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Path creation and renewal in a single industry town: the case of Verdal and the Windcluster Mid-Norway

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Introduction

Path creation and path renewal are novel concepts in studies of innovation processes and regional development and stems from the path dependency debate in the social sciences. A key argument is that new regional development paths are created on the basis of existing ones (Martin 2010), of which key mechanisms include indigenous creation, diversification, transplantation and upgrading (Martin & Sunley 2006). Entrepreneurship, and the 'mindful deviation' of strategic agents onto a new path, looms large as explanatory factor for new path creation (Garud & Karnøe 2001; Feldman & Francis 2006; Isaksen 2011). It is generally assumed that path creation has particularly poor conditions in old industrial regions. On the contrary, such regions are prone to different types of lock-in that inhibit change and novelty (Hassink & Shin 2005). A related regional 'setting' where the creation of new paths and renewal of old paths is deemed hard, is the single-industry town (Dale 2002) or area (Chapman 2005). This type of regional economy may be dominated by one large firm which surrounding firms rely for transactions, and which the region depends on for employment. Although such regions may prosper for long periods of time, they have limited heterogeneity in resources and thus have fewer ingredients that can be used to initiate new activities.

Regional economies of this kind are not hard to find, yet they continue to receive limited attention by scholars interested in regional development.

Detailed, historically informed studies of industrial and regional development, creation of new products and processes, competition between businesses and technologies and the aggregated outcome of these processes are crucial for an improved understanding of path dependent regional evolution. This is particularly the case for the 'disadvantaged' old industrial or single-industry type of region, not least because they face grand challenges in the globalized economy. Homogeneity in industrial structure and end markets means they are vulnerable to 'external shocks', such as sudden declines or intensified competition in international markets on which they rely. Nonetheless, our point of departure is that path creation, and even cluster emergence, can also take place in old industrial or single-industry regions (Menzel et al. 2010).

This paper attempts to provide novel insights into the path dependence debate by asking how a new path, here understood as the emergence of a new industry, is both potentially enabled and constrained by an old path. It is important to note that the notion of an 'old path' is not synonymous with a negative lock-in type trajectory: the 'old path' may be dynamic and subject to renewal and rejuvenation (Martin 2010). However, our interest here lies primarily in exploring the attempt to create a new path in a region typically associated with a constraining environment for innovation and initiation of new activities. We chose the unique case (Yin 2009) of the small oil and gas (O&G) specialized industry town of Verdal in Mid-Norway to study this phenomenon from a historical perspective. In the late 1960s, a major Norwegian industry corporation started developing a yard for the fabrication of steel structures to the offshore O&G industry. For almost three decades Verdal fared well and the yard grew to become a cornerstone in the region and a major industry site in Norway. However, O&G is an industry characterized by recurrent booms and busts, and failing

markets hit Verdal hard both in 1999 and 2009. The main element of the local response to the second shock (2009) was the attempt to initiate the 'Windcluster Mid-Norway' (WMN) project, and form *"the platform for a new national industrial adventure based in the market for production of wind energy (…) on the basis of Norwegian oil and gas activities"* (Interview, WMN manager, 2010). The WMN project is thus not only a strategy to diversify a vulnerable local economy, but even to create a cluster. Apart from the downturn in the O&G industry, it must also be seen in light of simultaneous hyped' expectations (Ruef & Markard 2010) for the growth in the wind energy sector both in Norway and abroad.

The following research questions are addressed: *First, what are the critical factors for transforming a single-industry town dominated by one very large company into a core of an emerging regional cluster within a different yet related industry? Second, what are the connections between the old path of offshore O&G and the new path of wind energy?* Our longitudinal case study of Verdal and the antecedents of the WMN project will shed light on processes of path dependent regional evolution under shifting conditions for new path creation. We particularly focus on the significance of exogenous shocks and the local responses that they provoked, both by firms and non-firm actors. Besides the theoretical contribution this paper makes by looking into path creation in a particular constrained context, our case study is highly relevant due to the fact that several similar Norwegian single industry regions specialized in O&G face the same kind of (recurrent) challenges. Moreover, a number of old industrial regions in Northern Europe are similarly attempting to develop new industry associated with the massive investments in offshore wind power (Dawley & Pike 2012; Fornahl et al. 2012) expected in the years ahead (EWEA 2011).

The paper is structured as follows. In the following theoretical section we focus on the path dependence/ creation debate and key mechanisms in new path creation. In the third section we briefly describe methods, before we in section four present our empirical analysis

and the 'historical paths' of O&G and the wind industry, the initiation of WMN and its successive development. In section five we discuss our findings and conclude the paper.

Theoretical perspectives on path creation

A core concept in the multi-faceted take on evolutionary theorizing in economic geography is path dependence, which points to how historical trajectories are shaped by past incidents, decisions and events (Boschma & Frenken 2006; Martin & Sunley 2006; Essletzbichler & Rigby 2007). Despite its widespread application there is no common understanding of the concept (MacKinnon et al. 2009; Martin 2012). In the 'canonical' model of path dependence, emphasis is on how actors over time become 'locked in' to particular institutional structures that inhibit the generation of novelty (Martin 2010). This view of path dependency refers to how current decision making and development opportunities are limited by decisions, events and experiences made in the past. Path dependent processes were mainly seen as constraining, and continuity was emphasized over change. As the concept was taken up by economic geographers studying local and regional economic development, this translated into a dichotomy: Regional economies were either on a successful path characterized by innovativeness and on-going renewal, or on the unsuccessful path of stagnation, decline or lock-in (cf. Hassink 2005; Karlsen 2005). Particularly, regions of the 'old industrial', 'branch plant' or single-industry' type have been seen as lacking diversified resources and innovative capacity for endogenous path renewal and creation on the one hand, and dependence on external markets and actors on the other. Consequently, a deviation to a new and more prosperous path in regions without endogenous innovative capacity would require an 'exogenous shock' of some sort (MacKinnon et al. 2009).

A non-constraining conceptualization of path dependence

Recently, however, a more nuanced perspective on path dependence has begun to emerge. The proponents of this new view argue that path dependence should be seen as enabling rather than constraining, implying that the generation of novelty is a generic feature of path dependent evolutionary processes (Martin 2010). The historical legacy of industrial development tells us that new paths may be latent in old paths. This is supported by recent empirical studies that document how the qualitative change of regional economies over time is tractable to regionally embedded knowledge genealogies (Neffke et al. 2011), and that new paths typically branch off from existing ones already present (Frenken et al. 2012) . This is captured in the notion of 'related variety' (Frenken et al. 2007), which points to the idea that neither too little nor too much diversity in regional economic structures provides beneficial conditions for knowledge spillovers and collaboration across and between sectors. The more or less strategic creation of a new path may thus be enabled by knowledge, competences, skills, and experiences inherited from previous local paths (Cooke 2010). This non-constraining perspective on path dependence views the evolution of regional economies as driven mainly by incremental change (Martin 2010), fuelled by reactive and adaptive responses by local actors to external influences (Raven et al. 2012) and emergent opportunities seized by entrepreneurs making new use of existing resources (Isaksen 2011) . However, mindful strategic reorientation may not only be an on-going process (Garud & Karnøe 2001), but also come as a response to critical incidents or shocks (Martin & Sunley 2006; Henn & Laureys 2010).

In the literature we thus recognize two contrasting perspectives on path dependent evolution: history as a *constraining structure* on the one hand, and history as a *vital heritage* on the other. In our view, path dependency should be seen as mechanisms found along a constraining-enabling continuum. In the context of regional development, this continuum

ranges from ‘locked-in declining trajectories’, which lack the dynamics of ongoing innovation and renewal, to ‘branching innovating trajectories’, in which regional assets recombine with new resources potentially leading to path creation. It is, however, crucial to note that these are never fixed but more or less dynamic, depending on a wide range of both endogenous and exogenous factors and forces. New paths on ‘old foundations’ may be created even in lagging regions. The analytical challenge is how to dissect processes of path renewal and creation that are part-and-parcel of on-going path dependent evolution.

Key mechanisms, processes and potential for path creation

A useful set of concepts for analysing path dependent evolution from a non-constraining perspective have recently been suggested by (Martin 2010). These are ‘layering’, ‘conversion’ and ‘recombination’. Although Martin’s account of these concepts is relatively brief, we find them overarching for much of the conceptual apparatus in use by economic geographers and others interested in issues such as regional development and innovation.

In the context of a local or regional economy, *layering* refers to on-going changes in the composition of the firm (and non-firm) ecosystem by firms’ entry, exit and survival. A key mechanism of layering is entrepreneurship. Entrepreneurs who reuse knowledge, competence and skills gained from practice to exploit new opportunities (Karlsen 2011) are key agents of path creation (Garud & Karnøe 2001; Feldman & Francis 2006). When developing new ventures, entrepreneurs create and attract new resources, but they also draw on the historical and regional context in which they operate (Isaksen 2011). This may particularly be true for experienced entrepreneurs who transfer skills and networks from one sector to another (new one) and thus function as cross-sectorial ‘mutation agents’ (Cooke 2010). Another important layering mechanism is spin-offing (Klepper 2007; Neffke et al. 2011), whereby routines and knowledge are transferred in an evolutionary manner from parent to offspring (Boschma & Frenken 2006). Whether in the form of employees that leave

their parent firm to start their own venture, or commercialization of R&D-based knowledge (Isaksen 2009), spin-offs spur growth and diversification of local economies and are particularly associated with clustering processes (Feldman & Braunerhjelm 2006; Klepper 2007). Spin-off firms usually have collaborative relations to their parent firm, but sooner or later they tend to develop their own markets and become entangled in other networks (Karlsen 2011). This means that spin-offs are important both for processes of specialisation and diversification, and may thus contribute to the renewal of existing paths and the creation of new ones. Another layering mechanism is inward investment or transplantation (Martin & Sunley 2006) in the form of new branch plants or takeovers of local firms, that may be attracted by certain regional assets in the form of markets, knowledge or infrastructure (Coe et al. 2008).

Conversion, the second concept introduced by Martin (2010) to the regional development discourse, refers to processes of change and innovation in firms. The extent of innovation varies greatly, but firms that do not innovate in one way or another are unlikely to survive in the long run. As spin-offs tend to diversify the regional economy, they could enhance the innovative potential as well as increase the resilience of a region to external shocks or disturbances (Pike et al. 2010). Conversion processes interact with layering processes, as when new firms employ novel technology or business organization, which in turn might have spill-over effects on established local firms. The whole gamut of local network externalities, from the skills of the local labour force to intermediaries and local supporting institutions, may then slowly coevolve with the local industrial path. Various local capabilities of conversion are captured by the concepts adaptation and adaptability (Pike et al. 2010). Whereas adaptation refers to reactive types of responses to shifting conditions, adaptability is the more proactive abilities to foresee and adjust to potential or expected

changes ahead. External shocks are sometimes needed to revitalize (or induce significant change to) introvert regional economies facing stagnation and decline.

Recombination refers to how historically developed resources and competencies may be recombined with new ones to form purposeful deviations onto new paths. Such recombinations of ingredients from different sectors are likely to result in more radical innovations (Asheim et al. 2011; Frenken et al. 2012). The relevance of this concept to this paper is obvious, as the WMN project explicitly aims at combining capabilities and experience from offshore O&G and wind energy. The processes of layering, conversion and recombination thus fuels development trajectories that are simultaneously path dependent and (potentially) path emergent and characterized largely by gradual change. It is, however, crucial to note that regional economies are often not made up of singular paths, but complex systems comprised of different firms that respond to continual competitive pressure in different ways at different rates, resulting in either continuity or change (Martin 2010). Particular development trajectories will depend on the degree of local industrial diversity and sectorial interrelatedness, and how and if sudden changes in one sector may affect another. This means that local paths could evolve 'on their own', but that there will often be several inter-linked processes of co-located industrial paths, i.e. co-evolution (Martin & Sunley 2006; Raven et al. 2012).

Path creation and cluster development in single industry contexts

This paper looks into path creation in a single-industry type regional economy dominated by one very large branch plant firm. Such organizational structures based on large vertically integrated firms are often regarded as a hindrance to the development of more varied firm ecosystems (Orsenigo 2006). Nevertheless, also typical branch-plant regions may have endogenous innovative capacity, depending not only on how the branch-plant unit is embedded in the regional economy and the nature and quality of its linkages to local or

regional sub-suppliers, specialized labour or R&D (Sæther et al. 2011), but also on the existence of entrepreneurs, firms and policy makers who strategically target or aim to develop new opportunities (Dorenkamp & Mossig 2010).

As stated in the introduction, the path creation process explored in this paper was from its initiation an attempt to create a new cluster (the 'Windcluster Mid-Norway'). Within the policy-making arena, the cluster model of regional development has exerted a particularly strong impact during the last decade and the frequency of cluster initiatives has progressively increased (Asheim et al. 2006). The cluster model can be seen as an explicit attempt to generate path renewal or path creation dynamics, also in the case were a cluster initiative is driven by the attempt to break out of or de-lock from a declining trajectory. Fromhold-Eisebith & Eisebith (2004) maintain that both top-down explicit cluster policies typically initiated by public support organizations, and bottom-up implicit cluster initiatives driven by firms, may have positive and complementary impacts on regional economic systems. Also, Wolfe & Gertler (2006) argue that government policies can play a critical role at different stages of cluster formation and growth, for instance in developing knowledge bases by providing education and funding research. Although often neglected, public policies may also be vital in terms of developing and securing access to physical infrastructure, natural resources and energy supply.

Analytical framework

To sum up our theoretical discussion, we see path dependent processes of evolution as enabling as well as constraining, and that the relative balance along the enabling-constraining continuum will depend on endogenous and exogenous factors and processes. As this paper deals with a single industry town context, our analytical framework has three focal areas. First, in grasping historical trajectories and new path creation, we apply the concepts layering, conversion and recombination to understand how the local economy develops over time. We

see these as overarching mechanisms of path evolution. Second, we investigate the role of external shocks, and postulate that they are crucial in setting in motion forces that drives development in different stages, particularly in the contexts such as our case study, i.e. regions that may lack endogenous capacity for diversification. Third, we analyse the particular reactive (adaptive) and proactive (adaptability) responses to exogenous shock, and argue that shocks and responses must be seen in tandem and that they are both context-specific and crucial for path dependent evolution and new path creation.

Research design and methodology

To empirically analyse path creation in a single industry context, we chose the case of Verdal in Mid- Norway. Verdal became an industry town in the late 1960s and has developed into one of the largest manufacturing sites in Norway, with a specialisation in O&G supply activities and one large firm as dominant employer. However, since 2009 Verdal has been the hotbed for an attempt to create an entirely new regional cluster altogether. We thus see Verdal as a unique case (Yin 2009) that may provide valuable new insights into path dependent evolution and cluster emergence in a type of context which receives limited attention in the academic literature.

The analysis leans on 21 in-depth semi-structured interviews conducted in 2010-2012, strategic documents and public reports, secondary data and participation in several local and regional industry events. The latter provided both highly valuable fly-on-the-wall observation, as well as informal discussion with a broad range of firm and non-firm representatives. Our interview informants are managers in local supply firms to the petroleum and wind energy industry, utility companies, as well as representatives from public support agencies. Our case study focuses particularly on the Verdal cornerstone company Aker, the local turbine developer Scanwind, and the local business development agency IndPro/Proneo. This is

because the strategies, activities and fortunes of these actors have critically influenced the enrolment (and disenrollment) of other actors in the attempt to create a new path.

The (co-) evolution of paths leading to Windcluster Mid-Norway

Verdal is a small industry town (see fig. 1) with approx. 8000 inhabitants within commuting distance of Trondheim, the 'technology capital' and third largest city in Norway. Agriculture and forestry dominated the region until the 1970s, but structural shifts in these sectors led to high levels of unemployment and the state responded by trying to initiate manufacturing activities (Kvarsvik 2002). In 1969 the public agency SIVA (The Industrial Development Corporation of Norway) established an 'industry growth facility' for housing a mechanic workshop at the area referred to as Ørin industry park. In 1970 this workshop was acquired by the large Norwegian manufacturing firm Aker[i]. Aker Verdal (renamed Kværner Verdal in 2011, hereafter referred to as Aker) quickly developed competencies within engineering and fabrication of steel foundation structures for the offshore O&G activities on the Norwegian continental shelf that had just begun at the time. The Aker branch plant grew to become a large vertically integrated company and the dominating employer in the area, and Verdal became a single-industry town (Karlsen 2009). Although subject to cyclical ups and downs, the period 1970-1999 was characterized by relatively steady growth.

Figure 1 Map indicating position of Verdal.

The prevailing oil path and two instances of 'shocks' to the local system

In 1999, Verdal was hit hard as low oil prices shook the O&G industry. Since O&G projects are highly capital intensive and demand certain resource price levels to pay off, sudden drops in oil prices result in projects being put on hold or cancelled. This exogenous shock (S1) triggered several local responses of the kind referred to as adaptations (Pike et al. 2010). The

Aker parent company responded (R1) reactively by restructuring its portfolio of plants in Norway and abroad to focus on certain core functions or competences, typical for the vertical disintegration corporate strategies that were popular at the time. At Aker Verdal, 400 employees lost their job, a major shock for the local community. In 2000, 5 subsidiaries were formed, of which 4 in mechanical engineering. Encouraged by the Aker management, a group of workers in inspection services also left to form a new firm. All of these new firms are fully or partly owned by Aker and have the parent firm as main customer. Following the restructuring of Aker there were also several independent start-ups locally, mostly within industrial services, mechanical workshops and so on. Studies done shortly after the restructuring process in 1999/2000 found that most of the newly established firms in the region were formed by previous Aker employees (Opheim 2002).

Verdal Municipality, in close cooperation with Aker, responded by applying for a restructuring program (RP) from central government to reduce the negative effects of plant downsizing to help revitalize the local economy. RPs are a policy instrument for municipalities and regions facing major challenges and significant decline in employment and/or population, and are jointly funded by the state, county and municipal levels and locally administered (Carlsson et al. 2013). The state approved the application and granted Verdal with an RP than ran from 2002-2008. The public-private development agency IndPro was set up to manage the Verdal RP. The programme had several elements (see Finne et al. 2008), but three were adaptive responses (R1) to the troubles at Aker and influenced subsequent industry path development. First, a comprehensive training programme aimed both at laid-off workers, workers at the Aker plant, and individuals who left to work in spin-offs or other new firms. Second, to stimulate the diversification of the local economy by providing entrepreneurial support and by attracting new (external) firms to the Ørin industry area. The third element was to develop the infrastructure at Ørin to facilitate new ventures. A key strength for IndPro

was that they could use several empty buildings abandoned by Aker as enticements in its acquisition strategies. Many of our informants also emphasize the (symbolic) act on Aker's behalf to take down a massive fence that circumscribed its manufacturing site. The cornerstone, which historically had been introvert, thus 'opened up' to the wider local community.

The efforts of the RP project to upgrade the local knowledge base and diversify the local firm population by both entrepreneur support and acquisition strategies paid off. When the restructuring process began in 1999, there were approx. 50 firms with 1700 employees at Ørin, of which 1000 worked at Aker. By 2004, 30 new firms (including Aker spin-offs, local start-ups, external start-ups) with a total of 200 employees, were established on the area previously used by Aker. The Aker spin-offs continued to rely on the parent company as their main customer, but many gradually started serving other sectors as well. The other new firms were mostly suppliers to the existing larger firms, tertiary sector service providers, and processing and manufacturers within agro-business, construction and a budding wind energy industry.

Although the RP has been evaluated as successful, it is crucial to note that the O&G industry boomed again in 2002, coinciding with the start of the RP, to the great relief of Aker as well as other O&G supply firms in the region. In retrospect, this phase can be described as a path renewal process. For instance, the continued success of Aker as an O&G supplier has been attributed in part to the skills upgrading that the learning processes of the RP contributed to (Interview, Aker 2010). These training courses focused on project management and certification in welding, inspection, mechanics and so on, resulting in many workers both at Aker and in other firms becoming multi-skilled. By 2009, Ørin was populated by more than 150 firms with a total of approx. 3000 permanent employees, of which 650 at Aker. Ørin had grown to become one of the three largest industry sites in Norway (Roel 2012).

Within a decade, the economic structure of Verdal had thus changed substantially. In addition, the organisation set up to administer the RP had developed and professionalized into an industrial business development agency that became a model for similar policy initiatives many other places in Norway (Finne et al. 2008). Through processes of layering and conversion (Martin 2010) leading to diversification and development of new local and external markets, Verdal's industrial heterogeneity and diversity increased. This compositional change in the local firm (and institutional) ecosystem should also change its potential for adaptation and adaptability in the face of new challenges (Dawley et al. 2010).

For soon, just as the RP was in its final stage, Verdal faced a second shock (S2). The 2008 (and onwards) financial crisis led to a new cyclical downturn and 'crisis' situation in 2009 (OED 2011). Aker suddenly (again) had no orders, and just as in 1999 workers were laid off, and the downturn was also soon felt by sub-suppliers. A key informant in the municipality states that *"in 2009, the situation was similar to the situation in 1999, at least in terms of pessimism. I mean, we do have a more robust structure here now, but it's not like Aker doesn't matter."* Despite the local diversification in preceding years, the response to Aker's difficulties was that the prospects of the entire town looked bleak, indicating that Aker still was (or was at least considered as) the cornerstone company of the local community.

However, the 2009 response (R2) by both firms and local authorities was more proactive than the 1999 response (R1). From local government, R2 included development of infrastructure to promote new ventures and to facilitate sectorial agglomeration of existing firms. But the most important feature of the recent (and still ongoing) R2 is its focus on developing inter-firm networks and extra-local linkages to new markets and knowledge sources, specifically the 'Windcluster Mid-Norway' (WMN) project. This project aimed at developing a wind energy related cluster, with an initial focus on the emerging offshore wind market. This explicit cluster strategy can in part be attributed to the hegemonic position

cluster strategies have attained over the last decade (Asheim et al. 2006) , also in the Norwegian policy context, but the cluster strategy hinged on having a certain set of firms and other actors locally and regionally that could be 'networked' together. Amongst these were both cornerstone Aker and several 'new firms' that had been established at Ørin after the 1999 shock, as well as large national research and learning institutions located in the region. However, before elucidating the results of these efforts, we must travel back in time and trace the more discrete regional path of the wind energy industry.

Figure 2 (Co-)evolving paths in Verdal and Mid-Norway

The marginal wind path and Windcluster Mid-Norway initiative

Due to lacking incentives, wind energy, which has been the fastest growing renewable energy technology in the world for several decades (EWEA 2011), plays a limited role in Norway's energy system (Borup et al. 2008). However, wind energy does have a relatively strong standing in the region of Mid-Norway where Verdal is located. Norway's first wind turbines were installed in Mid-Norway in the early 1980s, and by 2010 the region had 75% (amounting to 435 MW) of national installed wind energy capacity. The region also has two wind test sites and much of Norwegian wind energy-related technology development and R&D is carried out at the Norwegian University of Science and Technology (NTNU) and the affiliated research institute SINTEF in Trondheim. Most of the few Norwegian R&D spin-off firms focusing on wind energy stem from NTNU/SINTEF and are located in the region of Mid-Norway. During the 1990s and 2000s there were multiple wind research projects at these institutions, and in 2003 the NOWITECH offshore wind research project was established with NTNU/SINTEF as core actors in a network of national and international firms and R&D institutions.

Towards the end of the 2000s, market expectations for onshore wind energy grew in Norway as the energy sector awaited the implementation of a joint subsidy 'Green certificate scheme' (GCS)[ii] for new renewable energy with Sweden that would provide the necessary subsidies to realize wind farms and other energy projects with marginal profitability. In Norway, no regions have had more ambitious plans for developing wind power than the counties in Mid-Norway. Large investments are expected both in wind parks (onshore) in the region as well as in grids. In addition, the ambitious plans for offshore wind, particularly in German and UK waters (Rutten & Boekema 2012) has attracted the interest of firms from the Norwegian petro-maritime industry looking for new markets. This potential seemed relevant indeed when the shock of 2009 led O&G sector firms not only from Verdal but across Norway to strategically explore opportunities in the fast growing offshore wind sector (Hansen & Steen 2011).

The five actors that initiated WMN in 2009 were Aker, regional energy utility company NTE, local turbine developer Scanwind, petroleum supplier network LOG/Navitas (regional/national in scope), and NOWITECH. Proneo, the local business development agency that had evolved from IndPro, has acted as operational management of WMN and been a key player since the setup. Initially, WMN was a regional development project called 'Arena Vindenergi' financed by public bodies SIVA, Innovation Norway and the Research Council of Norway. In terms of gaining state support, the R1 from local actors was to apply for a restructuring programme. In R2 the local strategy was to apply for an 'Arena' programme. These are financed for typically 3 years, and aim to increase value creation in regional business environments. This external state funding was crucial for the cluster project to be launched (Interview, Proneo 2011), and it is thus evident that the top down strategy of cluster creation in this case fitted with the bottom up aspirations at Verdal, a topic discussed on a general level by Fromhold-Eisebith and Eisebith (2004).

The main actors of the Windcluster initiative

Scanwind is one of few wind turbine developers that have been established in Norway. The firm was founded by an entrepreneur who had previously worked on wind energy in a large engineering firm in Oslo. His idea was to start a new firm that would focus on developing large turbines that could operate in rough environments such as offshore and coastal Norway. It was both chance and strategic action (cf. Menzel et al. 2010) that Scanwind's establishment at Verdal coincided with the troubles at Aker Verdal in 1999. One reason why Scanwind chose Verdal was that investment incentives were provided, such as being allowed to use a production hall that had been abandoned by Aker. But Scanwind also needed investors to provide capital for technology development, and managed to attract investment capital from the regional utility company NTE. NTE had started developing wind farm projects early in the 1990s, but had experienced substantial problems with turbines that did not handle the harsh conditions of coastal Norway, and were on the outlook for robust technology. Between 2003 and 2010, 15 different Scanwind turbine models were developed and tested, and the technology reached the stage of commercialization (Interview, former Scanwind employees 2011/2012). This required new financial capital, and on the eve of the financial crisis, NTE sold a major share of Scanwind to a Swedish investment company. However, this company was severely hit by the financial turmoil and had to bail out of Scanwind. Then, in 2010, Scanwind was acquired by US industry giant General Electric (GE).

Towards the end of the 2000s GE recognized the strong growth and high expectations for the offshore wind market, but had not been successful in developing an offshore turbine in-house. According to one of our informants (Interview, WMN 2010)*"GE screened the entire world for technology that they could use offshore, and ended up buying Scanwind in 2009."* The crucial question for the region was if GE would simply take the technology and leave, or if they planned to develop manufacturing and/or test facilities in Verdal.

Considerable resources were spent on acquisition, particularly by local business develop agency Proneo, but also by local and regional politicians, and even from the Norwegian government. The managing director of WMN (Interview, 2011) explains that *"the project manager (Proneo) has long experience from restructuring work and knew which buttons to push. But there was also a general belief that this could become something big."* Our informant in Verdal municipality (Interview, 2010) explains that *"GEs strategies are based on doing fabrication close to the market. Distance to market was a weak point here, but we emphasized that the required infrastructure was here already, they wouldn't need to make investments."*

The GE acquisition game was being played out in 2009, exactly "*at the same time as it looked pretty bad at Aker"* (Interview, WMN 2010), which also coincided with upcoming Norwegian parliamentary elections. When visiting the Labour Party (LP) stronghold Verdal, LP Minister of Trade Sylvia Brustad promised 200 million NOK to SIVA for investments in infrastructure for development of the wind industry at Verdal. This contributed to GEs decision to establish a branch plant at Verdal, on the former Scanwind (Aker) site. A strong point for Verdal was, however, the proximity to the R&D community (SINTEF, NTNU and later NOWITECH) in Trondheim. The marketing of these assets and the potential for deepening R&D connections was part of the strategy of attracting GE to Verdal. The local unit, through this acquisition, was thus integrated as a strategic element in an international corporate structure. Such acquisitions provides possible access to extra-local networks and resources, implying that the GE takeover must be categorised as a case of transplantation (Martin & Sunley 2006).

From the 'wind side', the initiators of the Windcluster Mid-Norway project were NTE, Scanwind and NOWITECH. From the 'O&G side' the co-founders were Verdal cornerstone Aker and the O&G supply network LOG/Navitas. For LOG, the motivation to explore

offshore wind as a new but 'related' market in which member firms could transfer their capabilities was triggered by anticipated decline of O&G (Interview, Intpow 2012). Already in 2004, Aker had started exploring the offshore wind market. This market diversification strategy was a response to the long-term challenges of uneven demand and activity in O&G (Interview, Aker 2010).

Aker's strategy was to draw on their in-house engineering and design knowledge and experience the firm had developed in O&G since the early 1970s. However, an important precondition for venturing into offshore wind was that they also had infrastructure (yard, equipment, harbour etc.) that could be used for offshore wind activities, importantly without large investments. The opportunity to make new use of established physical infrastructure at Verdal, coupled with firm specific product and process knowledge is frequently mentioned when firms are asked why they opt for the wind energy industry.

Regarding Aker, it also appears that a relatively flat organizational structure with short organizational distances between designers, engineers and operators, and a multi-skilled labour force, the latter a direct result of the skills upgrading programs of the 1999 restructuring and subsequent HR strategies, was an important factor for the strategic diversification decision. In 2007 Aker won its first offshore wind fabrication contract for 6 tripod foundations for a German offshore wind demonstration project. This contract was used to *"gain knowledge of the industry and the market"* (Interview, Aker 2010). Key personnel from Aker also made several trips to potential customers in UK and Germany as part of this learning process. In 2011 Aker won its first EPC (engineering, procurement and construction) contract for delivery of 49 steel jacket foundations for a German offshore wind farm.

For the development of the regional wind path, an important spill¨-over effect of both Aker's involvement in offshore wind and the Scanwind-NTE turbine technology development endeavour was that sub-suppliers and other firms in the region were enrolled into the wind

energy industry. Local firms thus developed wind-specific capabilities, for instance in installation, operation and maintenance. Many of these emphasize the ability to reuse existing resources by supplying other firms who venture into the new market of wind. A manager explains that: "*Our infrastructure and equipment is ideal for wind related foundation and tower products. We have big cranes, lots of space, access to harbour and all that, and that there are firms here chasing the market, just outside our walls."* (Interview, Spenncon 2011). This also serves as an important reminder that the hard and practical stuff of infrastructure, natural resources and logistics plays an important part in industrial development, in addition to the (perhaps) overemphasized assets of creativity and soft networks. There were also other start-ups of wind-dedicated firms or projects, particularly in the period following the Scanwind takeover by GE and Akers success on the international offshore wind market.

Windcluster Mid-Norway as a strategy of recombination

Since the initiation in 2009, Windcluster Mid-Norway (WMN) has grown and currently has 65 members ranging from very large utility firms and main suppliers to O&G sector to a range of smaller sub-suppliers. Its members offer services and products across the entire value chain of wind power, both to the onshore and offshore market. Generally, firms based in petro-maritime industries focus on the offshore segment, whereas firms used to working onshore focus more on that market segment. WMN has been an active organization focused on establishing seminars, conferences and workshops for knowledge sharing and development of joint research and collaboration projects. Many firm managers assert that the networking effects of these initiatives have been positive and emphasize the benefits of being supplied with information about potential markets and projects, customers and suppliers. Proneo/WMN thus functions as a knowledge broker and cluster facilitator, which according to our firm informants is particularly important given the uncertain and unfamiliar market of wind.

In times of shifting and uncertain expectations about both wind and more traditional markets, the activities of WMN also seem to contribute to firms being 'tuned' to the wind industry, although it is clear that the level of engagement varies considerably. Paradoxically, rather modest levels of engagement are now characteristic of some of the founding WMN partners. In 2011 General Electric (GE) left Verdal, allegedly due to slower than expected growth of the offshore wind market in Northern Europe. In 2012, Aker recently announced that they will not opt for new offshore wind contracts (Stromsta 2012), mainly due to the large offshore wind farm project turning into a financial mess. However, another, and perhaps equally or more important reason for Aker's withdrawal from offshore wind, is that O&G boomed again after several major resource discoveries in 2011 and 2012, and Aker has since won several new O&G contracts.

At the same time many Norwegian firms targeting the offshore wind market struggled to enter it (see also Steen & Hansen in press). According to an informant at Aker (Interview, 2012), *"we have more than enough to do in our traditional market"*. Interest in the wind market from members of the O&G supply network LOG has also dropped considerably since 2009 (Interview, previous LOG employee, 2012), and it thus seems that Aker and other O&G sector firms in the region mirror other Norwegian O&G sector firms (Hansen & Steen 2011) in the sense that they seem to be in a O&G 'market lock-in'. It thus appears that short-term profits in a familiar sector receive resources and attention on behalf of more risky investments in an unfamiliar sector. The 'withdrawal' from offshore wind by Aker has a ripple effect with local sub-suppliers who leave that sector when their customer does. The self-reinforcing dynamics involved in the stage from cluster emergence to cluster growth (Menzel et al. 2010; Isaksen 2011) have thus seemingly been hampered by the withdrawal of Aker from the wind energy market, and GE from Verdal.

A key challenge for the attempt to create a 'wind path' has been the lack of a home market, both onshore and offshore (Hansen & Steen 2011). The green certificate scheme (GCS) should, however, give impetus to domestic onshore wind farm development, but will not affect the deployment rate of offshore turbines in Norwegian waters. These relative changes in respective market opportunities turning the lead organisations more reluctant to offshore wind, have led to changes in the WMN strategies. Although there are local and regional firms dedicated to both offshore and onshore wind, a deliberate inclusion of extra local/regional firms has taken place since the early cluster initiative. Also, in April 2013, WMN changed its name to 'Windcluster Norway' to better reflect both the geographical extent of both members and activity[iii]. This rescaling strategy can be seen as a response to the lack of local driving forces combined with external interests in the cluster collaboration.

WMN has nevertheless focused on supply network development and managed to maintain a high activity level. The support over the Arena program was also prolonged in 2012. Several projects have been initiated to promote members as suppliers for offshore wind farm projects abroad and to stimulate them to collaborate with R&D institutions, the latter done in cooperation with NOWITECH. Also, a new firm InTurbine was established on the remnants of Scanwind and GE, and recently acquired by a major Norwegian industry firm (Kongsberg) which has launched ambitious plans for taking part in the offshore wind market. In addition, the Scanwind entrepreneur set up a new turbine firm Blaaster which is currently developing its first pilots. In other words, important capabilities developed since the start of the wind energy activities in the region have been 'passed on' by labour mobility, i.e. key personnel moving to new firms (layering) and established firms with new activities (conversion). Nonetheless, the momentum required for a new regional cluster to emerge, as the WMN project initially set out to achieve, is currently difficult to gain sight of.

Concluding discussion

This paper set out to bring some new insights into the path dependency/path creation debate by investigating the development of old and new paths in the context of an offshore O&G specialised single-industry town, Verdal in Mid-Norway. Following two consecutive 'busts' in the O&G sector, as well as more incremental development processes, the town became the birthplace of an initiative to create a new path of wind energy related activities by rebundling capabilities from O&G and wind energy.

In this unique case for exploring path creation in a particular constraining environment, we first addressed a concrete research question: What are the critical factors for transforming a single-industry town dominated by one very large company into a core of an emerging regional cluster within a different yet related industry? Inspired by recent suggestions from Ron Martin (2010) on how to analytically disentangle on-going processes of evolution, this paper looked into processes of layering (changing composition of firm and non-firm actors as well as other assets), conversion (innovation and change in organizations) and recombination (more 'radical' or novel combinations of existing and new knowledge and other assets). Our historical analysis has revealed that two 'external shocks' (S1 & S2), which both challenged the local cornerstone company and its sub-suppliers, are pivotal elements in the transformation from single-industry town to (potential) cluster core. The external shock to the single industry town of Verdal in 1999 (S1) triggered responses (R1) that led to vertical disintegration of the local cornerstone, general diversification through entrepreneurship, spin-offs and inward investment, as well as upgrading of skills and infrastructure. These processes of layering and associated conversion led to a gradual diversification of the local economy, and can be seen as a case of path renewal in the sense that the old path was revitalized and strengthened. Verdal developed capabilities that enabled it to adapt to new challenges in new and more proactive ways. The 2009 shock (S2) to the then more heterogeneous firm

ecosystem in Verdal in 2009 was followed by more proactive responses (R2) by various firm and non-firm actors to combine new and previously unconnected elements from offshore O&G and the (electric) energy sector in an explicit attempt to create a new industrial path. It should however be noted that as of June 2013, this path creation attempt has yet to materialize in the regional economy of Verdal in any proper sense, and the 'cluster initiative' has been subject to a rescaling to the national level.

A second research question addressed was: What are the connections between the old path of offshore O&G and the new path of offshore wind energy? The consequences of R1 were critical in that they established the local preconditions for the 'new path creation' R2. However, these connections are not straight forward, but rather quite complex and contradictory. On the one hand the strategy of recombination rests on the deliberate reuse of infrastructure, competences, skill, expertise and experiences acquired over three decades of operations in the O&G sector. On the other hand this strategy is challenged by industry cycles that do not follow linear industry trajectories, as suggested in the literature on industry life cycles. On the contrary they are more cyclical, fuelling recurrent booms and busts. O&G actors in Verdal are typical for their sector in that their interest in offshore wind largely depends on the activity level in their traditional market. This may hamper a continual building of competence, skills and networks, necessary for competing in this novel, but fast growing sector in neighbouring countries. Nonetheless, an effect of the path creation attempt in offshore wind can also be seen as having contributed to path renewal of the old O&G path, as new knowledge and connections have been developed.

Based on the above summary of our analysis, two important lessons can be drawn from this paper. First, the importance of exogenous shocks implies that we should think of path creation and path renewal in single industry towns as a transformation through critical stages (cf. MacKinnon et al. 2009). Provided they are met by adaptive responses, exogenous

shocks can spur activities that lead to upgrading and diversity. Such a model departs from the non-constraining model of continual endogenous change proposed by Martin (2010), primarily because single industry environments *a priori* lack the Jacobian diversity (Cooke 2010) required for endogenous change. The second lesson is that adaptive capacity must be nurtured not only in firms, but also in business support agencies, and that top down policy measures can be vital to aid bottom up initiatives.

Our case has a relevant parallel in Fornahl et al.'s (2012) investigation of whether or not assets from the old industry of shipbuilding in Northern Germany have been reused in the rapidly growing German offshore wind sector. They conclude that resource transfer is fairly limited, but that offshore wind indirectly has had a revitalizing effect on the shipbuilding industry, which has been declining for several decades, for instance in demand for specialized vessels. Even if both regions are characterized by mature industries, the case of Verdal differs crucially in that the 'old path' is thriving (at the moment) and not declining as in the maritime regions of Northern Germany. O&G is a sector particularly characterized by cycles of booms and busts. These two contrasting market conditions imply that path creation in old industrial regions is not directly comparable with path creation in single industry towns. The opportunities for path renewal and new path creation will rather depend on how a single industry town is embedded in wider systems of production and endogenous capacity to initiate change (cf. Coe et al. 2008). However, to more fully understand processes of path creation in 'single industry' or 'old industrial' type regions, comparative research from evolutionary/relational perspectives is needed. From our perspective, such research endeavours must be sensitive to connections between different co-located paths and how these may be mutually influential.

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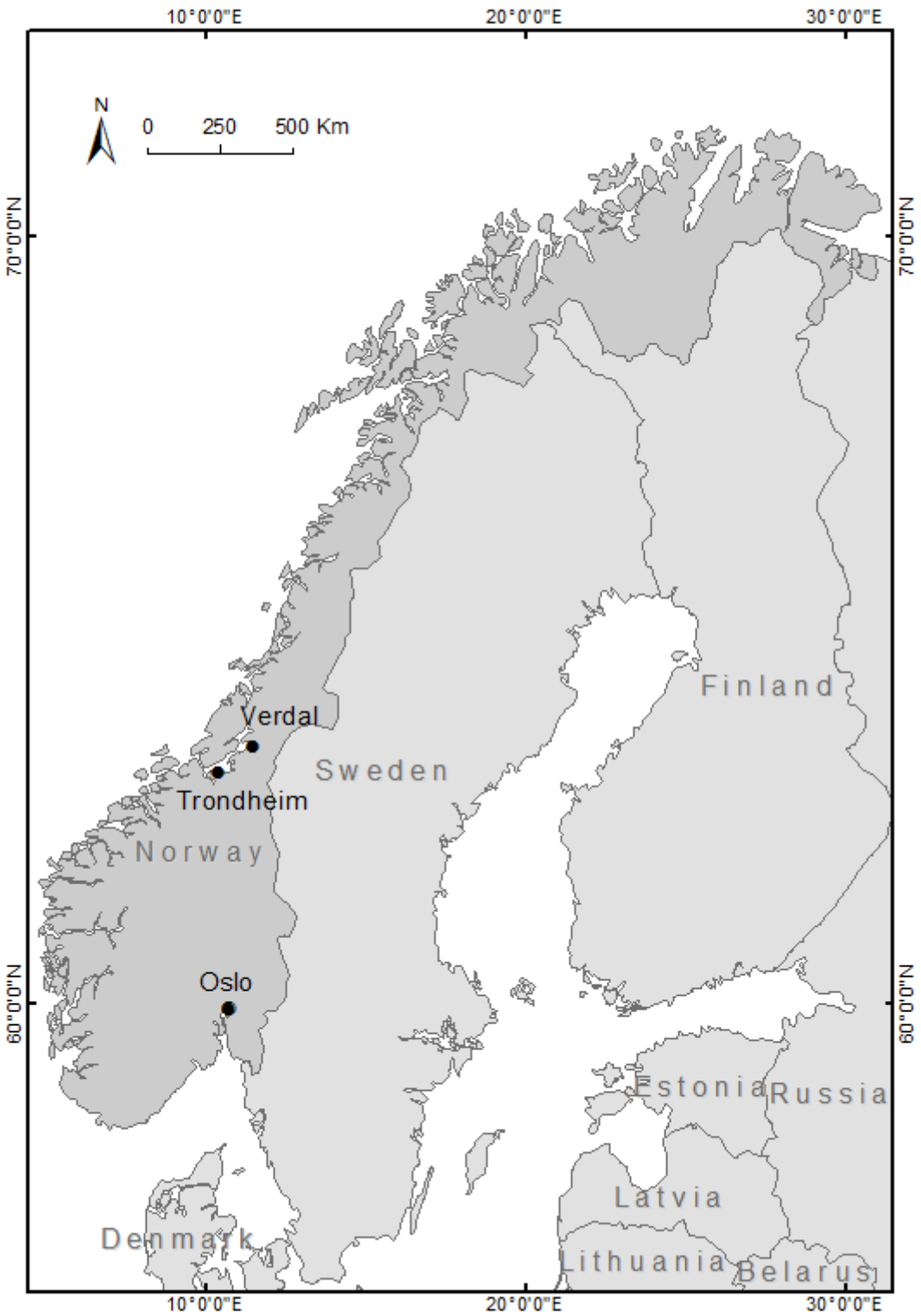
[i] Aker, now an investment company and major shareholder in Kværner of which the plant in Verdal is a business unit, was established in 1841 and traces its roots back to different activities dating to the start of the industrial revolution in the 18th century.

[ii] The Norwegian-Swedish joint 'green certificate scheme' (GCS) was implemented in January 2012 following many years of planning and discussion. The GCS is a technology-neutral, market-based support scheme which will last until 2035. The aim is to trigger 26.4 TWh of new renewable energy production in the two countries.

[iii] See: http://www.vindkraftnytt.no/nyheter-1/windcluster-mid-norway-blir-windcluster-norway.aspx?Action=1&M=NewsV2&PID=1150 (accessed 5 June 2013).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Sweden
Finland
Oslo
Estonia
Russia
Latvia
Denmark
Lithuania
Belarus

The Verdal oil and Mid-Norway wind paths