The impact of university-based incubation support on the innovation strategy of academic spin-offs

Abstract

This paper develops understanding about how incubation support and innovation strategy can determine the performance of academic spin-offs. Using a sample of spin-offs from the United Kingdom, the Netherlands and Norway, we analyse the potential moderating effect of incubation support (networking and entrepreneurial support) on innovation strategy effectiveness. The empirical results demonstrate: (1) a technology and market exploitation strategy has a stronger and more positive effect on the performance of spin-offs than a technology and market exploration strategy. In relation to an ambidextrous technology and market exploration and exploitation strategy, a market growth strategy (combining technology exploitation and market exploration) has a positive effect on performance while a product development strategy (combining technology exploration and market exploitation) has little effect on performance; (2) incubation support in the form of networking and entrepreneurial support has a positive effect on the performance of spin-offs; (3) networking support moderates the relationship between an exploitation strategy and spin-off performance while entrepreneurial support moderates the relationship between a market growth strategy and spin-off performance. By examining the interactions between types of innovation strategies and incubation support, this study provides a more refined understanding of the strategy selected by spin-offs. In doing so, it offers new insights about the role of incubator support in enhancing the effect of strategy on performance.

Keywords: academic spin-offs, incubation support, exploration, exploitation, ambidexterity, innovation.

1. Introduction

In today's economy, creating academic spin-offs to commercialise university research and knowledge is a fruitful mechanism to fuel the economy, create job growth and innovation (Fini et al., 2011; Gilsing et al., 2010; Bathelt et al., 2010; Mustar et al., 2008; Phan et al., 2005). In using technology developed from a university, academic spin-offs respond to market needs by offering innovative products or services. However, primarily due to lack of resources, uncertainty in technological development, market acceptance and limited entrepreneurial knowledge and skills, it is well known that academic spin-offs especially face a number of obstacles when pursuing their economic objectives (Gredel et al., 2012; Geenhuizen and Soetanto, 2009). A prevalent means often used by universities to overcome these obstacles is to establish or draw on the facilities of an incubator; a centralised facility that provides access to university support and policies (Bergek and Norrman, 2008; Löfsten and Lindelöf, 2005).

At a general level, the environment incubators are perceived to offer tends to be seen as one which nurtures commercial ideas in a way which makes them more likely to become marketable products (Nosella and Grimaldi, 2009; Hannon, 2005). As a consequence, incubators are linked to helping to overcome the failure rate too often associated with newly established firms. Faced by various challenges and the need to identify new approaches to support small firms, the format, nature and role of incubators has changed considerably since they were first founded in the US in the 1960's. No longer do they only offer small office space and shared facilities. Today's incubators come in various forms and many now also offer intangible services, such as business mentoring and coaching, access to capital and a range of professional services with networking especially becoming part of their valuable offering helping to ensure the survival and growth of small firms (Bruneel et al., 2012; McAdam and McAdam, 2006). This shows how incubator practices and what they can offer has changed considerably over the years, making them much more effective and supportive. It also shows why universities might see supporting incubators and/or the building of University-based incubators (UBIs) a way to respond to the rapid development in entrepreneurship policy and the increasing need for universities to be seen to engage and offer an effective means for stimulating and supporting regional innovation and economic growth.

Understandably, this move in incubator practices has been popular. Yet, the failure rate of academic spin-offs continues to remain relatively high (van Geenhuizen and Soetanto, 2009). There is also an indication that academic spin-offs are stagnant in their development and have a slow growth rate, bringing into question the impact of incubators in supporting tenants in performing market exploration and exploitation activities. For newly established and small firms, it is known that a trade-off between exploration and exploitation is inevitable as they compete for scarce resources (Bierly and Daly, 2007;

He and Wong, 2004). However, some studies suggest that maintaining an appropriate exploration and exploitation balance is critical for firm survival (Auh and Menguc, 2005; Smith and Tushman, 2005). Others propose that they can be treated as an ambidextrous process so that firms can successfully engage in both activities at the same time (Andiopoulos and Lweis, 2009; Gupta et al., 2006; Jansen et al., 2006; Lavie and Rosenkopf, 2006). In the overall literature on incubators, one aspect of the incubation process that has received little attention is that of tenant strategy. The lack of knowledge in this area is derived from the fact that most studies focus on incubators as the unit of analysis (e.g. Ratinho and Henriques, 2010; Totterman and Sten, 2005). While this approach has provided good insight into incubation practice in general, it rarely touches on how incubators' resources and types of support influence and impact on the strategy of their tenants. On the other hand, studies on tenants focus heavily on entrepreneurial outcomes during pre-start and launching phases and overlook that firms may face diverse obstacles receive different support from incubators and take different strategy paths as a consequence of the support received. So, a gap in understanding about the link between incubation practice and strategy clearly exists in the wider incubator literature.

Our interest is to address this gap and add to knowledge and understanding about the inter-relationship between firm strategy and incubation support. To do so, we use academic spin-offs as the context for our study and address the research questions: What is the impact of incubation support on strengthening the capability of spin-offs to perform exploration, exploitation or both strategies simultaneously? And to what extent does the support moderate the impact of those strategies on the performance of academic spin-offs? Using data collected from 141 academic spin-offs located at UBI's in the United Kingdom, the Netherlands and Norway we test our hypotheses. In doing so, this study contributes to knowledge and understanding and the emerging dialogue around the future of incubator support, especially that offered by UBI's, in the following ways.

First, we respond to scholar's call (e.g. Combelli et al., 2014; Sirén et al., 2012; Simsek et al., 2009) for more evidence that links the strategy of small firms to their performance. While previous research has asserted the link between strategy and performance, most studies focus on established firms and overlook the role of external support that is often received by small firms and especially spin-offs. In focusing on spin-offs, we extend understanding to show how incubators can determine outcomes and performance of tenant strategy. Clearly, this impacts on how incubators support firms and the need to work closely alongside tenants from the outset. Second, this study provides new empirical evidence around Voss and Voss' (2013) innovation strategy framework. It does so by examining the effect of incubation support on two strategic domains, technology and market, to show how these impact on spin-offs within UBI's. Finally, this study responds to the call for more policy-oriented research examining the added value of business incubators on survival, growth and innovation (e.g. Clarysse et al., 2014; Autio et al., 2014; Autant-Bernard et al., 2013; Huggins et al., 2008). We show this is

particularly important for innovative and technology-based firms, such as academic spin-offs, as they are generally perceived to be more vulnerable than other start-ups, despite often being located in a well-supported environment.

2. Setting the context

With the introduction of the Bayh-Dole Act in the US, the commercialisation of research and knowledge from universities became a popular policy in many countries. The study reported a substantial increase in public investments in university research and in other initiatives designed to endorse the capabilities of universities to produce academic spin-offs (Autant-Bernard et al., 2013; Mustar et al., 2008). McQueen and Wallmark (1982) introduced one of the earliest definitions of an academic spin-off. They argue that academic spin-offs should meet the following criteria: (1) founders have to come from a university, (2) the activity of the company has to be based on technical ideas generated in the university environment, and (3) the transfer from the university to the company has to be direct and not through intermediate employment. This definition is echoed by Smilor et al. (1990) and Carayannis et al. (1998) who define a spin-off as a company founded by a faculty member, staff member or student who left the university to start a company or who started the company while still affiliated to the university. Over the years, many definitions of academic spin-offs have emerged where scholars generally agree that these derive from technologies developed within a university and the individuals who pursue their commercialisation including academic staff, students and graduates (Clarysse et al., 2007; Pirnay, 2003; Steffensen et al., 2000; Klofsten and Jones-Evans, 2000). The shape and nature of such spin-offs takes many forms and are thus defined in different ways. Following Klofsten and Jones-Evans's (2000) and Pirnay (2003) definition, we define an academics spin-off more generally as a new firm created by students, graduates or academic staff to exploit the results of university research.

Academic spin-offs differ from other start-ups in terms of their constant need for innovation and their relationship with knowledge providers (McAdam and McAdam, 2008; Nosella and Grimaldi, 2005). For academic spin-offs, lack of legitimacy and market access can only be resolved by consistently innovating through the development of innovative products, services and business models. For this reason, academic spin-offs are likely to depend on the continued relationship with the university (Bathelt et al., 2010; Johansson et al., 2005) while other start-ups may not share such affection. With the backing of government and industry, universities have introduced support policies - such as business incubators - to nurture newly established spin-offs while at the same time fostering entrepreneurial spirit among students and academic staff (Gilsing et al., 2010; Link and Scott, 2007). In this study, the incubation of academic spin-offs is defined as a mechanism that links technology, capital and know-how to leverage entrepreneurial talent, accelerate the creation of new companies and

exploit the development of technology (Bruneel et al., 2012; Bergek and Norrman, 2008; Grimaldi and Grandi, 2005).

As incubation practices have spread internationally and the number of new incubators has grown exponentially, research on the subject is clearly burgeoning. Yet our knowledge of incubators and incubation practice remains fragmented. One of the biggest challenges in studying incubators is to deal with the heterogeneity in their objectives, stakeholders, type of services, and resources (Bruneel et al., 2012; Grimaldi and Grandi, 2005; Hannon and Chaplin, 2003). Making it more complicated, scholars have proposed different classifications, taxonomies and models to portray the variety of incubators developed resulting in varied perspectives with the conclusion being that no single framework is effective (Bruneel et al., 2012; Bergek and Norman, 2008). There is also a lack of theoretical base for incubation support in general and its impact on the operational and managerial practice of incubated firms (McAdam and McAdam, 2008). The following table shows a selection of studies that consider several different aspects of business incubators and where we identified types of support and its impact on incubated firms. We then use the overarching summary of those studies to justify the focus of our work.

Table 1. Selected studies of business incubators (with focus on support and its impact on tenants)

Authors	Research sample	Study findings/contributions	Types of support mentioned in the study	The impact of support on incubated firms/tenants emphasised by the study
Mian (1996)	Six university technology-based incubators in the US	The study argues that incubator is proven to be effective in providing a nurturing environment for the development of new technology-based firms.	Shared services Business assistance Networking services	The study suggests that support adds value to the development of new technology-based firms.
Mian (1997)	Four university technology-based incubators in the US	The study proposes a model / conceptual framework for assessing and managing university technology business incubators.	Shared incubator-services University-related services	The study argues that both types of support provide value – adding significant contributions to understanding incubated firms.
Colombo and Delmastro (2002)	45 incubated firms and 45 non-incubated firms in Italy.	The study shows incubated firms have a higher growth rate than non-incubated firms.	Technology brokerage services and access to public financial funds	The study argues that without a strong management team and high coordination with external service providers, incubators will fail in delivering effective support.
Meyer (2003)	4 spin-offs located at incubators in US and northern Europe.	The study claims that not all academic entrepreneurs are interested in creating fast growth firms some look for another venue to pursue their interests.	Typical start-up growth, financing and networking.	The study disputes the current argument on incubation support by claiming that support can produce a negative impact on growth.
Peters et al. (2004)	49 incubators in the US	The study argues that the existing models of incubators, e.g. profit, non-profit and university-based incubators, are ineffective in explaining the role of incubators in facilitating entrepreneurship.	Infrastructure Coaching Networking	The study claims that customised coaching programme and formation of networks are most relevant for incubated firms.
Lee and Osteryoung (2004)	39 Korean and 21 US university-based incubators	The study discusses several critical success factors for university-based incubators in Korea and US.	Physical/human resources Incubator services Networked program	The study proves that all support is equally important for the effective operation of incubators.
Chan and Lau (2005)	Six technology incubated firms in Hong Kong	Using the assessment framework, the study argues that the benefits required	Accommodation Pooling resources	The study claims that start-ups do not gain benefits from consulting advices on product development and

	science park	by start-ups at different stages of development are varied.	Networking	networking.
Bollingtoft and Ulhoi (2005)	The MG50 incubator in Denmark	The study proposes a new model of networked incubators.	Networking	The study shows a rather complex picture of networking at incubators by focusing on internal and external networks.
Rothaermel and Thursby (2005)	79 incubated firms located at ATDC, US.	The study supports the presence of knowledge flows from university to incubated firms.	Network with university	By looking on the citation of university research on incubated firms' patents, the study argues that supporting networks with this university is important.
Grimaldi and Grandi (2005)	8 incubators in Italy	The study argues that firms' requirements and needs encourage incubators to differentiate their range of services.	Various support	The study proposes two models of support. In model 1, support is more oriented towards the provision of tangible assets and market commodities while in model 2, support is oriented towards the provision of finance and intangible assets.
Totterman and Sten (2005)	3 incubators in Finland	The study argues that support in offering space, facilities and financial capital is not the key aspect that incubators should focus on.	Accommodation Assistance services Networking	The study argues that incubators should develop good networks themselves and involve stakeholders in the process.
Schartz and Hornych (2008)	An incubator in Hale, Germany	The study identifies key benefits of incubators, with an explicit sector-focus on the media industry.	High quality premises and equipment Consultancy services Image of location	The study found evidence of a low impact on internal networking activities on incubated firms. However, linkages to the university produce a high impact.
McAdam and McAdam (2008)	2 incubators in the UK and Ireland	The study found that as incubated firms develop, the propensity to make use of incubator support and resources increases.	Various services	The need of support provision changed dynamically following the growth of incubated firms.
Bergek and Norrman (2008)	16 Swedish incubators	The study develops a framework that can serve as a basis for identifying a best practice incubator model and for rigorous evaluation of performance.	Business support	The study claims that support is varied and can be applied within the spectrum of 'strong intervention' and 'laissez-faire.'
Aaboen (2009)	6 incubators in Sweden	Using an analogy of firms, the study raised a question on the actual customer of incubator, which has an implication on incubators' operation	N/A	The study argues that incubators act as a customer and need to mobilise resources into their domain.

		and services.		
Scillitoe and Chakrabarti (2010)	11 US incubators and 6 Finnish incubators with 28 US and 14 Finish new technology-based firms	The study shows that different interactions with incubator management influences business and technical assistance.	Networking Counselling	The study proposes that business assistance is best enabled through counselling interaction with incubator management while technical assistance is best enabled through networking interactions with incubator manager.
Schwartz and Hornych (2010)	150 firms located at German business incubators	Specialised incubators do not perform better than diversified incubators in terms of increasing incubator internal networking and links with academic institutions.	Networking support	Network is informal but there is a need to develop a trust-based relationship for establishing a mutual valuable network relationship.
Ratinho and Henriques (2010)	14 science parks and incubators in Portugal	The study found a modest contribution of Portuguese Science Parks and Business Incubators.	Administrative and management support Professional support	The study argues that a university link and the capability of the incubator teams are crucial in delivering support.
Bruneel et al. (2012)	7 incubators from various european countries	The study found that most incubators offer similar support but incubated firms from older generation incubators make less use of support.	Infrastructure Business support Access to networks	The study suggests the importance of establishing selection criteria and an exit policy for the effectiveness of support.
Bollingtoft (2012)	2 incubators in Denmark	The study suggests a bottom-up approach incubation model. The model is characterised in being established by the entrepreneurs and received no support from public and private funds.	Business support but focus on networking	Besides networking, the study argues that a high proportion of the management and business assistance is perceived as being very important.
Rubin et al. (2015)	8 incubators in Israel and 3 incubators in Australia	The study suggests that collaboration of incubated firms, graduated firms and management of incubators increases incubated firms' knowledge of technology, market and their likelihood of raising capital.	Support on technology and market knowledge Support on financial resources.	The study proposes an interrelationship model of incubators where three knowledge bearers (technology, market and financial resources) are emphasised.

From the above table, we can conclude several important facts. First, it is generally agreed that the survival and growth of incubated firms requires the support of incubators. Second, the types of support are varied, but overall business incubators offer support in (1) providing basic business requirements such as accommodation, workshop facilities and funding, (2) facilitating social ties with business players and university contacts that enable incubated firms to access market, financial and technological resources (McAdam and McAdam, 2008), and (3) providing entrepreneurial support such as mentoring, business coaching and training (Bergek and Norrman, 2008). These types of support arguably play a role in increasing the likelihood of the survival and growth of spin-offs (Grimaldi and Grandi, 2005; Meyer, 2003; Hannon and Chaplin, 2003). Lastly, the findings on the impact of those supports are still inconclusive. With some findings reporting a positive impact on the performance of incubated firms (e.g. Peters et al, 2004; Lee and Osteryoung, 2004; Mian, 1997), others have found no evidence (e.g. Chan and Lau, 2005; Meyer, 2003). Some studies (e.g. Bergek and Norrman, 2008; Bollingtoft and Ulhoi, 2005; McAdam and McAdam, 2008) also show just how complex the nature of support and its impact can be.

The mixed findings may be a result of the variety of approaches that have been used to study incubators and the incubation process. Studies have tended to use either the incubator or incubated firms/tenants as the unit of analysis. However, a variety of performance measurements such as survival rate, job growth and innovativeness are often used to assess the effectiveness of incubation support. However, most of the studies have overlooked the role of strategy of incubated firms/tenants. On the other hand, studies on small firm strategy and management practices have rarely considered external interventions such as incubation support in determining firms' strategic options. While Table 1 shows that many previous studies have traditionally measured the direct impact of incubation support, the indirect impact on firms' strategy has received little attention. In closing the gap, this study takes the perspective that if firm strategy and incubation support are aligned during the incubation process then the performance of spin-offs is more likely to be improved.

3. Hypotheses development

In constructing our hypotheses, we first suggest the direct impact of either support or strategy on performance. While we consider support as networking and entrepreneurial support, the strategy is defined in detail encompassing technology and market domains. In the second part, the interaction between support and strategy is hypothesised.

3.1 University incubation support and performance

We focus on two types of support provided by incubators, networking and entrepreneurial support. Networking support focuses on building networks and networking activities with the aim of creating a

value network for resource acquisition or business growth (McAdam and McAdam, 2006). By helping incubated firms develop their networks, academic spin-offs benefit from a faster learning experience and access to resources from universities. The second type refers to traditional entrepreneurial support such as mentoring, training and coaching. This support is intended to overcome obstacles related to the lack of entrepreneurial skills and knowledge.

The networks of academic spin-offs

The literature describes networks in various ways but agrees upon the fact that relationships encompass a firm's set of relations with other organisations and individuals (Jack, 2010; Fayolle, 2007). Networking support provided by incubators enables the construction of internal and external networks (Scillitoe and Chakrabarti, 2010; Bollingtoft and Ulhoi, 2005; Tötterman and Sten, 2005). Internal networks are relationships that involve formal or informal collaborations, joint ventures or basic information exchanges among tenants. Scholars (e.g. Rathinho and Henriques, 2010; McAdam and McAdam, 2006) suggests that by being located on the same site, a symbiotic environment can be established where firms share experiences, exchange business contacts or establish collaborative projects, as well as sharing equipment or research facilities. At incubators, knowledge sharing among tenants is the basic reason for start-ups to congregate (McAdam and McAdam, 2006; Löfsten and Lindelöf, 2005; Totterman and Sten, 2005; Bollingtoft and Ulhoi, 2005). Academic spin-offs may also access resources from external networks including professionals, the industry and university. For instance, collaborations with universities, research centres or other knowledge-based institutions enables firms to enjoy economies of specialization without prior investments (Schwartz and Hornych, 2010). Through their role as a connector to a wide network including the industry, universities, intermediaries, professionals and other small businesses, incubators aid the creation of support networks by bringing together a comprehensive array of actors with resources to match the needs of firms. Being connected in support networks is assumed to have a positive effect on the performance of spin-offs as it helps them absorb knowledge and access resources faster and in a less resistant way (Landry et al., 2006). Many studies (e.g., Jack, 2010; Agarwal et al., 2004; Carayannis et al., 1998) find that developing strong and diverse relationships should increase the process of exploiting opportunity and the productive capacity of firms, thereby enhancing their growth potential. We hence posit the following hypothesis.

Hypothesis 1a. Networking support will positively influence the performance of spin-offs.

Entrepreneurial support

According to Barney and Clark (2007), firms must own critical resources to explore and exploit opportunities. Firms search and convert resources into products or services for which revenue can be obtained. Academic spin-offs may have distinct resources in technological knowledge and skills yet

frequently lack other resources. Of the resources needed, entrepreneurial knowledge and skills would appear to be the most problematic (van Geenhuizen and Soetanto, 2004). The need for entrepreneurial knowledge is coupled with the need for management skills, overcoming difficulties in dealing with uncertainty and simultaneously managing different management tasks. With the objective of easing the obstacles that may hamper the growth of university spin-offs, university-based incubators provide a wide range of entrepreneurial support such as training and mentoring to improve entrepreneurial skills and provide access to a range of other more specialized professional services (Bergek and Norrman, 2008; Grimaldi and grandi, 2005). As most university spin-offs have to contend with the lack of entrepreneurial knowledge and skills, entrepreneurial support enhances the growth of academic spin-offs (Bøllingtoft and Ulhøi, 2005; Hannon and Chaplin, 2003). We hence propose the following hypothesis.

Hypothesis 1b. Entrepreneurial support will positively influence the performance of spin-offs.

3.2 Innovation strategy and performance

An earlier theoretical contribution by March (1991) identifies two generic innovation strategies. The first is exploration, whereby firms pursue new knowledge, capabilities and skills to develop new products or services to capture new market opportunities. The second is exploitation, whereby firms develop capabilities in order to excel in their ability to leverage existing knowledge and build on their existing products or services to serve existing markets. Levinthal and March (1993) propose another explanation and define exploration as the pursuit of knowledge of things that may come to be known, and exploitation as the use and development of things already known. Some studies suggest that maintaining an appropriate exploration and exploitation balance is critical for firm survival (Sirén et al., 2012; Bierly and Daly, 2007; Smith and Tushman, 2005). Another stream of studies proposes that exploration and exploitation can be treated as an ambidextrous process such that firms can successfully engage in both activities (Gupta et al., 2006; Jansen et al., 2006; Lavie and Rosenkopf, 2006; Lutbatkin et al., 2006). However, others have shown that achieving this is difficult (Bierly and Daly, 2007; Lubatkin et al., 2006; Smith and Tushman, 2005).

For newly established and small firms, a trade-off between exploration and exploitation is inevitable as they compete for scarce resources (He and Wong, 2004). Implementing both strategies is problematic for small firms due to the unsupportive organisational structure (Lubatkin et al., 2006) and limited resources, leading to tension and trade-offs (O'Reilly and Tushman, 2008; March, 1991). Moreover, while numerous studies explore the impact of exploration and exploitation on firm performance (Sirén et al., 2012; Raisch and Birkinshaw, 2008; Jansen et al., 2006;), most do not clearly define the context or domain where the strategy is applied. Indeed, exploration and

exploitation can be employed across different organisational functions such as technology, product and market development. For instance, firms may exploit a current technology with the goal of attracting a new market segment or exploring a new technology to provide a better service to existing customers. In an effort to reconcile the aforementioned limitation, Voss and Voss (2013) offer a strategy model where exploration and exploitation can be employed in product and market domains.

To illustrate the application of strategies in different organisational domains, Figure 1 shows four strategies involving exploration and exploitation in both technology and market development. The first two strategies denote the technology domain. First, *the technology exploitation strategy* (box 1) refers to a strategy focusing on incremental innovation of a current technology. With this strategy, firms build on existing knowledge and reinforce their capabilities, skills and infrastructure (Levinthal and March, 1993). Second, *the technology exploration strategy* (box 2) refers to the development of new technology. This may result in radical innovation as it requires new knowledge or a departure from existing knowledge (Berner and Tushman, 2003). With this strategy, new designs, new features or even new products are created (Raisch and Birkinshaw, 2008; Abernathy and Clark, 1985). In relation to the market domain, the third strategy refers to *the market exploitation strategy* (box 3), which is designed to retain and increase the current market base (Jansen et al., 2006). Lastly, *the market exploration strategy* (box 4) refers to a strategy aimed at attracting new customers or markets. With this strategy, firms develop a new marketing and branding strategy or build a new distribution channel.

Voss and Voss (2013) argue that firms may potentially combine strategies involving exploration and exploitation in technology and market domains. In the first strategy combination is *the exploiting strategy* where spin-offs exploit their current capabilities, technologies and markets, as a basis for further utilization (1+3). This strategy derives from potential demand and economies of scale offered by the current market. The second strategy combination is *the exploration strategy*, which refers to exploring technology and market domains where spin-offs invest resources to move beyond current capabilities and seek further opportunities by investigating in new technologies and new markets (2+4). The subsequent two strategies denote an ambidextrous strategy where exploration and exploitation are performed simultaneously across the technology and market domains. The first ambidextrous strategy refers to *the ambidextrous market growth strategy* where spin-offs combine exploiting their existing technologies with the objective of attracting new markets (1+4) (Ansoff, 1965). The second ambidextrous strategy refers to a product improvement strategy where spin-offs explore new technology targeting current markets (2+3).

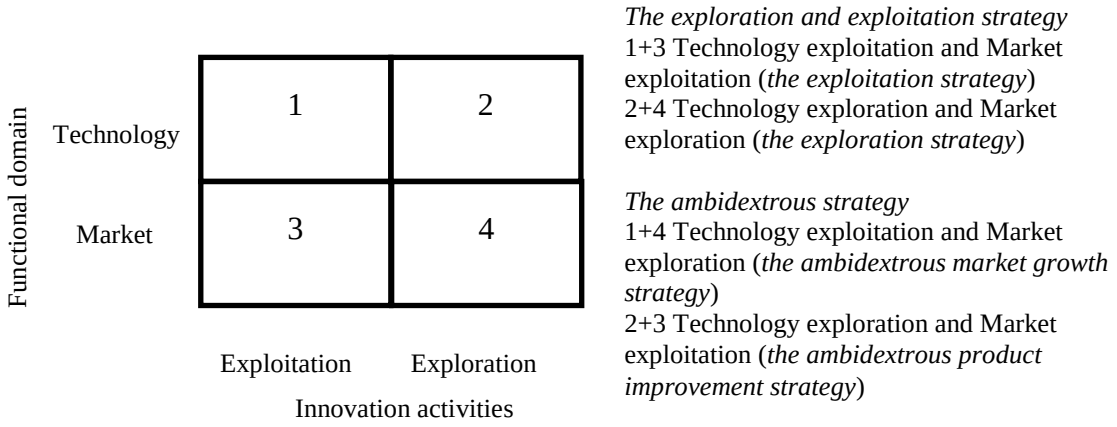

Figure 1. Technology and market innovation strategy framework

Exploration or exploitation strategies in the technology and market domains

Performing exploration and exploitation simultaneously is a challenge as it requires its own construct, resources, administrative routines and managerial behaviours (Lubankin et al., 2006). However, by employing one type of strategy across technology and market domains, spin-offs may avoid the organisational complexity associated with ambidextrous activities (Van Looy et al., 2005). Focusing on either exploration or exploitation is effective in achieving the objectives when the organisation's strategy has high consensus, focus and clarity without distressing the organisational structure and managerial routines (Voss and Voss, 2013). By reducing the conflict between different exploration and exploitation strategies, the impact on performance will generate better outcomes (Ebben and Johnson, 2005).

Through exploration in technology and market domains, spin-offs create new markets. By exploring new technology or new innovation, spin-offs identify opportunities to develop new products or services for new markets. An exploitation strategy in the technology and market domains leads to a similar outcome. Numerous studies (e.g., Yalcinkaya, 2007; Christensen and Bower, 1996) suggest that fully exploiting the current market will foster incremental product development, while exploiting current technology will help create better support for the current market. As prior studies consistently find a reinforcing effect where the outcomes from exploration or exploitation on technology benefit the market and vice versa, this leads us to believe that there is a positive effect of either exploration or exploitation strategies on spin-off performance. To summarise, we hypothesize the following:

Hypothesis 2a. The exploitation strategy where spin-offs perform technology and market exploitation will positively influence the performance of spin-offs.

Hypothesis 2b. The exploration strategy where spin-offs perform technology and market exploration will positively influence the performance of spin-offs.

The ambidextrous strategy in the technology and market domains

The next hypothesis focuses on the ambidextrous strategy across technology and market domains. With this strategy, spin-offs undertake different exploration and exploitation activities to maintain a competitive advantage in offering value to a new or existing market. For small firms, this strategy is more problematic than focusing on a single activity as exploration and exploitation involve a different learning model (Fayolle, 2007; Benner and Tushman, 2003) and a different organisational structure and hierarchy (Smith and Tushman, 2005). Levinthal and March (1993) argue that the basic problem in all organisations is engaging in sufficient exploitation to ensure their current viability while also dedicating enough resources for exploration. However, literature on organisational success tends to agree on the benefits of ambidexterity such as efficiency and flexibility (Adler et al., 1999), and differentiation and low cost strategic positioning (Porter, 1996). According to Gupta et al. (2006) and Andriopoulos and Lewis (2009), this strategy creates a loose coupling that obviates tensions. As a result, combined capabilities in the form of ambidextrous strategies will improve performance (Kogut and Zander, 1992).

The combined exploration and exploitation strategy enables academic spin-offs to apply two potential ambidextrous strategies. The first refers to *the ambidextrous market growth strategy* where spin-offs employ technology exploitation and market exploration. This strategy seeks to achieve performance by exploiting the current technology to serve a new market. According to Cao et al. (2009), a high level of exploitation activities can improve a firm's effectiveness in exploring new markets. Through developing superior products by exploiting current technologies, firms become aware of their capabilities in developing technology and have a better understanding of the functionality of existing products. By combining competencies and engineering knowledge with understanding new market trends, spin-offs are able to develop a sustainable business. Another ambidextrous strategy is combining technology exploration and market. In this strategy, spin-offs often perform experiments with their technology using their existing market as a test case. Through trial and error product testing, implying open innovation or a user-led approach, spin-offs use their current customers to provide feedback and suggestions in developing new products. This strategy, referred to as *the product improvement strategy*, enhances the performance of spin-offs if the current market values the new development of the product (O'Reilly and Tushman, 2008). For this reason, we construct the following hypotheses:

Hypothesis 3a. The ambidextrous market growth strategy where spin-offs perform technology exploitation and market exploration will positively influence the performance of spin-offs.

Hypothesis 3b. The ambidextrous product improvement strategy where spin-offs perform technology exploration and market exploitation will positively influence the performance of spin-offs.

3.3 The interaction effect

The exploration or exploitation strategy and incubation support

In this hypothesis, the university incubation support role is assessed on both the exploitation and the exploration strategy. In the exploitation strategy, spin-off activities are aimed at exploiting technology to satisfy demand or improve current markets. The need to exploit technology may be triggered by complaints or feedback received from current customers (Voss and Voss, 2013; Van Looy et al., 2005). Through exploiting current technology, firms may develop better products that actually offer greater value to their current customers. We argue that incubation support such as networking support reinforces the effect of the exploitation strategy on performance since the spin-off's efforts are mainly in technology domains and less in market domains (McAdam and McAdam, 2008; Mian 1997). As the products or services are originally developed at universities, the researcher or academic staff network and access to the research facility may lead to new ideas, solutions or information on technology development (Nosella and Grimaldi, 2009; Peters et al., 2004). These ties enable exchanging highly tacit knowledge and the specific technological content necessary in technology exploitation activities (Johansson et al., 2005). In addition, entrepreneurial support may also help spin-offs understand their current business and customers (Mian et al, 2012; Chan and Lau, 2005; Hannon and Chaplin, 2003). Training or coaching in marketing, business communication and customer satisfaction may help spin-offs sharpen their business proposition as a result of the exploitation strategy.

In the exploration strategy, spin-offs invest resources in exploring markets while also exploring new technology. As most of the products or services are constructed on a set of designs, subsystems, interfaces and components, spin-offs are able to develop other derivative products (Voss and Voss, 2013). Spin-offs that explore new markets while also pursuing new technology perform complementary activities where outcomes from one exploratory activity in one domain can be transferred to improve or add value to another domain. Similarly, spin-offs that find new technologies may be able to offer new business propositions that are attractive to a new market. In this case, support such as networking is essential as it enables accessing actors with resources (Bøllingtoft and Ulhøi, 2005; Hannon and Chaplin, 2003). On the other hand, in performing exploration activities, spin-offs often encounter obstacles such as market uncertainty, marketing and intellectual property issues as well as managerial problems in expanding the business (Mustar et al., 2008). During this exploration process, spin-offs may benefit from entrepreneurial support such as business coaching, mentoring and training (Hannon, 2005; Colombo and Delmastro, 2002). This support helps spin-offs

improve their internal capabilities that enable them to identify and seize opportunities during the exploration activities. We thus hypothesise the following:

Hypothesis 4a. Networking support has a positive moderating effect on the exploitation and exploration strategy and thus on the performance of spin-offs.
Hypothesis 4b. Entrepreneurial support has a positive moderating effect on the exploitation and exploration strategy and thus on the performance of spin-offs.

The ambidextrous strategy and incubation support

The next hypothesis relates to the role of support on the effect of an ambidextrous strategy on spin-off performance. Studies suggest that firms can successfully implement ambidexterity through structural differentiation (Benner and Tushman, 2003) or higher-order contextual systems (Gibson and Birkinshaw, 2004). However, performing both exploration and exploitation activities is difficult for small firms such as spin-offs as they lack the capabilities to manage the complexity associated with structural differentiation (Simsek et al., 2009; Siggelkow and Rivkin, 2006). They also lack the human resources and capabilities to manage multiple and different subunits. In performing both activities simultaneously, spin-offs face internal complexity due to the different capabilities and resources needed (He and Wong, 2004; Bierly and Daly, 2001; McKelvey, 1999). The difficulty is even greater when considering that an ambidextrous strategy needs to be implemented in the technology and market domains. When a firm makes greater efforts in one domain, for instance technology, the firm is likely to be subjected to the risk of obsolescence. The firm may enjoy short-term success, such as finding new features or new products, but this success may be temporary in the face of significant market changes (Tushman and Anderson, 1986). As a result, the potential of the newly invented product becomes irrelevant and may impede the future capabilities of the firm (Christensen and Overdorf, 2000). Moreover, failure to manage the ambidextrous strategy will increase the risk of falling into costly search and experimentation activities but without any significant results (Freel, 2005; Covin et al., 1990; Teece, 1986).

In employing an ambidextrous strategy, spin-offs need to develop their capabilities, organisational structure and skills to allow the construction of divergent cognitive models and objectives (Gibson and Birkinshaw, 2004). We thus argue that support in terms of networking and entrepreneurial support may play a role in facilitating an ambidextrous strategy in spin-offs. Support from the university implies not only accessing resources but also improving the spin-off's organisational capabilities through continuous interactions with university contacts. Access to a wide range of academic expertise (academic staff, student projects and university networks) and to entrepreneurial expertise (human resources, leadership and marketing skills) may help spin-offs overcome organisational needs to implement an ambidextrous strategy. This leads us to hypothesise that support

from the university will reduce the complexity of implementing an ambidextrous strategy and will positively influence the performance of spin-offs.

Hypothesis 5a. Networking support has a positive moderating effect on the ambidextrous strategy and thus on the performance of spin-offs.
Hypothesis 5b. Entrepreneurial support has a positive moderating effect on the ambidextrous strategy and thus on the performance of spin-offs.

Figure 2 summarises the five hypotheses constructed in this study.

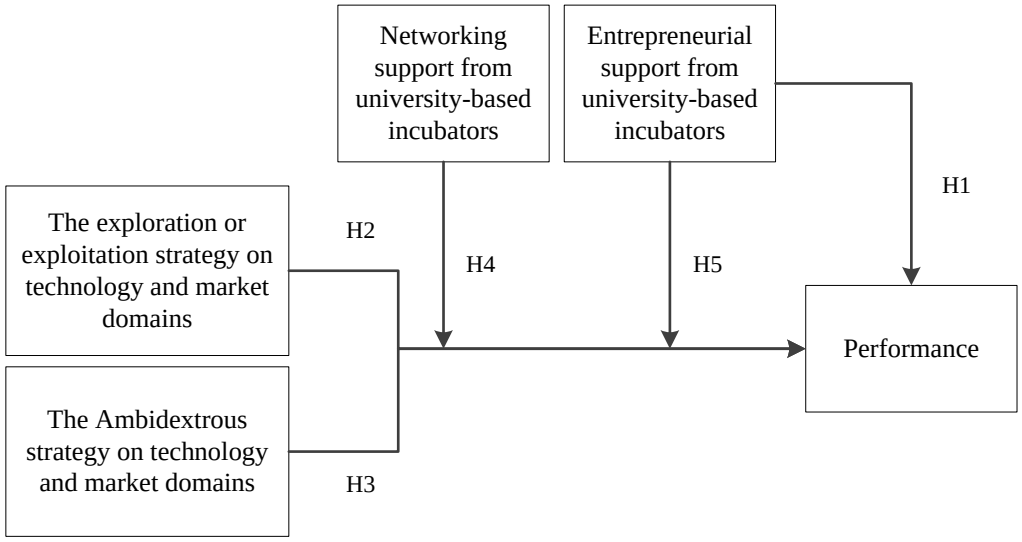

Figure 2. The summary of the hypotheses

4. Research approach

The study draws on surveys of university spin-offs in the United Kingdom, The Netherlands and Norway. In the United Kingdom, samples were collected from incubators located at the Daresbury Science Innovation Centre and Lancaster University (incubators at Infolab and Lancaster Environment Centre). The academic spin-offs at the incubators were created at three universities in the northwest, namely Lancaster University, the University of Manchester and the University of Liverpool. Although the support provided by the incubators varies, the main support entails access to the research facility and office space. The sample from the Netherlands includes spin-offs from the Technical University of Delft and most are located at the well-designed incubator building Yes!Delft. In this comprehensive programme, the spin-offs receive a set of support measures including a room and facilities in addition to value-added support, while applying more stringent rules to access the incubation program. From Norway, data were collected from the academic spin-offs of NTNU Trondheim located at two incubators, Leiv Eriksson Nyfotek and the Gloshaugen Innovation Centre (GIC). Similar to the preceding incubators, those in Norway provide a wide array of support ranging

from office space and shared services to business counselling, insurance, legal services and public relations.

As in other studies on academic spin-offs, we faced the challenge of defining the study sample. Although the most common sampling design that permits reliable generalization is random sampling, this was not possible in our case as the total population was unknown. Most universities have no all-inclusive database of their spin-off activities. Thus, a purposive sampling design was used. The aim of this method is to select a sample that can yield the most comprehensive understanding of the object of study. Accordingly, a sample of candidate spin-offs and a population/database was carefully developed from several sources. An initial list of spin-offs was collected from the managers of the business incubators, university technology transfer officers and professors. In addition, a snowball technique was used during the interviews with the founder(s) of university spin-offs. In this case, the respondents were asked to mention other entrepreneurs they knew to provide a further opportunity to obtain more data. We delineated the population of spinoffs from these universities based on the following criteria. First, the firms needed to satisfy the condition of commercialising knowledge and technology created at the university. Second, at least students, graduates or academic staff had to be actively involved in the firms. Further, the firms needed to satisfy the condition of receiving support from the incubators or university.

A total of 141 samples were collected in the period from 2009 to 2010. The average age of the academic spin-offs from the UK is 4.23 years, 5.12 years for those from the Netherlands and 4.45 years for those from Norway. With regards to the size of spin-offs, those from the UK and the Netherlands have similar patterns where most firms have between 6-25 full-time equivalent (FTE) employees. In contrast, the spin-offs from Norway are relatively smaller. In terms of industry type, the majority of the spin-offs in the UK sample are in ICT and those in the Netherlands and Norway in design and services. Table 2 describes the samples.

Table 2. The description of samples

	Number of firms	Average ages	Average number of employees (FTE)	Type of industry
The Northwest University, UK	58 spin-offs	4.23 (3.1)	0-5: 20.7%; 6-25: 58.6%; >25: 20.7%	ICT: 44.7%; Life science: 32.8%; Advanced engineering: 3.4%; Design and services: 15.5%; Other: 3.4%
TU Delft, The Netherlands	55 spin-offs	5.12 (4.7)	0-5: 30.9%; 6-25: 50.9%; >25: 18.2%	ICT: 27.3%; Life science: 9.1%; Advanced engineering: 23.6%; Design and services: 29.1%; Other: 10.9%

NTNU Trondheim, Norway	28 spin-offs	4.45 (2.2)	0-5: 42.9%; 6-25: 21.4%; >25: 35.7%	ICT: 21.4%; Life science: 14.3%; Advance engineering: 17.9%; Design and services: 39.3%; Other: 7.1%

4.1 Independent variables

4.1.1 The incubation support measurement construct

Networking support

Measuring the effectiveness of networking support is a huge challenge for any study on incubators and the incubation process. As incubators provide spin-offs with a variety of networking support, this can only be measured through its impact on spin-offs. For this reason, this study uses the characteristics of spin-off support networks as a proxy of networking support. Networking support is defined as a list of contacts that are crucial to delivering resources and resulting from the networking support provided by the incubators. Two indicators, strength of ties and network size, are used to identify the characteristics of the support networks created by the incubators.

Strength of ties. As people know each other better and become emotionally involved, they will develop strong ties that entail trust, commitment and willingness to support each other (Leana and van Buren, 1999; Adler and Kwon, 2002). These types of ties are important for start-ups such as academic spin-offs that attempt to market an unproven product and have limited resources. The variable was measured as the frequency of face-to-face interactions on a monthly basis between the spin-offs and their network contacts. Using the number of contacts (n) and frequency of interactions in a week (i), we measured the average frequency of interactions. A high value indicates a relatively strong relationship.

$$f = \frac{\sum_{t=1}^{n} i_t}{n}$$

Network size. The size of the network was measured as the number of contacts satisfying the following criteria: (1) defined as a person who contributes significantly to the development of spin-offs, and (2) resulting from the support of incubators. In this case, the spin-offs met the contacts through the mediation role of incubators. Although we did not set a limit for the number of contacts, the average number of contacts in our samples is 4.89.

Entrepreneurial support

In this study, entrepreneurial support is measured as the frequency of support received by academic spin-offs in two categories, namely, marketing and managerial support. In marketing support we included support relating to improving the spin-off's marketing strategy, sales, negotiation and communication skills. Managerial support implies that the incubator organizes training or mentoring related to small business management. This support includes leadership, human resources, finance,

tax and intellectual property management. We constructed three five-scale items for each support category (Appendix 1). A preliminary analysis with confirmatory factor analysis (CFA) shows that each of the items loaded significantly on the intended factor while the categorisation was supported by Cronbach's alpha.

4.1.2 The strategy measurement construct

Defining exploration and exploitation is quite a challenge as they are considered broad concepts. However, many studies provide a range of operationalization measurements. Following Bierly and Daly (2001), Katila and Ahuja (2002), and He and Wong (2004), we consider exploration and exploitation as two distinct dimensions of strategy rather than as two ends of a one-dimensional scale. In order to develop a measurement, we conducted a focus group discussion involving 6 founders from the academic spin-offs. Guided by the concepts in the literature, the discussion was intended to study the activities of the spin-offs during the incubation process. Prior to the discussion, we explained the concept, definition and purpose of the meeting, i.e., to clarify and describe the spin-off activities relating to the technology and market domains. In terms of market exploration, most discussants agreed that the term refers to all the activities that aim to find a new market base or establish new relationships with customers. Some examples of the activities referred to include the spin-off's new strategy in selling services in a new market in the healthcare sector. The other spin-offs offered other examples of selling their products overseas. Market exploitation is defined as the efforts of a spin-off to sell more services to a single customer. Here, for example, a spin-off developed a platform for oil exploration but also offered maintenance and logistics services to the same customer. Although technology exploration is a rather difficult concept, one explanation that emerged is that this refers to activities such as combining or borrowing new ideas or technologies to improve current or existing technologies. For some of the spin-offs in the ICT sector, this activity may refer to replacing a traditional approach to developing a technology with a new approach. Technology exploitation is described as activities that improve the capabilities of current technologies. Activities such as optimising algorithms or increasing the data processing speed are considered technology exploitation.

Based on the insights from the focus group and the predefined measurement developed by Jansen et al. (2006), we constructed three five-scale items for each of the four strategies (technology exploration, technology exploitation, customer exploration, customer exploitation). The questions are listed in Appendix 2. These items were designed to portray the spin-offs' activities in relation to their technologies and markets in the last three years. Although prior research indicates that innovation activities tend to be stable across a number of years (Bierly and Chakrabarti, 1996), a three-year timeframe for the strategy construct was chosen to create a consistent scale across the samples. The confirmatory factor analysis (CFA) shows that all items loaded significantly on the intended factor indicating convergent validity among the items of each scale.

4.2 Dependent variable

Using the performance measurement of Gupta and Govindarajan (1986) and Covin et al., (1990), as a basis, we measured the performance with three items and asked the respondents to indicate the extent to which their firms have achieved their objectives on a scale of 1 to 5. We gathered two-year time-lagged performance data by asking the respondents to compare their firms' performance in relation to those of other major competitors in terms of sales, profit and market share. We used the founders' evaluations because objective data such as financial measurements may not measure the effect of an exploration strategy. Compared to returns from exploitation, the outcomes of exploration are less certain, more remote in time and organizationally more distant from the locus of action and adaption (March, 1991). In addition, we assumed that the founders are knowledgeable informants, particularly with regard to their firm's performance. To confirm the veracity of our subjective measurement, a reliability assessment with confirmatory factory analysis was conducted. The overall results show a single factor loading with a high Cronbach alpha coefficient.

4.2.1 Control variable

In testing the hypotheses, we included spin-off age, size and level of innovativeness as control variables. The age variable was included as younger spin-offs are less likely to have established routines compared to mature firms and are more often highly innovative due to new ideas or inventions they are still developing. Older spin-offs, however, have more experience and are more established, which means they are better at attracting resources. Firm size was selected because some studies (Acs and Audretsch, 1988; Freel, 2003) argue that small firms are more innovation-intensive than larger firms. Finally, we included the level of innovativeness as a control variable because we assume that highly innovative spin-offs perform and require different innovation strategies compared to low and medium innovative spin-offs. While both the age and size variables are continuous, the innovation level variable is dichotomous where 1 represents spin-offs with patented technology and 0 represents spin-offs without patented technology.

5. Findings

The mean, standard deviation and correlation of the variables are shown in Appendix 3. Overall, the correlation among the independent variables is relatively modest, ranging from -.09 to .34. However, to ensure that multicollinearity is not an issue, we employed a mean centre procedure for the first-order variables and applied multicollinearity diagnosis. To test the hypotheses, we first added the control variables and the independent variables to produce the main-effect model, then the two-way interaction terms and finally the three-way interaction terms. Table 3 shows the result of the hierarchical regression analysis. In Model 1, we present the results of the analysis where the control variables were added to the strategy variables and the support variables. The results are as expected

except for the innovation level variable, which is non-significant. The spin-off age and size variables indicate a positive and significant coefficient, meaning that older and larger spin-offs have stronger performance than younger and smaller spin-offs. The results also show that most of the individual strategies, technology exploitation, technology exploration and market exploitation were non-significant. However, the effect of technology and market exploitation was slightly significant and stronger than the other strategy variables. This difference may indicate that exploitation has more impact on performance than exploration. Overall, the non-significant results support the findings of Lavie et al. (2010) and Voss and Voss (2013) emphasising the importance of examining the strategy combination and contingency effects rather than focusing on a single strategy.

With regard to the first hypothesis on the impact of incubation support on spin-off performance, we find that most of the variables show a positive and significant impact except for the management support variable. The strength of ties variable shows a positive and has the strongest impact compared to the other variables. While having a number of supporting contacts is beneficial to spin-off growth, it is through strong ties that academic spin-offs are able to gain legitimacy, acquire resources and exchange knowledge that later affects their performance. Moreover, support that provides entrepreneurial knowledge and skills proves useful for spin-offs.

In Model 2, we introduce the two-way interactions of adopting an innovative strategy in the technology and market domains as used to test H2 and H3. The result from Model 2 offers partial support to H2. In support of H2(a), the technology exploitation variable x market exploitation interaction was significantly positive. However, the technology exploration variable x market exploration interaction was non-significant. We thus have to reject H2(b). With regard to the third hypothesis on the impact of an ambidextrous strategy on performance, the analysis shows that the market growth strategy variable (technology exploitation x market exploration interaction) is positive and significant. The finding thus supports H3(a) and indicates that spin-offs that exploit their current technology and use the advantages to explore new markets reap the benefits from this strategy. Unfortunately, the finding shows that the product development strategy variable (technology exploration x market exploitation interaction) is non-significant meaning that H3(b) is not supported. Apparently, exploring new technology to serve an existing market has no significant impact on performance.

The next hypothesis concerns the moderating role of networking support and entrepreneurial support on the relationship between either exploration or exploitation strategy and performance. The results of the hypothesis testing are presented in Models 3 to 6. The findings show support for 4(a) especially with the strength of ties variable as a moderating factor. The interaction of strength of ties with either exploration or exploitation on the technology and market domain is positive and significant while the

network size variable is only significant when the variable interacts with the exploitation strategy. Moreover, the results also show that marketing support moderates the relationship between the exploration and exploitation strategy. Unfortunately, the finding fails to show any significant impact of management support on the strategy of spin-offs. Therefore, H4(b) is partially supported. Models 7 to 10 test H5. In the models, the three-way interactions of the ambidextrous strategy and networking support were added. The findings show that most of the interaction variables are non-significant meaning that H5(a) is not supported. Lastly, the findings support only the moderating role of marketing and management support on the relationship between the ambidextrous market growth strategy (technology exploitation x market exploration interaction) and performance. Thus, hypothesis 5(b) is partly supported.

Table 3. Regression results

		1	2	3	4	5	6	7	8	9	10
Main effect											
(CV) Spin-off age		.07†	.11*	.08†	.06†	.10*	.09†	.10†	.08†	.09†	.10*
(CV) Spin-off size		.21*	.22*	.24*	.35**	.37**	.36**	.25*	.28*	.26*	.21*
(CV) Level of innovativeness		.06	.04	.13	.12†	.09	.08	.07	.09	.07	.05
(SV) Technology exploitation		.10†	.53**	.61**	.18†	.27*	.20*	.21*	.16†	.20*	.19†
(SV) Technology exploration		.11	.10	.07	.05	.04	.02	-.07	-.10	-.02	-.06
(SV) Market exploitation		.13†	.19†	.12	.10	.11	.13	.18†	.15	.17†	.19†
(SV) Market exploration		.10	.02	-.08	-.10	-.07	-.08	-.09	-.05	-.02	-.05
(NSV) Strength of ties	H1a	.52**	.59**	.62**	.59**	.57**	.54**	.48**	.67**	.59**	.60**
(NSV) Network size	H1a	.29*	.19*	.16†	.67**	.32**	.43**	.19†	.18†	.24*	.28*
(ESV) Marketing support	H1b	.22*	.23*	.38**	.34*	.31*	.30*	.34*	.29*	.38*	.40**
(ESV) Management support	H1b	.08	-.10	-.11	-.12	-.07	-.07	-.06	-.05	-.08	-.06
Two-ways interaction											
Exploitation or exploration strategy											
Technology exploitation x Market exploitation	H2a		.58**	.55**	.57**	.63**	.56**	.60**	.64**	.59**	.66**
Technology exploration x Market exploration	H2b		.36	-.06	-.08	-.10	-.04	-.05	-.02	-.06	-.09
Ambidexterity strategy											
Technology exploitation x Market exploration	H3a		.54**	.53**	.67*	.56**	.65**	.65**	.59**	.68**	.54**
Technology exploration x Market exploitation	H3b		.06	.08	-.07	-.06	-.05	-.06	.08	.08	.10
Three-ways interaction											
Exploration or exploitation strategy x strength of ties											
Technology exploitation x Market exploitation x strength of ties	H4a			.66**							
Technology exploration x Market exploration x strength of ties	H4a			.43*							
Exploration or exploitation strategy x network size											
Technology exploitation x Market exploitation x network size	H4a				.77**						
Technology exploration x Market exploration x network size	H4a				.10						
Exploration or exploitation strategy x marketing supports											

Technology exploitation x Market exploitation x marketing support	H4b					.73**					
Technology exploration x Market exploration x marketing support	H4b					.60**					
Exploration or exploitation strategy x management supports											
Technology exploitation x Market exploitation x management support	H4b						0.05				
Technology exploration x Market exploration x management support	H4b						0.06				
Ambidexterity strategy x strength of ties											
Technology exploitation x Market exploration x strength of ties	H5a							.12			
Technology exploration x Market exploitation x strength of ties	H5a							.16			
Ambidexterity strategy x network sizes											
Technology exploitation x Market exploration x network size	H5a								.24†		
Technology exploration x Market exploitation x network size	H5a								.10		
Ambidexterity strategy x marketing support											
Technology exploitation x Market exploration x marketing support	H5b									.44**	
Technology exploration x Market exploitation x marketing support	H5b									.12	
Ambidexterity strategy x management support											
Technology exploitation x Market exploration x management support	H5b										0.49**
Technology exploration x Market exploitation x management support	H5b										0.10
F		56.62**	48.99**	54.49**	60.03**	68.52**	67.36**	59.65**	62.70**	64.32**	59.86**
R2		0.51	0.53	0.56	0.57	0.58	0.58	0.57	0.58	0.59	0.57
Δ			0.02	0.05	0.06	0.07	0.07	0.06	0.07	0.09	0.06

CV: control variable; SV: strategy variable; NSV: networking support variable; ESV: entrepreneurial support variable. *:p<.10; **:p<.05;***:p<.01

The results of the analysis show a consistent finding in that the effects of exploration and exploitation on the performance of spin-offs are subject to several conditions. Most of the variables representing the single strategy were non-significant. In contrast, the higher-order interaction effects provide strong evidence that an exploitation strategy on the technology and market domains has a stronger impact than a single strategy on a single domain. With the finding showing strong support of the role of exploitation on performance, we reiterate the argument that returns from exploration are less certain, more remote in time and organisationally more distant from action and adaption (Voss and Voss, 2013; Smith and Tushman, 2005; March, 1991). In exploring new ideas, the success of the strategy has less certain outcomes and more diffused effects compared to exploiting existing technologies or markets. With regard to the ambidextrous strategy of combining exploration and exploitation, the strategy to exploit current technology with the aim of exploring a new market produces better performance than the strategy of exploring new technology. It may be that exploration activities have distant implications on performance and the returns cannot be realized in the short term. The finding indicates that markets would be better served if spin-offs focus on strengthening their current capabilities and technology rather than exploring new possibilities in new technologies. The latter strategy has a rather negative implication on performance and alters a spin-off's current technology development path. These findings to some extent support Cao et al.'s (2009) contention that SMEs with limited resources benefits from both exploration and exploitation.

With regard to incubation support, our study tests the impact of two types of support on academic spin-offs. The finding confirms the hypothesis examining the impact of networking support on the performance of spin-offs. It would seem that in the context of academic spin-offs, networks are crucial as they offer access to resources and information (McAdam and McAdam, 2006; Lee and Osteryoung, 2004). Support through networking is relatively new and offers greater added value to spin-offs. Incubators that are able to develop as a hub of connections among players and key stakeholders in supporting spin-offs can create an advantageous environment for spin-offs and thus have a greater impact on growth. With regard to the effect of entrepreneurial support on performance, we find that support with the aim of enhancing marketing knowledge and skills has a positive impact on growth. The finding however failed to confirm the influence of management support on the spin-offs' exploration and exploitation strategy. This finding should be interpreted cautiously as entrepreneurial support such as management support has become common and is provided by many incubators. As most of spin-offs receive this support, its impact on performance may not be visible.

In examining the moderating role of incubator support, we find evidence that networking support moderates the relationship between strategy and performance. In this case, a strong and heterogeneous network strengthens the impact of an exploitation strategy on performance. In the exploitation strategy, spin-offs focus on exploitation activities across their technology and market domains.

Network contacts help spin-offs access highly tacit knowledge needed during exploitation. In addition, entrepreneurial support in the form of marketing support also proves a significant moderator for the exploration and exploitation strategy. This support also plays a significant role in the ambidextrous strategy where spin-offs perform technology exploitation and market exploration. It could be assumed that this support reduces the complexity in an organisation and provides the necessary skills for market expansion. To summarise, Table 4 shows the result of the hypotheses testing.

Table 4. The result of the hypotheses testing

Hypotheses		Result
1a	Networking support will positively influence the performance of spin-offs.	Supported
1b	Entrepreneurial support will positively influence the performance of spin-offs	Partly supported
2a	The exploitation strategy where spin-offs perform technology exploitation and market exploitation will positively influence the performance of spin-offs.	Supported
2b	The exploration strategy where spin-offs perform technology exploration and market exploration will positively influence the performance of spin-offs.	Rejected
3a	The ambidextrous market growth strategy where spin-offs perform technology exploitation and market exploration will positively influence the performance of spin-offs.	Supported
3b	The ambidextrous product improvement strategy where spin-offs perform technology exploration and market exploitation will positively influence the performance of spin-offs.	Rejected
4a	Networking support has a positive moderating effect on the exploitation and exploration strategy and thus on the performance of spin-offs.	Supported
4b	Entrepreneurial support has a positive moderating effect on the exploitation and exploration strategy and thus on the performance of spin-offs.	Rejected
5a	Networking support has a positive moderating effect on the ambidextrous strategy and thus on the performance of spin-offs.	Rejected
5b	Entrepreneurial support has a positive moderating effect on the ambidextrous strategy and thus on the performance of spin-offs.	Partly supported

6. Conclusions

In literature on incubators and incubation practices, much of the discussion focuses on incubation models where scholars argue the impact of different types of support on the process of nurturing start-ups (Rothaermel and Thursby, 2005). However, little is known about the impact of incubators on the growth strategy of their tenants. On the other hand, studies on strategy in the context of small firms do not consider the concept of incubation as a catalyst that strengthens the impact of strategy on

performance. The discussion on organisational ambidexterity, for instance, barely touches on the importance of receiving support from incubators as a factor facilitating both exploration and exploitation activities. By combining both research perspectives, this study contributes to developing understanding on how exploitation, exploration or a combination of both strategies affect the performance of spin-offs and whether the incubation support moderates the relationship between strategy and performance. Overall, we found that both innovation strategy and incubation support are theoretically and statistically aligned and determine the performance of spin-offs. More specifically, our study found interesting findings regarding the different role of incubation support in strengthening the impact of the firms' strategy.

Networking support: strengthening the exploitation strategy

Employing an exploitation strategy means that spin-offs exploit both the technology and market domains. As the playing field is separated into two domains, using this strategy has a significant consequence on resource allocation, especially for small firms such as academic spin-offs. Adopting this strategy creates synergy between the internal organisational structure, routines and practices (Jansen et al., 2006). By focusing on one activity such as exploitation, firms are expected to experience fewer integration challenges as they can share and transfer knowledge across different units and receive a wide consensus (Voss and Voss, 2013; Jansen et al., 2009).

As the findings show, networking support moderates the relationship between the exploitation strategy and the performance of spin-offs. For spin-offs that develop strong ties with their networks, the impact of the strategy on their performance is stronger than for spin-offs with weak ties. This may imply that networks created as a result of incubation support assist spin-offs in dealing with the lack of resources, capabilities and experiences needed to manage the tension that escalates when spin-offs exploit the technology and market domains. Network contacts such as researchers and professors may have high-level knowledge of technologies and provide access to these while industry contacts offer their insight into business and market access. As a result, the synergy created by a strong relationship between spin-offs and their networks produces a positive effect on the performance of spin-offs. This finding validates our argument that support provided by university-based incubators in the form of networking support strengthens the relationship between innovation strategy and performance.

Entrepreneurial support: Strengthening the ambidextrous market growth strategy

Differentiating activities for product and market development is an alternative strategy to ensure growth. Although employing this strategy may create tension in the organisational structure, the mitigation of two activities may foster performance. From our study, we find that marketing support moderates the relationship between the market growth strategy and the performance of spin-offs. Employing the market growth strategy means that the spin-offs aimed to increase revenue by

exploiting current technologies while exploring a new market. As one of the primary objectives of this strategy is to identify and develop a new market, entrepreneurial support in the form of marketing support is found to be important. Marketing support that covers activities such as mentoring in relation to market studies, internationalisation process, and regulation may complement a spin-off's capabilities in developing technology-based products.

Theoretical and practical implication

By examining innovation strategy in alignment with incubation support, we contribute to this emergent discourse in several ways. Traditionally, the argument was started by March (1991) as he posited a trade-off or a zero-sum game between exploration and exploitation. This contradiction has been long supported in many empirical studies (e.g. Gibson and Birkinshaw, 2004; Floyd and Lane, 2000). However, recent arguments insist that exploration and exploitation are not necessarily in fundamental oppositions and may be mutually supportive (e.g. Gupta et al., 2006, Beckman, 2006; Katila and Ahuja, 2002). This study differs from the empirical literature on this issue in two respects. First, an intervention factor of firms' strategy was used in the study. Examining the alignment between incubation support and more detailed mechanisms of exploration and exploitation in technology and market enrich the existing concept of strategy of small firms. Second, the analysis of the academic spin-offs' case is an interesting addition to the literature, which have so far mainly focussed attention on large firms or rather general small firms. This type of firm faces more uncertainty compared to other start-ups due to their innovation and university relationship. As a result, performing exploration and exploitation is highly relevant for academic spin-offs since innovation is part of their routines and should be practised consistently in spite of their limited capabilities and resources.

The results reported here provide evidence that focusing on an ambidextrous market growth strategy has a positive impact on performance. Theoretically, the findings add new empirical evidences to the on-going discussion regarding the ability of small firms to pursue ambidextrous strategy of exploration and exploitation. However, the study also found backing on the positive impact of performing a single strategy of exploitation. In this case, firms exploit their existing capability by incrementally developing not only their technological capability but also their market basis. Apparently, exploiting current technological capability is crucial while firms may either exploit or explore their market as is shown through the ambidextrous strategy of market growth. Nevertheless, this finding may contribute to the discussion on best practice and innovation strategy of small firms.

Moreover, the study found that the support from incubators is effective in helping academic spin-offs strengthening the impact of their innovation strategy on performance. This finding is particular important to the policy practice in supporting the survival and growth of academic spin-offs. Policy-

makers, universities, and business incubator promoters should be aware of their indirect impact on spin-offs' performance. In relation to incubation studies, we offer a fresh approach to measuring the impact of a university incubation process as well as providing a response to the call for more research examining the detailed process of university incubation and its impact on tenants (Grimaldi and Grandi, 2005; Rothaermel and Thursby, 2005; Phan et al., 2005). While most incubators have imported concepts and practices in delivering support for their tenants, there may be a need to look in more detail at the mechanisms of support which allow firms to exploit and explore their technology while also applying those activities to the market. As the findings show, both networking support and entrepreneurial support are support mechanisms, albeit relevant to different contexts. Incubators should therefore be able to design flexible or bespoke support that addresses the individual needs of spin-offs.

Limitation and future research directions

Although we considered the academic spin-offs from several universities that cover several different industry sectors, the findings should be generalized with caution. We expect that in specific industry sectors, one strategy is preferable or more effective than others. For instance, firms in the life science sector may be forced to innovate more than firms in the manufacturing sector. Firms in the service sector seek different resources for innovation compared to other non-service firms resulting in the creation of different innovation strategies. As the sample of this study covered various types of firms, further research should explicitly define these contexts and assess the impact of incubation support on strategic innovation. Another limitation of this study is the quality of measurement of the networks and types of incubation support. While we used strong ties and network size, neither represents the quality of the relationship. We encourage further research that offers additional insights on measuring the quality of networks. With regard to incubation support, the types of support could be extended; while in this study two categories were used, namely, marketing and management, further studies could consider other types of support such as access to funding and investments from venture capitalists and business angels.

References

Aaboen, L. (2009). Explaining incubators using firm analogy. *Technovation*,*29*(10), 657-670.

Abernathy, W.J., Clark, K.B. (1985). Innovation: Mapping the winds of creative destruction. *Research Policy*, 14(1), 3-22.

Acs, Z.J., Audretsch, D. (1988). Innovation in large and small firms: an empirical analysis. *The American Economic Review*, vol. 78(4), 678-690.

Adler P.S., Goldoftas B., Levine D.I. (1999). Flexibility versus efficiency: A case study of model changeovers in the Toyota production system. *Organisation Science*, 10(1), 43–68.

Adler, P. S., Kwon, S. W. (2002). Social capital: Prospects for a new concept. *Academy of management review*, *27*(1), 17-40.

Agarwal, R., Echambadi, R., Franco, A.M., Sarkar, M.B. (2004). Knowledge transfer through inheritance: Spin-out generation, development, and survival. *Academy of Management Journal*, 47(4), 501-522.

Andriopoulos, C., Lewis, M.W. (2009). Exploitation-exploration tensions and organizational ambidexterity: Managing paradoxes of innovation. *Organization Science*, 20(4), 696-717.

Ansoff, H.I. (1965). *Corporate Strategy*, McGraw-Hill, New York.

Auh, S., Menguc, B. (2005). Balancing exploration and exploitation: The moderating role of competitive intensity. *Journal of Business Research*, *58*(12), 1652-1661.

Autant-Bernard, C., Fadairo, M., & Massard, N. (2013). Knowledge diffusion and innovation policies within the European regions: Challenges based on recent empirical evidence. *Research Policy*, *42*(1), 196-210.

Autio, E., Kenney, M., Mustar, P., Siegel, D., & Wright, M. (2014). Entrepreneurial innovation: The importance of context. *Research Policy*, *43*(7), 1097-1108.

Barney, J.B., Clark, D.N. (2007). *Resource-based theory: Creating and sustaining competitive advantage*. Oxford: Oxford University Press.

Bathelt, H., Kogler, D.F., Munro, A.K. (2010). A knowledge-based typology of university spin-offs in the context of regional economic development. *Technovation*, 30(9), 519-532.

Beckman, C. M. (2006). The influence of founding team company affiliations on firm behavior. *Academy of Management Journal*, *49*(4), 741-758.

Benner, M.J., Tushman, M.L. (2003). Exploitation, exploration, and process management: The productivity dilemma revisited. *Academy of Management Review*, 28(2), 238-256.

Bergek, A., Norrman, C. (2008). Incubator best practice: A framework. *Technovation*, 28(1), 20-28.

Bierly, P., Chakrabarti, A. (1996). Generic knowledge strategies in the US pharmaceutical industry. *Strategic Management Journal*, 17, 123-135.

Bierly, P., Daly, P.S. (2001). Exploration and exploitation in small manufacturing firms. In 61st Annual Meeting of the Academy of Management, Washington DC, August (pp. 3-8).

Bierly, P. E., Daly, P. S. (2007). Alternative knowledge strategies, competitive environment, and organizational performance in small manufacturing firms. *Entrepreneurship Theory and Practice*, *31*(4), 493-516.

Bøllingtoft, A., Ulhøi, J.P. (2005). The networked business incubator—leveraging entrepreneurial agency? *Journal of Business Venturing*, 20(2), 265-290.

Bøllingtoft, A. (2012). The bottom-up business incubator: Leverage to networking and cooperation practices in a self-generated, entrepreneurial-enabled environment. *Technovation*, *32*(5), 304-315.

Bruneel, J., Ratinho, T., Clarysse, B., Groen, A. (2012). The Evolution of Business Incubators: Comparing demand and supply of business incubation services across different incubator generations. *Technovation*, *32*(2), 110-121.

Cao, Q., Gedajlovic, E., Zhang, H. (2009). Unpacking organizational ambidexterity: Dimensions, contingencies, and synergistic effects. *Organization Science*, 20(4), 781-796.

Carayannis, E.G., Rogers, E.M., Kurihara, K., Allbritton, M.M. (1998). High-technology spin-offs from government R&D laboratories and research universities. *Technovation*, 18(1), 1-11.

Chan, K. F., Lau, T. (2005). Assessing technology incubator programs in the science park: the good, the bad and the ugly. *Technovation*, *25*(10), 1215-1228.

Christensen, C.M., Bower, J.L. (1996). Customer power, strategic investment, and the failure of leading firms. *Strategic Management Journal*, 17(3), 197-218.

Christensen, C.M., Overdorf, M. (2000). Meeting the challenge of disruptive change. *Harvard Business Review*, 78(2), 66-77.

Clarysse, B., Wright, M., Lockett, A., Mustar, P., Knockaert, M. (2007). Academic spin-offs, formal technology transfer and capital raising. *Industrial and Corporate Change*, 16(4), 609-640.

Clarysse, B., Wright, M., Bruneel, J., Mahajan, A. (2014). Creating value in ecosystems: Crossing the chasm between knowledge and business ecosystems. *Research Policy*, *43*(7), 1164-1176.

Colombo, M. G., & Delmastro, M. (2002). How effective are technology incubators?: Evidence from Italy. *Research policy*, *31*(7), 1103-1122.

Colombelli, A., Krafft, J., Quatraro, F. (2014). High-growth firms and technological knowledge: do gazelles follow exploration or exploitation strategies?. *Industrial and Corporate Change*, *23*(1), 261-291.

Covin, J. G., Prescott, J. E., Slevin, D. P. (1990). The effects of technological sophistication on strategic profiles, structure and firm performance. *Journal of management studies*, *27*(5), 485-510.

Ebben, J.J., Johnson, A.C. (2005). Efficiency, flexibility, or both? Evidence linking strategy to performance in small firms. *Strategic Management Journal*, 26(13), 1249-1259.

Fayolle, A. (2007). *Entrepreneurship and new value creation: the dynamic of the entrepreneurial process*. Cambridge university press.

Fini, R., Grimaldi, R., Santoni, S., Sobrero, M. (2011). Complements or substitutes? The role of universities and local context in supporting the creation of academic spin-offs. *Research Policy*, *40*(8), 1113-1127.

Floyd, S. W., Lane, P. J. (2000). Strategizing throughout the organization: Managing role conflict in strategic renewal. *Academy of management review*,*25*(1), 154-177.

Freel, M.S. (2005). Patterns of innovation and skills in small firms. *Technovation*, 25(2), 123-134.

Gibson, C.B., Birkinshaw, J. (2004). The antecedents, consequences, and mediating role of organizational ambidexterity. *Academy of Management Journal*, 47(2), 209-226.

Gilsing, V.A., Van Burg, E., Romme, A.G.L. (2010). Policy principles for the creation and success of corporate and academic spin-offs. *Technovation*, 30(1), 12-23.

Gredel, D., Kramer, M., Bend, B. (2012). Patent-based investment funds as innovation intermediaries for SMEs: In-depth analysis of reciprocal interactions, motives and fallacies. *Technovation*, 32(9), 536-549.

Grimaldi, R., Grandi, A. (2005). Business incubators and new venture creation: an assessment of incubating models. *Technovation*, 25(2), 111-121.

Gupta A.K., Smith K.G., Shalley C.E. (2006). The interplay between exploration and exploitation. *Academy Management Journal*, 4, 693–706.

Gupta, A. K., Govindarajan, V. (1991). Knowledge flows and the structure of control within multinational corporations. *Academy of management review*,*16*(4), 768-792.

Hannon, P. D. (2005). Incubation policy and practice: building practitioner and professional capability. *Journal of Small Business and Enterprise Development*,*12*(1), 57-75.

Hannon, P.D., Chaplin, P. (2003). Are incubators good for business? Understanding incubation practice: the challenges for policy. *Environment and Planning C: Government and Policy*, 21, 861-881.

He, Z.L., Wong, P.K. (2004). Exploration vs. exploitation: An empirical test of the ambidexterity hypothesis. *Organization Science*, 15(4), 481-494.

Jack, S. L. (2010). Approaches to studying networks: Implications and outcomes. *Journal of Business Venturing*, *25*(1), 120-137.

Huggins, R., Johnston, A., Steffenson, R. (2008). Universities, knowledge networks and regional policy. *Cambridge Journal of Regions, Economy and Society*, *1*(2), 321-340.

Jansen, J.J., Van Den Bosch, F.A., Volberda, H.W. 2006. Exploratory innovation, exploitative innovation, and performance: Effects of organizational antecedents and environmental moderators. *Management Science*, 52(11), 1661-1674.

Johansson, M., Jacob, M., Hellström, T. (2005). The strength of strong ties: University spin-offs and the significance of historical relations. *The Journal of Technology Transfer*, 30(3), 271-286.

Katila, R., Ahuja, G. (2002). Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of Management Journal*, 45(6), 1183-1194.

Kogut, B., Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, 3(3), 383-397.

Klofsten, M., Jones-Evans, D. (2000). Comparing academic entrepreneurship in Europe–the case of Sweden and Ireland. *Small Business Economics*, *14*(4), 299-309.

Landry, R., Amara, N., Rherrad, I. (2006). Why are some university researchers more likely to create spin-offs than others? Evidence from Canadian universities. *Research Policy*, 35(10), 1599-1615.

Leana, C. R., Van Buren, H. J. (1999). Organizational social capital and employment practices. *Academy of management review*, *24*(3), 538-555.

Lavie, D., Rosenkopf, L. (2006). Balancing exploration and exploitation in alliance formation. *Academy of Management Journal*, *49*(4), 797-818.

Lavie, D., Stettner, U., Tushman, M. L. (2010). Exploration and exploitation within and across organizations. *The Academy of Management Annals*, *4*(1), 109-155.

Lee, S. S., Osteryoung, J. S. (2004). A comparison of critical success factors for effective operations of university business incubators in the United States and Korea. *Journal of Small Business Management*, *42*(4), 418-426.

Levinthal, D.A., March, J.G. (1993). The myopia of learning. *Strategic Management Journal*, 14(S2), 95-112.

Link, A.N., Scott, J.T. (2007). The economics of university research parks. *Oxford Review of Economic Policy*, 23(4), 661-674.

Löfsten, H., Lindelöf, P. (2005). R&D networks and product innovation patterns—academic and non-academic new technology-based firms on Science Parks. *Technovation*, 25(9), 1025-1037.

Lubatkin, M. H., Simsek, Z., Ling, Y., Veiga, J.F. (2006). Ambidexterity and performance in small-to medium-sized firms: The pivotal role of top management team behavioral integration. *Journal of Management*, 32(5), 646-672.

March, J.G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, 2(1), 71-87.

McAdam, M., McAdam, R. (2006). The networked incubator: The role and operation of entrepreneurial networking with the university science park incubator (USI). *The International Journal of Entrepreneurship and Innovation*,*7*(2), 87-97.

McAdam, M., McAdam, R. (2008). High tech start-ups in University Science Park incubators: The relationship between the start-up's lifecycle progression and use of the incubator's resources. *Technovation*, 28(5), 277-290.

McKelvey, B. (1999). Avoiding complexity catastrophe in coevolutionary pockets: Strategies for rugged landscapes. *Organization Science*, 10(3), 294-321.

McQueen, D.H., Wallmark, J.T. (1982). Spin-off companies from Chalmers University of Technology. *Technovation*, 1(4), 305-315

Meyer, M. (2003). Academic entrepreneurs or entrepreneurial academics? Research–based ventures and public support mechanisms. *R&D Management*,33(2), 107-115.

Mustar, P., Wright, M., Clarysse, B. (2008). University spin-off firms: lessons from ten years of experience in Europe. *Science and Public Policy*, *35*(2), 67-80.

Mian, S. A. (1996). Assessing value-added contributions of university technology business incubators to tenant firms. *Research policy*, *25*(3), 325-335.

Mian, S. A. (1997). Assessing and managing the university technology business incubator: an integrative framework. *Journal of business venturing*,*12*(4), 251-285

Mian, S., Fayolle, A., Lamine, W. (2012). Building sustainable regional platforms for incubating science and technology businesses Evidence from US and French science and technology parks. *The International Journal of Entrepreneurship and Innovation*, *13*(4), 235-247.

Nosella, A., Grimaldi, R. (2009). University-level mechanisms supporting the creation of new companies: an analysis of Italian academic spin-offs.*Technology Analysis & Strategic Management*, *21*(6), 679-698.

O'Reilly III, C.A., Tushman, M.L. (2008). Ambidexterity as a dynamic capability: resolving the innovator's dilemma. *Research in Organizational Behavior*, 28, 185-206.

Phan, P.H., Siegel, D.S., Wright, M. 2005. Science parks and incubators: observations, synthesis and future research. *Journal of Business Venturing*, 20(2), 165-182.
Peters, L., Rice, M., Sundararajan, M. (2004). The role of incubators in the entrepreneurial process. *The Journal of Technology Transfer*, *29*(1), 83-91.
Porter, M.E. (1996). What is strategy? *Harvard Business Review* (November-December): 61-78.
Raisch, S., Birkinshaw, J. (2008). Organizational ambidexterity: Antecedents, outcomes, and moderators. *Journal of Management*.
Ratinho, T., Henriques, E. (2010). The role of science parks and business incubators in converging countries: Evidence from Portugal. *Technovation*,*30*(4), 278-290.
Rothaermel, F.T., Thursby, M. (2005). University–incubator firm knowledge flows: assessing their impact on incubator firm performance. *Research Policy*,34(3), 305-320.
Rubin, T. H., Aas, T. H., & Stead, A. (2015). Knowledge flow in Technological Business Incubators: Evidence from Australia and Israel. *Technovation*, *41*, 11-24.
Scillitoe, J. L., Chakrabarti, A. K. (2010). The role of incubator interactions in assisting new ventures. *Technovation*, *30*(3), 155-167.
Schwartz, M., Hornych, C. (2008). Specialization as strategy for business incubators: An assessment of the Central German Multimedia Center. *Technovation*, *28*(7), 436-449.
Schwartz, M., Hornych, C. (2010). Cooperation patterns of incubator firms and the impact of incubator specialization: Empirical evidence from Germany. *Technovation*, *30*(9), 485-495.
Siggelkow, N., Rivkin, J. W. (2006). When exploration backfires: Unintended consequences of multilevel organizational search. *Academy of Management Journal*, 49(4), 779-795.
Simsek, Z., Heavey, C., Veiga, J.F., Souder, D. (20090. A typology for aligning organizational ambidexterity's conceptualizations, antecedents, and outcomes. *Journal of Management Studies*, 46(5), 864-894.
Sirén, C. A., Kohtamäki, M., & Kuckertz, A. (2012). Exploration and exploitation strategies, profit performance, and the mediating role of strategic learning: Escaping the exploitation trap. *Strategic Entrepreneurship Journal*,*6*(1), 18-41.
Smilor, R. W., Gibson, D. V., & Dietrich, G. B. (1990). University spin-out companies: technology start-ups from UT-Austin. *Journal of business venturing*, *5*(1), 63-76.
Smith, W. K., Tushman, M. L. (2005). Managing strategic contradictions: A top management model for managing innovation streams. *Organization science*, *16*(5), 522-536.
Steffensen, M., Rogers, E. M., & Speakman, K. (2000). Spin-offs from research centers at a research university. *Journal of business venturing*, *15*(1), 93-111.
Teece, D. J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research policy*, *15*(6), 285-305.
Tötterman, H., & Sten, J. (2005). Start-ups business incubation and social capital. *International Small Business Journal*, *23*(5), 487-511.
Tushman, M. L., Anderson, P. (1986). Technological discontinuities and organizational environments. *Administrative science quarterly*, 439-465.
Yalcinkaya, G., Calantone, R. J., & Griffith, D. A. (2007). An examination of exploration and exploitation capabilities: Implications for product innovation and market performance. *Journal of International Marketing*, *15*(4), 63-93.
van Geenhuizen, M., Soetanto, D. P. (2009). Academic spin-offs at different ages: A case study in search of key obstacles to growth. *Technovation*, *29*(10), 671-681.
Van Looy, B., Martens, T., Debackere, K. (2005). Organizing for continuous innovation: On the sustainability of ambidextrous organizations. *Creativity and Innovation Management*, *14*(3), 208-221.
Voss, G. B., Voss, Z. G. (2013). Strategic ambidexterity in small and medium-sized enterprises: implementing exploration and exploitation in product and market domains. *Organization Science*, *24*(5), 1459-1477.

Appendix 1. Incubation support

	To what degree have you receive the following support?
Marketing support	Marketing strategy

	Sales skills
	Negotiation and communication skills
Management support	Leadership
	Human resources
	Finance, tax and intellectual capital

All items are measured on a five-point scale, anchored to 1 = never; 2 = rarely; 3 = occasionally; 4 = frequently; 5 = very frequently

Appendix 2. Innovation strategy

Technology exploitation	We frequently refine the technology and innovation behind the existing products and services. We regularly implement small adaptations to existing products and services. We regularly improve the effectiveness and efficiency of our existing products or services.
Technology exploration	We invent new products or services. We experiment with new products or services. We invest the development of technology or ideas on products or services that are completely new to our company.
Market exploitation	We increase economies of scale in our existing markets. We introduce improved but existing products and services for our existing market. Our company expands services for existing clients.
Market exploration	We frequently utilise new opportunities in new markets. Our company regularly uses or tries to build new distribution channels. We regularly search for a new approach in new markets.

All items are measured on a five-point scale, anchored to 1 = strongly disagree and 5 = strongly agree

Appendix 3. Descriptive and correlation statistics

	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Spin-off age	5.43	5.32											
Spin-off size	6.20	4.22	.10										
Level of innovativeness	1:38% 0:62%		.05	.21									
Technology exploitation	3.21	2.54	.15	.05	.22								
Technology exploration	2.34	2.00	.11	.21	.24	.07							
Market exploitation	3.01	2.87	.07	.24	.17	.12	.10						
Market exploration	2.34	1.97	-.03	.15	.18	.12	.11	.13					
Strength of ties	0.65	0.41	-.03	.12	.20	.10	.05	.14	.09				
Network size	4.89	1.90	.07	.10	.19	.16	.02	.06	.06	.34			
Marketing support	3.34	1.90	.06	.06	.13	-.07	.06	.12	.10	.15	.12		
Management support	3.96	2.11	.12	-.04	.03	-.02	.05	-.09	.02	.11	.15	.04	
Performance	3.01	3.23	.25	.32	.16	.12	.15	.10	-.09	.35	.21	.12	.10