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Internationalization as a strategy to overcome industry barriers—An assessment of the marine energy industry

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ABSTRACT

Research on conditions to develop new innovations within emerging renewable energy industries is often done with a national focus. However, recent research on international entrepreneurship has revealed that firms operate on international levels very early in their life time. Thus, based on former research on international entrepreneurship and case examples, we build the propositions that firms in the marine energy industry use internationalization as a strategy to overcome industry barriers. Our primary source of data is a unique dataset from a global survey of all the companies in the marine energy industry who are aiming to commercialize a wave or tidal energy device.

This paper is organized in two steps: first we identified the most challenging industry barriers perceived by companies. Second we use these to form propositions which we assess through empirical data. The two most challenging barriers perceived by the companies are *need for capital* and *need for supportive political schemes*. Our findings reveal that internationalization certainly is a common strategy to access capital and attractive support schemes in foreign countries. The early internationalization has implications for researchers, managers and policy makers.

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1. Introduction

New energy technology is needed to secure a sustainable energy supply. To enable large scale utilization of renewable energy sources new technologies will have to be developed and commercialized. United Nation Environment Program (UNEP, 2009) estimates that global annual capital expenses on renewable energy, energy efficiency and carbon capture and storage need to reach as much as $500 billion by 2020, rising to $590 billion by 2030, representing an average investment of 0.44% of GDP between 2006 and 2030. The situation creates challenges for politicians and business opportunities for entrepreneurs. Since the challenge is global, the business opportunity holds an inherent international character.

Value added from renewable energy technologies has a high share of social value and the history of renewable energy has proven the need to adjust for market failures. Political involvement is necessary to facilitate development of new technologies and a market for these. Despite extensive negotiations on an international level to reach agreements on how to tackle the challenge, the implementation and final decisions are in the hands of national politicians (Lauber, 2004; Lund, 2007). There are major differences in how governmental support schemes for specific technologies are designed in different nations. This leads to differences in the national innovation systems and, hence, some countries are more successful than others in developing and commercializing renewable energy technologies.

As a result the concept National Innovation Systems (see e.g. Lundvall, 2007) has become popular when studying this phenomenon. There are, despite the global character of the challenge (and the business opportunities), few researchers who focus on internationalization as a distinct phenomenon within the innovation system tradition (Carlsson, 2006). The international dimension in innovation system studies has tended to focus on comparing industry development in different nations (e.g. Bergek and Jacobsson, 2003), rather than the international activities among the actors who build the industry—the innovative companies. This is a major weakness as internationalization has proven to be an important aspect of innovative firms' strategies (Keupp and Gassmann, 2009).

Wave and tidal energy represent vast and unexploited energy potentials and could also enable other marine businesses such as offshore aquaculture and production of hydrogen. Put in other words, the possibility to harness marine energy is arguably a desired scenario. Even if the society may agree to this, there might be system failures hindering the development. System failures, or barriers, is a situation in which market mechanisms and firms fail to achieve socially defined objectives (Edquist, 2001).

Various studies have focused on industry barriers related to the introduction of new energy technologies (e.g. Foxon et al., 2005; Jacobsson, 2008; Negro et al., 2007; Smit et al., 2007; Winskel et al., 2006). While accepting the important contribution from system

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studies, we observe that they do not focus the motivation of entrepreneurs who act as change agents in the system.

Obviously, some entrepreneurs seek to enhance the national conditions to commercial a certain product or to broaden the home market. This phenomenon may be called Institutional Entrepreneurship (for a review see Battilana et al., 2009). This study, however, seeks to complete these and the traditional innovation system tradition by focusing entrepreneurs who exploit foreign opportunities as an entrepreneurial strategy to overcome industry barriers. The focus is motivated by observations of international activities in the industry and the lack of explanation power on agency level (Lundvall, 2007) in the literature often used to analyze innovation systems related to renewable energy.

Guided by the rich international entrepreneurship literature this paper strives to view the industry through the lenses of innovative firms developing technology to harness wave and tidal energy. Through a survey among all the companies in the world who are aiming to commercialize these technologies we identified the main barriers perceived by the entrepreneurs themselves. Secondly we assessed to what extent they are exploiting other countries innovation systems to overcome these barriers. Inspired by Whetten (1989) we seek to move our understanding from just observing "What" is happening to deal with the "Why" through discussing the motivation behind the international orientation we observe.

2. Conceptual framework

The historical origin of the concept Innovation System (IS) goes back to the German economist Friedrich List's conception of "The National System of Political Economy" (List, 1856). List argued for national protection of infant industries and a proactive policy to build national institutions in order to learn about and apply new technology. The "modern" theoretical development of systems of innovations took place in parallel in the USA and in Denmark. With Freeman's (1987) book "Technology, policy, and economic performance: lessons from Japan" the concept was established internationally as National system of Innovation (NIS) and since then a number of studies have further developed and applied the concept. Today the concept has been widely used to analyze the conditions for innovations in many countries and is also adopted by international organizations like OECD, Unctad, the World Bank and the EU commission (Lundvall, 2007).

In the text box below we have included a brief history illustrating how the Danish wind industry gained from exploiting the Californian tax regime in the early 1980s. Svend Auken, former Danish Minister for the Environment and Energy (1994–2001) describes this international experience as a decisive episode for the Danish industry: "*The importance of the learning harvested by the major Danish manufacturing companies from manufacturing thousands of machines for the California market cannot be overestimated*" (Auken, 2002, p. 155).

The Danish wind industry exploiting Californian support system

The predominating interest of a nation to support certain business activities is usually the expected socio-economic benefit, typically measured in job creation and building up a sustainable industry. The outstanding success history is the Danish leadership in the production and distribution of wind energy turbines. As Danish wind policies are thorough documented, a less documented aspect of the Danish success in wind industry is their exploitation of ''the Great California Wind Rush'' in early 1980s, when the state of California introduced a very attractive tax scheme to support wind energy. In 1985, the last year of the ''Californian wind rush'', Danish wind turbine suppliers dominated the US market. More than 50% of all turbines installed in the USA this year were from Danish suppliers. This was advantageous for the Danish industry, but lead to a termination of the Californian support scheme due—partly due to lack of USA based companies' involvement (Righter, 1996). This example shows how internationalization may play an important part when companies seek to build competitive advantages.

Unfortunately, few studies within the IS framework have included internationalization specifically as an analytical dimension. In a review Carlsson (2006) identified only five empirical studies (Bartholomew, 1997; Fransman, 1995; Niosi, 2000; Niosi and Bellon, 1996; Niosi and Bellon, 1994). All these studies were dominated by an R&D focus and mainly multinational companies were included as private actors. The most comprehensive studies were done by Niosi and Bellon (1996; 1994) who conclude that small countries have a higher level of international involvement than larger countries, that national systems of innovation are more international now than before and that national policy plays a key role on the level of internationalization.

The unit of analysis in IS studies is either structural dimensions (the actors and institutions) or the functions/services delivered by the system (Radosevic, 1998). It is not designed to explain the activities observed at micro-level. With the same reasoning Lundvall (2007) challenge researchers to link entrepreneurship theories to the IS concept.

In this paper we strive to supplement the IS concept by introducing the research field International Entrepreneurship (IE). IE is a research field explaining the phenomena of rapidly internationalizing firms and is defined as "*a combination of innovative, proactive and risk-seeking behaviour that crosses national borders and is intended to create value in organizations*" (McDougall and Oviatt, 2000, p. 903).

IE was established as an alternative internationalization model (Oviatt and McDougall, 1994) that raised questions about the validity of prevailing internationalization models which stipulated and recommended incremental internationalization processes (e.g. the Uppsala model conceptualized by Johanson and Vahlne (1977)). The incremental internationalization models prescribed the successful internationalization to first include a national establishment of the business and after this a gradually internationalization. If companies in renewable energy industries are to follow the incremental path they are either dependent on an existing competitive national innovation system or need to pursue a rather resource demanding strategy to change the national conditions. As an alternative explanation Oviatt and McDougall established the concept of *International New Ventures* (INV). An INV is "*…a business organization that, from inception, seeks to derive significant competitive advantage from the use of resources and sale of outputs in multiple countries*" (Oviatt and McDougall, 1994). In contrast to the previous internationalization models the INV model prescribed the option to exploit international opportunities before the firm was established as a domestic player. Their work is influenced by Penrose's (1959) seminal work on entrepreneurship. As with Penrose they state that a new venture must acquire and assembly a set of resources to get a competitive advantage, but IE adds an international dimension. In this context resources are meant as assets (tangible and intangible) that are committed to or available for the discovery and exploitation of a new venture idea (Davidsson, 2004). Internationalization may be an integrated part in the process where companies try to access and leverage resources on their path towards commercialization and international growth (Zahra et al., 2003).

IE research is mostly built upon research directly on companies where the factors typically focused in IS system are referred to as contextual factors (for recent reviews of IE see Aspelund et al., 2007; Keupp and Gassmann, 2009; Rialp et al., 2005; Zahra, 2005). Thus, there are already established a conceptual link between the two perspectives.

In the text box below we present some short examples to show how wave and tidal energy companies act internationally.

Short examples of wave and tidal energy companies' internationalization

Hammerfest Strom (www.hammerfeststrom.com): Established in Norway in 1997 and installed world's first grid connected tidal stream machine in 2003. Formed a JV with Scottish Power in 2007 (UK has very favorable support schemes and an official objective of being the world leader in marine energy). In 2010 Hammerfest Strom received a £3.9 m in UK governmental grants for the construction and testing of a 1 MW tidal power device at UK governmental funded test centre. Scottish Power was awarded a concession for a 95 MW tidal energy project in UK's first round of marine site allocation—they will use Hammerfest Strom's technology.

Archimedes Wave Swing (www.awsocean.com): Idea of a wave energy device born in the Netherlands in 1993. During the 1990s testing was done in the Netherlands and in Ireland. In the period 2002–2004 a full scale device was tested in Portugal (Portugal had low bureaucracy related to concession and have high feed-in tariffs). In 2004 a subsidiary was established in the UK and the IPR rights were transferred. In 2006 the UK subsidiary secured £2 m from London based investors. In 2007 the UK subsidiary was chosen to be part of a governmental accelerator program and received a governmental grant worth £2.1 m to develop 2nd generation technology.

Ocean Power Technology (www.oceanpowertechnologies.com): Ocean Power Technologies from the USA had its first commercial operation in 1994 and spent most of their time during the late 1990s to research the feasibility of wave energy for the US Navy. In 2003 they floated on London AIM and raised £22.4 m. Later on they have made several JV to build wave energy projects in the UK, France, Spain and Australia.

Pelamis Wave (www.pelamiswave.com): As a result of many years of research at University of Edinburgh (Scotland), a company was established in 1998. The technology was tested in labs in Scotland, England, Norway and France. Secured €9.8 from a set of international investors (Norway, UK (investor network of 250 investors from 14 countries) and Switzerland) in 2002. First full scale test at a UK governmental funded test centre in 2004. Signed a €8.2 m contract with a Portuguese consortium to deliver world's first commercial wave-farm. After delivering the three first machines in 2006 they secured another £13 m in private investments from new and existing investors (now also from the USA and Italy). Three months before they published this press release:

> "*Portugal has been quicker to prioritise exploitation of its wave energy resource, and to recognise the commercial opportunity that it represents. The decision where to build this project was not ours but our customers. The Portuguese government has put in place a feeder market that pays a premium price for electricity generated from waves compared to more mature technologies such as wind power. This allows the commercial investment in early stage projects which is crucial to move the technology forward. This is exactly the same approach that delivered the wind industry in Denmark and Germany, which today has a turnover of over* €12*billion/year with* 60,000 *employed worldwide*." (Press release, 14th March 2006).

Based on the literature and case examples presented above, we raise this guiding research question.

To what extent do companies within the marine energy industry internationalize to overcome industry barriers?

3. Methodology

In this study we use empirical data in a two step designed study: first we assess data through an inductive method to reveal the most critical barriers in the industry (as they are perceived by the respondents). Secondly we make propositions that companies in the marine energy industry seek to overcome these barriers through internationalization strategies. The propositions are deductively assessed through the use of quantitative survey data and qualitative archive data. Some short industry cases are used to illustrate the phenomenon we investigate.

Our data is mainly drawn from a worldwide web survey sent to all companies in the world who were aiming to commercialize a wave or tidal energy device in 2007. Efforts were made to identify every company in the industry independent of geography. Hence, no sampling methods are used—we asked the whole population. The firms were identified through use of public lists (e.g. IEA, 2006), internet search and extensive use of networking in the industry. Pure research projects and embryonic projects were excluded. Finally, the survey was sent to 90 companies worldwide. To ensure commitment and avoid answers from persons outside the target group, telephone contact was taken on manager level before sending the web survey on personal e-mail addresses. 50 companies answered the survey with sufficient quality, which gives a response rate of 56 % of the whole population. In total the survey holds 214 variables.

To identify the perceived barriers we originated from quantitative data and complemented them with qualitative data from an open ended question. The categorization was done in an inductive fashion by stepwise categorizing the empirical data into more and more condensed categories.

To assess the research question we made one propositions of each category. With the high response rate our data is representative for the worldwide population of companies within the marine energy sector.[1] Hence, we have chosen to present our findings in a descriptive format.

4. Towards the propositions

When firms experiences shortage of a resource, like e.g. capital, it is a challenge. When the shortage is common for most of the firms in an industry it might be referred to as a barrier for the industry. To get a first impression of which barriers the marine industry faces we asked the respondents to rate a set of barriers we tentatively assumed to be relevant (see Table 1).[2]

To get a more nuanced picture of what the companies perceived as the barrier most relevant for their own commercialization plans we asked the open ended question: *In your case—what is the most important barrier for a more rapid development towards commercialization*? Their answers are aligned with the table above, but various variants of the challenge to find capital are added and the policy perspective was emphasized.

International Entrepreneurship (IE) is built upon Penrose's concept that firms must acquire and assembly a set of resources (funding, knowledge, technology, infrastructure, network, etc.) to build competitive advantages. We used this perspective to organize

[1] Confidence level 95%, margin of error 10%.

[2] These findings are previously published as part of the EU project Waveplam's report on non-technical industry barriers Neumann (2009). Non-technological Barriers to Wave Energy Implementation.

Table 1
Industry barriers rated by the respondents (%).

Relevant	Neutral	Irrelevant	Rated barriers
80	16	4	Lack of long term governmental support
69	27	4	Difficult to get licenses
63	20	16	Low price on substitute products
63	24	12	Lack of public awareness
61	22	16	Bad access to the grid
55	33	12	Occupied area conflicts with others (fisheries, navigation, etc.)
47	31	22	Lack of public known energy resource assessments
43	16	41	Lack of a dominant design/technology
41	37	22	Bad access to field data in proper format
37	35	29	Lack of international collaboration
37	29	35	Lack of standardization
33	43	24	Overprotective national policy
31	39	31	Difficult to establish a supply chain
29	41	31	Big environmental impacts

and categorize the data. Through an iterative process we were able to identify two main categories as the most important barriers perceived by the respondents—expressed as a resource need

1. *Need for capital.*
2. *Need for supportive political schemes.*

Typical answers were simply the words "*Cash*", "*Funding*" or "*Raising money*". Others were longer and more specific in their answers, like e.g. "*Finding a commercial partner to provide finances to the project*", "*Time taken applying for funding and the long timescales involved in getting funding*" and "*Getting the capital for* 1:1 *first demonstration unit*".

The political dimension was emphasized through various perspectives, but it was often connected to regulations, grid, concession and market schemes. Here are some examples: "*Low stability in government support agreement ruling and regulations*", "*Clear rules for shore grid connection*", "*Delays in consenting driven by excessive caution*" and "*Attractive kWh rates (*+20 *EUR cent) for minimum* 10 *years*".

The development of wave or tidal energy concepts is especially capital intensive early in firms' life cycle. In particular, it is challenging to secure funding enough to go from lab to full scale testing under real sea conditions. Due to the multiple technical challenges related to the marine environment, the phase from the first prototype to small array deployment is often called "valley of death" for ocean energy technologies. The technology shall stand years of wear and tear from heavy forces in the sea. In the end, the technologies need to be cheap enough to compete with traditional energy sources like fossil fuel and nuclear plants, but the path to reach this goal seems to be challenging because of the capital intensive technology development. Many respondents pointed out access to capital to be one of the main barriers as they were struggling to secure enough funding to continue the development of the technology and at the same time try to grow a competitive organization.

In renewable energy industries the social optimum investment point is higher than the private market actors are willing to invest (Stern, 2007). This fact has led to various support schemes in different countries. Some are of general characteristics while others are tailor made to facilitate marine energy. The schemes includes regulations, concession laws, access to grid, price subsidies and several other institutional issues—all heavily affected by political decisions. Access to resources tightly related to political support schemes was often mentioned as imperative to facilitate further development.

Hence, we propose

P1—Companies within the marine energy industry have high degree of international orientation.

P2—Companies within the marine energy industry internationalize to overcome the barrier of getting access to capital.

P3—Companies within the marine energy industry internationalize to overcome the barrier of getting access to supportive political schemes.

5. Data presentation

5.1. Industry overview

Of all the respondents 57% developed wave energy technology, 27% tidal energy technology and 16 % developed both types. The respondents are distributed from all over the world, covering four continents (see Fig. 1). USA and UK companies constitute 52% of total respondents. 94% of all companies are some kind of start-up companies and only 6% are projects developed in mature companies. In average 27% of the total development costs were reported to be covered by governmental funding, 73% were covered by private funding.

Table 2 shows the distribution according to the respondents technical development phase. The figures indicate that more than 50% of the teams already have, or are about to get, experience with their device under real sea conditions.

5.2. International orientation

Within international entrepreneurship theory there is established a construct consisting of four variables to measure companies' international growth orientation (Nummela et al., 2005). This gives a good indication of firms' willingness to explore and exploit foreign markets. Fig. 2 shows that even though 46% think their domestic market offer sufficient growth potential, the majority of firms in this industry have high international growth orientation. As many as 84% thinks it is important to internationalize rapidly. The same share agrees that internationalization is the only way they may achieve their growth objectives.

To get a further indication on how far the companies intended to use internationalization as a strategy we asked them to rate the statement "*We would move our main office to a foreign country if*

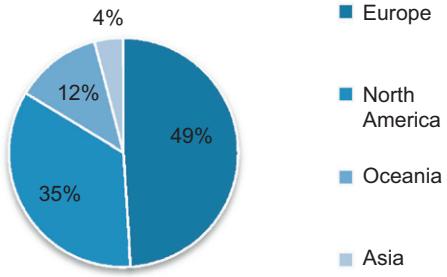

Fig. 1. Geographical distribution.

Table 2
Technical phases of the respondents.

Technical phase	Distribution in %
Conceptual	**6**
Numerical model, lab	**4**
Physical model, lab or sea (size 1:10 or smaller)	**35**
Prototype, sea (size 1:2–10)	**27**
Demonstration, sea (size 1:1)	**22**
Power park (1:1)	**6**
Total	**100**

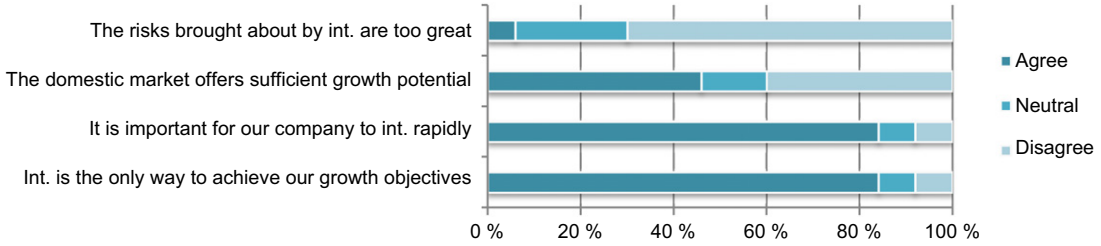

Fig. 2. International growth orientation (Nummela et al., 2005).

needed". It turned out that 58% of the respondents agreed to this statement. Further, 20% of the respondents reported that the concept they intend to commercialize originated from a foreign country (inward actions is also a type of internationalization (Welch and Luostarinen, 1993)).

To get a more detailed insight in the timing of their internationalization we asked them where they had (or expected to) accomplish their first full scale demo project and their first full scale commercial farm. We gave them only two alternatives—*mostly domestic* or *mostly abroad*. 38% expects their first demo project to be done abroad. This indicates a high level of intention to internationalize already before a commercial product exists. As many as 58% of the respondents expect the first sale of a full scale commercial farm will be in a foreign country. This means that more than half of the companies in the industry are searching for pilot customers abroad.

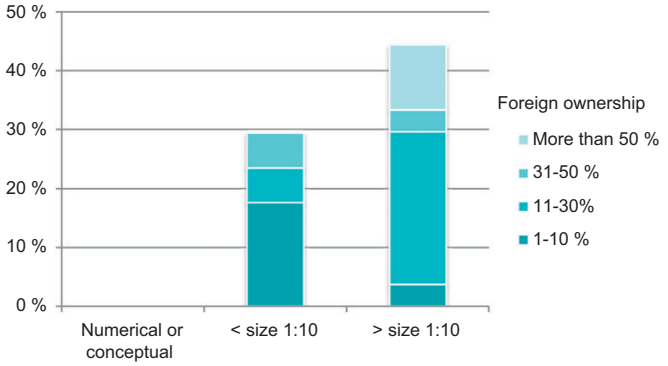

Fig. 3. Share of firms with foreign ownership at different development phase.

5.3. Accessing capital and support schemes

Marine energy is a capital intensive industry. According to CarbonTrust (2006) the average cost of a prototype in the UK has been £4000–9000/kW for wave energy devices (equals ca €5900–13,200/kW) and £5000–8000/kW for tidal devices (equals ca €7300–11,700/kW). Marine Institute of Ireland has made a Development & Evaluation Protocol for wave energy concepts which include a rough budget. The estimated cost on the recommended test procedure from concept verification to a full scale demonstration project is £9,000,000–21,000,000 (equals ca €13.2 millions–30.8 millions; Holmes et al., 2007).

Obviously the need for capital increases along the development of the technology. As mentioned above, this is particularly true when the development moves from lab to real sea conditions. This fact also seems to result in increased foreign ownership in the firms. Fig. 3 shows the share of foreign ownership at different technical development phases. The graphs reveal a clear trend towards more international ownership as the concepts evolves.

Fig. 4 shows which type of owners that are represented in firms at different technological phases (the numbers do not include information about share distribution among the different owners). As expected, the teams' ownership shares decreases as the companies evolve. Another interesting observation is that private and public investors are well represented already in lab testing phases, so are venture capitalists. By combining information from Figs. 3 and 4, we get an indication that a fair share of the new investors represented in the two most advanced phases are from foreign countries. In total 52 % report they have shareholders from two or more countries.

What about political support schemes? We asked the companies to rate the importance of five criteria if doing activities in a foreign country at prototype level, at 1:1 demonstration project level and at full scale power park level (see Fig. 5). Four of them are directly associated with national policy. The high rating of *a proactive government* indicates that companies do not only search for subsidies, but also national innovation systems where

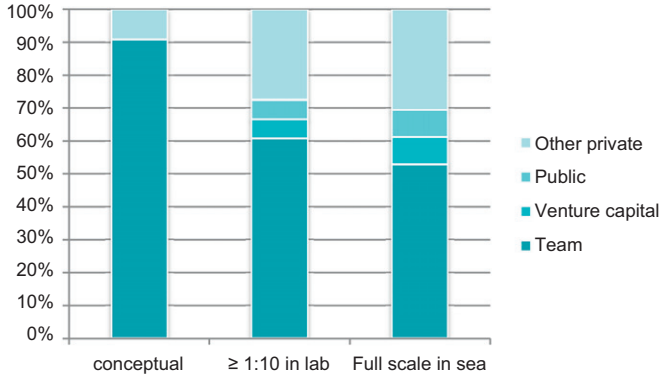

Fig. 4. Ownership distribution.

politicians have taken an active stand to support the development of the industry. This is further emphasized with the high share of companies who rate access to grid and concession procedures as important. *More available private funding* was less important than the criteria more directly related to national policies.

Based on information from IEA's review of different nations support schemes for marine energy (IEA, 2006) we find Scotland and Portugal to be the most attractive nations to establish a demonstration project in. These were also the two countries who most firms wanted to build their demo project in 14 of 50 companies reported they wanted to establish a demo project in Scotland. 7 planned to do it in Portugal. Among the companies who were aiming at Scotland or Portugal for their demo projects only 3 of 21 companies were domestic.

We assessed to what extent the companies really got access to governmental capital in other countries. While 28% had not received any governmental funding, more than 30% had received governmental funding in more than two nations. 2 companies actually reported they had received governmental funding from more than 5 different nations.

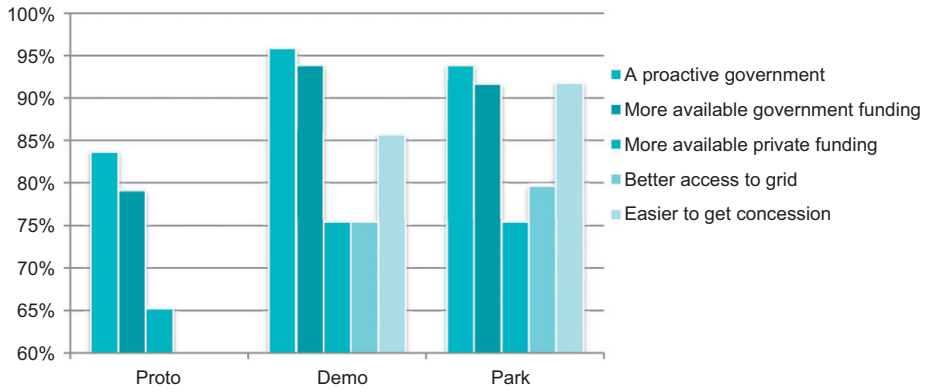

Fig. 5. Percentage of respondents who rated the criteria as important.

6. Discussion

The data presented support our propositions; companies in the marine energy industry have a high degree of international orientation and they do use internationalization as a strategy to overcome industry barriers. Companies source capital from foreign nations and they tend towards nations with proactive policy to develop marine energy. In this section we will discuss our findings in order to receive a deeper understanding of why this internationalization phenomenon exists.

6.1. Motivation for international orientation

More than ninety of the respondents categorized themselves as a start-up company. Normally start-up companies have limited resources and must therefore consider how one type of resource can be leveraged to acquire another (Brush et al., 2002). This applies in particular in phases before commercialization (Jones, 2001; Oviatt and McDougall, 1994). According to Kuemmerle (2002) the motivation to internationalize may be divided into two dimensions; "*…either in order to use extant firm-specific knowledge, primarily for manufacturing and sales activities, or in order to increase the firm's stock of knowledge, primarily through research and development activities*". He argues that new ventures' motivation for internationalization most likely is due to their need to increase their resource base. Simply because they need access to resources to develop a product they can sell. As new ventures are bounded by their limited resources, internationalization is often done through hybrid structures – i.e. through extensive use of their network and more or less strong relationships with local actors in the target country (Coviello and Munro, 1997).

There are factors pushing and/pulling firms towards internationalization (Etemad, 2004). It could be a difficult capital hunt and dissatisfaction with the support level and unpredictable political frameworks in their home country that are pushing the firm towards internationalization. It could also be that, rather than being pushed from their country, firms are pulled by the more attractive sources of private capital or favorable political support systems in a foreign country. Both perspectives are valid, and both deal with access to resources to ensure survival and commercial growth.

6.2. Internationalization to access capital and supportive political schemes

Our data supported both propositions, but *a proactive government* and *more available governmental funding* were rated as more important than *more available private funding*. We do not have empirical data from the marine energy industry to explain why, but arguments from innovation system research and related literature offer a possible explanation. Innovation System (Bergek et al., 2008) and adjacent theories like Cluster theories (Porter, 1990), are indicating that a shared vision between politicians and industry have an effect on the direction of search and available resources. This is also supported by venture capital research. Bruton et al. (2005) argue that a nations institutions influences the investor industry. In other words: supportive political schemes seem to facilitate better access to private funding.

The return on investment in marine energy is heavily affected by political risk as the market is, to a large degree, is governed by political decisions. Thus, companies in the marine industry might be dependent on more specialized investors who have high knowledge about the industry and, hence, are better suited to calculate the risk-reward balance when investing in early phases. Hence, private investors in countries where marine energy is considered to have a significant future market might be better informed about marine energy as an investment opportunity. They have easier access to industry information and they might have closer relations to visionary policy makers. Another factor facilitating international sourcing of capital is the fact that professional investors are operating more international now than before (Wright, 2005), making access to international investors easier.

According to Shane (2003) there are fewer entrepreneurs who pursue business opportunities when it is difficult to capture the return from their efforts to exploit an opportunity. The same applies to industries where market segmentation is difficult. Even if marine energy is an emerging industry the end product from marine energy is a direct competitor with every other electricity generating devices. Therefore the industry is, for the time being, dependent on politically supported niches to find markets for their innovations. As the policy behind these niches are designed on a national level and some nations offer more support than others, it can be challenging to compete without access to the most favorable support schemes. As our findings reveal, this often lead to the early strategically conclusion to internationalize in order to tap into foreign support schemes—"shopping of national innovation systems". The phenomenon might be an effect of risk management by the firms (Shrader et al., 2000).

This phenomenon will have different effect on the country that hosts foreign companies and the original home-base country of these companies. Host countries with attractive support schemes will get a good deal flow of new ideas and have the privilege to set the terms on how the new firms may access their support scheme.

The country of origin is in the risk of getting drained of innovations within this particular industry. In the long run it may lose competitive advantage in related industry as their national industry will be more isolated from the technology edge (Porter, 1990). On the other hand, in less protective cases, other nations support schemes might also be regarded as an opportunity for domestic companies as they may gain from early

internationalization. The Danish wind industry's experience from the "Californian Wind Rush" and Pelamis' experience in Portugal are good illustrations of this approach (see text boxes above).

The potential conflict between the objectives of a nation and multi-national companies is well known (Vernon, 2001). Further, prevailing literature on international business prescribes industries to internationalize in the growth or mature phase (Andersson, 2004; Fernhaber et al., 2007; Vernon, 1966). Findings in this paper reveal this to be the case for more immature industries as well: The nation wants to assure a "home-market" on a basis as broad as possible, whereas the entrepreneur is interested to "pick" the best support systems based on their current and future needs.

The concept of innovation system was designed to inform policy and to establish a wide perspective on innovation. It is widely used to assess nations' ability to develop and deploy new innovative technologies. A prerequisite to advise policy is to understand the micro-level of an innovation system (Lundvall, 2007). International entrepreneurship combines the phenomenon of entrepreneurship and early international activities. This paper is a first attempt to supplement the concept of innovation system with the perspective of international entrepreneurship through an empirical study. Our data shows that firms are willing to exploit foreign support schemes and that it is possible for nations to attract foreign firms in very early phases.

7. Conclusions

Through the results from a worldwide web survey sent to all the companies in the world aiming to commercialize a technical concept to harness large scale wave or tidal energy, we identified their perceived most important barriers as *need for capital* and *need for supportive political schemes*. Based on the survey, case data and archival data we can conclude that firms in this industry regard internationalization as a viable strategy to overcome these barriers. Many of the firm in the marine energy industry are, despite of the early stage of their evolution, exploiting foreign resources and regard their market to be international. With the use of knowledge from International Entrepreneurship literature and adjacent research we have attempted to explain the motivation behind this early internationalization.

8. Implication

Our findings reveal an international reality that national policies typically not are designed for. This adds a new dimension for policy designed to support the development of new renewable energy technologies and markets.

As internationalization seems to be the norm public institutions in countries with attractive political support systems should develop experience with handling foreign companies. Entrepreneurs should screen countries to find those that fit best into their strategy and subsequently seek partners in these countries.

The internationalization phenomenon might be used strategically by those countries who are aiming to take lead in marine energy. The rational for governmental policies should be to attract companies with competitive technology.

Internationalization offers threats and opportunities on all levels. If actors involved in the industry accept internationalization as an embedded part of the game, the industry could develop faster than without. On the contrary, if actors work to hinder or over exploit internationalization, the industry development is hampered.

9. Future research

This study reveals several interesting research questions for future research.

First of all this paper is empirical focused. Efforts to combine the theoretical perspectives of the top–down Innovation System concept with the bottom–up International Entrepreneurship research would be useful.

There is insufficient research on how the development of a new industry is affected by international activities between the pure R&D phases and the fully commercial ones. An in-depth case study will provide a better insight in the process of *how* companies make use of foreign opportunities in phases before they get a commercial product. This could give vital contributions to the research on international entrepreneurship and our understanding of how the development of new renewable energy technologies may be accelerated. Further, research with focus on how these early international activities could transform into access to international customers and markets will be welcomed by the research community, as well as managers and investors.

National support schemes are rarely crafted out with the goal of optimizing the overall speed of the industry, but rather on optimizing each nation's interest. It is in the international society's interest to obtain more knowledge about how entrepreneurs could optimize the use of different national support systems in a way that reduces the time to market. This knowledge would be extremely valuable inputs to further development and diffusion of renewable energy technologies.

From a nation's point of view questions about how to build policies to best attract and include competitive concepts arises. How early in a start-up's life cycle is it appropriate to attract them? Already in the concept phase, in the demo phase or is it best to wait until a fully developed technology searches for a pilot market—And how should national industry be integrated?

From the perspective of the country of origin, further research should aim to shed light on the challenging task to design policy that attend the start-up companies' desire to internationalize and the nation's objective to keep the companies "taxable". In the long run it is a question of sustaining the nation's competitive advantages. Overall, countries might find it appropriate to support the ocean energy sector even without significant home market, knowing that national companies can yield significant shares in a large export market.

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