* The correlation is significant at level 0.05 (2-code).
** The correlation is significant at level 0.01 (2-code).

Conclusion

The analysis confirms the positive relation between the centrality of a spin off in a network, created by interlocking directories, and the company profitability, above all, in very vital clusters from an academic-business point of view. Notwithstanding the network in which the spin offs are inserted is not so cohesive, the interlocking directories seem very defused, above all in the presence of interdisciplinary expertise within the Board of Directors of the spin off; this suggests that said clusters enable a great process of knowledge and innovation spreading promoted by said companies, leading to a consequent development of the relevant social-economical context. In terms of policy, the analysis confirms the importance of creating external relationships reducing dependency on resources. Among the main elements capable of affecting the development process of a spin off, great importance is given to the *venture investor* which is capable of supplying the financing required by the development of the new academic-business initiative. In regards to this, some authors (Shane and Stuart, 2002) demonstrated how those spin offs mainly connected with the *venture capitalists* have greater chances of receiving from the same the funds required for the development of their activity and, as a consequence, less chances of failing in achieving their own targets; clearly, the development of the relationships towards a business world and with industrial partners is regarded as a key variable of success for a spin off that however requires time to be developed, such as that it is considered a process in continuous evolution (Hite and Hesterly, 2001). Furthermore, some research has demonstrated how newly established academic spin offs have greater possibilities to receive finance on behalf of *venture capitalists* compared to other types of technological start-ups (Angel and Vendrell–Herrero, 2010). What has been illustrated up to now lets us easily understand the importance of a network of financers and solid *venture capitalists* capable of actively supporting all the development process of a spin off in the lack of which the odds of failure of a spin off relentlessly increase. This is particularly true in the initial stage of a spin off's life in which the asset contribution is fundamental for the following growth and development (refer to datum in Tables 3, 4, 5). The goals, ambitions and preparation of the personnel of a spin off are factors that influence the decision to start up a new business of this type and are also the factors which mainly affect its development in time (Piccaluga, 1999); it is also true that researchers and university professors who start up a new entrepreneurial initiative of this type have great professional expertise in the sector, but ignore management elements above all relevant to administration and finance, which are fundamental for the

sustainable development in time and capable of allowing the spin off to face the market challenges. Doutriaux (1987), distinguishes full time employment from part time employment within spin offs and points out how, on one hand the spin offs mainly appear being capable of facilitating the combination between theory and applied research, between universities and industries, and on the other hand, run a risk in concentrating too many commitments in the entrepreneurial initiative, neglecting the academic ones. However, the researchers-entrepreneurs capability to favour relationships between universities and industries in a dynamic way is, without doubt, able to guarantee a profitable collaboration relationship with the *parent-organization*. (as deduced in Tables 3, 4, 5). As a consequence, to enable the development and sustainable growth of a spin off in time, on one hand it is necessary to provide for the lack of management expertise of the academic personnel, aiming at the management training as well as the essentially technical one (or as an alternative, turning to professionals), and on the other hand, incentivize a greater integration with the *parent organization*, whose competences and relationship network at disposal play a fundamental role (as deduced in Tables 3, 4, 5). However, because of the limits of the present research, in the future it is worthwhile to lead the analysis towards clusters which are less dynamic from a technological and entrepreneurial point of view, so as to consider how external relationships act on business services in said environment.

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