Post-print. This is the Authors' Original Manuscript of an article published in *Technology Analysis & Strategic Management* (2015), Vol. 27, Iss. 3, pp. 249-266 [online]

The funding of new technology firms in a pre-commercial industry – the role of smart capital

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Abstract

In this article, we focus on how investors add value, in addition to finances, to resource-constrained young technology companies in a pre-commercial and capital-intensive industry. Based on a review of the entrepreneurial finance literature, we group investors' value-added contributions into four categories: *'Business development', 'Technology development', 'Investor's outreach'* and '*Legitimacy'.* We build our study on six case studies of firms in the pre-commercial and emerging marine energy industry. Our case companies have received investments from business angels (BAs), venture capitalists (VCs) and larger corporations (CVCs). We observed that the contributions from the investors clearly differ and that CVC investors appear to be especially important as their involvement help increase young technology firms' credibility, which could be a crucial factor in pre-commercial and emerging industries. Overall, by engaging 'smart capital', a company can move from a situation of true uncertainty to one of manageable risk.

Keywords: smart capital; investor value-added; venture capital; CVC; BA; new technology-based firms; pre-commercial industry; emerging industry; marine energy

Introduction

New technology-based firms are important participants in the growth of new industries and in the renewal of existing industries because of their introduction of new innovative technology. In addition to being innovative, these firms are also characterised by being growth-oriented and having limited internal resources. Developing and commercialising innovative and complex technology is challenging, time-consuming and expensive, and resource-constrained new ventures require external funding to get past the technology development phase.

In addition to financial capital, new technology-based firms also require input in areas such as industry-specific expertise, contacts with potential customers, technology competence, knowledge of foreign markets, or expertise in business administration. These are areas where investors can contribute, and previous research has studied the post-investment contribution provided by equity players such as independent venture capital firms (Busenitz, Fiet, & Moesel, 2004; Gorman & Sahlman, 1989; Sapienza, 1992; Sapienza, Manigart, & Vermeir, 1996), business angels (Madill, Haines, & Riding, 2005; Politis, 2008; Sætre, 2003) and corporate venture capital (Gompers & Lerner, 2000; Maula, 2001; Maula, Autio, & Murray, 2005; Zu Knyphausen-Aufseß, 2005). Overall, previous studies have shown that investors can contribute by active involvement in their portfolio companies and that the post-investment contribution by the different investor types is somewhat overlapping. However, relatively few studies include different types of investors (Luukkonen, Deschryvere, & Bertoni, 2013), and Large and Muegge (2007) state that new insights can be reached by examining how different types of investors add value to new ventures. Furthermore, most studies on VCs and CVCs have investigated the investors' value-added contributions from the investors' perspective (Park & Steensma, 2012), and there is an over-representation of studies using cross-sectional data that do not really illuminate how investors add value to the ventures (Sørheim, 2012). There are also relatively few studies exploring the emergence of industries (Forbes & Kirsch, 2011), and a study of different investors' involvement and value-added input into new technology firms in an emerging and pre-commercial industry has, to our knowledge, not been done before.

The goal of this paper is to explore different investors' involvement and non-financial value-added into new technology-based firms in a pre-commercial industry. More precisely, we present six case studies of Nordic companies in the marine energy industry (wave and tidal energy) that intend to develop devices to harness energy from ocean waves and tides.

The marine energy industry is an emerging and pre-commercial industry. This means that there exist no commercially viable solutions yet, that there is still a battle between different

technology designs, that the value-chain is undeveloped and that there is a lack of industry standards. Furthermore, the majority of the firms in the industry are small and independent firms which in addition to facing an expensive and complex technology development process, also must struggle with the industry's limited credibility among potential public and private stakeholders due to being a pre-commercial industry for 15-20 years. This results in an extensive demand for funding, technology competence and credibility among young firms in the industry, and even though the many uncertainties surrounding the emerging industry limits the interest of potential investors, there are still a wide variety of investor types investing in new firms in the industry. Our research questions are as follows:

- *What kind of contributions do different types of investors bring to the table besides funding?*
- *To what extent are the investors' post-investment contributions relevant for technology firms in a pre-commercial industry?*

To address these questions, we consider the characteristics of different investor types and investigate to what extent they are relevant to aspects that are critical to the development of new technology firms.

This study makes several contributions. First, we show how different investor types add non-financial value to young technology firms in a pre-commercial industry with high uncertainty in technology and market development. Second, we show that having larger and established firms as investors could give a legitimation effect that is crucial for young firms in a pre-commercial industry. Furthermore, our study is one of few studies who investigate the impact of investors' post-investment contributions from the entrepreneurs' perspective.

The paper is structured as follows: First, we briefly present the marine energy industry before we outline relevant theories of different investors' contributions to new technology-based firms. Then, we describe our methods and case studies before we discuss our findings and analysis. Finally, we conclude and suggest implications.

Frame of reference

The marine energy industry context

The marine energy industry comprises firms developing devices to harness energy from ocean waves and tides, and is an emerging, pre-commercial and global renewable energy industry. So far, no commercially viable technologies exists, but recently many full-scale tests have been performed, especially in the UK, which has been the industry leader for several years (Elliott, 2009). The industry

is facing a 'technology battle' between a wide range of technological solutions, but no single design has yet become dominant among either wave or tidal energy developers.

The technology development process is a long and capital-intensive process demanding access to a wide range of technologies, and includes several rounds of pilot tests. The full-scale pilots include large physical structures, sometimes weighing hundreds of tons, and installing and operating them in harsh ocean environments leads to high costs for demonstration tests. The total costs of developing a project from concept verification to full-scale demonstration project are well beyond £10 m in addition to several years of testing and verification of the technology. Furthermore, as it is pre-commercial, the marine energy industry does not have a developed value chain and firms have to identify and engage potential suppliers and partners from other industries. This can be a challenge as the industry has limited credibility due to being in a pre-commercial phase for almost two decades.

In 2013, around 150-200 firms were developing marine energy technologies globally and earlier studies have found the majority of these to be small, young and highly international firms (Bjørgum, Moen, & Madsen, 2013; Løvdal & Aspelund, 2011) with limited financing possibilities from the private sector (Leete, Xu, & Wheeler, 2013). These financial limitations were strengthened by the financial crisis of 2008 and a slower progress in the industry than expected, which specifically made VC funding more difficult to receive. However, an increased commitment to the development of a marine energy industry from large nations as the UK and France has helped to maintain funding possibilities for firms in the industry. In fact, studies have found that £1 of public support has unlocked around £6 of private investments in the UK (Renewable-UK, 2012), and a major part of these private investments has been from larger corporations that demand long-term commitment from governments before investing (Renewable-UK, 2012). This pattern, where there are many new firms with a broad set of technologies in the beginning and where larger firms enter as the industry moves towards commercialisation, is recognisable from other emerging capital-intensive industries like biotechnology (Hopkins, Crane, Nightingale, & Baden-Fuller, 2013).

The combination of complex and capital-intensive technology development and many independent start-ups, results in a large demand for external funding, additional technology expertise and legitimacy. These firms face extraordinarily high uncertainty and do not have the ability to fund their development and growth entirely from internal or public sources (Rasmussen & Sørheim, 2012). To address this uncertainty, these firms could seek the involvement of investors who contribute with smart capital, i.e., investors contributing not only with resources related to funding (Mason & Harrison, 2003). Experienced investors can bring a wide range of business skills and

resources as general business insight, and more importantly specific industry knowledge, networks and experience (Cressy & Olofsson, 1997; Lindstrom & Olofsson, 2001; Mason & Harrison, 2003). The most common external funding sources are business angels, venture capitalists and corporate venture capital. To examine how investors are involved and how they contribute, we now consider the characteristics of the different funding sources and how they are expected to act as providers of smart capital.

Different capital sources and their post-investment contributions

In this study, *Informal investors,* or *business angels (BAs),* are considered to be private individuals who offer their own equity as risk capital to unlisted companies in which they have no formal or family-related connections (Moen, Sørheim, & Erikson, 2008). As a financing source, BAs often invest in new technology ventures in the seed, start-up or early stage, filling the gap between founders, family and friends on one side and VC funds on the other (Harrison & Mason, 2000). BAs can represent 'smart capital', using their business experience and networks from earlier careers to play a vital role in their portfolio companies' development and growth (Mason, 2007). Furthermore, the resource acquisition role of BAs is quite important for resource-constrained new ventures to be able to overcome the internal lack of resources and their networking activities can support the early development and growth of new and small firms (Mason, 2007) and help obtain additional funding (Sørheim, 2005). Previous research emphasizes that BAs have a role as internal resource providers, especially when it comes to general business development although this vary across the investor population (Politis, 2008). Their external contribution is to a large extent related to their networking role. However, the ability to act as resource providers could be constrained because of the pre-commercial nature of the industry covered in this study. Generally, the number of BAs with direct experience from a specific pre-commercial industry is most likely limited, and this could reduce the potential for their value-adding network effects. Other limitations are the capital requirements for these firms, which are very high compared with other attractive industries like ICT and web start-ups.

Venture capital (VC) firms are run by professional management companies that invest from a fund consisting of capital from private persons and/or institutions, for example, banks and pension funds. VC firms are not interested in funding basic research; they generally invest in start-up or later phases (De Clercq, Fried, Lehtonen, & Sapienza, 2006) when both technological and market risks are lower. VCs are also hands-on investors who utilise their business competence, experience and extensive networks so that their portfolio companies can access and build strategic alliances and connect with customers (Berg-Utby, Sørheim, & Widding, 2007; Busenitz et al., 2004).

Several studies have been performed on VCs' value-added activities, and although the findings are contradictory regarding the effects of a VC investment on a portfolio firm's performance, the majority of the studies conclude that the effect is positive (Sørheim, 2012). Gorman and Sahlman (1989) categorise the value-added services of VCs as follows: "(1) help to obtain additional financing, (2) strategic planning, (3) management recruitment, (4) operational planning, (5) introductions to potential customers and suppliers, and (6) resolving compensation issues (Gorman & Sahlman, 1989). In a review of 20 peer-reviewed articles on the non-financial, value-adding activities of VCs, Large and Muegge (2007) identify eight different value-adding types of input provided by VCs. They make a clear distinction between internal and external activities. External activities are; (1) *legitimation* and (2) *outreach*, while examples of internal activities are; (1) *recruitment*, (2) *strategy*, (3) *consultation*, and (4) *operation.*

From the perspective of a young, technology-developing venture in a pre-commercial industry, the most likely contributions from VCs may be help with additional funding, general business management and strategy, and the reputational effect of having a VC investment. This reputational effect can be important in attracting other investors (De Clercq et al., 2006) or critical in persuading potential stakeholders to be involved in the venture's future development. Furthermore, Sapienza, Manigart, and Vermeir (1996) found that VC investors with experience from the venture's industry added significantly more value than VCs without such relevant industry experience, and this is also likely to be valid regarding VCs with experience within the marine energy industry.

On the other hand, recent studies questions the role of VCs in emerging and capital-intensive industries since the investment time frame and the uncertainty of the development of these industries is not suited for VC investment (Hopkins et al., 2013; Leete et al., 2013). This can be explained by VCs looking for returns that are not very realistic when investing in firms facing long and capital-intensive technology development (Mazzucato, 2013). Another important point is the uncertainty related to the political framework for the firms in this industry. This means that the business models for operations is still under development and this is unattractive for VC firms with a maximum of 10-year horizon on each fund.

Corporate venture capital (CVC) is established corporations investing in younger and smaller firms. Larger corporations are generally focusing their investments on securing strategic benefits by accessing new technology or get foothold in new markets (Benson and Ziedonis, 2009; Van de Vrande and Vanhaverbeke, 2012). This strategic investment focus gives large corporations a low portfolio pressure and a low required rate of return in the short-term compared to VCs, and makes it possible for them to invest higher amounts to create larger benefits in the long-term.

Companies in related established industries will often choose to take a minority position in start-ups in a pre-commercial industry. They want to have a "listening post" in order to prepare for future development and be able to take a position as technology and markets mature. This means that CVCs may invest in early-stage firms developing pioneering technologies that may not otherwise have been able to obtain funding from VCs (Chemmanur & Loutskina, 2009). This difference in investment motives between CVCs and VCs also affect how they add value to their portfolio companies. Maula, Autio and Murray (2005) showed that there is a complementarity and that VCs are mostly involved in "nurturing" the venture (e.g. expertise on company formation and early growth), whereas CVCs provide technological support and a strengthening of the commercial credibility of the firm. This strengthening of a new firm's credibility is an important effect of having a CVC investment and may be considered a 'stamp of approval' of the new technology. Furthermore, this effect may be a door opener towards potential stakeholders such as investors, public agencies and other industry players.

From the portfolio companies point of view, a corporate investment is attractive because it can provide both considerable funding and access to critical resources such as networks, manufacturing and technology expertise (Maula et al., 2005). Moreover, Park and Steensma (2012) observed that CVC investments were most beneficial to new ventures that required specialised as opposed to generic complementary assets although other investors may have had better offerings. They also found that CVC funding was most beneficial to ventures operating in "uncertain environments" (Park & Steensma, 2012). Maula, Autio and Murray (2003) argued that complementary aspects of the business of the CVC investor and the portfolio firm are a prerequisite for knowledge sharing and successful relations (Maula, Autio, & Murray, 2003). Furthermore, Gompers and Lerner (2000) found that the performance of CVC's portfolio companies was most successful when there existed similarities, a 'strategic fit' and a 'knowledge fit', between the corporation's and the venture's line of business. This means that CVCs have an important role as an internal resource provider especially when it comes to technology development and can play a crucial role as external resource provider when there is a good 'fit' between the CVC and the portfolio company.

Based on our review of investors' value-added contributions, we have identified four categories in which investors can add non-financial value to pre-commercial technology firms in an emerging industry. As we can see from table 1, *'Business development'* is a broad category comprising value-added activities such as strategic planning, operational planning and involvement, mandating and mentoring of the entrepreneur which our literature review have found central for

VCs (De Clercq et al., 2006; Gorman & Sahlman, 1989; Large & Muegge, 2007), and to some extent also for BAs (Politis, 2008) and CVCs (Maula et al., 2005). Furthermore, the '*Technology development*' category is relevant when evaluating CVCs' value-added to technology ventures (Maula et al., 2005) and it is especially important for firms in a pre-commercial industry with very long and complex technology development processes. The category *'Investor's outreach'* comprises value-added activities such as help to obtain additional funding and introductions to potential customers and partners which earlier research has found to be central contributions for both VCs (Gorman & Sahlman, 1989) and BAs (Mason, 2007). The fourth category, *'Legitimacy',* is built on the investors' potential value-added reputational effects identified by earlier research (De Clercq et al., 2006; Large & Muegge, 2007) which are very important for young firms in a pre-commercial emerging industry. In addition, in line with Large and Muegge (2007), we separate our framework into investors' internally oriented and externally oriented value-added activities.

Table 1: Overview of the four value-added categories and the different investors' contributions as identified in the literature

	Category	**Description**	**BA**	**VC**	**CVC**
Investor's internal value-added contributions	*Business development*	Hands-on contribution in strategy, business administration and organisational development.	Low to moderate	Moderate to high	Low to moderate
	Technology development	Relevant technology skills, competence in testing and quality control, access to technology or technical facilities such as laboratories, testing sites and equipment.	Low	Low	Moderate to high
Investor's external value-added contributions	*Investor's outreach*	Actively providing direct access to different stakeholders such as financial sources, public agencies and industry partners.	Low to high	Moderate to high	Low to high
	Legitimacy	A passive contribution in which the perceptions of the investor's brand and image help strengthen the new venture's credibility and reputation to external stakeholders.	Low	Low to moderate	Moderate to high

In addition to describing the four different categories, table 1 also compares the input of the different investor types in the four categories based on our findings in the literature. Table 1 shows that we can expect to identify a somewhat complementary relation between the value-added contributions of CVCs and of VCs in which CVCs have moderate to high value-added in the areas in which VCs have low value-added ('Technology development' and 'Legitimacy'). Regarding BAs, we

can expect to see many of the same contributions as for VCs although perhaps less valuable contributions overall. In addition to the differences in table 1, other important complementary aspects to consider are the timing and the amount of capital provided by the investor groups (De Clercq et al., 2006). The timing of the investment is especially important because BAs are expected to be the most active investors in early-stage technology ventures (Harrison & Mason, 2000), and such investments could turn out to be critical for the ventures to survive the first years and develop further. Based on the case studies, we can analyse and discuss the role of different investor types for new technology firms in a pre-commercial industry from the entrepreneurs' perspective, and thereby contribute new insights within both the literature on investors' value-added contributions (Large & Muegge, 2007; Luukkonen et al., 2013; Sørheim, 2012) and the literature on emerging industries (Forbes & Kirsch, 2011)**.**

Methodology

The study is exploratory in nature and seeks to understand how different investors support new technology-based firms in the marine energy industry to commercialise their technology. The firm is the unit of analysis, and each firm in the study represents an individual case study. Because the study as a whole covers six different firms, it can be described as a multiple-case design (Eisenhardt, 1989; Yin, 2009). Two researchers conducted the interviews in the autumn of 2012. The interviews lasted approximately one hour and were based on a semi-structured format to allow free-flowing conversation and in-depth inquiry into topics that emerged during the interview. More specifically, the interviews focused on relevant themes from the entrepreneurial finance literature such as ownership structure, pre-investment phase, investor engagement and contributions, investor relationship and future financing. The interviewees all had great insight and long involvement in the firm, being founders and/or CEOs. In order to increase the credibility and reliability of the study, we have triangulated interview data with data from secondary sources (Yin, 2009). Our secondary sources include the case companies' websites, news articles, press releases, industry websites, industry reports, international industry-specific conferences (U.S., Scandinavia and Scotland), publicly available consent applications and investor websites. The secondary sources were used to gain deeper knowledge and understanding of the industry, to identify case companies and prepare for interviewing them, and to validate as much information as possible after the interviews.

By combining the different sources of information, an in-depth description of the funding process was obtained. From this in-depth description, we identified characteristics that were central in the process of interaction with the investors. Following our research questions, we needed case

companies that were likely to have a relatively rich history of private investments and experience with different investor types. To find such case companies, we had the selection criteria that companies should have received external funding, should have full-time employees and have conducted, or being close to conduct, prototype tests in ocean environment (a technological milestone). We also chose companies from the Nordic countries for this study because this is one of the leading marine energy regions. This also means that the included companies are relevant to compare in the sense that they are in the same industry and at the same stage in their life-cycle. Using industry web pages, contact with industry organisations and public agencies, we identified 15 companies that fulfilled the selection criteria. From these, we contacted eight companies, of which six were willing to participate.

We transcribed all the interviews and then performed a within-case analysis of each company in which we produced a 7-10-page summary of each company based on the interviews and additional information from external sources. These case summaries were sent to the interviewees for approval and to ensure construct validity. This is of vital importance in order to avoid misunderstandings related to the content in the case studies. We then designed tables related to the research questions and performed a cross-case analysis (Eisenhardt, 1989; Miles & Huberman, 1994) by analysing and identifying common and differential factors between the individual cases. This analysis uncovered the different patterns regarding investors' internal and external value-added contributions.

The case companies

In Table 2, we see that the case companies are in a technology development phase, and all but Langlee have tested scale devices of their technology in ocean environments. Some of the technological solutions are unlike anything else in the industry. For example, Flumill's tidal energy device is constructed of composite materials and based on the principle of 'The screw of Archimedes'. Minesto is developing underwater wings to generate power from the tides, whereas Floating Power Plant (FPP) is the first in the world with a floating hybrid device that generates electricity to the grid from both ocean waves and wind. Furthermore, Table 2 also illustrates the size of the devices and the extensive rounds of testing they need in the technology development process. When commenting when they believe they will deliver their first commercial marine energy project, the case companies' answers were between 2015 and 2019. In table 2, we also see that all the companies are quite small with between 4 and 30 regular employees.

Table 2: General description of the case companies

Firm	Founded	Employees	Technology	Full scale unit	Technology development progress
Floating Power Plant, Denmark	2004	4 regular, 15 including partners and board	Hybrid wind & wave energy	-6 MW wave & 6 MW wind -1,800 tons -80 m wide	Continuous ocean tests of 1:2 scale device (37 m wide, weighing 320 tons) since 2008. This has been grid connected since 2012.
Flumill, Norway	2002 (2009)	5 regular, around 15 with partners	Tidal energy	-2,1 MW -160 tons -18x48 m	Built a tank to prove the concept in 2010. In 2012, a 1:2 scale pilot was tow tested and grid connected during ocean testing at the Orkney Islands. In 2013, Flumill began developing a full scale demonstration plant with 2-4 devices.
Langlee, Norway	2006	5	Wave energy	-50 kW -70 tons -15x15 m	Several tank tests. Full scale ocean testing is planned in the Canary Islands in 2014.
Minesto, Sweden	2007	Around 25	Tidal energy	-0,5 MW -7 tons -12 m wing	In 2012, a grid connected 1:10 scale pilot was tested. Since late 2012, a 1:4 scale pilot has been continuously tested in the waters of Northern Ireland.
Seabased, Sweden	2001	Around 30	Wave energy	-100 kW -12 tons -4 m buoy	Extensive ocean testing of their device since 2006. Currently installing the first 42 units (25 kW) of a 10 MW park which is supposed to be finished by 2015.
Wello, Finland	2008	8	Wave energy	-0,5 MW -220 tons -30 m	Tested first a 1:18 scale pilot in ocean conditions in 2011. Since 2012, Wello has been testing a full scale, grid connected prototype at the Orkney Islands.

In table 3 below, we see that the case companies have many different types of investors with different investment motivations. These perceived motivations are based on the interviews with the case companies, the investors' webpages or the investors' annual reports. Even though the motivations are not directly stated by the investors, they give some insight into why the different investors are involved in new firms in this pre-commercial renewable energy industry.

Table 3: Description of the investors and their perceived investment motivations

	Types of investors	Perceived investment motivations
Floating Power Plant (FPP)	- Five BAs on the board represent majority of shareholders (about 100 passive small investors). - Regional public VC fund with renewable energy focus has invested £1.2 m. - Multinational energy firm has invested around £0.5 m for around 7 % of the shares.. - Joint venture (JV) partner in the U.S. has invested capital.	- Major BAs: Purely financial motive - Regional public VC fund: Invest in renewable energy projects within its region. - Multinational energy firm: Possible future customer of FPP. Want to aid the firm so that if the technology comes through, they have a high knowledge of it. - US JV partner: This firm is specialized in bringing renewable energy ideas to the commercial marketplace.
Flumill	- Founder owns 14%. - Local composite company invested, took charge of project management and re-started Flumill in 2009. Owns 25%. - Scottish energy consultant firm with no other major investments invested in 2010. Owns 16%. - Renewable energy company with professional investment owns 43% and has injected over £4 m since 2010.	- Local composite company: Strongly believes in the idea and the future market. Will be supplier of core parts to the device. - Scottish energy consultant firm: Believed in the idea's potential and wanted equity share to motivate efforts to develop the company. - Renewable energy company: Does usually not invest in such early-stage companies, but have a regional engagement and a focus on renewable energy combined with a belief that they can actively help Flumill.
Langlee	- Swedish BA has invested £2.5 m and is majority owner. - Two minor BAs	- Main BA: BA knew the CEO from earlier business relationships and had faith in the CEO and Langlee's product.
Minesto	- Idea originates from Swedish multinational focusing on other industries. Has still a minor share. - Two private investment funds (VC1 and VC2) are the biggest owners. - The local university has a small stake - VC firm that specialised in buying portfolios has a small owner share. - There are 5-10 minor BAs.	- Swedish MNC: Believe in the idea and want to support it further. - VC1: Focusing on new ventures within clean tech and life science that "give a good return and at the same time provides global and environmental benefits". - VC2: Long-term perspective on its investments with focus on regional firms. - Portfolio VC: Financial motive, bought a part of MNC's spin-off portfolio.
Seabased	- Majority of shares are held by the company's two founders - <u>Other investors are:</u> - Private investors on the board and other private persons as the CEO - Swedish pension fund - Japanese invested £1.03 million for 1.46% of the shares. - Dutch electric cables firm - The university	- BAs: A mix of personal and financial motives - Swedish pension fund: Long-term investor with primarily financial motive. - Japanese MNC: MNC has a strategy to invest in new renewable energy technology. It sees their investment as a strategic positioning in an emerging global industry. - Dutch multinational electric cables firm: Collaborating with the University, interested in new renewable energy and possible future supplier.
Wello	- The BA invested a small amount in early phase - A VC fund focusing on renewable energy is lead investor. - Finnish public VC fund is co-investor The VC and the public VC has over two investment rounds injected around £7 m including an unknown amount in governmental grants.	- BA: Investor knew founder and believed in the potential of the idea. Both personal and financial motive. - VC fund: Focusing on renewable energy. Partners have a lot of experience from energy and electricity industries. - Public VC: Invests in early stage Finnish technology firms with international growth potential. The goal is to cover shortcomings in the market and supplement private investors.

Analysis and discussion

The purpose of this study was to investigate different types of investors' post-investment contributions among young technology firms in a pre-commercial industry. In this section we present the overall findings from the cases regarding the different types of investors' involvement and their value-added contributions. We then present and discuss the findings related to the research questions from the introduction.

What kind of contributions do different types of investors bring to the table besides funding?

Table 4 below gives a description of investor involvements that have added value to the case companies. We observe that four of the six case companies have BAs as their first investors (the exceptions being Flumill and Minesto, whose BAs came in later), which underlines how important BAs are as providers of capital in the critical first phase, even for start-ups in a pre-commercial industry with long time horizons. All of the case companies have experience with having, or trying to attract, VCs as investors. For future financing, some of the firms emphasize that they will try to stay away from VCs because of VCs' focus on accelerated development plans, which they consider to be too short-term in this type of industry. Furthermore, the case companies report extensive efforts towards raising more capital from investors, especially VCs as they are the most visible ones. For example, one of the companies contacted almost 70 and met up with around 30 investors, mostly VCs, in 2012 with none of these meetings leading to an investment proposal.

Table 4: The investors' external and internal value-added contributions in the case companies

	Investors' internal value-added contributions	Investors' external value-added contributions
Floating Power Plant (FPP)	Three of the BAs use 20%-80% of their time to help run the company. Energy company contributes with knowledge of electrical infrastructure, public applications, and technical support on testing site. JV partner is actively developing two sites in the U.S.	The BAs have actively provided connections that have led to technology partnerships, and funding from VC fund and informal investors. The BAs are working to establish a consortium with industrial and financial partners to conduct full-scale testing in France, Spain or the UK. JV partner searches for co-financing of U.S. projects.
Flumill	The composite company has been in charge of technology development and management since 2009. This investor designed and built a specific testing tank at its own facility to verify the technology. The CVC investor has two people active on the board and is consulted on technical and financial issues on an ad hoc basis. The Scottish investor was CEO 2010-12 and is now developing a new application of the technology.	The composite company has good industrial network, especially within subsea industry. The Scottish investor was recruited through personal relations with the composite company. It has good knowledge of the UK energy market and a well-established network. The CVC investor provides connections to the electrical components industry. Its reputation nationally has improved Flumill's credibility among external stakeholders.
Langlee	The majority-owning BA has little involvement in business development; however, one of the other BAs	Investors have provided some industry contacts. Majority-owning BA helped Langlee securing a loan it needed when struggling with public funding procedures.

	is on the board. From 2012, annual strategy meetings with investors are occurring.	
Minesto	The two VC funds are actively engaged in business development, both formally by the board, and informally. The CVC investor is engaged in the board, and is also working on technological issues and provides access to physical facilities.	VC1 has provided international industrial connections and provided a financial advisor who succeeded in gathering additional funding from both BAs and VC2. The buyout fund provided a link to an important international technology partner. The internationally renowned brand of the CVC investor has been crucial as a door-opener, especially in the start-up phase.
Seabased	BAs are engaged in business development and strategy through the board. The pension fund contributes with expertise in financial management. The Dutch CVC is also a supplier of electric cables for Seabased; however, these roles are kept separate.	The BAs provide a global personal network towards funding sources and industry actors such as the Japanese CVC investor and the Swedish pension fund. The CVC has a global presence and will be in charge of financing and project management of Seabased's future global projects. The CVC is a globally renowned firm, giving credibility to Seabased internationally.
Wello	BA and two representatives from the VC fund are on the board. The VC representatives are also informally involved on a day-to-day basis in strategic issues.	BA provided connection to the VC fund. Two of Wello's main suppliers have been provided by the VC fund. One of these is a portfolio firm of the VC that it used a lot of effort to persuade to collaborate with Wello. Wello experience a good reputational effect by having VC investors when negotiating with suppliers.

In table 5 below, we have grouped the different investors' contributions in the four value-added categories presented in the theoretical section through a subjective comparison of the case companies. Our assessment comprises the amount of input from the investors, how important the case companies regard this input, and the potential outcomes of the different contributions. Based on these inputs, we rank the investors' contributions in table 5 by giving them a 'scoring' between three and zero stars. Here, (***) reflects a strong impact which means that the investor's contributions within a category have been central in the development of the firm and that these contributions are difficult to acquire from alternative sources. (**) is given when the investor's contributions have had considerable, but less significant impact on the firm's development, while (*) is given when the investor's contributions have had a minor positive impact within the specific category. In table 4 above, we have briefly illustrated many of the value-added activities of the investors, but we will further show some examples to give a better understanding on how we have assessed the different investor contributions. For example, 'Flumill's Scottish Informal investor' with experience and network in the UK energy sector has had a strong impact (***) in *'Business development'.* His contributions through being the company CEO for two years, a board member since 2010 and in charge of their UK subsidiary since 2011, have been crucial for the development of the firm and made it easy for Flumill to be present in the UK market. 'Wello's Finnish public VC' on the other hand, is assessed as having had a minor impact (*) in '*Business development*' with its inputs mainly as a member of the board.

In the '*Technology development*' *category* 'FPP`s Energy company' has made a considerable impact (**) as it has been central in the full-scale ocean testing of the device through helping FPP with environmental consents and bureaucracy, handled 95% of the electrical infrastructure (grid connecting and cabling), and has also given FPP access to their expertise in operations and maintenance during a two-year testing period. Within the *'Legitimacy'* category, several of the case companies state that having VCs and/or larger firms as investors makes it easier to approach external firms or interact with government agencies. For example, 'Flumill's local CVC' has made a strong impact (***) within the '*Legitimacy'* category by being a highly reputed investor and renewable energy producer in Norway. When evaluating their consent for a demonstration plant and a £6 m government grant, Flumill's CTO stated: *"Without (…) as a majority, a big shareholder, we would have never gotten the consent and the grant because that gave the company the strength we needed*". For Minesto, the global brand of their CVC investor has made a strong impact (***) on their credibility and helped open doors in Sweden and the UK right from establishment. 'FPP`s energy company' on the other hand, is evaluated to only have given a minor impact (*) within the '*Legitimacy'* category. This is because the investor wants to keep its involvement in FPP unofficial, which creates limitations on how much FPP can gain credibility by being associated with the investor.

Table 5 illustrates that the case companies' investors have contributed within all the different value-added categories but also that the three investor types have made different contributions. It appears that a majority of the BAs have made most impact within *'Investor's outreach'*, whereas the VCs overall make the strongest impact within both *'Investor's outreach'* and *'Business development*. Consistent with earlier research (De Clercq et al., 2006; Politis, 2008) VCs and BAs appear to be mainly involved within the same categories, but with VCs having a slightly more significant contribution since their involvement have more impact within '*Legitimacy*'. The input from the CVCs is completely different because they have provided the most important contributions within *'Technology development'* and *'Legitimacy'*.

Table 5: An assessment of the investors' value added in the different categories.

	Investors' internal value- added contributions		**Investors' external value-added contributions**	
	Business development and strategy	Technology development	Investor's outreach	Legitimacy
Informal Investors				
Flumill's Scottish Informal investor	***	*	*	
FPP's American JV partner	*		*	*
FPP's active private investors	**		***	
Langlee's main business angel			*	*
Langlee's smaller BAs	*			
Minesto's private investors			*	
Seabased's private investors	*		*	
Wello's BA	*		**	
VCs				
Seabased's pension fund	*			*
Wello's VC	**		**	**
Minesto's buyout fund			*	*
Minesto's 1st VC	**		**	*
Minesto's 2nd VC	**		**	*
FPP's local public VC				*
Wello's Finnish public VC	*		*	*
CVCs				
Flumill's local SME	***	***	**	
Flumill's local CVC	**	*	**	***
FPP's energy company		**		*
Minesto's CVC	*	**		***
Seabased's Japanese CVC			**	***
Seabased's Dutch CVC		*		*

Note: * reflects a minor impact, ** considerable impact, and *** reflects a strong impact. The grey cells show where the individual investor has its most valuable input.

To what extent are the investors' post-investment contributions relevant for technology firms in a pre-commercial industry?

To identify the relevance of the investors' contributions, we elaborate on the most important contributions in each of the four categories.

Business development

In our study, all the different investor groups have value-added input in this category. As earlier studies have shown (De Clercq et al., 2006; Politis, 2008), the case companies regard the VCs' input to have the strongest impact in this category although many BAs also contribute to a certain extent. Overall in our study, the VC investors' personal skills and experience combined with their understanding of technology and business development are considered important However, few of the VCs' contributions are considered critical from the case companies' point of view.

Technology development

Consistent with earlier studies (Maula et al., 2005; Mäkelä & Maula, 2008), our findings show that active CVC investors can strengthen the ventures' technology development. For Flumill, the technology competence of its investors has had major importance, and FPP received valuable technological input on site-specific tasks and access to physical infrastructure from their CVC investor. Consistent with Park and Steensma (2012), the case companies in this study valued the CVCs' ability to contribute to specific technology development more than the CVCs' general technology competence. Conversely, it is difficult to identify how rare the knowledge provided by the CVC investors is, as it could alternatively be provided by collaborating with other technology firms. However, one of the intriguing findings from this paper is the lack of contribution from VCs and BAs on the technology development side. This can be explained by the pre-commercial nature of the industry, which makes it possible only for a very limited number of individuals to contribute with relevant technology competence, and also because BAs and VCs do not usually have technological motives behind their investments.

Investor's outreach

As in earlier studies (Large & Muegge, 2007; Maula et al., 2005; Politis, 2008), all the investor types were actively providing connections valuable to the case companies. This category is where the BAs add most value; but in our study the connections provided by VCs and CVCs have made larger contributions to the firms' development overall. However, the BAs have a varied range of involvement, which is highlighted by the active BAs of FPP whose involvement in acquiring additional funding and industry partners has been of major importance to FPP. Furthermore, as described by Sapienza, Manigart and Vermeir (1996), the investors with background from related industries such as 'Wello's VC' and 'Flumill's local CVC', have provided important industry-specific connections that would otherwise be difficult to acquire. For a young technology company, having investors who are

actively working to raise additional funding or provide valuable connections could be decisive for the company's future.

Legitimacy

Having credible investors appears to be highly valuable to our case companies, and as described in de Clercq et al. (2006), it is particularly the CVC investors who help legitimise the new ventures as trustworthy players. This is illustrated by Minesto, whose multinational owner with a global brand made it easier for potential partners and investors to accept both the company and the technology in Minesto's crucial start-up phase. For Flumill, the investment by their CVC investor with a reputation as a solid long-term player in the national energy industry, was crucial when applying for and receiving a £6 m public grant to build a demonstration site. It is also interesting to notice that the CVCs are patient investors with long horizons on their investments in this pre-commercial industry. This can be explained by their motivation for doing the investment. The CVCs want to take part in and stimulate to the development of firms that might open new commercial opportunities (besides the financial investment in the particular firm).

Although the legitimacy effect is most significant for the companies with CVC investors, VC investors and even informal investors can also enhance a firm's credibility with certain stakeholders in our study. This can be illustrated by Langlee, whose £2.5 m investment from a BA had an important effect on soft funding because a credible investor believed in the technology's potential.

All in all, our findings indicate that for a new technology venture in a pre-commercial industry, the most important investor contributions are the external contributions in which the investors, either actively or passively, help attract new or strengthen previously existing resources. Moreover, one of the most intriguing findings of this study is that the contribution of the investors clearly differs. The investors appear to have complementary roles in bringing the companies from a pre-commercial to a commercial stage. It is also interesting to note that although the CVCs' contribution to technology development is important, the major benefit of having a CVC on board is that it adds legitimacy to a young technology firm. This legitimacy effect is of course important for any start-up firm in a capital-intensive industry, but will of course be of outmost importance in a capital-intensive pre-commercial industry. The legitimacy effect appears to be of vital importance to firms in emerging industries facing true uncertainty with regard to both technology development and the maturity of the market. By engaging "smart capital", the company can move from a situation of true uncertainty to a situation with manageable risk where firms are more likely to attract a broader group of investors.

Furthermore, we believe the findings in this study could be transferable to other pre-commercial and capital-intensive industries with limited financing and involvement of different investor types. This could for example be other new renewable energy industries (Mazzucato, 2013) or the development of biotechnology industries (Hopkins et al., 2013).

Limitations and further research

This study has an exploratory focus because little is known regarding the investors and investor involvement in pre-commercial emerging industries such as the marine energy industry. The exploratory nature of the study means that the number of cases is limited to six companies from the Nordic countries. With the limited number of cases, there will be a danger that the results are sensitive to the specific case selection. However, through meetings on conferences, conference presentations and company web pages, we have knowledge of most of the marine energy firms in the Nordic region and we argue that the findings in our cases could be transferable, but it would be interesting to see whether similar results can be observed among companies in other geographical contexts and industries. Additionally, there are limitations to consider when analysing the collected data because we only have data from the entrepreneurs' view of the entrepreneur-investor relationship. This means that the findings reflect the perceived value-added contributions from the entrepreneur's point of view. Future research should examine the relation from both the entrepreneur and investor perspectives. Furthermore, terms like "value-added" and "contribution" underline that the focus is on investors' positive involvement. Thus, there is a danger of overemphasizing the positive impact and neglecting the potential negative impact. Another potential bias in our study is that it only includes relatively successful young firms in the sense that they all still exist. Finally, there is a need for longitudinal studies with numerous cases to reveal the complete picture of the role of investors for new technology firms in emerging and pre-commercial industries.

This study has revealed intriguing findings related to the involvement of investors in the pre-commercial and emerging marine energy industry. However, the staging of capital and interplay between investors is understudied and needs further attention. More precisely, if different types of investors stage their investments differently in a pre–commercial industry. It is also likely that this affect the interplay between the investors involved. More studies on the use of specific resources from different investors', studies with larger samples, in other markets or industries and over time, will increase the understanding of the role of different investors in the development of new technology firms in pre-commercial and emerging industries. Additionally, the co-evolution of financial institutions and technology firms in emerging and capital-intensive industries is an interesting avenue for further research. Is it actually possible to develop these emerging industries

without a parallel development of financial institutions focusing on the industry? And, what role should the government have when building these robust financial institutions?

Conclusion and implications

This article contributes to the understanding of investors' involvement in young technology firms in a pre-commercial industry. This is one of the first studies comparing involvement from different types of equity investors from the demand side (i.e. seen from the company's point of view). The study has investigated how different types of investors add value besides funding, and our results clearly show that there is a difference in various investors' value-added. BAs and VCs made their most important contributions in '*Business development*' and '*Investor's outreach',* whereas CVCs' most important contributions are in *'Technology development'* and especially *'Legitimacy'*. However, the credibility and reputational effects created by having a CVC investment appear in this study to have the most impact on the development of resource-constrained new technology firms in a pre-commercial industry.

Furthermore, for new technology-based firms facing market and technology uncertainty, our results show the benefit of having complementary investors with different value-added input and investment timing. An attractive investor path for firms in the marine energy industry could be having active BAs and CVC investors in the earliest phases which could lower the uncertainty, and VCs and other CVCs later as the company and industry matures.

Our study suggests further that companies in this pre-commercial industry are too focused on attracting VC investors, and that established firms and CVCs may have a more relevant role than traditional VCs in developing emerging industries by early involvement in new technology-based firms. Public policy makers should consider this and implement mechanisms that make it easier and more attractive for new ventures and established firms to be introduced and work together.

Acknowledgements

The authors thank Niko Ristola for assistance in data collection and the Norwegian Centre for Sustainable Energy Studies (CenSES) for its financial support. Furthermore, we would like to thank the two anonymous referees for their valuable comments to earlier versions of this manuscript.

References

Berg-Utby, T., Sørheim, R., & Widding, L. Ø. 2007. Venture capital funds: Do they meet the expectations of portfolio firms? ***Venture Capital***, 9(1): 23-41.

Bjørgum, Ø., Moen, Ø., & Madsen, T. K. 2013. New ventures in an emerging industry: access to and use of international resources. ***International Journal of Entrepreneurship and Small Business***, 20(2): 233-253.

Busenitz, L. W., Fiet, J. O., & Moesel, D. D. 2004. Reconsidering the venture capitalists' "value added" proposition: An interorganizational learning perspective. ***Journal of Business Venturing***, 19(6): 787-807.

Chemmanur, T. J., & Loutskina, E. 2009. How Do Corporate Venture Capitalists Create Value for Entrepreneurial Firms?: Unpublished working paper, Boston College, Massachusetts.

Cressy, R., & Olofsson, C. 1997. European SME financing: an overview. ***Small Business Economics***, 9(2): 87-96.

De Clercq, D., Fried, V. H., Lehtonen, O., & Sapienza, H. J. 2006. An Entrepreneur's Guide to the Venture Capital Galaxy. ***The Academy of Management Perspectives***, 20(3): 90-112.

Eisenhardt, K. M. 1989. Building Theories from Case Study Research. ***The Academy of Management Review***, 14(4): 532-550.

Elliott, D. 2009. Marine renewables: a new innovation frontier. ***Technology Analysis & Strategic Management***, 21(2): 267-275.

Forbes, D. P., & Kirsch, D. A. 2011. The study of emerging industries: Recognizing and responding to some central problems. ***Journal of Business Venturing***, 26(5): 589-602.

Gompers, P., & Lerner, J. 2000. The Determinants of Corporate Venture Capital Successes: Organizational Structure, Incentives, and Complementarities. In M. Randall (Ed.), ***Concentrated Corporate Ownership (pp. 17-54)***. Chicago: University of Chicago Press.

Gorman, M., & Sahlman, W. A. 1989. What do venture capitalists do? ***Journal of Business Venturing***, 4(4): 231-248.

Harrison, R. T., & Mason, C. M. 2000. Venture capital market complementarities: The links between business angels and venture capital funds in the United Kingdom. ***Venture Capital***, 2(3): 223-242.

Hopkins, M. M., Crane, P. A., Nightingale, P., & Baden-Fuller, C. 2013. Buying big into biotech: scale, financing, and the industrial dynamics of UK biotech, 1980–2009. ***Industrial and Corporate Change***, 22(4): 903-952.

Large, D., & Muegge, S. 2007. Venture capitalists' non-financial value-added: an evaluation of the evidence and implications for research. ***Venture Capital***, 10(1): 21-53.

Leete, S., Xu, J., & Wheeler, D. 2013. Investment barriers and incentives for marine renewable energy in the UK: An analysis of investor preferences. ***Energy Policy***, 60(0): 866-875.

Lindstrom, G., & Olofsson, C. 2001. Early stage financing of NTBFs: An analysis of contributions from support actors. ***Venture Capital***, 3(2): 151-168.

Luukkonen, T., Deschryvere, M., & Bertoni, F. 2013. The value added by government venture capital funds compared with independent venture capital funds. ***Technovation***, 33(4–5): 154-162.

Løvdal, N., & Aspelund, A. 2011. International Entrepreneurship in the Offshore Renewable Energy Industry In R. W. a. R. Wuebker (Ed.), ***Handbook of Research on Energy Entrepreneurship*** Cheltenham, UK: Edward Elgar Publishing

Madill, J. J., Haines, J. G. H., & Riding, A. L. 2005. The Role of Angels in Technology SMEs: A Link to Venture Capital. ***Venture Capital***, 7(2): 107-129.

Mason, C. 2007. Informal Sources of Venture Finance. In S. Parker (Ed.), ***The Life Cycle of Entrepreneurial Ventures***, Vol. 3: 259-299. New York: Springer US.

Mason, C., & Harrison, R. 2003. Closing the regional equity gap? A critique of the Department of Trade and Industry's regional venture capital funds initiative. ***Regional studies***, 37(8): 855-868.

Maula, M. 2001. ***Corporate venture capital and the value-added for technology-based new firms.***, Helsinki University of Technology.

Maula, M., Autio, E., & Murray, G. 2003. Prerequisites for the creation of social capital and subsequent knowledge acquisition in corporate venture capital. ***Venture Capital***, 5(2): 117-134.

Maula, M., Autio, E., & Murray, G. 2005. Corporate Venture Capitalists and Independent Venture Capitalists: What do They Know, Who do They Know, and Should Entrepreneurs Care? In T. Elfring (Ed.), ***Corporate Entrepreneurship and Venturing***, Vol. 10: 101-126. New York: Springer US.

Mazzucato, M. 2013. ***The entrepreneurial state: Debunking public vs. private sector myths***. London, UK: Anthem Press.

Miles, M. B., & Huberman, A. M. 1994. ***Qualitative data analysis: An expanded sourcebook***. Newbury Park, CA: Sage Publications, Incorporated.

Moen, Ø., Sørheim, R., & Erikson, T. 2008. Born Global Firms and Informal Investors: Examining Investor Characteristics. ***Journal of Small Business Management***, 46(4): 536-549.

Mäkelä, M. M., & Maula, M. V. J. 2008. Attracting cross-border venture capital: the role of a local investor. ***Entrepreneurship & Regional Development***, 20(3): 237-257.

Park, H. D., & Steensma, H. K. 2012. When does corporate venture capital add value for new ventures? ***Strategic Management Journal***, 33(1): 1-22.

Politis, D. 2008. Business angels and value added: what do we know and where do we go? ***Venture Capital***, 10(2): 127-147.

Rasmussen, E., & Sørheim, R. 2012. How governments seek to bridge the financing gap for university spin-offs: proof-of-concept, pre-seed, and seed funding. ***Technology Analysis & Strategic Management***, 24(7): 663-678.

Renewable-UK. 2012. Wave and Tidal Energy in the UK - State of the industry report, ***http://www.renewableuk.com/en/publications/index.cfm/Marine-SOI-2012***.

Sapienza, H. J. 1992. When do venture capitalists add value? ***Journal of Business Venturing***, 7(1): 9-27.

Sapienza, H. J., Manigart, S., & Vermeir, W. 1996. Venture capitalist governance and value added in four countries. ***Journal of Business Venturing***, 11(6): 439-469.

Sætre, A. 2003. Entrepreneurial perspectives on informal venture capital. ***Venture Capital***, 5(1): 71-94.

Sørheim, R. 2005. Business angels as facilitators for further finance: an exploratory study. ***Journal of Small Business and Enterprise Development***, Vol. 12(Iss: 2): pp.178 - 191.

Sørheim, R. 2012. Venture capitalists as smart investors. In H. L. a. C. Mason (Ed.), ***Handbook of Research on Venture Capital***: 159-172. Cheltenham, UK: Edward Elgar Publishing.

Yin, R. K. 2009. ***Case Study Research - Design and Methods, fourth edition***. Thousand Oaks: SAGE Publications.

Zu Knyphausen-Aufseß, D. 2005. Corporate Venture Capital: Who Adds Value? ***Venture Capital***, 7(1): 23-49.