

Collective actors in academic entrepreneurship

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Abstract

This article reviews the literature on entrepreneurial and top management teams in a specific category of high technology ventures: research-based spin-off companies. We consider the scholarly articles published in top journals in management and organisation studies since 1993. We find that the major theoretical underpinnings of this literature are given by human and social capital theories, as well as the upper echelon theory. The intention-behaviour theory, instead, plays a less prominent role. We also find that this literature is rather fragmented and that theory-building contributions tend to prevail. The main topics that this literature investigates concern the relationships between firm life cycle and team composition and the patterns of team change in relation to the achievement of firm goals; less attention is paid to decision making processes and to team conflict.

Introduction

The purpose of this review is to outline the current state of the art and the emerging trends in management and organization research on the antecedents of the formation of collective organisational actors, namely entrepreneurial teams and top management teams. In particular, attention is devoted to the influence of these actors on firm growth patterns in research-based spin-off companies.

The majority of studies concerning academic entrepreneurship have specifically focused on policies aimed at fostering technology transfer from research organisations to the business sector by means of spin-off companies (Rothaermel et al. 2007). However, this stream of literature overlooks the organisational processes which enable spin-offs to achieve profitability and to pursue growth patterns (Mustar et al. 2006). We believe that further improvements of our knowledge on growth drivers of spin-off firms are necessary and are acquiring increasing importance. The reason for this is due to the fact that policies which have been implemented in Europe in the last decades have succeeded in the generation of new firms, but only a minority of spin-offs has managed to reap the economic returns of their innovations and to continuously develop profitable innovations, i.e. to accomplish the technology transfer mission which is expected from them (Wright et al. 2007; Mustar et al. 2008).

In this review we focus our attention on the organisational processes concerning collective actors in spin-off. The reason for this is due to the increasing evidence in Entrepreneurship research according to which entrepreneurial and top management teams are an important factor of corporate success (Birley & Stockley 1999). Entrepreneurial and top management teams have been long studied in large, established corporations, but they have been investigated in new, entrepreneurial firms only recently (Foo et al. 2006; Wright et al. 2007; Ensley et al. 2006). As a matter of fact, an emerging trend in Entrepreneurship studies concerns corporate governance in small and entrepreneurial firms (Huse 2000; Audretsch & Lehmann 2012). These studies suggest that the development patterns of entrepreneurial firms are highly influenced by the features of their entrepreneurial and top management teams.

Despite the long-standing recognition according to which entrepreneurship in high tech industries is a collective phenomenon (Kamm et al. 1990; Cooper & Daily 1997; Clarysse & Moray 2004) and despite the centrality of academic entrepreneurship for innovation and industrial renewal, the topic of teams within academic entrepreneurship is widely underresearched. With regard to this point it is interesting to recall the review on university entrepreneurship by (Rothaermel et al. 2007), covering publications in top management and organisation journals until mid-2000s, identifies only four contributions to this debate.

In this review we show that despite some recent advances, our knowledge of team dynamics in spin-off companies is still very limited and the current state of scholarship remains limited and fragmented. The first major theme investigated by this stream of literature concerns the transfer of human and social capital from academic inventors to a spin-off company; another relevant theme is related to the consequences of specific configurations of founders in terms of human and social capital on the development patterns of a spin-off. With regard to this latter point, specific attention is paid to the acquisition of other types of resources, to organisational change, to innovation and to business goals. While most studies ground on a resource-based perspective, others explicitly refer to the upper echelon perspective, which is particularly insightful to conceptualise the link between demographic characteristics of key actors in organisations and their impact on decision-making processes. Instead, we find that the intention-behaviour perspective is rarely adopted to understand these processes. Even though growth is a dynamic concept, we identified only a relatively low number of studies relying on a longitudinal design.

We believe that the current state of evolution of scholarship offers a wide range of opportunities to apply concepts and models developed in other sub-fields of entrepreneurship research that are gaining increasing recognition. These opportunities stem from the fact that research on collective actors in academic entrepreneurship is still quite fragmented and is characterised by limited cumulativeness. Most studies on this topic are theory-building contributions concerning different aspects of teams and their relationship with some dimensions of performance. We believe that the development of the field would benefit from hypothesis-testing contributions, aimed at testing on large samples the propositions developed by means of qualitative inductive case studies – which represent the most common methodological approach in this field. Furthermore, we notice that longitudinal studies are relatively rare. This fact is surprising, given that growth is a dynamic notion. Such an approach seems to be particularly important in order to appreciate the way in which configurations of entrepreneurial and top management teams influence the modes of firm growth.

Methodology

This review provides an account of the theoretical and methodological approaches adopted by international scholarship on the topic since 1993, and synthesises the outcomes of these studies. Based on a critical analysis of this body of research, we elaborate managerial and policy recommendations and we identify the gaps that further research should address. Our analysis follows a systematic approach and aims at developing an integrative synthesis of the issue at stake (Rousseau et al. 2008).

To this purpose, a search for articles published over a 20-year period (1993–2013) was undertaken. The choice of journals was based on the rankings by the Italian Agency for Research Evaluation of the most authoritative business research journals; more specifically, we restricted our analysis to those journals ranked in categories A and B, in a scale going from A to D. A keyword search was conducted on the Scopus database in two steps. First, we retrieved the articles by means of the following keywords: “top management team”, “TMT”, “upper echelon”, “board composition”, “board of directors”, “board member”, “board formation”, “entrepreneurial team”, “entrepreneurs team” and “founders team”. Subsequently, we narrowed the scope to articles dealing with these issues in academic entrepreneurship and academic spin-off companies¹. From all empirical works, only articles that focused on the formation, the composition and the effects on performance of the top management team and the entrepreneurial team in spin-off companies, as opposed to the characteristics of the individual founder, were selected. Furthermore, articles that considered the conditions favouring the formation of a spin-off were excluded. To this purpose, we operated a preliminary screening of the abstract of the articles retrieved.

Tables 1 and 2 in appendix offer an overview of the theoretical frameworks and the methodological approaches adopted in the articles we analysed in this review, and their main key findings.

Definition of main concepts

Entrepreneurial team and top-management team

The concept of “entrepreneurial team” is ambiguously defined in the literature (Schjoedt & Kraus 2009), and it often overlaps with that of the “top management team” (Birley & Stockley 1999). However, some authors emphasise the specificity of these two concepts (Vyakarnam & Handelber 2005; Ucbasaran et al. 2003).

As a first point, generally speaking it is important to emphasise that a team is a group of individuals who are bound by a commitment to a common goal, and thus they coordinate their action in order to pursue that goal, they share the outcomes of their activity and they are considered as a social entity by themselves and by others (Schjoedt & Kraus 2009). However, some studies (e.g. (Watson et al. 1995)) use the terms “team” and “group” interchangeably.

Early definitions by (Kamm et al. 1990; Kamm & Nurick 1993) qualify entrepreneurial teams in greater detail, as two or more individuals, who are involved in prestart-up activities, they

¹ We applied the following query: ((TITLE-ABS-KEY("spin off*" OR "spin-off*" OR "spinoff*" OR "spin-out*" OR "spin out*" OR "spinout*" OR "academic entrepreneurship" OR "academic entrepreneur" OR "academic entrepreneurs" OR "university start up" OR "university start-up" OR "university-based start-up*" OR "university based start-up*" OR "university start-up*" OR "university start up*" OR "academic high-tech* start-up*" OR "academic high tech* start-up*" OR "Science-Based Entrepreneurial Firm*" OR "Science Based Entrepreneurial Firm*" OR "Science-Based Entrepreneurial" OR "technological entrepreneur*" OR "research based spin-off*" OR "research based spinoff*" OR "research based spin off*" OR "research-based spin-off*" OR "research-based spinoff*" OR "research-based spin out*" OR "research-based spinout*" OR "research-based spinoff*" OR "research-based spin out*")) AND PUBYEAR > 1992) AND ((TITLE-ABS-KEY("top management team*" OR "TMT" OR "upper echelon*" OR "board composition" OR "Board* of directors" OR "board* member*" OR "board formation" OR "entrepreneur* team*" OR "founders team*" OR "founding team*" OR "entrepreneurial group*" OR "founders group" OR "founding group" OR "founders" OR "senior manage*")) AND PUBYEAR > 1992).

formally establish a firm, and they share its ownership. In addition to these criteria, (Ensley, Carland, & Carland, 1998) require individuals to have a direct influence on the strategic choice of the firm; following this line of reasoning, (Ucbasaran et al. 2003) establish a quantitative threshold – i.e. ownership of at least 10% of the equity in the venture – in order to be able to include an individual in an entrepreneurial team. These definitions also emphasise the fact that financial interest may or may not be evenly distributed among team members, and that specific responsibilities and tasks may be attributed to individuals, sub-groups or to the entire team. (Ensley et al. 2000) argue that a key role in a team is played by the lead entrepreneur, who is the actor who creates the vision and then gathers around them to form an entrepreneurial team other new members who share the same vision.

Further definitions of entrepreneurial team are given by (Cooney 2005) and (Schjoedt & Kraus 2009), who build on earlier contributions, by introducing the criteria of “significant financial interest”, “active participation” and “commitment to venture’s success”. These criteria exclude those who have minority stakes and silent partners, and include those who contribute to the venture with their work instead of with capital. Furthermore, they emphasise the fact that an entrepreneurial team defines goals and success criteria of a firm, thus suggesting that growth orientation is an outcome of entrepreneurial team decision-making processes.

Also the definition of top management team is characterised by a certain degree of heterogeneity across studies (Nielsen 2010). In their foundational article, (Hambrick & Mason 1984) refer to the top management team as to the small group of powerful actors belonging to the dominant coalition of an organisation and who influence its strategic decision making. Typically, members of a top management team occupy formally defined positions of authority, such as president, CEO, director, member of executive committees or critical line or staff functions (Pettigrew 1992; Roure & Madique 1986). It emerges that the concept of top management team is very useful to understand decision-making process in large corporations with a clear division between ownership and management.

As (Ucbasaran et al. 2003) notice, in entrepreneurial firms the notion of entrepreneurial team encompasses both ownership and decision making prerogatives; indeed, in spin-offs “*[t]he division between shareholder power, which remains in hands of the entrepreneurial team and management authority, which is given by the shareholders to the Board of Directors and the CEO in particular remains often theoretical*” (Clarysse & Moray 2004, p.56). This observation clearly limits the relevance of the distinction between the concepts of entrepreneurial team and top management team in spin-offs.

On a final note, (Cooney 2005; Vyakarnam & Handelber 2005; Ucbasaran et al. 2003; Ganotakis & Love 2012) highlight that entrepreneurial teams are dynamic entities, as their members can join (or leave) the team at any stage of the life cycle of a firm. In academic entrepreneurship, substantial part of the entrepreneurial process – e.g. recognition of the opportunity, access to finance, identification of customers, teambuilding – occurs before a firm is legally incorporated (Vanaelst et al. 2006). In many cases – although not always (Müller 2010) – academic founders carry out pre-start up activities when they are employees or students in their parent organisation. It is therefore important to acknowledge the fact that

teams operating in the pre- and post- start up stages may have different compositions and individuals may play distinct roles in these stages. To this purpose, (Grandi & Grimaldi 2003; Grandi & Grimaldi 2005) distinguish among “research group of origin”, “founding team” and “entrepreneurial team”. The first term refers to the individuals involved in the research project and in the development of the technology which a spin-off is built on; the subset of these individuals who are involved in the spin-off and are part of its entrepreneurial team at the moment of incorporation are referred to as the “founding team”. The “entrepreneurial team” instead comprises members of the founding team and non-academic members in each stage of its life cycle.

Spin-off

Despite the increasing conceptual and empirical research on the topic, the literature on technology transfer makes use of a heterogeneous terminology to refer to new ventures generated in a research environment. As (Bathelt et al. 2010) suggest, the absence of a clear-cut definition can be explained by the heterogeneity of the process due to the existence of different institutional environments which favour technology transfer processes.

Indicative of the variety of conceptual approaches is the plenitude of labels used to refer to the phenomenon: research based spinoff (Mustar et al. 2006; Clarysse & Moray 2004), science-based entrepreneurial firms (Moray & Clarysse 2005; Knockaert et al. 2011; Vanacker et al. 2013), academic start-up (Colombo & Piva 2012; Grandi & Grimaldi 2005), university start-up (Criaco et al. 2013), university spinout (Vanaelst et al. 2006; Lockett & Wright 2005; Vohora et al. 2004), university spin-off (Rasmussen et al. 2011; Bathelt et al. 2010; Pirnay et al. 2003; Lockett et al. 2003), and academic spin-off (Fini et al. 2009; Zhang 2009; Bjørnåli & Gulbrandsen 2010).

All these definitions share the common notion according to which spin-offs are new firms created to exploit commercially some kind of knowledge, technology or other research results which have been developed within a parent organisation. As such, spin-offs are well distinct from other technology transfer mechanisms – e.g. patenting or consultancy – that do not require the foundation of a new firm; furthermore, (Pirnay et al. 2003) explicitly qualifies spin-offs as “for-profit” organisations.

More specifically, the literature on academic entrepreneurship focuses attention on those ventures which are generated in public research organisations, such as national laboratories, research institutes and universities. “Research-based spin-off” is a broader term which refers to ventures generated in any kind of public research organisation, while “university” or “academic spin-off” specifically refers to initiatives generated in universities. As a matter of fact, the literature on academic entrepreneurship excludes from its scope of analysis those ventures whose parent organisation is a corporate R&D department. “Science-based entrepreneurial firms”, instead, is an even more far-reaching term that refers to spin-offs generated both in the latter institutional context and in public research organisations.

A first distinction of spin-offs is related to the notion of “institutional link”. As a matter of fact, the whole entrepreneurial process of a spin-off is heavily influenced by the relationship with its parent organisation – what (Mustar et al. 2006) define as the so-called “institutional link”.

With regard to this relationship, a first level of analysis concerns the intentionality of the process from the parent organisation's point of view. This criterion determines the distinction between "push" or "planned" spin-offs – i.e. those which are the result of a deliberate strategy implemented by the parent organisation which proactively provides incentives and offers support to the new ventures and spin-offs – and "pull" or "spontaneously occurring" spin-offs, initiated by academic inventors without any explicit encouragement from their parent organisation (Steffensen et al. 1999; Pirnay et al. 2003; Chiesa & Piccaluga 2000; Lockett et al. 2003).

A second level of analysis of the institutional link concerns the type of resources that a parent organisation transfers to a new venture. According to an early and broadly accepted conceptualisation, spin-offs are formed around cognitive resources produced in a parent organisation and embodied in technologies, in people or in a combination of technologies and people. Each of these three forms of knowledge defines a distinct type of spin-off (Carayannis et al. 1998; Nicolau & Birley 2003; Nicolaou & Birley 2003; Markman et al. 2008). A more fine-grained examination of the codified knowledge transferred by the parent organisation leads to the distinction between spin-offs based on new scientific and technological discoveries from those based on new research methods (Müller 2010). Furthermore, several definitions point out that a parent organisation may transfer additional resources or services to a spin-off, such as capital, management advice, and facilities (Carayannis et al. 1998). However, the transfer of a technology or of new knowledge is a necessary condition to define a venture as a spin-off (Clarysse & Moray 2004). According to this criterion, ventures that benefit from advice or are hosted in university facilities without an active involvement of an academic inventor or without the exploitation of a discovery achieved in a research organisation should not be regarded as spin-offs.

The second distinction of spin-offs worthwhile mentioning is related to the actors involved in the founding team of a spin-off. As our investigation aims at understanding the role of collective actors in spin-off, this area of analysis clearly acquires paramount importance. For some authors, the founders of spin-offs can only be academic personnel, including doctoral students (Steffensen et al. 1999), while other scholars include also technicians (Fini et al. 2009), students (Rappert et al. 1999; Pirnay et al. 2003; Clarysse & Moray 2004), and alumni (Laukkanen 2000). Interestingly, when a spin-off is based exclusively on a technology developed in a research organisation and its inventors are not involved in the firm, the entrepreneurial function in the new venture is deployed by non-academics who act as "surrogate entrepreneurs" (Franklin et al. 2001; Lockett et al. 2003). In this case the inventors may maintain an equity stake in the venture, without any involvement in decision-making (Nicolau & Birley 2003). However, some authors, e.g. (Fini et al. 2009), exclude this type of ventures from the concept of spin-off. The parent organisation may or may not be involved as a founder (Fini et al. 2009). In either case, it should not be considered part of the entrepreneurial team, according to the prevalent definitions of this concept (see the previous paragraph where we discuss the notion of "entrepreneurial teams" in greater detail).

The third relevant distinction of spin-offs is related to the critical issue of the timing of the start-up and the relationship between the founders and their parent organisation at that moment in time. There is no consensus in the literature with regard to this issue. One

perspective defines spin-offs as only those firms whose founders have left their parent organisation in order to start up the company (Carayannis et al. 1998). Although this may be the case of “genuine” spin-offs, such a circumstance rarely happens in practice (Pirnay et al. 2003). Therefore, many definitions acknowledge the fact that founders usually maintain their previous job in their parent organisation, and are therefore at the same time both academics and entrepreneurs (Steffensen et al. 1999; Clarysse & Moray 2004; Lockett et al. 2003; Druilhe & Garnsey 2004). A different case is represented by those spin-offs launched by alumni: in this case the start-up may occur immediately or even many years after a student’s graduation (Müller 2010).

Performance

Performance of ongoing firms has traditionally been evaluated with economic and financial indicators. (Grandi & Grimaldi 2005) point out that the criteria of success relevant for established companies – such as turnover growth, market share, return on investment, return on equity, return on sales – do not adequately capture success the case of newly established, high technology based companies. Although some studies (e.g. (Ensley & Hmieleski 2005; Colombo & Grilli 2010)) employ these “traditional” indicators to assess the success of high technology firms and spin-offs, the literature on high technology based firms has developed specific indicators of performance including the time-to-market of new products (Schoonhoven et al. 1990), the ability to raise venture capital (Shane & Stuart 2002), sales and survival (Eckhardt et al. 2006).

As (Vanaelst et al. 2006) suggest, success is a multidimensional concept and different dimensions of success characterise the various stages of the life cycle of new ventures and of spin-offs, in particular. In their view, success corresponds to the achievement of organisational fit in each stage of a firm life cycle. For instance, they point out that success for a start-up may mean obtaining funds from venture capitalists, while for an older company it may mean the achievement of break-even.

(Grandi & Grimaldi 2005), instead, focus on the transition from the pre- to the post-start up stage, by suggesting that the criteria used by venture capitalists for their investment decisions are more meaningful indicators of success of a pre-start up firm. These criteria include the characteristics of the market, the external environment, the technology, the business, and the founding team. By building on these indicators of success, the authors conceive performance along two dimensions of firm success: the articulation of the business idea and market attractiveness. The former refers to its degree of detail while the latter to its capacity of being attractive for the market place.

The transition between pre- and post-start up stage is also examined by (Müller 2010) who considers the velocity of establishment of a new company as a dimension of performance.

Conceptual frameworks

We identify two central relationships investigated by the literature on collective actors in academic entrepreneurship: the first considers the determinants of entrepreneurial/top management team composition in terms of the diversity of the resources embodied in team

members; the second investigates how different team configurations affect decision making processes. Both issues, team composition and quality of decision making relate to organisational outcomes, including performance in terms of growth.

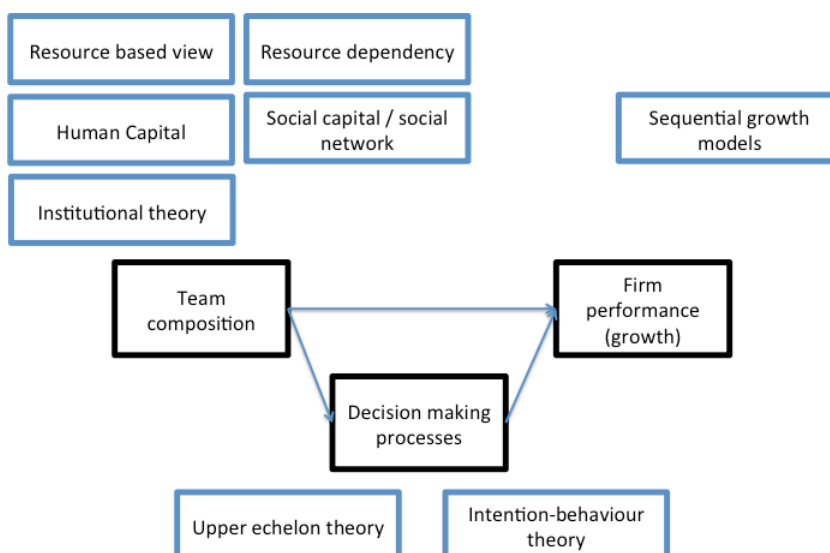
In order to conceptualise these relationships the literature exploits the insights offered by various theoretical frameworks. In particular, the determinants of team composition are analysed through two lenses: the Resource Based View and the Resource Dependency Theory. In particular two categories of resources, Human and Social Capital, are examined in greater detail by relying on specific theories. A different perspective to team formation is given by Institutional theory; in particular, this theory introduces the concept of isomorphism which is particularly insightful in order to appreciate the transfer of the organisational and behavioural structures characterising the parent organisation in an academic spin-off. The core insight offered by the resource-based perspective is that firm performance depends on the firm's endowment of resources and that the entrepreneurial/top management team embodies crucial resources.

The Upper Echelon theory and the Intention-Behaviour theory deepen the analysis on the phenomenon by focussing on the relationship between team composition and team members' attitudes on one side, and decision-making processes and their influence on firm performance on the other.

Since we are interested in firm growth, we also take into consideration the theories investigating this phenomenon with specific regard to spin-offs.

Figure 1 summarises the key relationships characterising the phenomenon under examination, and the relative theoretical approaches.

Figure 1. Theoretical perspectives on the relationship between team composition and firm performance.



Resource based view

The Resource-Based View (Barney 1991; Grant 2006) is a widely-adopted approach in strategic management which argues that firm performance depends on the resources it controls. Another closely related theoretical framework is given by the Knowledge-based

view (Kogut & Zander 1992; Conner & Prahalad 1996), an extension of this perspective which highlights the importance of cognitive resources in the value creation process. According to a basic interpretation of the resource-based approach, the ownership of a specific resource or the stock of resources controlled by a firm are drivers of competitive advantage; a more fine-grained elaboration of this framework suggests that firm performance is dependent on an original combination of complementary assets (Youndt et al. 2004; Teece 1986).

The Resource-Based View is widely adopted as a theoretical perspective also in academic entrepreneurship. The reason for the popularity of this approach lies in the assumption according to which entrepreneurial firms' competencies in their early development stages substantially coincide with those of their founding or entrepreneurial teams. In spin-offs this overlap is even more obvious, due to the fact that the technologies which they are based on typically entail a tacit dimension embodied in the research group of origin (Colombo & Piva 2012; Clarysse et al. 2007; Knockaert et al. 2011).

More specifically, two categories of resources appear particularly prominent in the context of entrepreneurial firms: human capital and social capital.

The concept of human capital, introduced by (Becker 1975), refers to the experience, formal education, expertise and reputation of an individual. Human capital is composed of a "specific" and a "general" component. The former consists of knowledge, skills and capabilities developed by an individual by means of training and experience in a specific domain which can be applied only to the narrow scope of jobs or tasks; by contrast, the latter represent general competencies with a broad scope of application (Colombo & Grilli 2007; Criaco et al. 2013). Following (Gimmon & Levie 2010), (Criaco et al. 2013) consider three forms of specific human capital referring respectively to: experience in entrepreneurial activities in general, professional experience in a specific industry, and in teaching and researching. It is important to highlight the fact that human capital and scientific prominence also play a signalling role of the quality of the entrepreneurial idea (Murray 2004).

With regard to collective actors, team human capital may be considered as a function of individual human capital. The importance of this idea lies in the fact that team human capital is widely acknowledged as a key resource in entrepreneurial firms (Ucbasaran et al. 2003) and, to a greater extent, even in spin-offs (Wright et al. 2007; Criaco et al. 2013) as they are characterised by high levels of tacit knowledge intensity and are highly dependent on the founding teams' capabilities. In order to fully appreciate this concept, it is important to bear in mind the difference between human capital and other individual characteristics, such as personality traits: human capital can be developed over time and transferred among individuals (Wright et al. 2007), while demographic characteristics are more static.

Social capital, instead, refers to the ability of individuals to access social resources embedded in their social network (Bourdieu 1986; Burt 1992). Relationships with customers, funders and key knowledge providers are of great relevance in the entrepreneurial process (Florin et al. 2003) as they enable opportunity recognition, acquisition of resources – including human capital – and legitimation of new ventures (Elfring & Hulsink 2007). According to the social capital perspective, individuals who are connected to these actors are the most valuable in an entrepreneurial team. With specific regard to academic entrepreneurship, two phenomena

are of particular relevance: the process of accumulation of social capital through academic inventors' career (Murray 2004) and the transfer of founders' social capital to a new venture (Grandi & Grimaldi 2003; Nicolau & Birley 2003; Nicolaou & Birley 2003; Shane & Stuart 2002; Bozeman et al. 2001).

Although the Resource Based View has given us valuable insights on the relationship between resource endowment and performance, this approach neglects the moderating effect of the environment (Clarysse et al. 2011; Lockett et al. 2005; Knockaert et al. 2011). Building on the contributions offered by (Katila & Shane 2005; Rajagopalan et al. 1993; Simsek et al. 2007), (Clarysse et al. 2011) suggest that dynamism, complexity and munificence of the environment impact the growth patterns of young, high-growth technology-based firms. Dynamism is given by the rate of change of the industry structure where a firm operates, and the opportunity for a firm to appropriate the rents of an innovation over a long period of time. Complexity, instead, refers to the heterogeneity of the variables that a firm should consider in its decision-making process, while munificence concerns the level of resources, including financial resources, available in the environment in which a firm operates. Following this line of reasoning, (Colombo & Piva 2012) argue that the environmental and internal conditions of the time of foundation critically influence the development pattern of high technology ventures.

The literature adopting the resource based perspective on the topic of academic spin-offs has well established the fact that high-technology start-ups and spin-offs lack the necessary resources at their start-up to develop a suitable competitive advantage. In particular, spin-offs are characterised by a lack of resources and capabilities in the areas of commercialisation and business development, due to their focus on technical activities. This lack of resources exposes firms to the so-called "liability of newness" and "liability of smallness". The liability of newness is related to interactions with stakeholders and refers to new firms' inferiority in terms of reputation, social capital and bargaining power in comparison to existing firms; the liability of smallness is related to the lack of financial resources and managerial capabilities which increases the likelihood of exposition to the fluctuations of the economic cycle (Knockaert & Ucbasaran 2013).

The resource endowment of founding teams of firms at their start up has been conceptualised as a direct and indirect driver of spin-off performance. Analyses of performance have focused on of the speed of the start-up process (Müller 2010) and of the launch of the first product (Knockaert et al. 2011), on economic performance (Criaco et al. 2013). Indirect effects concern the impact on team composition (Vanacker et al. 2013; Vanaelst et al. 2006; Clarysse & Moray 2004; Bjørnåli & Aspelund 2012) and on the opportunity costs borne by entrepreneurs when deciding to remain in the business (Criaco et al. 2013). Both these latter factors ultimately affect firm performance from the point of view of growth patterns, of economic performance and firm survival.

Process of entrepreneurial team formation

The literature offers relatively few models addressing the process of formation and change of entrepreneurial teams (Cooney 2005). The entire process is activated when one individual –

the lead entrepreneur – or a group of individuals identify an entrepreneurial opportunity; subsequently, the lead entrepreneur or the group develops a business idea and initiates the process of formation of an entrepreneurial team. The literature has identified three distinct theoretical lenses useful to interpret the entrepreneurial team formation process, and in particular with regard to members' entry and exit: the resource-seeking perspective assumes that teams are formed in order to access the skills and resources embodied in specific individuals; the interpersonal attraction perspective suggests, instead, that team formation is limited by members' psychological needs and by their structure of social networks (Forbes et al. 2006); the institutional perspective claims that team members tend to reproduce the institutional arrangements characterising the organisations or social context in which they are embedded (Ensley & Hmieleski 2005).

The first perspective, the resource-seeking perspective, builds on explanations and insights offered by human capital, social capital and resource dependence theories. According to this perspective, the composition of an entrepreneurial or top management team is a function of the firm's needs in terms of resources which a firm bears each stage of its life cycle. An entrepreneurial team decides to involve new members when it acknowledges a gap in the current configuration of resources. Human capital, social capital and resource dependency theories differ in the sense that they focus on the existence of diverse criteria for member selection. The human capital theory suggests that new members are chosen among those individuals who are characterised by skills, experience and competences which may contribute to filling the resource gap and thus to economic performance; instead, the social capital theory suggests that new members should be those individuals who can best bring important contacts and use existing relationships most effectively; the resource dependence theory (Pfeffer & Salancik 1978; Pfeffer 1987) emphasises the relevance for firms of the need to reduce uncertainty related to critical resources by acquiring control over them. According to this approach, membership to an entrepreneurial team should be granted to those individuals who contribute to the reduction of uncertainty as they provide access to critical resources; moreover, following this line of reasoning, the approach also argues that team composition varies with changes in uncertainty which are associated to different classes of resources throughout the entire life cycle of the firm.

In particular, according to the resource-seeking approach, an entrepreneurial team activates processes of team enlargement once it perceives a gap between its resource endowment and what it considers necessary to run a business; on the basis of this need, the team decides the selection criteria and the incentives to offer to new members. The entry of new members is typically related to the assessment of the original business idea and of its fit with the environment; this examination may then lead to a new process of resource acquisition as a result. Therefore, a team keeps its stability until it identifies a new resource gap or it fails to develop satisfactory human relationships, thus leading to the dismantling of the team and to the abandoning of its business idea. Indeed, emotional attachment to a team, and the levels of conflict within a team play a central role in the members' decision whether or not to remain in a team or to leave it (Kamm & Nurick 1993; Ucbasaran et al. 2003).

The resource-based perspective is very fruitful also to understand the composition of boards and top management teams in entrepreneurial firms, including spin-offs, with specific regard

to the presence of external directors. While in large corporations the function of external directors is given by a monitoring role, in entrepreneurial firms their function is to fulfil mentoring roles, by providing advice and guidance to the entrepreneurial team (Clarysse et al. 2007; Hülsbeck & Lehmann 2012).

In this stream of literature we include the studies by (Grandi & Grimaldi 2003; Grandi & Grimaldi 2005) who argue that the team formation process aims at creating teams which are complete in terms of the necessary organisational roles characterising innovation teams following the conceptualisation by (Roberts & Fushfeld 1981). As a matter of fact, the authors identify five main roles: idea generator, internal entrepreneur, project leader, technological gatekeeper and project sponsor. Each of these roles are characterised by specific competencies and personal traits. It is important to note that a team needs all these roles to successfully finalise an innovation project.

The alternative rationale for interpreting team dynamics is suggested by the so-called interpersonal attraction perspective which is given by the existing team members' desire to fulfil their social psychological needs. According to this view, existing team members do not undertake an analysis of their resource gaps, nor do they consider the potential contribution of new members; selection, instead, is based on criteria of interpersonal attraction and social connections, as suggested by the similarity/attraction theory developed in the field of psychology (Byrne 1971) and the notion of homophily in sociology (Ruef et al. 2003). According to this perspective, individuals build relationships with people who share similar values, approaches to problem solving and are characterised by common backgrounds, education, professional experience and personality traits. The psychological explanation of this tendency lies in the fact that this behaviour allows founders to preserve the organisational culture of the venture and, ultimately, have a certain degree of control over it. The sociological explanation to this rationale assumes that individuals usually socialise with people who seem to be similar to oneself and that they search for partners under conditions of bounded rationality; under these conditions, therefore, the likelihood of new members being similar to existing ones is clearly very high. This perspective explains why teams often feature a suboptimal level of team heterogeneity (Forbes et al. 2006).

(Hite & Hesterly 2001) suggest that resource seeking and interpersonal attraction mechanisms are involved in different stages of the entrepreneurial team formation process: they claim that in the initial stages of a firm life cycle, an entrepreneurial team exploits the social connections of its members, or those of key stakeholders such as funders or the research organisation of origin – in order to acquire resources including entrepreneurial and managerial capabilities. In particular, the process of identification of individuals who carry or provide access to such resources is regulated by homophily and mostly involves the strong ties of the entrepreneurial team members. In academic spin-offs, this path-dependent mechanism favours the presence of academics at the expense of other professional profiles in the entrepreneurial team; as a consequence, entrepreneurial and top management teams of spin-offs are rich in scientific human capital, but lack industry and leadership experience (Colombo & Piva 2012). The degree of team heterogeneity in terms of the experiences of the entrepreneurial teams is arguably low even when non-academic members have become part of the team, because they are selected from the existing social networks of key stakeholders.

Heterogeneity is a valuable characteristic of the human capital of entrepreneurial teams, particularly in a dynamic perspective due to the fact that the importance of the different forms of human capital varies throughout the various development stages of a new venture. It is possible to argue that firms with homogeneous human capital tend to include new members in order to acquire the human capital they need; however, this occurs only during the growth stage of new ventures' life cycle, namely when it adopts an intentional approach to network creation and it deliberately chooses which individuals to partner with. In this stage, the weak ties of the entrepreneurial team members provide the most valuable contributions responding to the need of acquiring new human capital. In fact, weak ties carry information concerning new opportunities which are necessary for the renewal of the initial business idea. However, (Greve and Salaff 2003; Steier and Greenwood 2000) claim that weak ties are relevant also in the early stages of the firm's life cycle as they contribute to the provision of valuable information for the definition of a firm's business plan.

The third theoretical lens used to interpret entrepreneurial team formation is given by the institutional perspective. In particular, it has been applied to the case of academic spin-offs in order to understand the drivers of board composition (Ensley & Hmieleski 2005). The concept of institutional isomorphism refers to the tendency of a new actor in a field to replicate the activity and the organisation of those who are considered successful in that field (DiMaggio & Powell 1983). Through this process new actors achieve cognitive and socio-political legitimisation (Roberts and Greenwood, 1997), i.e. they are known and acknowledged in their field. (Ensley & Hmieleski 2005) argue that spin-offs seek to gain legitimisation in order to overcome the liability of newness characterising high technology start-ups. They claim that spin-offs tend to reproduce the institutional norms of the university or of other successful academic spin-offs, rather than those characterising their own industry. Institutional theory distinguishes between three different forms of isomorphism: coercive, mimetic and normative. Coercive isomorphism refers to the pressures that a new actor receives from other organisations which it depends on; in the case of academic entrepreneurship, (Ensley & Hmieleski 2005) point out that spin-offs' scope of action is limited to a certain extent by universities requiring spin-offs to align to specific technology transfer policies; this kind of pressure does not apply to independent start-ups. Mimetic isomorphism, instead, refers to an actor's deliberate decision to reproduce the organisational structures and norms characterising successful existing organisations in order to reduce uncertainty. High technology industries are characterised by high uncertainty, therefore this is the reason why mimetic isomorphism is expected. However, it is interesting to note that academic spin-offs tend to conform to the norms of other successful spin-offs, which represent the closest cases of success academic entrepreneurs are aware of; instead, independent start-ups are more likely to imitate the successful firms in their industry. Finally, normative isomorphism refers to the set of norms characterising a specific professional group. Spin-offs are likely to be prone to adopt the norms of academia, which represent a strong profession whose norms are reproduced through formal training and scientific societies; by contrast, independent start-ups are likely to involve multiple professional groups, none of which is dominant. On these grounds, (Ensley & Hmieleski 2005) argue that the top management teams of academic spin-offs are more homogeneous in composition and

are more stable than independent start-ups; finally, they also claim that these features of team composition are translated into lower performance levels.

Upper echelon theory

The Upper Echelon theory (Hambrick & Mason 1984; Hambrick 2007) has offered a conceptual underpinning to many studies concerning the *effects* of the action of top management teams.

In particular, this theory has strongly influenced the conceptual development of the studies on the effects of entrepreneurial and top management team action, by assuming a linear decision making process consisting in a sequence of stages given first by the analysis of a problem, then definition of strategic options and enactment of such options which finally drives to performance outcomes.

The authors of this theory claim that the experiences, values and personalities of powerful actors in the organization (e.g. the dominant coalition as defined by (Cyert & March 1963)) filter information from the environment on the basis of which strategic decision-making is undertaken. The experiences which top executives have had throughout their lives determine how information from the environment is perceived and interpreted; these perceptions and interpretations represent the basis for strategic choices, which are in turn key determinants of organizational outcomes (Hambrick & Mason 1984).

It is important to stress the fact that experiences, values, beliefs and attitudes which directors build their cognitive maps on are neither easily measurable in a reliable way nor observable. For this reason, by building on research on demography (Hambrick & Mason 1984) introduce managerial characteristics as proxies to be used in order to represent the deep level features which affect executives' perceptions and their interpretation of the environment and of the organization. This approach assumes that surface-level attributes are representative of deeper cognitive and psychological processes.

Demographic characteristics may be classified into three groups (Lawrence 1997a):

- immutable individual characteristics: age, gender, ethnicity, education;
- individual's societal position, i.e. marital status;
- features which define an individual's relationship with an organisation: organisational tenure, team tenure, functional background, international experiences and prior work experiences.

The most studied demographic characteristics of individuals are the following: age, education, socioeconomic background, functional experience, previous professional or entrepreneurial experiences (Ensley, Amason, 1999; Beckman, Burton, O'Reilly, 2007), prior joint working experience (Eisenhardt and Schoonhoven 1990) and values (Quinn, 1988). Some studies associate unmeasured deep-level psychological constructs (e.g. cognitive style or risk aversion) to surface-level characteristics (Eisenhardt and Schoonhoven, 1990; Hambrick and D'Aveni, 1992). Although the Upper Echelon theory includes values and personalities of key actors in organisations among the determinants of collective decision-making, empirical

studies tended to operationalize these deep level features of individuals with demographic variables, considering behavioural processes and cognitive diversity as a black box (Birley & Stockley 1999; Clarysse & Moray 2004; Lawrence 1997b; Priem et al. 1999). Indeed, the cognitive approaches are based on the idea according to which it is necessary to go beyond surface-level attributes in order to investigate the actual cognitive aspects that may be apparently hidden at a first glance and that demographic surface level features do not capture (Kilduff et al. 2000).

Further developments of the Upper Echelon theory have better specified the factors moderating the relationship between top management team composition and organisational outcomes. More precisely, the theory predicts the reflection of managerial characteristics in strategy and performance under conditions of high ambiguity, where multiple alternatives are plausible and managers can exercise discretion over them. Individual characteristics also matter when managers face challenging tasks, or wish to deliver high performance levels. In conditions given by heavy job demands, executives reduce the complexity of decision making by capitalizing on previous work experience; in this way, their backgrounds assume a central role (Hambrick 2007).

The contributions belonging to this theoretical stream claim that the linkage between team heterogeneity along these dimensions and venture performance is contingent to the nature of the problems addressed by teams: heterogeneous teams achieve superior performance in a turbulent environment or when they face novel problems, whereas homogeneous teams are more efficient in dealing with routine tasks and in reacting fast to unambiguous problems, by virtue of smoother coordination (Hambrick & Mason 1984).

In addition to the previous argumentations, it is important to consider that also theories on the organisation of small groups contribute to enhancing our understanding of decision-making processes and their link to performance. A first attribute to take into consideration is given by the analysis of groups is power, i.e. the capacity to influence others (Robbins & Judge 2008). As a matter of fact, the distribution of power among the members of entrepreneurial and top management teams has been recognised as a driver of performance. More precisely, performance is enhanced by the allocation of power to those members who can provide the most valuable contribution, given the stage of the life cycle and the environmental conditions which characterise the firm. This implies that an equal distribution of power among team members is not efficient but that allocation of power should, instead, change over time (Smith et al. 2006).

In relation to this stream of research the second attribute which is particularly important is given by the culture of a team. The model developed by (Van Muijen et al. 1999) classifies orientation towards the group as expressed by each team member into four ideal-types. Support-oriented members are those who are internally oriented and very flexible; they privilege participation, mutual trust, team loyalty and informal communication. Rule-oriented members are those who are internal oriented but have a clear focus on control; they primarily have regard and respect towards authority, they consider rationality of procedures and division of work as important, and they privilege hierarchical structures. Goal-oriented members focus on control as well, but they are externally oriented; they are motivated by

contingent rewards and by the achievement of performance goals. Finally, innovation-oriented members are flexible and externally oriented. Besides being creative and open to change, they also experiment and search for new information in the environment.

Intention-behaviour theory

An alternative approach to conceptualising decision-making processes is based on the idea that personal attitudes towards a given behaviour are among the leading factors which influence the intention to perform that behaviour, triggering in turn an actor to actually engage in that specific behaviour (Fishbein & Stasson 1990). Attitudes can be defined as individuals' personal evaluation of a specific entity, namely physical objects, other people, behaviours, general outcomes or even policies (Ajzen, Fishbein, 1977). They are important for organization theory since they play an important role in motivation theories, i.e. in explaining those psychological processes which determine the development of goal-directed behaviour by providing important insights to the choices which individuals take and which lead to specific lines of action. The reason for such relevance from a theoretical point of view is associated with their specificity: unlike features of personality, which are considered stable over different contexts, attitudes are more specific and variable, since they differ according to the specific kind of situation which is taken into consideration.

An early theory adopted in attitude-behaviour research is given by the expectancy-value theory. According to this theory, each individual's attitude is determined on the basis of the combination of one's beliefs concerning a specific action or object and the value of the attributes on which those beliefs are based. The basic principle underlying this theory is related to the idea of belief, i.e. the associations made by individuals between certain objects (behaviours for instance) with specific attributes, which in the case of behaviours are the expected effects of such actions. Clearly, beliefs on their own are not sufficient to determine attitudes: it is necessary to include one's idea of the likelihood of expected consequences (defined by the authors as attributes) of the behaviour in question occurring. In this way it is possible to determine individual's attitudes and subsequently, behaviour. This idea of the likelihood of expected consequences is represented effectively by one's subjective probability which can be seen, therefore, as the strength of a belief. Following this line of reasoning, according to the expectancy-value theory behaviours are predicted by the sum of the all the combinations of the strength of beliefs with one's valuation of expected effects (Fishbein, Ajzen, 1975; Ajzen, Fishbein, 1980).

Due to the fact that empirical findings adopting such theory were often contrasting or at least not so promising and revelatory as one might have hoped, debate on the topic started to question the predictive potential of attitudes, their conceptual utility and the existence of theoretical and methodological flaws, in particular in light of the rich complexity of human behaviour. More precisely, the possibility of discrepancies between "declared" attitudes and concrete actions (defined as literal and evaluative inconsistencies, Ajzen, Fishbein, 2005) called for the observance of the so-called compatibility principle between attitude and behaviours (Ajzen, Fishbein, 1977; 2005). The basic idea was good levels of predictability of behaviours can be achieved when examining attitudes and behaviours characterized by the same four dimensions used to define them, namely action, target, context and time, thus

explaining why a great number of studies which observed general attitudes to predict specific behaviours did not produce satisfactory findings. In this case the principle of aggregation is needed: a general attitude can be related only to a variety of behaviours represented by multiple-act criteria (Ajzen, Fishbein, 2005).

Another important issue was given by the need to take better into account the complexity of attitudes through multidimensional scores and not single dimensions only. Drawing from this line of reasoning a tri-dimensional perspective emerged, where individual's evaluations are made up of three separate components, namely cognitive, affective and behavioural responses.

In this context, building up on the tri-dimensional perspective, Ajzen and Fishbein (1977) developed the theory of reasoned action to address the problem of literal inconsistency by taking into account the role of intention when considering behavioural responses as determinants of behaviours. This theory, which can be considered as an evolution of the expectancy-value theory, is based on three constructs, behavioural intention, attitude and subjective norms, which are causally linked with one another (Ajzen, Fishbein, 1977). Such constructs correspond to the three separate categories of responses mentioned previously in the tri-dimensional perspective and can be identified as belief, attitude and intention.

Basically the main difference with expectancy-value theory is given by the inclusion of intention in the model, which is defined as the immediate antecedent of behaviour and is determined by attitudes combined together with subjective norms. In other words, an intention is developed following the interaction between attitude (determined as in expectancy-value theory by beliefs and personal evaluations) and subjective norms, given by the opinions of referent others along with one's motivation to comply to those opinions (Ajzen, Fishbein, 1977). Finally, the model also includes a set of background variables which affect beliefs, namely individual factors, social ones and information (Ajzen, Fishbein, 2005).

The last contribution to the theory on the relationship between attitudes and behaviours is provided by the theory of planned behaviour which develops the theory of reasoned action further by including an additional component of the model, namely perceived behavioural control, taken from the self-efficacy theory developed by Bandura (1977). The basic idea is that one's beliefs and expected consequences are not enough to predict the behaviour/attitude relationship; it is of uttermost relevance to take into consideration one's confidence, one's ideas of success and of one's ability of making things happen (Ajzen, 1991). In this way the theory is extended and can be applied to the so-called non volitional behaviours, i.e. those which are not completely under an individual's control.

Building both on these perspective and on the Upper Echelon theory, (Ensley & Pearce 2001) argue that firm performance depends on the extent to which members of top management teams share similar strategic mental models concerning future states and underpinning team level decision-making processes. Strategic mental models portray a vision of a future state that a top management team develops as the outcome of conflict processes among team members; such a shared mental model is, therefore, a predictor of team behaviour (Ensley & Pearce 2001).

With regard to these ideas it is important to recall that the literature has conceptualised two

separate forms of conflict: cognitive conflict, that refers to task-oriented disagreements arising from the presence of different judgments over an issue under debate, and affective conflict which is emotive and determined by individual-oriented disagreement arising from personal disaffection. Cognitive conflict is beneficial for decision making as it improves the quality of ideas thanks to intellectual exchanges and confrontations among team members, provided that the team norms accept cognitive conflict and that it does not entail affective dimensions; instead, affective conflict is detrimental as it does not entail idea generation and may harm team stability. Commitment of team members to shared goals contributes to reducing the risk of affective conflict, while team cohesion and intense communication increases cognitive conflict and minimizes affective conflict (Amason & Sapienza 1997; Amason 1996; Ensley et al. 2002; Hambrick 2007).

Cohesion is a social and affective state of groups that refers to the sense of morale, belonging and reciprocal attraction among members. Members of a cohesive team share values and tacit understandings, and tend to develop trustworthy relationships. This not only improves decision-making processes by fostering the creation of a shared meaning of ambiguous problems and minimizing opportunistic behaviours, but it also strengthens motivation and commitment to shared goals. Cohesive teams tend to exhibit higher levels of satisfaction and to perform greater efforts (Ensley & Pearce 2001).

Within this stream of literature, adopting the intention-behaviour paradigm as a theoretical lens to interpret phenomena we find the seminal work by (Wiklund et al. 2003) in order to examine the relationship between motivations and attitudes towards growth and actual or realised growth. In particular, motivations, attitudes and beliefs of entrepreneurs and entrepreneurial teams on growth outcomes have been recognised to have important impacts on growth outcomes.

Moving from evidence provided by these studies and combined with insights drawn from the Upper Echelon theory, according to which firm growth can be seen as the reflection of the characteristics of the small firm management team, along with the intention-behaviour framework, in particular the theory of reasoned action and planned behaviour (Ajzen, Fishbein, 1977; 1980; Ajzen, 1991), the seminal work by (Wiklund et al. 2003) specifically focuses on the analysis of small business managers' specific beliefs in relation to growth attitudes. The basic idea underlying this work is that small business managers may have particular cognitive beliefs which affect their idea of the consequences of firm growth which in turn impact their overall attitude towards growth. In particular, the authors draw from prior research which highlights the fact that small firms are focused not solely on the generation of returns and that in some cases greater importance is given to non-economic motivations, such as the desire to work independently and to be able to develop one's ideas (Douglas & Shepherd 2002); in other words, these previous studies suggest the idea that the fact that some small firms do not grow may be traced back to a specific wish to preserve a small environment, thus implying that interesting insights on the topic may be derived from a thorough understanding of attitudes and a careful examination of underlying beliefs of the firms' managers.

More specifically, (Wiklund et al. 2003) identify eight fundamental ideas which may impact

attitudes thus explaining possible lacks of growth aspirations by small firms' managers, as follows: owner-manager's workload; time spent by the owner-manager on preferred tasks, employee well-being and atmosphere, variations in income, probability to survive during hard times; enhanced control, variations in independence from external stakeholders, level of quality of products and services offered. The authors collected data from three independent telephone interview studies over a ten year period of time and the results highlight the major importance given to non-economic factors, in particular to employee well-being, suggesting that the lack of growth aspirations may be related to the will to preserve the atmosphere of a small organisation and that this may also lead to conflict within the managerial team in relation to growth issues (Wiklund et al. 2003).

On a final note, it is important to recall that studies based on the intention-behaviour paradigm have contributed greatly to the development of behavioural change theories. As a matter of fact, in the specific case of attitudes towards growth, related beliefs and their impact on actual growth, research on the topic is particularly worthy of attention for the managerial implications which can be derived. In particular, we refer to the possibility of identifying strategies aimed at modifying attitudes and developing socially desirable behaviours through persuasive techniques (Sheppard et al., 1988; Dreisler et al., 2003; Wiklund et al., 2003; Smallbone, Massey, 2012).

Research methods

Research on collective actors in academic entrepreneurship privileges an inductive qualitative approach consistent with the theory-building effort that most studies undertake. As we have already pointed out, the field is relatively under researched and thus most of research is exploratory in nature or aims at extending theoretical propositions developed with reference to large established corporation to the case of new, high technology ventures and spin-offs. Only a minority of studies pursues a hypothesis-testing approach, grounding their theoretical expectations on related literature (Criaco et al. 2013; Colombo & Piva 2012; Colombo et al. 2006; Grandi & Grimaldi 2005).

The very large majority of the articles considered in our systematic review examine firms as the unit of analysis of the study. We believe that this level of analysis is the most appropriate to understand the linkage between top management teams and organisational outcomes. This is due to the fact that the firm level enables us to appreciate the outcomes of decision-making processes at the team level. However, we also found some studies that take individual founders or managers as units of analysis (Müller 2010; Fini et al. 2009).

We find that the field is generally split among studies analysing science-based firms, including spin-offs (e.g. (Criaco et al. 2013; Vanacker et al. 2013; Knockaert et al. 2011; Clarysse et al. 2011; Stam & Elfring 2008; Colombo et al. 2006) and those zooming in on research-based spin-offs (Bjørnåli & Gulbrandsen 2010; Bjørnåli & Aspelund 2012; Colombo & Piva 2010; Clarysse & Moray 2004; Murray 2004). Among the studies broadly considering science-based firms we focussed on those providing insights on the specific behaviour of spin-offs, and excluded those that considered the nature of the firm as a variable in their analysis but did not derive any conclusions regarding spin-off firms. With regard to this issue, it is very important

to mention the studies by (Colombo & Piva 2012) and by (Ensley & Hmieleski 2005). The first focuses on a large scale dataset of Italian high technology firms, and compares the firms of academic origin to a matched sample of independent firms; the firms were matched on the basis of affinity in terms of age, localisation and industry utilising the propensity score matching technique developed by (Rosenbaum & Rubin 1983). The latter, compare spin-offs and high tech start-ups in the USA. Spin-offs were defined as high-technology start-ups located in either a university incubator or technology park at one of three different universities in the South Eastern United States, while the sample of independent firms had a national scope.

Most of the studies analyse firms based on different technologies and operating in different high-technology sectors; interestingly (Müller 2010) compares high technology to medium technology cases. The most frequently investigated technology areas are ICT and software, microelectronic, material technologies and to a lesser extent biotechnology-biomedical technologies. The four studies that focus on one single technological area are all case studies: (Murray 2004) and (Clarysse & Moray 2004) examine the cases of one spin-off in the regenerative medicine industry, and one in the telecommunication industry; (Vanacker et al. 2013), (Knockaert et al. 2011) and (Elfring & Hulsink 2007) adopt a multiple case study design, focussing on firms in the biotech, micro-electronics, and IT industries.

For what concerns the geographical scope, most of the literature considered examines European cases – in particular, the Flemish and Italian cases. Only (Bjørnåli & Gulbrandsen 2010) perform an international comparison, by appreciating the cases of American and Norwegian spin-offs.

Looking closer at the research design, we find that only a minority of studies adopts a longitudinal approach. This is the case of the qualitative study by (Clarysse & Moray 2004) – that follows a spin-off in the telecom industry for 20 months along all its stages of development, from opportunity recognition by means of the start-up up to its first capital increase – and in the quantitative study by (Colombo et al. 2006) who rely on 10-year longitudinal data of a sample of 401 Italian new technology based firms established between 1980-2000, mostly operating in ICT services, in software and ICT manufacturing.

Most studies, both those adopting a quantitative and qualitative approach, collect data by means of in-depth face-to-face and telephone interviews or mail questionnaires with the founders and/or the members of the top management teams of the spin-offs. Some large scale quantitative studies, data are gathered by means of public and proprietary databases of firms operating in high technology industries (Colombo & Piva 2012; Criaco et al. 2013).

In the case of data gathered from primary sources informants are typically requested to illustrate the characteristics of team members, to discuss strategic choices and key strategic decisions. In most studies, informants are asked to provide information on the current state of the firm, as well as on the time of foundation of the firm or even on the pre-start up stage. The reconstruction of a firm's history based on critical events is consistent with (Burgelman 1983)'s longitudinal-processual approach. Exceptions to this are given by studies based on invariant features of the founding team (e.g. (Criaco et al. 2013)), (Colombo & Piva 2012; Colombo & Grilli 2010; Colombo et al. 2006) longitudinal studies based on a proprietary

dataset consisting of demographic and financial measures, and (Clarysse & Moray 2004)'s longitudinal study which analysed the evolution of one spin-off for a 20 month-period by means of qualitative techniques.

Even though the vast majority of the studies we have considered take the firm as a unit of analysis, it is possible to distinguish between those which gather information on team dynamics and on firm strategy from one or a few key informants, and those which investigate all the members of the entrepreneurial/top management team or the majority of them.

In the first subset of studies, we include those who addressed *only* key founders, since they are regarded as the most informed people in the firm (Knockaert et al. 2011); in other cases, either information was provided by the CEO in charge at the time of the investigation, who, however, was generally a founder or a "surrogate" entrepreneur (Bjørnåli & Gulbrandsen 2010), or by a founder or the CEO (Clarysse et al. 2011). Similarly (Murray 2004) interviews either a founder or the academic inventor of the technology on which a spin-off is based. (Colombo & Piva 2010) interviewed both one academic founder and one founder with previous industry experience when the latter was present. (Grandi & Grimaldi 2005) instead interviewed at least two academic founders for each company but gathered data from a single questionnaire for each start-up as informants showed a strong agreement on their personal views. It is important to note that studies taking the venture as the unit of analysis may interview a serial entrepreneur more than once (Elfring & Hulsink 2007).

The second subset of works includes (Ensley & Hmieleski 2005) and (Colombo & Piva 2012)'s quantitative studies which construct the relevant firm-level variables on the basis of individual-level measures. (Ensley & Hmieleski 2005) investigate all the members of top management teams, and consider in their analysis only firms for which at least half of the components have replied to the survey. Among the qualitative studies, (Vanaelst et al. 2006) gather information from all the members of research origin of the teams and from all the members of the entrepreneurial teams who are still in the company at the time of research; information about team members who left the company are supplied by these informants. These studies do not gather information from the founders who left the team, and most of them do not use employees and stakeholders as informants because they are considered to be less aware of the company history and dynamics (Colombo & Piva 2010).

All the studies relying on primary information from members of the entrepreneurial/top management team rely also on additional sources (typically, interviews with technology transfer offices, business partners, customers, investors), archival documents, patents and publications (Murray 2004), and from official documents that allow to track changes in the entrepreneurial and top management teams (Bjørnåli & Gulbrandsen 2010).

Triangulation of multiple data sources is necessary to verify and integrate primary information, and it is crucial to minimize the effects of retrospection in those studies examining a firm's history without relying on a longitudinal design. In particular, the retrospection bias is addressed by limiting the age of the firms under investigation; however, we find some heterogeneity in the threshold of firm age: while (Grandi & Grimaldi 2003) consider firms that were 3 years old at the time of initial data collection, (Vanacker et al. 2013) and (Fini et al. 2009) include in the analysis firms that are 5 and 6 years old; the longest

period between data collection and firm foundation is found in (Bjørnåli & Gulbrandsen 2010) who consider firms that were 9 years old. Another precaution used to limit retrospection bias is related to the fact that informants are asked to discuss a phenomenon that is a major event for their firm and for this reason is more likely to rest impressed in one's memory.

Among the studies adopting a hypothesis-testing approach, (Grandi & Grimaldi 2005) and (Grandi & Grimaldi 2003) analysed a non-random sample of 42 Italian academic start-ups related to different technologies including electronics (30%), mechanics (7%), software (11%), and ICT (18%). Also (Fini et al. 2009) take founders as the units of analysis of their empirical study. They consider 88 founders of 47 Italian spin-offs established between 1999 and 2005 operating in different industries including mechanics and automation (30%), electronics and ICT (19%), energy and the environment (17%).

Dependent variables

The studies we have examined offer a variety of different dimensions of performance. This finding is not surprising in light of the heterogeneity of the phenomenon of academic entrepreneurship as we highlighted in the section devoted to definitions.

A first stream of studies adopts measures of performance that are associated to an economic-financial conception of value. This is the case for instance in (Ensley & Hmieleski 2005) – who consider “traditional” indicators such as net cash flows and revenue growth, in (Colombo & Grilli 2005) – who analyse firm size in terms of revenues and employees, and in (Knockaert et al. 2011) – who focus on the valuation of the spin-off at the moment in which its parent organisation exited the venture, either under the form of a sale to investors or to industrial parties or as the firm's liquidation. (Vanacker et al. 2013) instead consider the ability to raise finance, by appreciating the number and the quality of investors. (Criaco et al. 2013) examined firm survival in a population of university start-ups of different ages which were active in 2008 and identified those still active in 2011 and those out of business.

A related stream of studies takes intermediate drivers of value creation. These dimensions concern: the articulation of the business idea and its market attractiveness (Grandi & Grimaldi 2005); the structure of the social networks in terms of strong and weak ties and the contribution of such networks to key entrepreneurial processes such as opportunity recognition, access to resources and legitimacy (Elfring & Hulsink 2007); the establishment of alliances with regard to the time required for a firm to establish an alliance, measured in years from foundation, distinguishing between the technological or commercial purpose of the alliance (Colombo et al. 2006).

A third group of studies focuses on the characteristics of team composition. In this stream of studies, the work by (Bjørnåli & Gulbrandsen 2010) is particularly interesting as it examines the composition of the entrepreneurial and management team in terms of professional profiles, capabilities and social ties. (Clarysse et al. 2007) focuses on a specific aspect of team composition, namely complementarity and substitutability of members who are external to the founding team. They measure complementarity as the number of outside board members that had complementary experience to the founding team, and substitutability as experience

which is similar to at least one of the founding team members. Experience is considered in relation to three areas: R&D, commercial and finance. A more detailed analysis is carried out by (Colombo & Piva 2012) who consider a series of ten organisational characteristics of the founding team and of the firm's network. The team level variables include: number of founders with a master degree and with a Ph.D. degree, number of years of education – distinguishing between managerial and scientific-technical education, number of years of joint-work experience – distinguishing between technical, and commercial positions and taking into consideration if such experience was matured in the same sector as the focal start-up, the presence of founders with managerial or self-employment experience. With regard to the features of the firm indicating the ability to expand their competence endowment, the authors considered the percentage of employees working in technical functions and in commercial functions, of employees with a university degree, the presence of external managers, the establishment of technological or commercial alliances with public research organisations and with other companies, the acquisition of services from public research organisations and the involvement in research projects funded by the European Union. (Ensley & Hmieleski 2005) examine differences between high tech start-ups and spin-offs in terms of top management team composition and dynamics. The dimensions of team composition overlap those investigated by (Colombo & Piva 2012) with regard to heterogeneity of education, functional expertise, industry experience, and skills. Furthermore, they extend the analysis to team dynamics by looking at cohesion, potency, conflict, and shared strategic cognition. Cohesion was measured using the six-items Perceived Cohesion Scale developed by Bollen and Hoyle (1990). Potency was measured as the team's belief in its ability to perform effectively by using Guzzo et al.'s (1993) scale. The measure of conflict was derived from Jehn's (1994) "Interpersonal conflict scale" in order to assess both cognitive and affective conflict. Shared strategic conflict instead was measured by means of Venkatraman's (1989) "Strategic Orientation of Business Enterprises" scale.

Other studies investigate the dynamics of team composition, in terms of entry/exit dynamics (Vanaelst et al. 2006), and orientation towards external relationships. With regard to the latter dimension, (Grandi & Grimaldi 2003) consider founding teams' self-assessed intention to set up relations with external agents and the frequency of interaction of the founding team with external agents.

Explanatory variables

Human capital is a key theoretical construct that is explored in the majority of studies that take an hypothesis testing approach and that precisely define the variables under investigation. Human capital is analysed at the team level, through measures expressing the consistency and diversity of different dimensions of founders or managers' experience. (Clarysse et al., 2007) distinguish between functional experience in R&D, commercial and finance. In particular, they consider the "degree of experience" as the cumulative number of years of experience in a particular category divided by the total experience of all team members measured in number of years.

Further studies integrate the dimension of human capital with other variables expressing organisational constructs. Within this stream of studies, we find (Grandi & Grimaldi 2003)

and (Grandi & Grimaldi 2005) who consider the number of organisational roles characterising the innovation teams present in the research team of origin. Focussing on the pre-start up stage, they also consider the number of years of joint work experience of founders, the frequency of interaction with extra-academic actors and the openness to consider stimuli from extra-academic environment in the decision making process. It is important to note that all these measures were self-reported.

Also (Criaco et al. 2013) extend a framework based on human capital: in line with (Gimeno et al. 1997), they operationalize psychic income with the presence in the founding team of at least one member whose close relatives were entrepreneurs or self-employed. Another key variable in their theoretical model of firm survival is given by switching costs, which are measured as the average age of the founding team.

Motivational factors are another element which complement an analysis based on human capital variables, as in (Müller 2010)'s study on the speed of the entrepreneurial process. She considers self-reported measures of founder(s) motivation, by distinguishing among financial incentives, career progression in academia, desire of self-employment and reaction to a specific market opportunity.

(Colombo & Grilli 2010)'s extension of human capital, instead, deals with the presence of venture capitalists among the investors in the firm. It is important to note that (Clarysse et al., 2007) capture the effect of human capital in boards which include representatives of a public research organisation and venture capitalists by introducing an interaction term in their econometric models.

The studies instead that aim at identifying the specificities of spin-offs with respect to other types of high technology firms take the nature of the firm as key explanatory variable (Colombo & Piva 2012; Clarysse et al. 2007; Colombo et al. 2006).

Similar dimensions are also investigated in theory building studies, which however introduce the dimension of social capital in their analysis. For instance, (Vanacker et al. 2013) explore the presence of investors in the social network of founders as potential explanatory variables as well as the composition of the entrepreneurial team, the characteristics of the firm's business model and financial performance measures.

It is important to stress that this group of studies explicitly considers the firm life cycle in their theory building effort. This is the case in (Knockaert et al. 2011), who focus on the main resources of the spin-off at founding and in (Clarysse & Moray 2004). Similarly, (Bjørnåli & Gulbrandsen 2010) and (Elfring & Hulsink 2007) explore the stage of the life cycle in which the spin-off is and the current characteristics of its entrepreneurial team as potential explanatory variables.

Outcomes

Many of the studies on entrepreneurial and top management teams in academic spin-offs aim at developing conceptual models on the dynamic relationships between the features of the core knowledge (which a spin-off builds on), the firm's life cycle, the environmental conditions, team composition, and firm performance – including growth orientation.

In order to disentangle this relationship, first of all we look at the literature on firm life cycle with specific regard to conceptualisations of the typical patterns of research-based spin-offs. A common feature shared by all these models concerns the distinction between a pre- and a post-start-up stage.

Extending earlier conceptualisations of the process of spin-off creation (Ndonzuau et al. 2002), (Vohora et al. 2004) propose a model that identifies five evolutionary stages in the life cycle of a spin-off:

- research activities;
- framing of an entrepreneurial opportunity on the basis of research outcomes;
- organisation of the resources needed for the start-up;
- re-orientation of the business model in order to be continuously aligned to environmental and market dynamics;
- achievement of sustainable returns refer to the post-start up stage.

The first three phases refer to the pre-start up stage, while the latter two are related to the post-start up.

These authors suggest that the process of development of research-based spin-offs is not linear, as within each phase the firm iteratively considers decisions relative to the previous phases in light of the feedback provided by environmental conditions. However, in order to shift to a subsequent stage of development, a spin-off has to successfully accomplish a transition through the relative “critical juncture”. The model identifies four critical junctures:

- recognition of an entrepreneurial opportunity from the outcomes of a research project, which links the research stage to the business idea stages;
- achievement of entrepreneurial commitment by introducing a “venture champion” in the research group;
- development of credibility in the business environment, which permits the acquisition of the necessary resources for the launch of the new venture;
- achievement of sustainable returns which prove the quality of the business idea.

It is possible to acknowledge that this conceptualisation borrows a wide range of insights from the so-called “classical” models of development of SMEs (e.g. Greiner and Churchill & Lewis), in particular with regard to the idea that a venture has to overcome a series of “critical” stages in order to progress to the next phase. However, this model explicitly states that in each stage a firm may need to revisit some of the previous decisions and activities, thus limiting the determinism of the conceptualisation.

Much scholarly attention on academic entrepreneurship has been devoted to the policies and the contextual factors which influence each of these stages (Lockett et al. 2005; Löfsten & Lindelöf 2003; Stankiewicz 1994; Cantner & Kösters 2012) and in particular to the impact on the decision of starting up a new venture.

We then consider how environmental conditions affect growth orientation, features of business models and the composition of entrepreneurial teams in terms of critical skills. (Clarysse et al. 2011)’s theoretical model provides an insightful contribution on this issue by

examining two dimensions of the environment: stability and complexity. They argue that firms operating in a *stable* and *low complexity* environment pursue an organic growth pattern, characterised by an increase of revenues. The factors associated with this model of growth are given by the presence of a stable team of experienced founders, the elaboration of a product-based value proposition which refers to a specific niche, orientation towards value chain control and the use of operating cash flows to finance growth. In *stable* and *complex* environments, new ventures pursue an organic growth pattern, characterised by an increase of employment associated with a reduced increase of revenues. The factors associated with this model of growth are given by founding teams and personnel endowed with technical skills which support the development of a technology-based value proposition. These kind of firms establish technological partnerships and obtain financial resources from external investors. In *unstable* and *complex* environments, firms follow a growth pattern characterised by acquisitions which increase both revenues and employment. The factors associated with this model of growth are given by the presence of a founding or top management team endowed with commercial and technical experience. Growth is associated with the acquisition of both technology providers and firms operating downstream in the value chain. Financial resources are provided by a variety of specialised investors. Finally, in *unstable* and *simple* environments new ventures follow a growth pattern characterised by acquisitions. The factors associated with this model of growth are an experienced founding team endowed with a wide collaboration network and financial resources to be deployed at start-up; the value proposition is based on a distinct technology-based product.

A complementary perspective which may be used to conceptualise the features of a spin-off business model and its growth patterns takes the firm's key cognitive and technological resources into consideration. According to this view, spin-offs initiated by researchers with the aim of exploiting codified knowledge through industrial activities are characterised by a collective entrepreneurial function, they operate in high technology or high growth markets and are characterised by a clear growth orientation; by contrast, those initiated by students tend to be led by an individual entrepreneur and exhibit lower growth potential (Pirnay et al. 2003). A more fine-grained, bi-dimensional conceptualisation considers the positioning of the core knowledge of a spin-off along the science-technology continuum and the features of its value proposition, distinguishing between product- vs. service-based propositions. The first dimension discriminates between science-based firms and engineering-based firms (Autio 1997). The former transforms scientific knowledge into basic technologies, while the latter transforms basic technologies into application-specific technologies. The literature has offered different conceptualisations of the features of the relative value propositions. A first perspective classifies spin-offs as expertise providers, as technology developers or as product manufacturing (Stankiewicz 1994; Hindle & Yencken 2004); (Druilhe & Garnsey 2004) offer a more detailed articulation which distinguishes between providers of research services, technical consultancy, distribution, intellectual property licensing, software, production and assembling, and infrastructure developers. They argue that each of these business models is characterised by specific requirements in terms of the suitable combination of technical and commercial expertise and complementary resources.

All these theoretical conceptualisations are extremely insightful: the interest and the

importance which they represent lies in the fact that they link new ventures' needs in terms of resources to both environmental conditions and to the features of the entrepreneurial opportunity and of the business idea. More specifically we identified a series of contributions which focus on how the *structure* and the *human capital* of entrepreneurial and top management teams in new ventures change depending on the nature of the entrepreneurial opportunity and external conditions, as synthesised in the new venture life cycle models. In particular, we focused our attention on how these factors relate to firm performance.

In order to provide an overview of these contributions the remainder of this section is structured as follows: first, we consider the features of team structure and the resources which act as drivers of performance outcomes; in particular, with regard to this latter point, it is important to note that many studies in our review have considered access to finance as a key dimension representing performance outcomes and triggering such outcomes at the same time. Then, we analyse the dynamic process of team change.

Turning our attention to the features of team structure, it is useful to start by taking into consideration human capital. In particular, it is important to note that an entrepreneur or an entrepreneurial team is required to achieve an appropriate balance between generalist and specialist capabilities (Lazear 2004), in order to effectively perform its function and leading role in the firm. In particular, it is well established that the entrepreneurial teams of spin-offs exhibit specific features in comparison to other high technology firms as they tend to be made up of academics with similar educational background and professional specialisation and characterised by the lack of involvement of individuals with business experience (Chiesa et al. 2000; Colombo & Piva 2012; Colombo & Piva 2010; Ensley & Hmieleski 2005; Vanacker et al. 2013). In addition, the human capital of academic spin-offs is typically specialised in one area of scientific expertise (Johansson and Lööf, 2008), and the scientific excellence of founders is indeed acknowledged as an important factor underpinning successful spin-offs (Zucker et al. 1998).

Moving to entrepreneurial ventures in general, the level of human capital of the founding team is associated with various dimensions of performance such as firm size at start-up (Colombo et al. 2004) and firm growth (Colombo et al. 2004). As for what concerns firm survival, (Criaco et al. 2013) report that studies on general entrepreneurship which consider founders' human capital as a determinant of survival have found mixed results. In addition, (Colombo & Delmastro 2002)'s study comparing spin-offs with independent high technology ventures finds only marginal differences in performance levels. Their analysis confirms the findings of an earlier study by (Westhead 1997), while according to (George et al. 2002) spin-offs are more innovative but do not achieve a better financial performance.

Going back to the studies on academic entrepreneurship which we took into consideration for this review in relation to human capital, they show that previous professional experience in the same industry as the new venture, and business and entrepreneurial education positively affect new venture performance (Colombo & Grilli 2005; Delmar & Shane 2004) and firm survival, in particular (Nerkar & Shane 2003; Criaco et al. 2013). More specifically, (Criaco et al. 2013) finds that also university human capital is positively associated with survival, due to the fact that it expresses technical competencies which represent a source of competitive

advantage for a spin-off. By contrast, industry experience is negatively associated with survival, as it arguably provides founders with a greater number of alternative employment opportunities.

A further dimension of performance is examined in (Knockaert et al. 2011)'s theory building study: the velocity of new product development. The authors suggest that those spin-offs whose founding teams are endowed with both technical and commercial capabilities are capable of launching their first product faster. Furthermore, they argue that cognitive overlaps between members with technical and commercial expertise positively influence time-to-market; these cognitive overlaps derive either from common working experience or from a career pattern characterised by both technical and commercial experiences. By focussing on spin-offs founded by researchers who leave academia, (Müller 2010) finds that the start up stage is shorter when projects are carried out by teams rather than individuals, and in the case of initiatives where team members have specialised knowledge, instead of both business and technical competences.

Research on the topic has shown that not only the amount but also the quality and heterogeneity of human capital has a positive impact on the performance of spin-offs (Ensley & Hmieleski 2005). By comparing investments in technical and commercial capabilities, (Colombo & Piva 2010)'s explorative study suggests that spin-offs invest in technical capabilities more than other high technology firms; however, in a subsequent study (Colombo & Piva 2012) find that there is no significant difference in terms of investments in this type of capabilities at expense of commercial capabilities between spin-offs and other high tech firms.

With regard to the idea of diversity of human capital, it is important to recall that due to the fact that spin-offs control a rich technological competence and technical base, technical champions generally do not have the necessary managerial capabilities, and, therefore, the introduction of managerial competences is deemed necessary in order to sustain growth processes. Moreover, it has been well-acknowledged in the literature that academic spin-offs differ in terms of resource requirements and entrepreneurs' knowledge and experience (Druilhe & Garnsey 2004). This aspect is particularly relevant given the role of knowledge gaps throughout the different stages of the firm's life cycle (Lockett et al. 2005), each of which are characterised by specific issues which academic spin-offs need to face (Ndonzuau, Pirnay, & Surlemont, 2002). (Colombo & Grilli 2010) find that firms exhibit higher growth rates when founded by individuals with greater university-level education in management and economics and more prior work experience related to the technical functions of the sector where the new firm operates. Furthermore, the presence in the founding team of one or more individuals with prior managerial experience and human capital in management and economics contributes to accessing venture capital. However, (Colombo & Piva 2012) find that the propensity to hire an external manager in spin-offs is similar to that in other high tech firms.

A relevant analysis of human capital concerns its relationship with the different organisational roles of innovation teams. While roles in founding teams of origin tend to be associated with the norms of academic communities and linked to the development of research projects, their articulation according to the typical roles characterising innovation

teams is beneficial in terms of connective capabilities with external actors, in particular when gatekeepers are present (Grandi & Grimaldi 2003). By extending (Roberts & Fushfeld 1981) model, (Vanaelst et al. 2006) identify an additional role which is specific to spin-offs and is referred to as that of the coaches and consultants who provide the research team of origin with advice on business development tasks. These actors are located at a certain distance from the initial creation activities and can be considered “privileged witnesses” of the entrepreneurial process, who contribute to the success of the entire process. These results are consistent with the findings in (Beckman & Burton 2008)’s work which discusses the generality of entrepreneurial ventures: the completeness of the functional structure at start-up is associated with the speed of the financing process. It is important to note that, in a dynamic perspective, a critical change in organisational roles occurs in correspondence of the “critical juncture” represented by the start-up of a new venture (Vohora et al. 2004). To effectively manage this stage, the leader of the research group of origin has to be aware of the need to take a different role in the new venture (e.g. technical champion); in fact, leaders of academic teams do not have the transformative leadership attitude which is necessary in entrepreneurial teams (Clarysse & Moray 2004; Vanaelst et al. 2006). An additional critical issue which spin-offs face at their start-up deals with the exit of those members of the research team of origin who decide to prefer to stay in academia. This change leads an entrepreneurial team to identify new members which carry specific capabilities so as to re-equilibrate human capital at the team level (Grandi & Grimaldi 2003). However, continuity between the research team of origin and the entrepreneurial team is beneficial for the speed of introduction of the first product on the market, as it allows for the transfer of tacit technical knowledge from the pre- to the post-start up stage, thus contributing to the improvement of product development (Knockaert et al. 2011).

Consistently with the expectations of human capital theory, openness to entry of new members is less likely to occur in the entrepreneurial teams of spin-offs which control all the resources for the development of the business idea (Grandi & Grimaldi 2003), and, referring to the generality of entrepreneurial firms, in large entrepreneurial teams (Ucbasaran et al. 2003). However, availability of human capital may have detrimental effects on performance as it reduces the pressure for a team to undertake an externally-oriented resource seeking strategy, thus limiting its visibility and hindering access to critical resources.

With regard to social capital as a key resource, the studies we reviewed examine two related aspects: the process of formation of social capital and its impact on venture performance. It is interesting to note that social networks of academics play an important role due to the fact that they determine the structure of spin-off companies (orthodox, hybrid or technology), in particular for the embeddedness of the academic in a network of exo-institutional and endo-institutional ties (Nicolaou & Birley, 2003). With regard to the first issue, (Elfring & Hulsink 2007) suggest that firms develop their social network through a two-step process. In their initial stages, new ventures’ social networks are dominated by strong ties that are transferred by their founding team; strong ties are particularly important for the legitimation of a firm. Moreover, the initial endowment of social capital plays a particularly important role due to the fact that network activities of spin-offs with the parent organization result in access to technological competencies, in the provision of infrastructures and expertise (Gübeli &

Doloreux, 2005) and in the transfer of complex knowledge; on the other hand, however, they increase spin-offs' dependency from the support provided by basic research (Johansson, Jacob, & Hellstro, 2005). Academic inventors create professional relationships thanks to their career both at a local level, with individuals associated to their laboratory life, and at a cosmopolitan level, with the broader international scientific community (Murray 2004). A new venture's endowment of social capital tends to coincide with the social capital of its research team of origin (Grandi & Grimaldi 2003). Most importantly, the authors establish a connection between human capital and researchers' social network, by suggesting that more prominent researchers are characterised by a broader scientific network, due to the fact that their knowledge is more valuable for their peers. In line with this finding, (Colombo & Piva 2012) show that spin-offs tend to be more open than high technology firms towards the establishment of both technological and commercial alliances in order to purchase technical services from public research organisations; however, they do not differ from non-academic organisations in terms of propensity to enter in alliances.

In the second stage of network creation, spin-offs deliberately establish new connections with key actors; in this stage, weak ties are the most important for future development as they are associated with novel information sources which foster the renewal of the original business idea. However, in firms that pursue radical innovation both strong and weak ties are already crucial in their early stages of development: information carried through weak ties is very much needed in order to fine-tune the business idea. As for what concerns strong ties they reduce the likelihood of failure because of strong intellectual property protection, quality signalling effect and the involvement of investors (Rothaermel & Thursby 2005). These patterns of social networks are specific to industrial and academic spin-offs and have not been found in independent start-ups. As a firm evolves, it re-shapes its social network by abandoning those weak ties which do not contribute to the venture and by strengthening those that prove to be valuable.

This pattern of network creation contributes to explaining why human capital and the entrepreneurial team's cognitive profiles become increasingly heterogeneous as a spin-off grows throughout the stages of its life cycle (Vanaelst et al. 2006); it is also very useful in order to understand the dynamics of formation of the board of directors. The formalisation of a board of directors and the entry of external managers is another critical event in the life cycle of a spin-off which require role differentiation in the venture (Bjørnåli & Gulbrandsen 2010; Vanaelst et al. 2006; Clarysse & Moray 2004). In their theory building study, (Bjørnåli & Gulbrandsen 2010) combine insights from the social network and resource theories; they suggest that board composition changes along the firm's life cycle. At founding, the board consists of the scientist-entrepreneurs and people from their networks. Board composition changes as the spin-off grows, with new members being selected outside their founders' network on the grounds of their possible contribution in terms of capabilities

Much of the literature we examined is concerned with the strategies enacted by entrepreneurial teams in order to acquire from the external environment the capabilities they are in need of by leveraging on their existing human and social capital. Even though (Colombo & Piva 2010) show that at foundation spin-offs have lower financial needs than similar independent high technology ventures, access to financial and human resources has been

emphasised as a critical issue for spin-offs. These two classes of resources tend to be closely interrelated (Moray & Clarysse 2005; Heirman & Clarysse 2005; Vanaelst et al. 2006): the literature on the topic has devoted attention at conceptualising the effects on entrepreneurial team dynamics of the presence of external investors or of active search strategies for venture capital.

An insightful theory-building study within this stream of literature, which is worthwhile mentioning is given by the work by (Vanacker et al. 2013): in their work they examine the interplay of path-dependent and intentional mechanisms of network creation in relation to venture capital access. Building up on (Shane & Stuart 1996), according to which founders' relationships with venture investors help the spin-offs to acquire financing and avoid failure, their study examines the mechanisms in play in the different stages of a firm's life-cycle, and conjectures a dynamic relationship between the two mechanisms by suggesting that managerial resources accessed by means of interaction with venture capitalists drive the formation of a management team enabling the subsequent creation of relationships directed to the acquisition of financial resources. They suggest that a research-based firm establishes a relationship with venture capitalists belonging to the same institutional environment as the members of its entrepreneurial team. A *localised* search process occurs because of institutional norms, bounded rationality, and informational asymmetries. They also conjecture that firms backed by experienced venture capitalists tend to have a greater number of options in terms of potential investors in subsequent rounds of financing than those firms backed by less reputable funders. Venture capitalists play a "coach" function in particular in newer and smaller ventures (Colombo & Grilli 2010) and those who are more experienced have a stronger network position providing access to more qualified investors. Furthermore, venture capitalists tend to include professional managers in the top management teams of the firms they back. Indeed, (Clarysse et al. 2007) found that the human capital profile of top management teams in ventures that are not backed by external equity shareholder is similar to that of their entrepreneurial teams. On the other hand, spin-offs that are backed by venture capital and corporate venture capital are not necessarily more oriented towards the establishment of alliances than other high technology firms; by contrast, to this end spin-offs exploit the reputation associated with their parent organisation (Colombo et al. 2006).

Although human and social capital of entrepreneurial teams play a major role in providing access to venture capital, also the features characterising the spin-off's core technology affect the propensity to seek for venture capital and to open the entrepreneurial and managerial functions up to representatives of investors. In particular, in presence of a weak technological regime spin-offs seek a lower number of investors but with a better reputation than other high technology firms (Colombo & Piva 2010).

Finally, we review the factors leading to team exit. (Vanaelst et al. 2006) distinguish between intrapersonal and interpersonal causes of conflict according to the cause of conflict which may be internal vs. external to an individual. They suggest that intrapersonal conflict arises e.g. when a team member's personal ambition cannot be reconciled with the venture's ambition. Interpersonal conflict, instead, refers to the already discussed notion of cognitive and affective conflict. They find that affective conflict generally prevails over cognitive conflict

as a cause of exit, and that members' exit does not necessarily mean that the emergence of forms of conflict is removed. This result is in line with (Ucbasaran et al. 2003)'s findings on the drivers of exit in the case of general entrepreneurial firms. Finally, (Vanaelst et al. 2006) provide support to the positive role of cognitive conflict for the definition of business strategy.

On a final note, we highlight that even though some of the studies we analysed (Grandi & Grimaldi 2003; Criaco et al. 2013) assume that the choices of entrepreneurial teams are to some extent influenced by their members' attitudes, they fail to examine in detail their impact on firm growth. Entrepreneurship literature acknowledges the importance of the relationship between entrepreneurial teams' attitudes and beliefs and firm growth. However, the cumbersome research design requirements due to the fact that growth represents a phenomenon which develops gradually over time and takes time to be fully observed represent clear limits to the possibility of investigating this phenomenon. Nevertheless, some studies based on longitudinal data have provided empirical evidence supporting the existence of a weak but positive relationship between growth attitudes and behaviour, which appears to be more pronounced in the case of small firms (Wiklund & Shepherd 2003; Delmar & Wiklund 2008; Wiklund et al. 2003).

Discussion and conclusion

This review has found that studies investigating the contributions of collective organisational actors to spin-off growth represent a rather small stream of the studies on academic entrepreneurship dating back to the last twenty years. As a matter of fact, the mainstream literature on academic entrepreneurship is mainly concerned with innovation policies both at a system-level and at a research-organisational one aimed at fostering technology transfer and the foundation of spin-offs; scholarly interest for the post-start up stages of spin-offs life cycle is notably more limited.

The large majority of studies comprised in our review investigate the relationship between entrepreneurial and top management team composition and performance. In particular, scholarly attention has mostly been devoted to the initial founding phase of the spinning off process, discarding what occurs in the later stages.

In particular, performance emerges as a multi-dimensional concept which in the case of high-technology firms is not completely captured by traditional financial indicators: the ability to introduce innovations and to raise venture capital are among the most important dimensions of performance examined by the studies we have taken into consideration. It is important to stress that these indicators of performance express "intermediate" goals which ultimately contribute to financial performance. Moreover, those studies that specify different performance measures for the various stages of the firm's life cycle are particularly insightful as they introduce the existence of a dynamic mechanism which is useful to understand the entry and exit dynamics in the entrepreneurial or top management teams of academic spin-offs. More specifically, we have noticed that the framework which most of the studies within this stream ground on is offered by human and social capital theories, along with homophily theories. Therefore, team dynamics are mostly conceptualised by assembling the insights offered by these perspectives.

Furthermore, we have found that scholarship has produced a certain number of efforts in conceptualising the life cycle stages of spin-offs as well as the dynamics of the entrepreneurial team. In these studies the role of investors has received great attention; in particular, such works have considered access to finance as a goal and as a driver of team change. In some cases, the influence of the parent organisation's reputation is taken into account as an explanatory factor of spin-off dynamics.

Most of these studies examining the life cycle of spin-offs are theory-building contributions addressing specific features of the phenomenon, on the basis of a limited number of case studies. Interestingly, we find that, unlike mainstream entrepreneurship research which is characterised by a North-American bias, several of these studies are based on European cases. However, we believe that further developments of the field would highly benefit from investigations aimed at testing the relationships conjectured by these theories on large-scale samples.

While this literature has focussed on the issue of financing, other dimensions of performance – such as the ability to innovate, to establish strategic partnerships, to reach new markets and customers – are virtually unexplored. We believe that explorations of these dimensions of performance would highly benefit from the insights offered by the conceptualisations of typologies of spin-offs which capture both the features of their business ideas and of their environmental conditions. For the study of these issues it is essential to adopt a long-term perspective: in fact, much of the literature focuses its attention on the pre-start up and early stages of a spin-off life cycle. Unfortunately, up until now we lack evidence of what happens in the later stages of development of the spin-off, in particular in order to undergo growth trajectories.

Furthermore, we found that the studies in our review acknowledge the importance of the nature of the technology which a spin-off is based on, but – except for one case – they do not derive specific conjectures on the differences between technologies. We argue that the development of the field would benefit also from the analysis of ventures based on multiple technologies. In fact, much of scholarly attention is devoted to appreciate complementarities between technological and managerial capabilities in entrepreneurial teams, but the very nature of technologies is taken into account very seldom.

For what concerns research design, we found that only a few studies adopted a longitudinal approach that is the most appropriate to investigate an inherently dynamic phenomenon such as the relationship between entrepreneurial team composition and performance.

Moreover, our review highlights that only a few studies rely on the insights offered by the intention-behaviour approach to decision-making. The conceptual diversity of the academic entrepreneurship research would definitely benefit greatly from studies adopting this framework.

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