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Key Success Factors Positively Affecting Organizational Performance of Academic Spin-Offs

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Universities create academic spin-offs (ASOs) as a strategy to market innovations produced through research. By their nature, ASOs are exposed to risky endeavors and often fail in achieving an adequate level of performance. In this paper, we focus on performance generation in ASOS. By way of a literature review, we contribute with the identification of nine factors associated with positive performance in ASOS: championed start-up, heterogeneity of founders' skills, access to funding, environmental wealth, networking capital, relative size, trustworthiness, innovativeness and motivation for venturing. The paper describes and discusses the performance factors and suggests implications for research to further study performance in ASOS.

Keywords: Academic spin-off; performance; critical factors.

1. Introduction

Universities usually create academic spin-offs (ASOs) as a strategic choice to transfer innovation to the market by commercially exploiting the results of research activities they perform [Cooper (1971); Roberts (1968); Roberts and Wainer (1966); Trebilcock (1969); Vohora *et al.* (2004)]. The strong links with academic institutions, and the direct access to research results, make these organizations intrinsically innovative [De Cleyn and Braet (2010)] and potentially highly profitable. At the same time, given their very nature and the threats embedded in novelties that shall be accepted by the market, they are also exposed to highly risky endeavors. They turn out to be fragile with regard to their capabilities of achieving adequate performance levels to survive in the market [Balderi *et al.* (2011)].

ASOs have been studied in the literature for a long time [Cooper (1971); Kroll and Liefner (2008); Mets *et al.* (2007); Roberts (1968); Roberts and Wainer (1966); Trebilcock (1969)]. In spite of the attention devoted to these organizations, evidence has shown that ASOs still fail to be performant [Zhou *et al.* (2010)]. There are several studies focusing on ASOs investigating performance factors, but not always by directly studying their direct impact on performance. As an example, intangibles,

namely intellectual capital assets, were used to explain value creation [Greco *et al.* (2013)], patents were used to explain creativity [Lindholm (1997b)] and to justify innovation transfer capabilities of ASOs [Kroll and Liefner (2008)]. Sales turnover and its growth rate are many times assumed to be an indirect measure of performance [Covin and Slevin (1991); Delmar *et al.* (2003); Hoy *et al.* (1992); Lumpkin and Dess (1996)]. Other times, growth is used for the same purposes [Shane and Stuart (2002)], but measured in different ways: in absolute terms [Westhead and Birley (1994)], with the number of employees [Delmar *et al.* (2003)], with the increase of stock prices in the stock market [Davila *et al.* (2003)], or with increases in the turnover [Yagüe-Perales and March-Chordà (2012); Walter *et al.* (2006)].

All these studies have the merit of pinpointing the relevance of specific factors to support performance and have contributed to the identification of a number of individual factors that are associated with performance in ASOs. A comprehensive overview of the different factors affecting performance in ASOs is missing, and we believe it would be of benefit for ASOs managers, research institution managers and policy makers when they are interested in knowing how to maximize the chance of spin-off survival in the market.

This paper contributes to the literature by identifying performance factors that sustain performance of ASOs. Our work is motivated by the following research question: *what factors positively support ASOs organizational performance*? By way of a literature review, we identify key performance generators and we discuss how they positively support performance of ASOs. We identify nine different factors: championed start-up, heterogeneity of founders' skills, access to funding, environmental wealth, networking capital, relative size, trustworthiness, innovativeness and motivation for venturing. By discussing the results of the review, we eventually derive implications for researchers for future studies on ASOs organizational performance, for academic managers and policy makers by suggesting targets for policies and actions to sustain the development of these factors in newly created ASOs.

2. Methodology

This paper is based on a concept-based review of the literature following methods to ensure transparent and reproducible literature reviews [Tranfield *et al.* (2003); Webster and Watson (2002)]: the literature relevant for our research question was selected through a staged process with specific selection criteria which are described below and summarized in Table 1. We searched for relevant literature on EBSCO host, one of the most complete interdisciplinary databases of scholarly literature in the fields of economic, commercial and social sciences. Our literature search covered the period from 1968 up to March 2016.

To search for the literature relevant to our research question, we queried the database with two different sets of keywords. We first looked for articles combining the term "spin-off" in the paper and "performance" in the abstract (accounting for all their variations and different forms like plurals, different writing styles: i.e. spin-off, spinoff). The results of the first search produced a group of 198 articles.

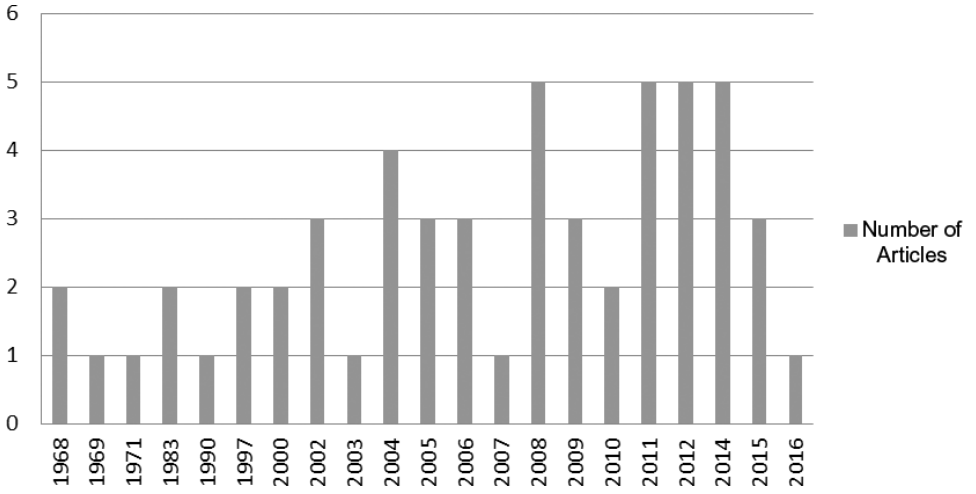
Table 1. Description of the literature search protocol.

Stage	Description of the actions performed at this stage	No. of articles
1	All articles containing the words "SPIN-OFF" "title" AND "PERFORMANCE" "abstract"	198
2	All articles containing the words "UNIVERSITY SPIN-OFF" "title" OR "ACADEMIC SPIN-OFF" "title" AND "PERFORMANCE" "abstract"	96
3	Duplicate articles	15
4	Final number of articles from the literature search (1, 2 and 3)	279
5	Abstract read selection	116
6	Full text read selection	43
7	Relevant articles cited	12
Total number of scientific articles used in the review		55

Contextually, we conducted a second search to complete the interrogation of the database including compound words: "university spin-off" in the field "title", or "academic spin-off" in the field "title", and "performance" in the field "abstract". The query produced a total result of 96 articles. The two groups of results were partially overlapped. We identified and removed 15 duplicate articles in the two groups, leading to a final group of 279 papers selected at the end of the search stage.

The first selection step was based on reading the abstracts. In this stage, we discarded all papers that were outside our research question (i.e. not discussing ASOs or not discussing performance or performance factors of ASOs). After this selection, 116 papers were retained and were read in full to further refine the selection. In the full text selection, we discarded papers which were not discussing the performance of ASOs, or not discussing factors positively affecting performance. At the end of the full text selection stage, 43 articles were retained.

Reading the full text also contributed to identifying 12 new articles cited in these articles, which corresponded with our research question, but were not included in the



Source: Our elaboration.

Fig. 1. Time scale of selected scientific articles.

database used for the literature search and hence were not part of the initial results of our search.

In the end, the total number of articles that were analyzed amounted to 55 (43 selected after the full text read plus 12 identified in sources cited in these articles). Figure 1 shows the distribution across the years of the papers selected for the review.

One of the three authors was in charge of the literature search steps 1 and 2. All the three authors participated in the abstract and full text selection steps, and the decision to exclude some sources or retain for the subsequent step in the literature search protocol was taken unanimously among them. The final group of 55 articles was used to compile and discuss a paper-concept matrix. All the authors read the full text of the 55 articles. One author drafted a paper-concept matrix. Concepts we looked for were performance factors positively affecting the performance of ASOs. All three authors discussed the drafted paper-concept matrix in subsequent rounds. The final paper-concept matrix contained the identified factors positively affecting the performance of ASOs discussed by the literature sources selected.

3. Factors Positively Affecting the Performance of ASOs

The literature review contributed to identifying nine factors positively affecting the performance of ASOs. The identified factors are described in the subsequent sections.

3.1. *Championed start-up*

A strategic role in relation to the performance of ASOs is attributed to the incubation which is described as a set of services supporting the creation and start-up of the enterprise, whose use by the ASO is positively associated with performance [Davenport *et al.* (2002); Debroux (2008); Harrison and Leitch (2010); Lindholm (1997b)]. The spin-off in its early phase is affected by the skills available at the departments of the universities in which they are born [Rasmussen *et al.* (2014)].

During the start-up phase, particular attention is paid to the pre-incubation phase, in which spin-offs are guided on a path of pre-development of the entrepreneurial idea, and this eventually results in increased performance once the spin-off enters the market [Freitas *et al.* (2011); Ndonzuau *et al.* (2002); Vohora *et al.* (2004)]. In the start-up phase, the role of the parent institution in caring for the venture of the spin-off is relevant: university technology parks [Link and Scott (2005)], institutes of research and technology [Davenport *et al.* (2002)] and other types of research oriented organisations [Simeone *et al.* (2015)] can play the role of spin-off incubators [De Coster and Butler (2005)]. Moreover, such care influences the birth of new spin-offs and promotes the passage from an accidental to a purposefully guided creation of ASOs [Davenport *et al.* (2002); Wright *et al.* (2007)]. The services these institutions offer are real strategic consultancy acts [Tsukagoshi (2008); Van Burg *et al.* (2008)]. The services offered are able to accompany the spin-offs in the management of the intellectual property to guarantee access to risk capital via venture capital [Clarysse *et al.* (2011)], to help spin-offs manage the knowledge created [Clarysse *et al.* (2011)], and to support the design of ASO contracts to try to

avoid or reduce conflicts among future partners in the allocation of quotas and ensure the commitment of the researcher in the spin-off [Macho-Stadler *et al.* (2008)].

On the basis of these considerations, we hence identified a success factor that we named *championed start-up*. This factor serves to identify the ASOs which made use of supporting services, specifically delivered by the parent institution, during their start-up phase. This factor can be measured as a Boolean value, discriminating between spin-offs who had, and spin-offs who did not have, access to these services and made use of them. The services most frequently cited are those related to: incubation which also includes the usage of specific facilities at the parent institution, market and business development, technology transfer, knowledge management and partnership management. The presence of these facilities in the parent organization in which the spin-off is born is not enough to ensure performance. It is hence necessary, when measuring this factor, to make sure that these facilities and services exist at the parent institutions, and also to ascertain whether the spin-off under investigation did or did not actually use them.

3.2. *Heterogeneity of founders' skills*

The patrimony of knowledge, competencies, managerial skills, working and education experiences of human resources, [Geenhuizen *et al.* (2012)] becomes part of the development of intellectual capital that can positively influence the competitiveness of the ASOs [Greco *et al.* (2013); Harrison and Leitch (2010)]. In the selected literature, the role of human resources and their skills and competences have been widely stressed, particularly in relation to the team of founders. Leadership and championing competences are discussed as a source of performance [Abramo *et al.* (2012); Howell *et al.* (2005); Schon (1963); Walter *et al.* (2011)], either internal or external to the spin-off [Rasmussen *et al.* (2011)]. The presence of different capabilities in the entrepreneurial innovation process — particularly in relation to that of making alliances for R&D to obtain intellectual property, talent, and also industry information and contacts — was related to the growth of the ASO [Zhou *et al.* (2010)].

Mastering the market is a weak point for this type of organization [Clarysse *et al.* (2011); Lindholm (1997a,b); Taheri and van Geenhuizen (2011)], especially when compared to corporate spin-offs, since their founders (typically academics) lack a true market experience. The possibility for the founders to complement the missing skills resorting to the rich experience of the parent organization [Eriksson and Moritz Kuhn (2006); Xie and White (2004)] was positively associated with positive performance and the speed of innovation.

No predominant role of a specific skill of human resources emerged from the literature as important for the performance. The attention was on the bundle of the competences that founders of the spin-off can count on and that this bundle contributes to the performance. We hence defined a success factor called *heterogeneity of founders' skills* representing the degree of heterogeneity of the different skills (technical, managerial, relational) in the teams of the founders of the spin-off. Skills might be identified by the main area of expertize of the spin-off's founders. Proxies of

these skills might be the scientific area (for scientists), or the degrees and the previous entrepreneurial experiences (both for scientists and for business partners). The factor can be measured both as Boolean (i.e. heterogeneity yes or no), or as a discrete or continuous measure by making use of heterogeneity statistical indexes.

3.3. *Access to funding*

The access to funding for ASOs is described as an enabler of a triple advantage: (i) financial independence in the start-up phase, (ii) access to specialized competencies to achieve targets; and (iii) greater ability to work with partners [Bollazzi and Giudice (2006)]. The literature discusses how funding becomes central for sustaining spin-off performance, in particular in those fields [Mets *et al.* (2007); Tsukagoshi (2008); Yagüe-Perales and March-Chordà (2012)], where the presence of relevant investments [Balderi *et al.* (2011)] is considered instrumental to fulfil the pursued activities, and the use of sophisticated equipment can be associated with the participation of private and institutional investors (i.e. biotechnologies for instance).

Access to funding is hardened for ASOs by the resistance of venture capitalists or of the banking system created by the difficulties of assessing the innovation potential in the spin-off value proposition and by their attitude of stressing the perception of the risk represented by spin-offs rather than the opportunity [Debroux (2008); Heirman and Clarysse (2004); Shane and Stuart (2002)]. This leads to a reduction of financial resources made available by the investors, or in an increase in the time necessary to access financing adding business risks that eventually depress performance [Yagüe-Perales and March-Chordà (2012)].

On the spin-off side, the relationships between entrepreneurs and investors also positively influence access to funding [Shane and Cable (2002)]. The resistance opposed by founders to maintain control of decision making makes them look for risk capital only when they think it is necessary [Giudici and Paleari (2000); Ortín-Ángel and Vendrell-Herrero (2010)], reluctantly accepting the intervention of venture capital in the management of their companies [De Coster and Butler (2005)].

We hence identified a third success factor called *access to funding* measuring the difficulty the spin-off encounters gaining access to external funding sources to support risk capital and financial needs. This factor can be measured through qualitative instruments by interviewing ASOs members on their experience in getting access to funding. The presence of public funds directly targeted to support spin-offs, or to support innovation or technology transfer processes, or the presence of specific venture capitalists, or banks supporting innovation strategies and spin-offs creation, could also be considered as a proxy to measure this factor.

3.4. *Environmental wealth*

The geographical proximity of ASOs to private investors, such as venture capitalists, can represent a crucial element for financing and eventually for performance [Pinch and Sunley (2009)]. The knowledge of the local production context in which the company operates, and the reputation of the company, can favorably affect its evaluation in case of a financing proposal.

The proximity of research centers and universities represents the most relevant aspect in the cooperation with spin-offs [Lejpras and Stephan (2009)], though the literature does not necessarily imply that the location should be a metropolitan or urban one. In fact, if on the one hand, Taheri and van Geenhuizen [2011] identified an advantage with such proximity, on the other, Yagüe-Perales and March-Chordà [2012] stressed the tendency of a spin-off to be located in a non-metropolitan area. The role of the environment in helping the ASOs to sustain performance is by some reputed to be more important than governmental support [Sternberg (2014)], as the environment might be the source for addressing the lack of skills and resources that spin-offs need to support their performance [Benghozi and Salvador (2014)].

We therefore identified a critical success factor called *environmental wealth* which represents the level of wealth (or paucity) of resources in the environment in which the spin-off is located. The factor can be measured for instance by calculating the number of companies in the territories, or the number of companies with which the ASO has (or might have) a symbiotic relationship, by making use of data from territorial information systems, or national and economic statistics.

3.5. *Networking capital*

The creation of networks, and the possibility to entertain networking relationships, have been indicated as one of the key factors of the success of a spin-off [Burgelman (1983); Greco *et al.* (2013); Howell *et al.* (2005); Walter *et al.* (2006, 2011)], allowing entrepreneurs to create new ties for the network's development [Rasmussen *et al.* (2015)]. Companies that are part of a large network can benefit from greater knowledge, increasing local diversity and exchange of technology [Pérez and Sánchez (2003)]. The size of the network also benefits from the positive influence of former international experiences of the founder [Taheri and van Geenhuizen (2011)]. The size of the network refers both to that of the spin-off and to that — personal one — of the individual founders [Hayter (2015)].

The need to build networking capital is sometimes a necessity as "ASOs are often naturally compelled — by strategic focus or necessity — to enter into partnerships with third parties, which should be based primarily on market access" [De Cleyn *et al.* (2009)]. The construction of partnerships might be made easier thanks to access to the resources and alliances of the parent organization. The presence of a network is able to compensate for the inadequateness of investments in R&D and the vulnerability of ASOs, usually small enterprises, in the face of competitive changes [Feldman and Klofsten (2000)]. In particular, as stated by Scholten *et al.* [2015] "when entrepreneur try to bridge between to different networks [...] specific human capital increases the relative impact of bridging ties on early spin-off growth". The existence of patents facilitates the possibility to sign agreements for participation in the risk capital [Ortín-Ángel and Vendrell-Herrero (2010)].

According to Lejpras and Stephan [2009], cooperation among partners is an important factor in the creation of innovation in research spin-offs, and a stimulus for the production of innovation in sectors characterized by a high level of

competence. It is worthwhile to point out that the positive influence of this factor on performance is not unanimous. For instance, according to Heirman and Clarysse [2004] and Lejpras and Stephan [2009], partnerships with other companies do not produce a positive influence over time for the development of the first product and, in particular, the necessary cooperation with universities tends to be associated with a longer time for the finalization of the product (an exception is represented by software products).

Based on this, we named a fifth success factor *networking capital* measuring the size of the network to which the spin-off, either through directly created ties, or through the ties of the founders and other staff, has access to established commercial relationships. The networking capital could be measured by the number of commercial agreements, structured agreements, participation with networks of cooperation, memorandum of understandings, and participation with the stock of other companies. Personal and professional ties of the founders are sometimes also seen as proxies of networking capital. For instance, it is assumed that founders who earned a PhD from a foreign institution, or had previous international experience, could count on higher network capital [Taheri and van Geenhuizen (2011)].

3.6. *Relative size*

The literature agreed on the fact that spin-offs are small companies [Harrison and Leitch (2010)], and the spin-off size is a factor frequently discussed in relation to performance. This is usually measured in relation to the number of employees [Eriksson and Moritz Kuhn (2006)], the number of people on the team [Ortín-Ángel and Vendrell-Herrero (2010)], or the volume of sales [Yagüe-Perales and March-Chordà (2012)].

The small size of spin-offs, when compared to competitors or partners, is more reassuring and gives the impression that it does not represent a threat for them [De Cleyn *et al.* (2009)]. This makes it less subject to aggressive policies carried out by competitors, and at the same time represents a stimulus for future partnerships [Lejpras and Stephan (2009)] or a strategy for the management of intellectual property [Lindholm (1997b)].

Rather than size in absolute terms, we posit that it is the size in relation to that of the competitors that might better predict the performance of the spin-offs, since the performance generation potential here is related to the absence of obstacles from larger competitors who do not perceive the spin-off as a threat. Size in relation to competitors might indirectly support performance, reducing the chance of receiving aggressive competition. At the same time, we also hypothesize that a smaller size in comparison to that of competitors might correspond to leaner organizations and potentially greater flexibility. We thus identified a sixth critical success factor called *relative size*, describing the dimension of the spin-off in relation to that of the main competitor(s) (either as a single number or as an average). The size can be measured with organizational metrics like number of employees, number of members of the top and executive teams, or capital, or turnaround.

3.7. *Trustworthiness*

In relation to ASOs, trust not only represents an individual trait [Kohtamäki *et al.* (2004)], but also a system that is repeatedly evaluated according to the presence of personal relationships, able to change culture and society at large. The concept of trust is recurrent in the creation of performance [Taheri and van Geenhuizen (2011)] and is often associated with the characteristics of personal relationships [Howell *et al.* (2005)]. The measure of trust increases or decreases according to the common perception of the set of values bequeathed by the organization, and based on the development and diversification of the roles inside the team [Pinch and Sunley (2009)], thus providing a bond between trust and culture.

On the other hand, excessive trust and responsibility could be counter-productive for the companies. Excessive obstinacy in pursuing the target or an overcharge of responsibility could compromise not only the leadership of the innovator, but the unconditional commitment of a new idea can result in a drawback for optimism and favor resistance to change [Walter *et al.* (2011)].

Our seventh critical success factor called *trustworthiness* describes the needs of the spin-off to achieve an adequate trust level from its stakeholders to build a reputation in the market. Trustworthiness can be measured through brand image and reputation, through sentiment analysis on social media — especially for ICT oriented spin-offs, or for those who make frequent use of social media as a communication strategy. Trustworthiness can refer to the spin-off as a whole, or also at the individual level to the founders.

3.8. *Innovativeness*

In the literature, the capacity of spin-off companies to introduce technological innovations in the market is taken for granted. On the other hand, when the factor *innovativeness* is connected to the capacity to produce performance, a diametrically opposed trend is shown. In fact, for Lejpras and Stephan [2009], performance cannot be explained by innovation only, as it needs to interact with other factors (technological and commercial risk, customers' satisfaction, timeliness longevity and repeatability, protection of competitive advantage) [Freitas *et al.* (2011)]. Innovation is positively described in ASOs when it produces an external impact in the socio-economic environment [Freitas *et al.* (2011)]. Other times, it is reputed to produce a negative impact on performance of ASOs, [Clarysse *et al.* (2011)], at least unless it is accompanied by technology transfer services from the parent institution.

Lindholm [1997b] considered the patent as a measure of innovativeness, whilst Abramo *et al.* [2012] connected the innovation introduced with the participation of a spin-off, highlighting how the scientific performance of researchers increases as a result of the creation of a spin-off company. The need for the university then is to protect intellectual property and according to De Coster and Butler [2005], it is associated with the need of these companies to share participation in the stock. In managing innovation through patents, companies should carefully select the target market and choose the proper degree of protection of intellectual property and method [Mets *et al.* (2007)].

We named an eighth critical success factor *innovativeness* to describe the capacity to bring actual innovation to the market by ASOs. Innovativeness of the spin-off can be measured quantitatively through the number of patents, or copyright agreements, the spin-off owns. It can be instead measured qualitatively by looking at the differences in terms of value proposition of the spin-off in relation to the rest of the market.

3.9. *Motivation for venturing*

Garvin [1983] linked motivation of the founders to start the spin-off with two particular situations: "frustration" for the job, and the "perception" to gain more money giving birth to a new enterprise. Also, Novotny [2014], studying the relationship between motivation and success, highlighted that the dissatisfaction of the university remuneration represents the main motivation that leads to the creation of a spin-off. On the contrary, Lindholm [1997a] identified in the "push" given by the founder as the motivating factor for the creation of a spin-off. The literature identified, in fact, a direct relationship between the intensity with which champions pursue their innovative ideas, and the success of innovation [cfr. Howell *et al.* (2005); Schon (1963)]. According to Eriksson and Moritz Kuhn [2006] it becomes relevant, then, to identify motivation in particular during the start-up phase.

We then named a final critical success factor called *motivation for venturing*, measuring the extent of dissatisfaction among the founders with their employment at the university influencing the idea to start a spin-off. This factor is intrinsically related to the perception of the founders in relation to their employment with the university or the parent research institution. Such motivation can hence be measured either qualitatively or quantitatively through interviews or surveys, by assessing the satisfaction or dissatisfaction of the founders regarding their employment.

4. Discussion

The resulting landscape of determinants of performance of ASOs is a complex one, where different factors are in place. Concerning the potential of generating performance, the description of the factors identified points out that some of the performance determinants are part of the spin-offs since their start-up. This is the case for the factors we named *networking capital*, *motivation for venturing* and *heterogeneity in skills*, which heavily depend on the background and on the profiles of the team of spin-off founders [Burgelman (1983); Garvin (1983); Greco *et al.* (2013); Howell *et al.* (2005); Novotny (2014); Walter *et al.* (2006, 2011)]. Some other factors depend instead on specific choices made during the spin-off design, and eventually during the management. We are referring here to the *relative size* factor which is a consequence of a cognizant decision of not increasing the size of the spin-off. Finally, still other factors are instead dependent on the context in which the spin-off is started (*championed start-up*) [Davenport *et al.* (2002); Debroux (2008); Lindholm (1997b)], or in the environment in which it decides to operate (*environmental wealth*) [Pinch and Sunley (2009)].

Since all the factors mentioned above are a consequence of a cognizant organization design process, they are possibly measurable also directly from the birth of the spin-off. Therefore, this might imply that spin-offs can be born to be specifically performant, or can be born and raised in an environment specifically designed to support their performance. This we believe produces implications for the spin-off managers and for universities and research institutions willing to maximize the chance of success of their spin-offs.

At the same time, few performance factors are also dependent on third party organizations [Link and Scott (2005); Rasmussen *et al.* (2014)]: the *championed start-up* related to the services offered by the parent organization, the *environmental wealth* which is also a consequence of the actions of policy makers, and the *access to funding* which might be affected by the presence of public funds dedicated to spin-offs, or by the presence of private institutions (banks or venture capitalists).

Finally, other factors are dependent on the relation between the spin-off and its stakeholders or its market [Clarysse *et al.* (2011); Freitas *et al.* (2011); Howell *et al.* (2005); Taheri and van Geenhuizen (2011)]. This is the case for the *innovativeness* factor, which also depends on the differences among the value proposition of the spin-off and of the competitors, and the *trustworthiness* factor which instead depends on the relation that the spin-off creates through its activities with its stakeholders.

Being that not all the performance factors are under the control of the spin-off in the design phase, their performance cannot only be the result of a design choice, but will instead depend on the interaction among design choices and contingent factors. This we believe will produce consequences for further research on the performance of ASOs.

A final consideration here relates to the potential influence among the factors we identified through the review. Authors discussing these factors also mentioned sometimes that they might have influences on others. In Fig. 2, we summarize all the purported interdependences potentially existing among the factors which we encountered in the literature we analyzed.

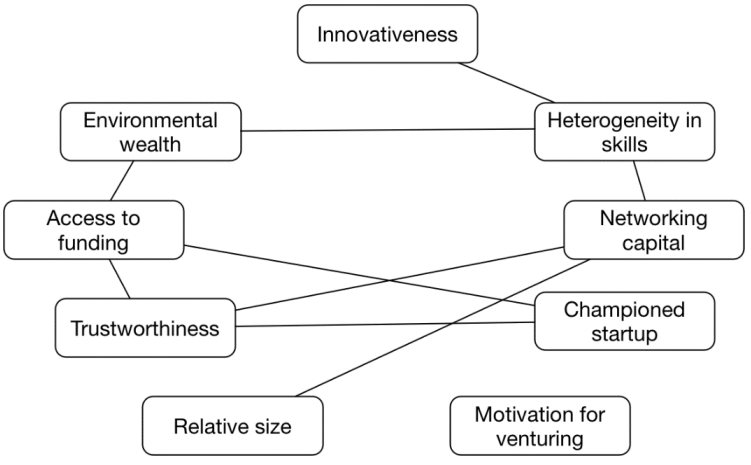


Fig. 2. Performance factors and purported interdependences.

4.1. *Implications for research*

A first implication for the study of the performance of ASOs concerns the purported interdependences among the different performance factors. These interdependences might be virtuous (i.e. one factor sustaining the other, hence reinforcing the performance potential of the ASO), or of vicious types (i.e. one factor harming or hampering the other, hence weakening the performance potential of the ASO), or even equifinal (i.e. performance might be achieved by the co-presence of different combinations of factors).

One possible suggested direction would be to investigate the concurrent contribution of more factors on performance. We see opportunities here for empirical works testing the influence of the identified factors to identify equifinal configurations leading to positive performance. At the same time, the kind of interdependences that develop out of these factors to support performance (i.e. virtuous or vicious) should also be studied. We believe it would be a good contribution not only to focus on the co-occurrence of different factors but also to study them under a causal perspective, identifying trajectories of cause–effect relationships where one factor may contribute to strengthen (or weaken) another one. For instance, as already mentioned, networking capital is one of the factors that showed a high number of interdependencies with others. While this is coherent with the role that the literature assigns to networks for business [Corvello and Felicetti (2014); Henning and Saggau (2013); Eschenbaecher and Graser (2011)], it would be interesting to investigate to what extent the network capital could overpass the limits imposed to ASOs by the lack of other factors including a wealthy environment, or the difficulty of attracting resources.

Another implication of our work concerns the potential existence of other factors sustaining performance, and the relevance of the identified ones through the lifecycle of the spin-off. We do not claim that the list of factors discussed here is exhaustive and that does not imply the further performance factors, not yet discussed by the literature, could be potentially identified.

Concerning the nature of the factors, and their relevance through the lifecycle of the spin-off, we have to point out that out of the nine factors we identified, the vast majority are intangible. The (apparently) reduced relevance of tangible factors is, to some extent, not surprising as ASOs usually resort to parent institutions' facilities [Balderi *et al.* (2011)]. We believe this is connected with the nature of the spin-off, which the literature agrees to be an organization of small size [Harrison and Leitch (2010)], born within the walls of a parent institution. The performance factors discussed by the literature are to be potentially interpreted as related to these characteristics. Also, some of the factors we identified are specifically referring to this (relative size and championed start-up). If, by way of the action of the performance factors in play, the ASO would eventually grow in size, it should be questioned if the same performance factors will also remain in different lifecycles of the organization, or if new ones will pop up, or even if some of the identified ones will potentially turn from supporters to rivals for performance. A final implication would then be to study

the performance of ASOs from this long-term perspective, taking into account the stage of the lifecycle.

4.2. *Implications for managers*

Concerning managers, the results of our work raise two implications. First of all, given the difficulties in assessing the performance of ASOs by managers (i.e. financial institutions management), we could suggest using the factors we identified to complement other forms of evaluation (i.e. financial based for instance) of ASOs.

The results of our work also raise an implication for the management of academic and research institutions, which are parent organizations to the spin-off. Throughout the literature, their role in supporting the birth and the growth of the spin-off and in providing them access with the basic tools to start this venture emerges as relevant for stimulating performance. So, having specific facilities for supporting technology transfer processes from universities to spin-offs is necessary in order to improve the chances for new-born spin-offs to be performant. Universities willing to invest in the third mission should be aware that reinforcement of their technology transfer offices and processes is necessary. We would advise them to include in such reinforcement not only the administrative support necessary to apply for funding or patent registration for example, but also the managerial support to accompany the ASO in processes like strategy formulation, strategic positioning, or marketing and communication.

4.3. *Implications for policy makers*

Concerning policy makers, our work provides some guidance to those who would like to foster innovation and economic development by sustaining the birth and growth of ASOs. Policy makers are in the position to create the pre-conditions that stimulate the development of some of the identified success factors.

An indirect implication for policy makers stemming from our work would be to try to support the birth and the growth of spin-offs with funding opportunities, ensuring an adequate level of accessibility to these (i.e. by making the administrative burdens to access funds reasonable, or by carefully managing funding schemas). A second aspect would be to foster the enrichment of the environment in which spin-offs will eventually work by way of targeted economic development policies. Since the wealth of the environment is a factor sustaining performance in spin-offs, an action of policy makers in stimulating the enrichment of the environment will improve the chances to gain access to valuable assets, like partners and networking opportunities, eventually stimulating the development of innovation in the territory.

5. Conclusion

This paper examines the performance of ASOs, and through a literature review, identifies nine factors which are associated with positive performance. The paper discusses the factors and the purported interdependences among them. The review

contributes to shed light on the complexity of factors positively influencing spin-off performance, and raises implications for future studies on the same topic.

Concerning the results of our work, we have to acknowledge some limitations. First of all, by its specific objective, our work is limited to the identification of the factors that positively influence performance. This implies that it would not be correct to state that the absence of the factors described here would lead to the lack of performance.

A second limitation to acknowledge is that we are not discussing factors hampering performance, but we just reported the factors positively influencing performance. Following this limitation, it is also worthwhile to mention a caveat to have in mind for the interpretation of the results. We report the factors identified in the literature as associated with positive organizational performance of ASOs. There is no room to claim that they actually cause positive performance, and causality among performance factors and performance should be specifically tested in empirical settings.

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