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Spatial knowledge dynamics of innovation processes: local and non-local aspects of buzz and collective learning

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Abstract

Most studies in economic geography think of innovation as an outcome measured by patents or innovation statistics. This simplistic view on innovation causes scholars to draw conclusions supporting a spatial determinism that favours local ties over international. This paper aims to understand if geographically proximate partners are more important at some phases of the innovation process than at other phases. First the paper takes a critical look at the fuzzy conceptualization in economic geography, including local buzz, face-to-face, collective learning and global pipelines. Second, the paper applies a novel, biographical methodology, namely innovation biographies, which places the innovation event as its analytical focus and study the process as it unfolds over time (from idea-generation ? to problem-solving ? to implementation). The paper presents three innovation biographies from suppliers to the wind turbine industry. Results suggest that local linkages (buzz) are crucial in the early stages of generating new ideas, whereas in other phases (problem-solving and implementation) geographical co-location does not play an important role, although these processes are highly dominated by collective learning processes and require face-to-face contact. In sum, the innovation biography method contributes in uncovering innovation processes and how these rely on many different configurations of spatial knowledge dynamics, including buzz, local ties and global pipelines. The findings imply that policy should be designed to support companies working across regional and national borders and not only favour local networking.

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Keywords: Innovation processes, local ties, buzz, global pipelines, innovation biography, wind turbine industry

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1. Introduction

This paper argues that we lack a greater understanding of the innovation process in economic geography. Innovation is often studied as an outcome such as patents or innovation statistics (Garud, Tuertscher, & Van de Ven, 2013), however it is important to remember that innovation processes are contingent processes (Pavitt, 2005) that unfold over time. Often the road that leads to innovation is tortuous and timely. In the process of innovation, firms interact with many different types of actors trying to solve different problems. The character of the connections a firm has to other firms during an innovation process differs from being shallow to intensive and concentrated and connections vary in duration (Granovetter, 1973). The consequence of reducing innovation processes to innovation outcome is that it simplifies our understanding of the collective learning processes that lead to innovation, and hence also our understanding of the role geography plays for innovation. It is argued in this paper that by studying the innovation process as it unfold over time, characterized by different patterns of interaction between actors at different point in time, it can help to clarify when and how geographical proximity between actors play a role in the innovation process.

Firms innovate, in part, by combining existing and new knowledge (Kogut & Zander, 1992). Because only few firms are able to generate all the knowledge it requires internally, firms involved in innovation processes consequently search for external knowledge. It is increasingly acknowledged that firms' ability to acquire external knowledge is constrained by the firm's own experiences and competences (Nelson & Winter, 1982) including its geographical and technological distances to the source of knowledge (Antonelli, 2001; Jaffe, Trajtenberg, & Henderson, 1993).

However, there are numerous examples from the literature showing how firms are able to overcome its geographical boundedness and gain access to extra-local knowledge that can be integrated in the firm's innovation process (e.g., Bramwell, Nelles, & Wolfe, 2008; Gertler & Levitte, 2005; Niosi & Zhegu, 2005; Rosenkopf & Almeida, 2003). To capture this, Bathelt et al. (2004) have developed the concepts of 'local buzz and global pipelines' to comprise the dyadic relationship between local and global knowledge flows. Local buzz complements collective learning processes (Asheim, Coenen, & Vang, 2007) that take place either within the boundaries of an organisation or between organisations, for example, in research projects or in user-supplier relationships.

Global pipelines are on the other hand channels of communications to knowledge providers located outside the regional economy, which outward looking firms have invested in. Bathelt et al. (2004) argue that the co-existence of high levels of buzz and many pipelines in a regional economy creates advantages that are not available to outsiders, thus, increasing the innovative output.

Amin and Cohendet (2005) question this dual distinction between the local and the global. Where the local is understood as a company's "home base" defined by territorial borders and where local ties are stronger and more important than long-distance ties. Amin and Cohendet (2005) on the contrary argue

that it is possible to build just as strong ties without physical proximity, through which also tacit knowledge can be shared.

Consequently, there is a great interest in understanding the fundamental dynamics of the dyadic relationship between local and global knowledge dynamics. Firm-based studies in economic geography have either focused on the degree to which firms collaborate internationally (Gertler & Levitte, 2005; Murtha, Lenway, & Hart, 2001); the *types* of global pipelines (such as inventor mobility and alliances, Rosenkopf & Almeida, 2003), or on identifying the type of actors that function as global pipelines (Benneworth & Hospers, 2007). What is still lacking, however, is a more thorough understanding of when during the innovation process firms choose to integrate external knowledge from both local and non-local knowledge sources. This paper aims to fill this gap by focusing on the innovation process as it unfold over time and ask when and how is geographical proximity important in the process of innovation?

To answer this question I apply a relatively recent developed methodology building on a biographical approach (Strambach, 2012). The biographical method is characterized in that it focuses on the innovation event itself: the actors involved; the relationships between them; their knowledge contribution; and their geographical and institutional settings (Strambach, 2012, pp. 61-63). The biographical method includes, in addition to the geographical dimension, a strong emphasis on the time dimension since it focuses on the entire "lifespan" of the innovation activities from idea generation to production of the new product. The method thus involves interviewing actors who have been involved in the innovation activities in the entire lifespan of the innovation process.

A secondary objective of this study is, thus, to assess the usefulness of applying an innovation biography method to the examination of spatial knowledge dynamics of innovation processes. The paper will discuss the value of the biographical method and suggest improvements and adjustments for future studies.

The structure of the paper is as follows. The second section reviews the literature on the importance of local knowledge dynamics in innovation, it introduces the notion of innovation processes and it takes a critical look on concepts used to explain geography of innovation. The third section presents the method of innovation biographies and section four introduces the empirical focus of this paper, namely the Danish wind turbine industry. Section four also presents the three cases. The fifth section analyses the interviews with regards to the importance of local and non-local knowledge dynamics for the innovation process. And the last section concludes and discusses the implications of the findings for the literature, for firms and for policy makers.

2. Theoretical Background

In the field of economic geography, the role of geographical proximity for innovation has been subject to an ongoing debate since late 1800s and early 1900s when Alfred Marshall presented his seminal work on industrial districts. Marshall's studies concern agglomeration of small and medium-sized companies in the same or related industries, and he argued that geographical proximity between these companies and

their specialized suppliers promotes knowledge spillover. Marshallian externalities have in addition to knowledge spillovers also been ascribed to economies of specialization and labour market economies (such as specialized local labour pool) (Niosi & Zhegu, 2005).

Several currents of literature have built on Marshall's work and argued along the line of knowledge spillover in order to explain why economic activities tend to agglomerate in some regions, and why some regions prosper more than others. Most prominent, in the late 1980s and 1990s scholars (mainly based in USA) were occupied with proving empirically and by quantitative means the evidence of localized knowledge spillover (Anselin, Varga, & Acs, 1997; Audretsch & Feldman, 1996; M. Feldman & Florida, 1994; M. P. Feldman, 1999; Jaffe et al., 1993; Jaffe, 1989; Maurseth & Verspagen, 2002). These studies have tried to measure localized knowledge spillover in more or less sophisticated ways, mostly through citations of patents and scientific literature. Generally they have supported the overall hypothesis that knowledge production and innovation is associated with geographical proximity to the source of knowledge.

Other currents of literature including the work on clusters (Porter, 1990, 1998), regional innovation systems (Cooke, 2001, 2004) and the concept of 'learning regions' (Maskell & Malmberg, 1999) have in line with the literature on localized knowledge spillover emphasized the importance of local ties for knowledge production and innovation. Although, extra-regional or global relationships are recognized to occur, it seems to be a fact that local or regional connections between firms are considered more valuable because these enable an easier transfer of tacit knowledge. The distinction between tacit and codified knowledge plays a key role in the argument of the importance of local "sticky" knowledge.

For instance Maskell and Malmberg (1999, p. 180) argue:

> *"The interactive processes of solving problems, where the needs of one party become the driving force for action of another, contain both codified and tacit elements. Indeed, we argue that in an era when codified knowledge is globally disseminated faster than ever before, tacit and spatially more 'sticky' forms of knowledge are becoming increasingly important as a basis for sustained competitive advantage."*

Hence, the argument seems to be that because of globalization of economic activities and the prevalence of the Internet which eases transfers of codified knowledge local sticky knowledge matters more than ever before (Lorentzen, 2008).

However, more and more studies also reveal that international knowledge linkages are crucial to firms' innovation processes (Bramwell et al., 2008; Niosi & Zhegu, 2005; Simmie, 2003). For instance, Simmie (2003) shows how the most innovative firms are located in key metropolitan areas and rely strongly on international sources of knowledge. Niosi and Zhegu (2005) show how international knowledge spillover can explain the geographical dispersion of aerospace clusters. And Bramwell et al. (2008) reveal that many inter-firm linkages are non-local in the Canadian Waterloo ICT cluster, and they face difficulties in approving the local intra-cluster dynamics, which the literature prescribe.

In line with these studies, Amin and Cohendet (2005) argue that "being there" through relational or social proximity is possible without physical proximity. Many relational ties are localized; however, many other ties of equal commitment and intensity are spatially stretched. Therefore geography of innovation should according to Amin and Cohendet not be understood as "islands of innovation" strongly delineated by territorial borders, in which internal links or the "home base" is clearly distinguishable from external and distant relations.

This disagreement in the literature calls for studies to clarify the dual relationship between tacit/local vs codified/global distinction. Thus, there is a need to bridge the gap between the two overall currents in economic geography. One current stresses the importance of the local environment and local ties as more important for innovation than non-local ties and a more recent current that highlights the importance of international linkages. Before turning to disentangling some of the conceptual confusion that has led to this disagreement in economic geography, it is important to gain a better understanding of the innovation process.

2.1 The Innovation Process

Another issue related to the current debate on the role of geography on innovation is that it tends to focuses almost narrowly on innovation as an output. This limitation in focus reduces the time of innovative activity to a single point in time, often without taking into consideration the long process of knowledge generation, problem solving and testing and prototyping etc. that goes before any innovation is introduced to markets. Consequently, the role of geography is reduced to a matter of statistical (often static) measures of causalities which generates knowledge of the type: Firms are more likely to innovate if they are located in close proximity to the source of knowledge (Jaffe et al., 1993) or firms from regions with high levels of social capital are more likely to introduce product innovation (Laursen, Masciarelli, & Prencipe, 2012). These insights are extremely valuable and have enriched the literature on the role of geography for innovative activity. However, they have a tendency to misrepresent the actual role of geography in innovation processes because they disregard how innovation processes unfold over time and how the role of geographical proximity may vary at different points in time.

For that reason, it is valuable to remember that innovation processes are contingent processes that differ in accordance to the economic sector, technological field, type of innovation, historical period and country concerned (Pavitt 2005). Innovation processes develop through time and are extremely uncertain processes (Dosi, 1988). Although innovation processes almost always are driven by a goal, either a vague or clear idea about an end-product, they seem to be fluid processes that can be affected by lots of different types of external factors. On the technical part external or inter-firm knowledge input, or test results can completely change the concept of the innovation project, and take the innovation project in a different direction. Managerially, resources can run out and the innovation project can face difficulties in reaching the goal because of limited resources. Many innovation projects are therefore uncertain and face the danger of being closed down.

The type of innovation processes that is in focus in this paper is similar to the innovation processes described by Lundvall (1988) and others where firms (often SME) provide specialized production inputs to (often large) customers. The B2B relationships that characterize this type of innovation process is rather relational than arms-length and include a high degree of knowledge sharing regarding the development, operation and improvements of the input (Pavitt, 2005).

There are different ways to characterize innovation processes, including practical approaches in innovation management that build on tools like stage-gate processes (Cooper, 2008). However, for this purpose technological innovation processes are defined in a simple way as containing three overlapping steps or phases: Idea generation – problem-solving – implementation (Garud et al., 2013; Utterback, 1971). This is not a depiction of a linear understanding of innovation, on the contrary in reality these stages are hard to distinct from each other, they are often intertwined and knowledge feed back to earlier stages from later ones and vice versa. The innovation process is understood as the process of sequential events that unfold from an idea emerge to its implementation within firms (Garud et al., 2013).

Following Utterback (1971): "The idea generation phase is operationally defined to extend from the time of the first thought related to the idea is communicated until a proposal is written or at which the major effort of at least one person is directed toward work on the idea." The idea generation phase contains two elements: the identification of a need and matching the need to a mean, such as a technical solution.

The problem-solving phase extends from when the idea has been proposed and initial resources have been allocated to the time at which a solution or prototype is completed. The sub-processes of the problem-solving phase often count: 1) identifying sub-problems, 2) specifying technical requirements for solutions that meet the sub-problems, 3) evaluating different solutions and 4) deciding on which solution to carry on with. Furthermore it contains elements of design, testing and validating solutions.

Implementation is related to manufacturing of the solution and bringing the original idea to its first use or market introduction (Utterback, 1971). It regards manufacturing engineering, plant startup, marketing, production, diffusion, ongoing services etc.

As is evident, the three phases characterising the innovation process rely on a high degree of knowledge sharing and learning. It is the objective of this paper to increase our knowledge on how these processes of knowledge sharing and learning vary in spatial terms as the innovation process unfolds over time. In the next section we turn to some of the key concepts that have been applied in understanding the geography of innovation.

2.2 Proximity in the innovation process

Collective learning processes (interactive learning), face-to-face, buzz and global pipelines are concepts that have come to play an important role in understanding the geography of innovation. However, there exists a lot of definitional confusion about these concepts (Asheim et al., 2007) so there is a need for clarification of the content of the concepts including how they are related to the geographical dimension of innovation processes. In this section it is the aim to clarify some of the confusion and propose a model

(see Table 1) that captures the local and non-local aspects of these key concepts: collective learning processes, face-to-face collaboration, global pipelines and buzz. Next, we relate these concepts to the literature on innovation processes.

Table 1: Spatial knowledge dynamics: Local and Non-local dimensions of collective learning processes and buzz

	Local	Non-local
Collective learning processes **Where:** Inter-firm learning, collaborative work, user-supplier relationships, **What:** complex tacit knowledge, formal networks	Local ties	Global pipelines
Buzz **Where:** fairs, conferences, workshops, customer meetings **What:** state-of-the-art knowledge, informal networks, rumours, anticipation of future needs or direction of industry, information on regulations	Cluster embeddedness/ Local milieu	Temporary Spatial satellites

The model in Table 1 presents a reinterpretation of the key concepts in understanding geography of innovation. It includes two key terms in economic geography, collective learning processes and buzz, which are concepts for different means of knowledge sharing and diffusion. In the following it is argued that these two concepts embrace the knowledge dynamics which lead to innovation. Table 1 also presents how these concepts are understood when we add the spatial dimension (local and non-local).

The first row in Table 1 concerns knowledge sharing through collective learning processes (interactive learning). Collective learning processes are at the heart of innovation processes because these facilitate the combination of different pieces of knowledge in the creation of new solutions. Interactive learning can take place internally in a company between colleagues or between companies and other external partners. Collective learning is often facilitated through face-to-face collaboration, in particular when there is a lot of complex tacit knowledge involved. However, face-to-face collaboration is not the only mean to interactive learning. Other types of proximities can facilitate collective learning processes, such as organizational, institutional, cultural and social (Boschma, 2005). For example, if two colleagues are physically located at two different sites: one at the company and another at a customer, the transfer of complex tacit knowledge is still likely to occur because the two colleagues build on organisational proximity and a common understanding.

There are two conceptual issues related to collective learning that have caused confusion in the literature of economic geography. First, the perception of face-to-face contact as a necessity in collective learning processes has become a key reasoning in the argument of the importance of local ties over global ties. However, as argued above, face-to-face contact is not a necessity for collective learning processes, because other types of proximities can substitute being physically co-present (Hansen, 2014). Moreover, face-to-face contact is a general mean of communication and consequently also mediates other things than collective learning, for example buzz, which we return to below. Using the concepts of face-to-face and collective learning interchangeably has consequently contributed to conceptual confusion and ambiguity in understanding the geography of innovation. Consequently, in this paper it is argued that it is not the face-to-face notion that ought to be the focus for theoretical development but rather the concept of collective learning process.

Another issue related to the misuse of face-to-face contact derives from the conflation of face-to-face contact with physical co-presence of actors (see for example Asheim et al., 2007, p. 659). However, face-to-face contact between actors is not dependent on parties being localized in the same territory. Face-to-face meetings also take place and are arranged between employees from companies that are located far from each other, for instance between suppliers and users, consequently facilitating learning of tacit knowledge in non-local ties. The latter is what Bathelt et al (2004) have named global pipelines, and is included in the upper right corner of Table 1.

The second row in Table 1 is concerned with the concept of buzz. There is no clear definition of buzz. For example, Storper and Venables (2004) define buzz as both means, sources and effects of communication at one and the same time (Asheim et al., 2007). In this paper it is argued to define buzz based on its content about an industry's state-of-the-art and direction etc. and consequently analyse the role and effect of buzz in innovation processes.

Buzz is "the idea that a certain milieu can be vibrant in the sense that there are lots of piquant and useful things going on simultaneously and therefore lots of inspiration and information to receive for the perceptive local actors" (Bathelt et al., 2004, p. 38). Buzz consists of specific information about what other actors (competitors, customers, suppliers, governements, universities etc.) are doing, and provides insight into the state-of-the-art of the industry or of a technological field, the latest development and the perception or anticipation of the direction of the industry, information on regulation systems and signals on new policies. Buzz is in contrast to collective learning processes less binding. It has an informal character and it often requires trust before information of this character is exchanged between parties.

Bathelt et al (2004, p. 38) argue that *"buzz does not require particular investments. (…) is more or less automatically received"*. On the contrary, it is argued that it is hard for a company to receive qualified buzz if the company has not invested time and resources and credibility into its relationships and ties that are the carriers of buzz. Sometimes it takes investment in new employees who carry on knowledge from other parts of the industry or from other parts of the world, other times it requires being present at

conferences and fairs. Consequently, I argue that buzz do require investments in form of time and resources allocated towards building the relationships or "channels" to receive buzz.

Buzz both has a local and non-local dimension. Local buzz is received from the local milieu or from a company's embeddedness in a cluster. It can be achieved through linkages to the industry and to participating in fairs and conferences that addresses issues and needs of a specific industry. However, it can also be necessary for a company to learn about buzz in other geographical locations, for example if a company wish to reach foreign markets. Following Asheim et al. (2007) buzz can be transmitted both electronically and face-to-face and can therefore be both local and global. In this paper it is argued that a company can connect to other geographical locations by building relationships to local companies (for example customers and/or suppliers) and tap into buzz about the current state-of-affairs for the industry in a certain region. This I choose to call (temporary) spatial satellites. 'Temporary spatial satellites' is not included in the analysis carried out in this paper.

3. Methodology

To advance our understanding of the nature of local and non-local knowledge dynamics among sub-suppliers in the wind turbine industry in Denmark the analysis builds on an inductive methodology following a grounded theory approach (Glaser, Strauss 1967). To achieve an appropriate balance between interpretation and data, it has been useful to begin the data gathering process concurrently with a continuous process of investigating the nature of the research question, developing a research design, refining the method used to gather data, and initiating a data dependent coding of the gathered data (Heath, Cowley 2004). Most importantly, it has been key to decide on the data gathering method at a very early stage in order to begin this process.

This study makes use of a biographical approach focusing on innovation processes in supplier in the wind turbine industry. Consequently, it is not a firm's intended procedure in general that is the focus of this study but the process of product development activities that takes place within and beyond the borders of the firm. Through interviews with people who have been involved in the innovation process it has been the purpose to uncover a) the actors involved b) the relationships between them c) their knowledge inputs and d) their geographical and institutional settings (Strambach 2012, pp. 61-63).

There are several reasons why such a relatively novel approach is considered worth to apply in studies of innovation activities, and why such an approach may differ from previously applied methods in the field of economic geography.

First, the methodological approach of innovation biographies has been argued to be, in an economic geography perspective, very advantageous because the biographical method can focus on the distributed knowledge generation activities and their evolvement over time, and this, without being limited by a certain territorial scope or time-frame. As Strambach (2012, p.62) puts it: "Knowledge interactions can be mapped regardless of geographical or sectoral scale". Thus, the starting point of an analysis building on a

biographical approach distinguishes itself from other economic geography studies in that it does not have a very rigid focus on knowledge dynamics within and beyond one particular region, for example cluster studies. Instead it applies a more flexible territorial understanding. Similarly, some methods only focus on one point in time, often represented as a three years period. The innovation biography method allows working with a flexible time-span because it aims to keep its focus on how innovation processes unfold in time and space. Consequently, by focusing on a single innovation event this method enables reconstructing the time-space paths of knowledge dynamics in a more flexible way than other established data gathering approaches.

Second, the advantage of the innovation biography approach is that it gives concrete insight into tangible procedures of new product development without using the methods of observations (such as studies by Garud et al., 2013; Van de Ven, 1999), which is extremely time-consuming. Furthermore, the method of innovation biographies also overcomes the risk of being presented for *the ideal situation* of the company or for a lot of post-rationalization. That is often the case when researchers interview managing directors or head of R&D divisions about general aspects of a phenomenon.

The method of innovation biography, focuses on the innovation process at the micro level and how this process is linked or embedded in a macro context of the larger technological innovation system

The data collection process is balanced between the narrative of the project owner and a focus on the firm's context and its linkages to other partners in the process of innovation. For each case (innovation event), the aim has been to interview at least two people with a good understanding of the project, preferably the project owner and an R&D Director or a Managing director.

Table 2: Cases: Name of firms and product, interview dates and name of interviewees

Firm	Product	Dato	Interviewee	Interview references
Hempel, Lyngby	Fast curing polya spartech	28-08-2012	Group Wind Power Segment Manager	Hempel I
		13-09-2012	R&D Director	Hempel II
		28-09-2012	Chief consultant	Hempel III
Liftra, Aalborg	Blade Dragon, blade installation crane	06-11-2012	Managing Director	Liftra I
		06-11-2012	Managing Engineer	Liftra II
Swire Blue Ocean	Pacific Orca, Windfarm installation vessel	08-11-2012	General Manager & Director	Swire I
Knud E. Hansen		12-11-2012	Senior Naval Architect	Swire II

Table 2 lists the 3 cases of innovative events this study focuses on: The fast curing polya spartech by Hempel, the Blade Dragon by Liftra and the Pacific Orca by Swire Blue Ocean in collaboration with the vessel designing company Knud E. Hansen.

First, the narrative part of the interviews is constructed to enable the interviewee to provide an uninterrupted narrative of the innovation project that is in focus. A second part of the interview is structured over a number of questions about the relationships to other actors in the innovation process. And for interviews with managing directors or R&D directors, a part of the interview is guided by a number of questions about the firm's internal organization and established procedures for developing new products, and about other actions the firm may use to integrate external knowledge into the firm (e.g. hiring skilled staff, licensing patents, creating strategic alliances). In this part, the interviewer faces the risk of being presented for the ideal situation instead of the reality, however, it has been aimed to ask for examples.

The interviews have been transcribed and coded in Atlas.ti. The coding process followed two approaches: An open-ended process following the issues the interviewee raised, and a more structured approach that followed the phases of the innovation process, types of actors involved and the flows of knowledge.

The interview material is analysed with regards to its time dimension. First of all the focus is on coding the different phases and sub-processes an innovation project runs through, such as idea generation, problem-solving and implementation. It is important to note that such categorization has to be flexible because each project often has its own logic, meaning the order of the phases might differ and it is not necessary that all projects run through all phases. Moreover, some phases might be repeated at a later stage and hence, should be coded as development I and development II. Second, there might be other issues related to time that influence the project, for example communicating over different time zones, impact of transportation time on decision making, etc.

The material is also analysed with regard to its spatial dimension with a strong focus on where the external knowledge origins from and how it is integrated into the product development. The different types of knowledge involved in the project are likewise analysed regarding the way (type of knowledge flow) it is integrated into the firm.

4. The wind power industry of Denmark

In this section the empirical focus of the paper is presented by introducing to the broad settings of the wind turbine industry. In particular the section stresses the process of globalization which has characterized the industry in recent decades.

Few years ago the majority of the world's production capacity of wind turbines was located in Northern Europe, with its center of gravity in Denmark. However, in 2010 the production units in Europe supplied approximately 41 % of the world's installed wind power capacity (measured in MW) while production units in China and India delivered close to 48 %. This development is a result of a rapidly globalization process, which the wind power industry experiences in these years. One of the major reasons for this trend is changes in the development of the wind power markets.

Until a decade ago the wind power industry was dominated by a handful of Danish wind turbine manufacturers. Since then the Danish wind turbine manufacturers have undergone a process of consolidation and today only Vestas is considered Danish.[1] And in parallel with this development the international competition has increased as is seen on Figure 1 showing the largest wind turbine manufactures in 2010 and their shares of the world market of installed MW wind power. Consequently, Denmark is no longer the undisputed geographical center for wind power. Today, many other regions in Europe and across the world employ significant shares of the total wind power employment.

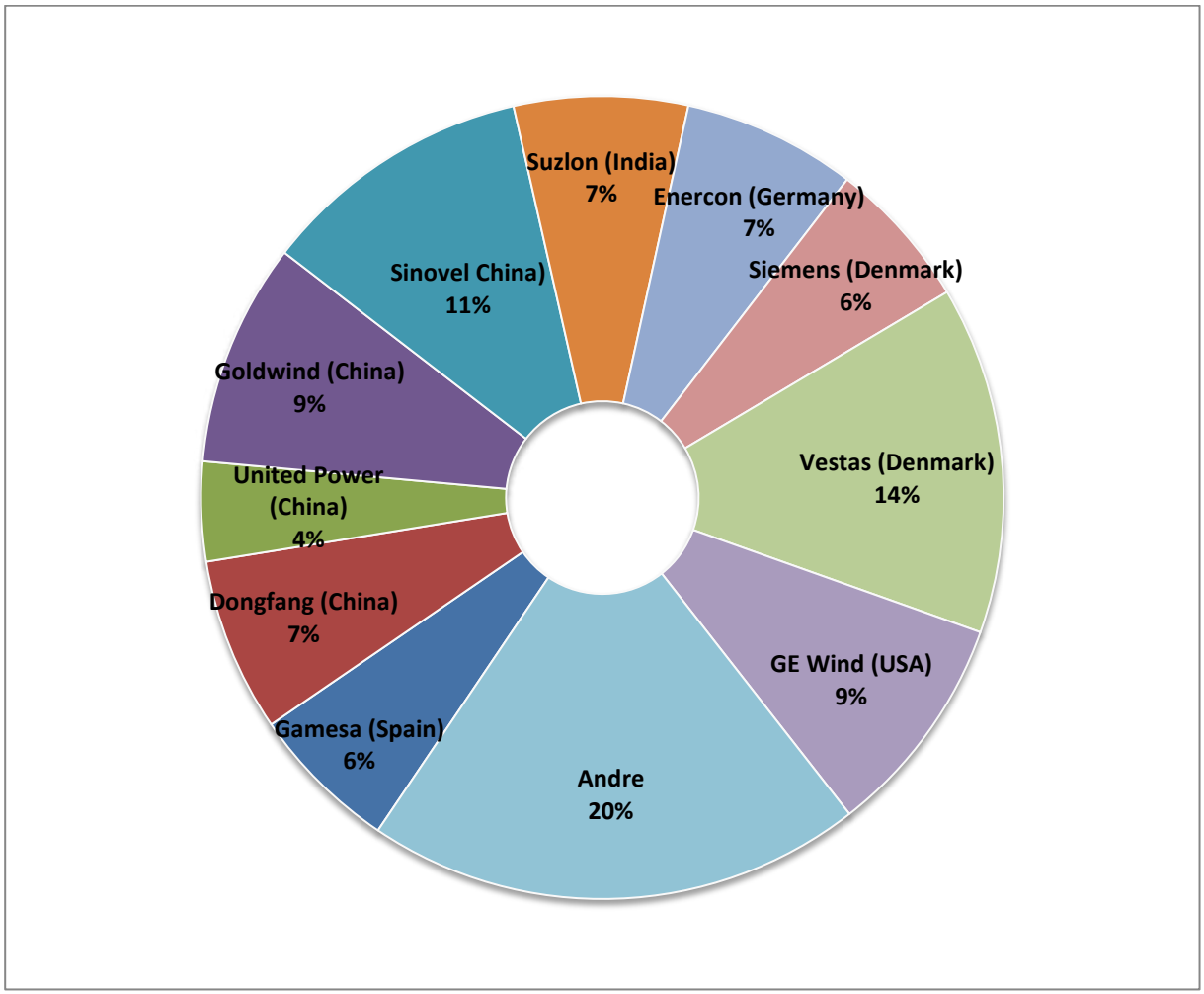

Figure 1: The largest producers of wind turbines in 2010 based on marked shares (Source: Vindmølleindustrien 2012)

[1] Siemens Wind Power has until recently also been considered Danish, since the company is based on the former Danish company Bonus Energy. However, in 2011 Siemens Wind Power moved the headquarter to Hamburg as a result of a reorganization of Siemens. Siemens Wind Power still has production sites and R&D facilities in Denmark.

This development has partly been driven by the spatial distribution of the demand for installed MW wind power, since there is a tendency that the creation of local production units follows the spatial distribution of installed MW (Vindmølleindustrien 2012). The reasons are partly casued by public provisions on local markets that prescribe a certain shares of locally manufactured components in regions where wind turbines are installed. And partly caused by the size of product units (towers, blades and rotors), which have reached a size that make it difficult and costly to transport over long distances.

Nevertheless, Denmark is still an important player in the wind power industry. In 2011 the global turnover increased to 102.8 bn. and half of the global turnover was placed in Denmark (approx. 52 bn.). The employment in the wind power industry in Denmark has been stable in the years 2009-2011 around approximately 25,000 persons. Seen over a 5 year period from 2006 to 2011 wind power related export from Denmark has increased by 8 % per year. And although the export decreased by 16.1 % from 2010 to 2011 the export from the wind power sub-suppliers increased from 2010 to 2011. These figures illustrate a situation that is characterized by Vestas' downturn but at the same time an increasing export from sub-suppliers who has succeeded in going global and reached other markets.

The globalization is driven by large manufacturers that act internationally and which have led Danish sub-suppliers to adjust to the new situation. In most cases the sub-suppliers have followed the manufacturers to the 'new' markets and have succeeded in becoming sub-suppliers for 'local' manufacturers, for example in China.

Another tendency supporting the local dynamics of the wind turbine industry in Denmark is a movement of foreign key players' relocation to the "wind power hub" of Denmark (Andersen & Drejer, 2006). Another study shows that in a survey of 107 wind power related companies more than one in four are either wholly or partly controlled by a non-Danish company (Drejer & Andersen, 2012).

Because of the strong anchoring of the wind power industry we would expect a lot of knowledge dynamics to be anchored here and less knowledge to *flow* beyond national borders. However – the international competitive challenges that the industry experiences today have made scholars recommend the industry to start looking beyond national borders in integrating new knowledge, in order to stay competitive.

ANALYSIS HAS BEEN LEFT OUT OF THIS VERSION BECAUSE THE AUTHOR AWAITS ACCEPTANCE FROM INTERVIEWEES

5. Conclusion

The reach of the conclusion is of course limited in terms of generalization because the analysis only builds on three innovation events. However the analysis produces qualitative insight into the process of innovation and has given a much more nuanced picture on the aspects of local and non-local connections in innovation processes. The literature has been much occupied with proving or disapproving the importance of local ties for innovation process. This analysis have asked a different set of questions and have consequently shed new light on how the importance of geographical proximity varies across the different phases an innovation process runs through.

One important thing the analysis points to is the importance of local buzz for the initiation of new innovation projects. The results suggest that local linkages, configured as buzz, are crucial in the early stages of generating new ideas. This is an important finding which it would be interesting to examine further in order to support a more general assumption on the role of local buzz for the generation of new ideas.

In other phases (problem-solving and implementation) geographical co-location does not play an important role, although these processes are highly dominated by collective learning processes and require face-to-face contact. In particular carrying out the development of a new product requires face-to-face contact between suppliers and sub-suppliers that can facilitate transfer of complex tacit knowledge.

The innovation biography method contributes in uncovering innovation processes and how these rely on many different configurations of spatial knowledge dynamics, including buzz, local ties and global pipelines. It is worth considering repeating studies in other types of industries, such as creative industries or more science based industries, which it could be assumed would show different patterns of interaction in innovation processes.

The findings imply that firms need to be flexible in their organization and capable to operate at different locations throughout innovation processes. At a policy level, it implies that policy should be designed to support companies working across regional and national borders.

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