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Competitive firms in thin regions in Norway: The importance of workplace learning

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The article departs from empirical studies of two competitive firms in an organisationally thin region in Norway. The main question in the article is how these firms have achieved global competitiveness. The article focuses its inquiry on how the firms organise their innovation activity, giving special attention to the firms' organisational learning and absorptive capacity. It is found that find that workplace learning enables the firms to utilise knowledge in uncommon ways. The learning rests on specific organisational traits in the firms, such as broad participation, long-term on-the-job training, the use of practice-based knowledge in innovation projects, and links to national and global knowledge sources. The characteristics of thin regions indicate that these traits make up a generally applicable strategy in such regions.

Keywords: *global competitiveness, innovation activity, organisationally thin regions, workplace learning*

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Introduction

In this article we argue that firms in thin regions depend on workplace learning in order to be competitive. Their location suggests that they cannot rely on local resources outside the firm to the same degree as firms in core regions. Our focus on workplace learning parallels recent contributions to the literature. Ekman et al. (2011) point to the organisation of innovation and learning processes both at the firm level and within the sociocultural and institutional structures of Nordic societies – which stimulate broad participation – as important factors behind the strong economic performances of Nordic countries. On the basis of extensive European data, Lorenz (2011) reveals that Norway, Denmark, and Sweden (and the Netherlands) have a comparatively high number of learning organisations. These are characterised by variations in tasks, decentralisation of responsibilities and decisions, opportunities for use of initiative on the shop floor, and integration of learning and changes in work. Gustavsen (2011) refers to this type of organisation as the good work that was largely developed through the Nordic collaborative model and as a response to the previous emphasis on Fordist work organisations. The learning work organisation enables greater use of employees' expertise, experience, and initiative in innovation processes. In addition, egalitarian welfare societies contribute to trust and knowledge flow within and between organisations, which also stimulates innovation processes. Lundvall & Lorenz (2012) thus maintain that high levels of social capital and trust in the Nordic countries trigger incremental innovations, high productivity, and job growth in these countries.

The above-mentioned macro-studies demonstrate that workplace learning matters for firms' competitiveness and that this learning is linked to characteristics of Nordic societies, such as cultural factors, institutional structures, social capital, and trust. However, the studies lack a geographical approach beyond the national level, which is important because subnational regions differ in ways that affect workplace learning. This is where economic geography can contribute with theoretical knowledge about regions and regional innovation systems, such as Tödtling & Trippl's (2005) typologies for organisational characteristics of regional innovation systems. In this article we use our concept 'thin region' to denote regions in which the regional innovation system is organisationally thin (Tödtling & Trippl 2005). A thin region has either no or weakly developed industrial clusters and a weak endowment of knowledge generation and diffusion organisations. These characteristics lead to little local knowledge exchange and little innovation activity based on regional resources. Many earlier studies have focused on organisationally thick regions, such as regional clusters, where firms can to some extent base their innovation activity on nearby external expertise and other resources (Porter 1998).

We aim to improve current understanding of the role that the organisation of innovation activity and improvement work in firms located in thin regions has in the firms' competitive strength. Hence, our unit of analysis is the firm level, specifically workplace learning in firms. However, we also combine analyses at the firm level and the system level (conceptualised as an organisationally thin regional innovation system). Our research question is: How do firms located in a thin Norwegian region achieve competitiveness through their workplace learning practice? In the following theoretical section we explore the concept of workplace learning in more depth and in the context section we discuss the region and the case-study firms.

Organisational learning and economic geography

In this section we present and discuss concepts that are used in the case analyses. The theoretical framework lies in the intersection between economic geography and the organisational learning literature, with an emphasis on the latter, since the unit of analysis is the firm level.

Widely defined, innovations are the only long-term, sustainable growth alternative for developed, high-cost economies. In an increasingly global economy, firms in such countries cannot compete on low costs; they need to have differentiated products, high productivity, and smart organisation (i.e. they need to be innovative). Innovation activity is mainly based on three factors (Edquist 2005). First, firms have to build some unique internal competence and capability, which means the organisation of knowledge and learning processes inside firms is of vital importance. Second, firms have to bring in external complementary knowledge, as innovation activity is an interactive and dynamic process carried out within a fairly stable network of private and public actors (Lundvall 2007). Third, innovation activity is stimulated and hampered by 'the wider setting' (Edquist 2005), such as rules and regulations, market development, technological advances, and institutions (in the meaning of 'rules of the game'). We address all three factors: what goes on inside innovative firms and in innovation networks, how they are influenced by being in a thin region, and the 'Nordic learning organisation model'.

Knowledge linkages

Within economic geography and the innovation system approach, the type and geography of knowledge linkages have been intensely discussed (Keeble 2000; Gertler & Wolfe 2004; Maskell et al. 2006; Trippl et al. 2009). The innovation system approach builds upon the fact that innovative firms have to develop unique competences and that they acquire external supplementary competence and are stimulated and hampered by external conditions. One outcome of the discussion is a more nuanced perspective on knowledge linkages, such as the distinction between static information transfer (e.g. codified text through books and the Internet) and dynamic learning processes within and between organisations. However, the discussion to date has not involved a clear-cut distinction between different types of internal and external knowledge and how these types are combined in innovation processes. We therefore present the discussions in the organisational learning literature about knowledge as a social phenomenon and about organisational learning and absorptive capacity.

Knowledge as a social phenomenon

Becker-Ritterspach (2006) criticises the flow-of-knowledge approach for treating knowledge for having liquid-like properties, wherein the characteristics of pipelines and storage facilities determine the flows. From this perspective, knowledge is treated as an asset that can easily be transferred, ignoring the social nature and embedded character of knowledge. New streams of research have emerged, which take into account the situated and embedded nature of knowledge. First, research has demonstrated that knowledge is a social phenomenon in which practice underlies innovation. A practice-based orientation has been supported by Lave & Wenger (1991), who identify 'communities-of-practice' as the place where work and learning happen in a firm. Brown & Duguid (1991) develop this concept in a business context and suggest there is a need for working, learning, and innovating to be unified in organisations. It is through communities-of-practice that knowledge is used and created.

Another research stream examines knowledge in problem-solving groups and recognises that solving increasingly complex problems requires the ability to combine the knowledge held by individuals with diverse perspectives. In this approach, knowledge needs to be used in practice in order to solve novel problems through interactions between individuals. In an ethnographic study of the work involved in the production of a new product, Bechky (2003) suggests that knowledge-sharing among individuals, communities, or organisations can be looked upon as a process of knowledge transformation. Misunderstandings are avoided by developing a common ground, on the basis of which it is possible to create a richer understanding of the product and the specific problems. Hence, knowledge is not shared through transfer but rather through a process of transformation.

Hargadon & Bechky's (2006) study of creative problem-solving indicates a shift from a focus on the individual to a focus on the interactions within a collective. The logic behind this shift can be traced to the increasing complexity of problems, which requires solutions that combine the knowledge, efforts, and abilities of people with diverse perspectives. Ethnographic data are used to understand moments when collective creativity has occurred and suggests that it occurs 'when social interactions between individuals trigger new interpretations and new discoveries of distant analogies that the individuals involved, thinking alone, could not have generated' (Hargadon & Bechky 2006, 489). Creative problem-solving is thus a social process, in which problems are solved by pooling the knowledge of diverse people.

In sum, the above-described research shows that knowledge is a social phenomenon and that practice and collaboration underlie innovation and organisational learning. Recognising the social phenomenon of knowledge means that we do not necessarily know how the innovation process will be adapted in each situation.

Organisational learning and knowledge sourcing

The complementary literature on organisational learning is comprehensive, and has paid particular attention to organisations' ability to learn. Organisational learning is seen as a means to achieve strategic renewal at the firm level. Learning processes are regarded as being of utmost importance for firms' innovation activity and performance, and knowledge is seen as the most important way for firms to gain competitive advantage (Barney 1991; Shan & Harry 1998). In this article we define organisational learning as 'the process of improving actions through better knowledge and understanding' (Fiol & Lyles 1985, 803). Organisational knowledge is a result of common experiences and knowledge-sharing activities between the members of an organisation (Lave & Wenger 1991), and can be codified, for example in documents describing the shared routines of an organisation (Zollo & Winter 2002). Knowledge-sharing activities are what usually differentiate organisational learning from individual learning.

The main approaches in the organisational learning literature are supplemented by innovation research in which a central finding is that firms seldom innovate in isolation (Fagerberg et al. 2005, 180). This means that firms should, through their knowledge linkages, be able to find new external knowledge and apply this knowledge in their organisation. Access to external knowledge is an important but insufficient condition

for organisational learning and innovation. Absorptive capacity concerns an organisation's relationship with new external knowledge (Todorova & Durisin 2007). In this article we use absorptive capacity to discuss how external knowledge can be absorbed in firms' internal organisational learning processes to create innovations. When absorptive capacity is important, developing and maintaining it becomes 'critical to a firm's long-term survival and success because absorptive capacity can reinforce, complement, or refocus the firm's knowledge base' (Lane et al. 2006, 833). When the idea of absorptive capacity was developed it consisted of three key components: (1) recognising the value of new knowledge; (2) assimilating that knowledge; and (3) applying knowledge for commercial ends (Cohen & Levinthal 1989; 1990). Cohen & Levinthal state that a firm's absorptive capacity depends on the knowledge source and existing knowledge within the firm.

A firm's ability to identify and assimilate new external knowledge thus depends on the knowledge a firm already has and its organisational structure. The new external knowledge needs to match the internal knowledge in the firm and the company should pay attention to assimilating the new knowledge (Zahra & George 2002). This implies that the more similar the new knowledge is to existing knowledge, the more easily a firm can assimilate the new knowledge. By contrast, the more different the new knowledge is, the harder it is for a firm to absorb it.

However, firms are able to absorb new knowledge that is different to their existing knowledge. This transformation reflects a capability that 'through the process of bisociation helps firms to develop new perceptual schema or change to existing processes' (Zahra & George 2002, 195). Whereas Zahra & George argue that transformation is the activity that comes after assimilation, Todorova & Durisin (2007) argue that transformation is an alternative process that depends on the capabilities within the organisation. Assimilation is a process that makes it easier to absorb new knowledge, whereas transformation is a more complex process since the new knowledge challenges the existing cognitive structures of a firm. In this article we use transformation as the fourth component of absorptive capacity.

In the analytical framework (Fig. 1) we suggest that what goes on within innovative firms (i.e. organisational learning as described by the concept of absorptive capacity) and what goes on in innovation networks (i.e. external knowledge linkages) facilitates innovation capability. Our argument is that knowledge as a social process links internal processes in firms with external knowledge in order to develop innovative capability.

Our theoretical point of departure is that absorptive capacity is particularly important for firms in thin regions. We argue that these firms often have to bring in, assimilate, transform, and apply external knowledge from different places. Local knowledge (in both a geographical sense and a cognitive sense) is frequently not available to the same extent as in core regions, which means that firms in thin regions have to develop some specific organisational traits that support their absorptive capacities. In the remaining part of this article we examine how this theoretical assumption stands up to empirical investigations of organisational learning and innovation activities in two competitive firms in a Norwegian thin region.

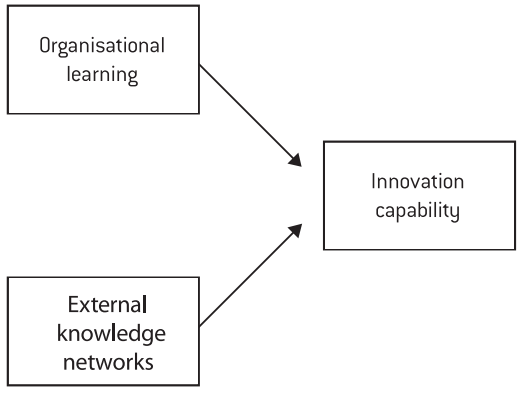

Fig. 1. Analytical framework

Method and data

Our research began with the observation of competitive firms in the Lister region, which is located in the county of Vest-Agder, in southern Norway. We then constructed our analytical model – based on theoretical reviews – to study and explain the observations. In the following section, we present our study methods and data from the case firms in the Lister region.

The two case firms, which are located in the Lister region, were selected based on our knowledge of the region and the local firms. Flyvbjerg (2006, 230) describes this approach as the information-oriented selection of cases, where the research strategy is to maximise the utility of information from small samples and single cases. The cases we present are maximum deviant cases or unusual types of case (Flyvbjerg 2006). We knew from earlier research that Lister can be characterised as a thin region (Isaksen 2014), and from newspapers articles and other information sources that the two case firms might be interesting to study, as they were referred to as innovative despite their location in this type of region.

The main data source consisted of semi-structured interviews held in April 2012 with managers from the two case firms: Farsund Aluminium Casting (FAC) and Andersen Mekaniske Verksted (AMV). In the case of FAC the interview was organised as a focus group interview in which four management representatives participated, while in the case of AMV the CEO (chief executive office) and an engineer were interviewed separately. A semi-structured interview guide was used for the topics we wanted to discuss with the interview subjects. The topics and questions were constructed on the basis of our review of theory. Each interview lasted approximately two hours. In addition, to the interviews we later had guided tours of the companies, during which the production processes were presented and we had the opportunity to ask questions about them. In total, we interviewed six persons (five managers and one engineer) in three interviews. The interviewees received the summarised results to add comments and correct mistakes. Each interview was also transcribed verbatim. We were also able to go through various documents such as online newsletters and news clippings to complete our analysis. The interviews provided first-hand accounts of the process within the firms, but they might have been influenced by the strategic behaviour of the interviewees. To reduce bias, the data were triangulated across the interviews and complemented

with secondary data to draw attention to any strategic behaviour and critically reflect on our data. An overview of the research procedures is presented in Table 1.

In the second stage of the analysis, we used the HyperRESEARCH software program to computerise the coding and retrieval process. Through grouping and comparison of the content it was possible to generate a set of aggregated dimensions; these were in line with the preliminary analysis. In the following, we present the two case firms and the results of the data analysis structure for each firm, including the recurring themes that were both meaningful to the interviewees and significant in the aggregated dimensions extracted by us.

Two competitive firms in a thin region

The Lister region is located between the city regions of Stavanger (c.270,000 inhabitants) and Kristiansand (c.130,000 inhabitants).[1] The distance from the centre of the Lister region to Stavanger (to the north-west) and Kristiansand (to the east) is 140 km and 90 km, respectively. Although the physical distances are short, the quality of the roads means that Lister is beyond daily commuting distance to the two regions.

The Lister region has two small cities, each with just under 10,000 inhabitants in the city municipality, and is otherwise fairly rural, with a total of c.36,000 inhabitants (see endnote 1). It is thus a small region characterised by organisational thinness. The percentage of people with higher education is well below the national average (Statistics Norway 2014).

The Lister region is a stronghold for manufacturing industries – particularly in the process industry, with two smelters – and in mechanical engineering. We calculated the location quotient for these two industries as between two and three, which means that they have two to three times as many jobs in Lister as would be expected based on the number of jobs in these industries in Norway. We identified globally competitive firms within the two industries in Lister (i.e. innovative firms with competitive products on the world market and/or that employ unique process technology) (Isaksen 2014).

Farsund Aluminium Casting (FAC) produces aluminium parts for the European automotive industry as a first-tier supplier and had c.200 employees, according to the interviewees in 2012. The parts are made of aluminium, are fairly large, thin, and light, and are moulded in one piece. FAC is quite R&D (research and development) intensive and between 2005 and 2012 it carried out five innovation projects financed by the Research Council of Norway; the projects were conducted in cooperation with SINTEF, the largest independent research institute in Scandinavia, which operates in partnership with the Norwegian University of Science and Technology (NTNU) in Trondheim.

Table 1. Overview of the research procedure

Research method	**Qualitative**
Data collection	**Semi-structured interviews:** Two unique cases: 3 in-depth interviews (6 persons) All interviews recorded and transcribed verbatim
	Observation: Guided tours
	Document analysis Brochures, online newsletters, and news clippings
Data analysis	**Within-case analysis:** HyperRESEARCH software to code the documents Grouped the content – aggregated dimensions Narrative strategy in writing up the data

FAC was established in 1998 under the ownership of the international corporation Alcoa. The factory is located adjacent to an aluminium smelter owned by Elkem and Alcoa in Farsund, and heated, flowing aluminium is transported from the smelter to FAC's production hall. FAC went bankrupt in 2009, following the financial crisis and the related problems for car producers. However, Porsche was then about to introduce its new Panamera model and FAC was the only producer of one vital part – rear suspension – for this model. The production equipment (i.e. the mould to produce the part) is owned by Porsche. The mould was developed by FAC for Porsche, which could in principle take the mould and let another supplier produce the part. However, FAC was and still is the only producer in the world able to produce the part in one piece, as FAC has developed some unique technology and has the workers with the necessary knowledge to use the technology. As the operations director explained, 'It would have been difficult to move this factory without the people.' This led Porsche and BMW to guarantee five years of production by FAC. Porsche subsequently bought 70% of FAC, which was resold to a German automotive parts manufacturer in 2012.

Andersen Mekaniske Verksted (AMV) had c.150 employees in Lister in 2012. The company is privately owned by a young person who holds a master's degree in technology and who is a fifth-generation descendant of the original entrepreneur, who founded the company in 1860. The firm has two strands of activity. It produces a range of advanced equipment for tunnelling and the mining industry including dumpers and trucks with computer-controlled drilling systems. These are developed and produced from scratch by AMV. The firm imports simple steel blocks from suppliers in Poland, and develops, produces, and installs mechanical, electrical, electronic, and hydraulic parts. The other strand of activity consists of subcontracting and some development of drilling equipment for the oil and gas equipment supplier industry in Kristiansand, which has synergies with the activities for the tunnelling and mining industry.

Compared to FAC, the innovation activity in AMV relies more heavily on experience-based knowledge, also known as the Doing, Using, Interacting (DUI) innovation mode (Jensen et al. 2007). Customers are important sources of information, and AMV has a highly systematic method for handling customers' feedback as input for product innovations and engages both engineers and workers in innovation projects. In 2012, mining equipment from AMV was used in Spain, China, South Korea, the Philippines, Brazil, and Chile. The maintenance of the equipment is carried out by the firm in Lister. AMV has a unit in Chile that employs 40 persons in the development of equipment and training in the country's copper mining industry.

In the following, we examine how FAC could have developed world-class technology to the extent that Porsche and BMW

guaranteed the future existence of the company, and how AMV, a fairly small firm in a peripheral part of Norway has been able to produce mining equipment for a range of global customers.

Case analysis

The case analysis highlights a set of recurring themes related to organisational learning in the two case study firms. For each firm we first present a summary Table (Tables 2 and 3 respectively), which lists quotes from the interviews, recurring themes from the interviews, and aggregate dimensions from those themes. Thereafter, we present a thick description (Ryle 1949; Geertz 1973; Denzin 1989) of the analysis, including quotations (which we have translated from Norwegian to English).

Farsund aluminium casting

Organisational learning mechanisms

Information from the interviews revealed that FAC has put a lot of effort into recruiting talented personnel. Despite its location, FAC has been able to recruit and retain both operators and engineers (including two with PhDs). The R&D director explained that the majority of the workforce have local roots and want to live in the area, while others have been recruited from abroad through FAC's network. The fact that the workers want to live in the region and that there are not many alternative workplaces gives FAC a stable workforce. The turnover of employees is quite low, which is important for long-term organisational learning.

FAC has developed its own training programme and material. The R&D director said that 90% of the training is hands-on training, during which FAC adjusts workers' competence to each product and activity. The organisational structure is flat, so the distance from the management to the worker is short, both in daily communication and in decision-making issues. This enhances flexibility and ensures efficient development and start-up procedures for new products. In product development, engineers work in teams with geographically dispersed participants. Some are responsible for the design, others for simulations, and yet others for calculating the strengths. During the innovation process the development team uses e-mail and Skype or telephone to stay in daily contact. When a new product is going to be launched, FAC organises teams that will have responsibility for the product. In sum, human resource management practices, a flat organisational structure, and teamwork constitute the identified organisational learning mechanisms:

> They (the customers) understand that we have unique expertise that implies effective development and implementation of new products. This is our strong card. We are a small organisation with only a short distance from top to bottom. Overnight we can make a change in the design, a simulation, and the next morning implement the change. (R&D director, FAC)

Interplay between technology and practice-based knowledge

There seemed to be a strong interplay between technology and practice-based knowledge in FAC. On the one hand, FAC has invested extensively in the most advanced technology such as monitoring software and an innovative X-ray filter that can show oxides in aluminium. FAC was the first company in Europe to acquire and adopt this technology. Furthermore, FAC has developed their own software for running cutting-edge simulations. However, the firm relies on developers and operators who know how to run the machines and interpret the results. Even when a simulation is 100% accurate, the operators still need to make adjustments when the production is running. Even with the newest and most advanced technology, operators with practical experience who can use the technology and make the necessary adjustments are needed.

Innovation capabilities

The findings related to FAC highlight how the firm's employees are able to make use of what is regarded as prior knowledge (e.g. X-ray and simulations) in new and innovative ways. For example, the simulations can be run by an engineer who knows how to run simulations in the best way. This is normal procedure in any

Table 2. Case analysis: Farsund Aluminium Casting (FAC)

First-order categories (based on quotes from interviews)	Second-order themes (recurring themes)	Aggregate dimensions
90% hands-on training	Training	Organizational mechanisms
Access to people	Recruitment	
Keep the competence	Retaining	
Short distance from top to bottom	Flat organizational structure	
Work in groups with specialists	Team	
Daily communication	Communication	
Both software and hardware	Technology	Interplay between technology and competence
Need competence to make it unique	Use of technology	
The operators are most important, as they know what to look for	Practice-based knowledge	Uncommon knowledge use
Experienced engineers who understand without describing with words	Applied knowledge	
'We get a request with specification from customers'	Collaboration	Knowledge linkages
'We have had R&D projects with NTNU and SINTEF almost since the establishment'		

Table 3. Case analysis: Andersen Mekaniske Verksted (AMV)

First-order categories (based on quotes from interviews)	Second-order themes (recurring themes)	Aggregate dimensions
A lot of time in training the people Approach high-school students Vulnerable if someone quits The distance between someone on the floor and CEO extremely short Advisory board develop	Training Recruitment Retaining Flat organizational structure Team	Organisational mechanisms
State-of-the-art equipment Ability to understand and apply in a logical way	Technology Use of technology	Interplay between technology and competence
The engineers have a lot of experience and can find creative solutions Complex combinations	Practice-based knowledge Applied knowledge	Uncommon knowledge use
'We need to be there all the time'	Collaboration	Knowledge linkages

aluminium plant. What seems to distinguish FAC is that the firm allows its operators to provide feedback during the production process. The operators know what to look for beyond what is expected from the simulation. The R&D director argued that the operators have developed a specific capacity to understand the process. In his view, the operators are the most important factor for success. They have to be well trained, have the right type of experience from production, and have to know what to look for. They are able to combine different types of knowledge in practice:

> What we have noted is that someone has a special ability to understand the thermal conditions in a process system. It's important. How do you get the metal floating long enough in certain areas of the part when casting parts with both thick and thin walls? They look at the part and see how it is. (R&D director, FAC)

Knowledge linkages

The most important knowledge linkage in FAC's innovation processes is beyond the region, in particular to global, demanding car producers located in other countries. Without demanding customers FAC would not have the necessary stimuli and motivation to innovate. Every time a new car model is designed and planned, FAC is involved in a dialogue with the car producers about the design and the quality specifications. Each time there are new specifications that push FAC's technological limit one small step further, but with one eye to the economic consequences of pushing the limits. FAC needs to balance the technological possibilities with economic restrictions. When the customers have presented their demands, an internal development group is organised and collaborates closely with customers. In the development phase this means at least one meeting each week with the customer:

> We were selected as a company that could not be replaced. The part we have developed for Porsche, they realised that they could not launch the car without us … [and they] understand that we have technology that they will use. (R&D director)

The development group consists of people with different types of knowledge. Most of these people are from FAC and live and work in the Lister region, but some live abroad and work with FAC. The products FAC creates are so complex that the company needs very specialised knowledge, which only handful of people in the world have. The external knowledge linkages go to people with very specialised knowledge who have been working with FAC for years and know the production processes very well. They do most of their work from their offices abroad, with regular visits to FAC and daily Internet communication. Cognitive and institutional proximity (Boschma 2005) among geographically dispersed members of product development teams helps to compensate for lack of daily face-to-face contact. Alongside these linkages, FAC has, almost since its establishment, involved NTNU and SINTEF in more general knowledge development projects. The close collaboration with these two knowledge organisations is partly a result of personal knowledge linkages. The R&D manager has a PhD from NTNU and in his former job at NTNU he had a 20% position in SINTEF. The collaboration is also partly a result of the long R&D tradition in the Norwegian aluminium industry.

Andersen Mekaniske Verksted

Organisational learning mechanisms

Andersen Mekaniske Verksted puts a lot of effort into training its personnel. Although the mechanics are educated, they still need to learn the specific tasks required at AMV. Thus, a lot of time is spent training new employees and making sure that they are able to develop their competence. The mechanics become experts in their fields and, with training and experience, can come up with solutions on their own. AMV experiences difficulties in recruiting workers, as the firm competes with the oil and gas industry in Norway, which pays much higher salaries. However, AMV approaches students in schools in order to make them aware of the company. The people AMV recruits often stay with the company for a long time. This is partly explained by the variety of tasks they are exposed to. The engineers are given easier tasks in the beginning so that they can see how the production works and the drawings are designed. After a while they are given more difficult tasks and eventually they end up constructing

larger structures. The distance between the mechanics and top management and the development team is very small, meaning that people on the shop floor often provide critical input to development. This provides the organisation with a flexible and efficient way of innovating:

> I think we offer something that is not so common in the industry, they work with everything. They're not only drawing or calculating. A project manager draws, makes mechanical structures, hydraulics, [and] interaction with the electro department for coordination. He learns much … [new recruits] become skilled engineers in a short time. (CEO, AMV)

Interplay between technology and practice-based knowledge

The interplay between technology and the competence in the firm is crucial. The mechanics and operators need to know how to run highly advanced machines. More importantly, much of the production also requires the operators to be able to solve issues on the spot. This flexibility is regarded as their main competitive advantage: 'Many of the people we have on the floor are not dependent on the final drawings in order to make [a prototype]' (CEO, AMV).

Innovation capabilities

Mechanics at AMV are able to handle complex assemblies by applying their practice-based knowledge of the materials. Our findings indicate that the engineers are able to draw on their experience in order to make use of practice-based knowledge. Furthermore, people on the floor are not pacified by half-finished drawings, since they are able to envisage the complete picture based on their previous experience. The combination of theoretical knowledge and practice-based knowledge enables them to develop new products in an efficient and effective manner: 'Engineers have so much product expertise that they can just mix and perform tricks and reuse much of the parts that have been designed and are ready, and put together a new product' (CEO, AMV).

Knowledge linkages

The most important knowledge linkages are with demanding customers, with whom AMV tries to have close relationships. In total, 60% of the market for its products is in Norway and 40% abroad. The most important Norwegian customers are the offshore oil and gas equipment industry in Kristiansand, only a two-hour drive from Lister. AMV has produced drilling equipment since the early days of the development of the Norwegian oil and gas industry in the 1970s.

The customers abroad are within the mining industry. AMV meets customers regularly, discusses improvements to products, and delivers tailor-made products:

> The work we do is not nine-to-four. It is plant operation for twenty-four hours a day, at any time. We need to be visible in the market all the time. It creates customer confidence and makes him [the customer] choose us, even though we may have relatively more expensive products than the competitors. But [the customer] with this confidence [knows] that he will have his wishes fulfilled and get the product refined at any time. (CEO, AMV)

Discussion

In the following discussion we develop the aggregated dimensions that emerged in the analysis of the two firms. The findings are condensed in a model that structures the discussion (Fig. 2).

Existing research indicates that organisations achieve competitive advantages through organisational learning and external knowledge linkages, as demonstrated in the analytical framework in Fig. 1. We examined how two globally competitive firms in a thin region innovate, which led to an extension (Fig. 2) of the original analytical framework. The findings show how employees are able to utilise and link existing knowledge in new and innovative ways through their learning in the workplace. In both of the studied firms, the workers' practice-based knowledge is an important antecedent for the development of innovation capabilities.

The analysis of the cases shows that the organisation of workplace learning matters for innovation (i.e. how learning is organised and practised). The practice is important, such as having a short distance between management and the workers in the company so that decisions can be made quickly. Short distance also indicates the existence of trust between the management and the workers. Workers can discuss products and workplace learning improvements with the management on equal terms, which implies that the workers' practice-based knowledge matters in innovation processes.

Employees and teams have the autonomy to make their own decisions in the production process and in the development of new products and services. In order to find new combinations of knowledge use, the employees not only need access to the latest technology but also need to be able to use the technology. The interplay between technology and the employees' practice-based knowledge makes up much of the innovative capabilities of the two firms.

The innovative capability is not limited to the firms' own employees, but includes knowledge found in external linkages. Both customers and research institutions are important in the process of workplace learning and in the development of innovative capabilities.

While knowledge use has been thoroughly studied and conceptualised in the literature, we analysed how firms rely on

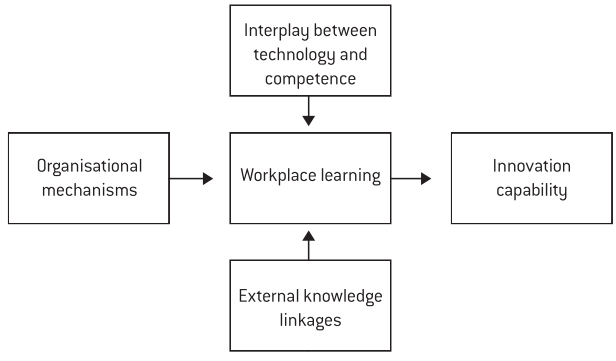

Fig. 2. Model of innovation capability

their employees' learning through work and their use of practice-based knowledge in innovation processes. Starting at the core of the model in Fig. 2, workplace learning by use of practice-based and scientific knowledge implies that firms are able to develop innovative capabilities. This knowledge use can be understood in line with Nonaka's (1994) and Nonaka & Takeuchi's (1995) interpretation of tacit knowledge. The argument is about how tacit knowledge ('We can know more than we can tell' (Polyani 1966, 4)) can be created and distributed through shared experience between individuals in a group and an organisation. The interaction between tacit and explicit knowledge forms a 'knowledge spiral': pieces of explicit knowledge are linked through a combination process. The knowledge becomes tacit through internalisation. Tacit knowledge is shared through a socialisation process and becomes explicit through externalisation. However, even if there is a combination of tacit and explicit knowledge, the main finding in our cases – in contrast to Nonaka's model (Nonaka 1995) – is how employees are able to use tacit (experience-based) knowledge in novel ways (i.e. to learn and apply the knowledge to create innovations).

The case studies also revealed the importance of a favourable organisational environment for the firms' competitiveness. These observations relate to theories on organisational structure. In his study of change processes, Okhuysen (2001) suggests a positive relationship between a flexible working process and the performance of innovative groups. By contrast, Hargadon & Sutton (1997) emphasise that working groups can learn from each other by connecting ideas. Song et al. (1997) suggest that internal mechanisms such as evaluation criteria reward structure, and management expectations are positively related to cross-functional cooperation and innovation. Foss et al. (2009) suggest that job design is important to knowledge-sharing for motivational reasons. In the present article we have demonstrated how organisational learning mechanisms are important in the use of practice-based knowledge.

Finally, our findings demonstrate that even if the firms have good practice-based knowledge (i.e. engineering knowledge of how to use and construct products with metals and mechanics), they also need access to supplementary external knowledge. External knowledge linkages make it possible for firms to gain access to knowledge that is critical in the innovation process. Our findings therefore support the central finding in innovation research: firms seldom innovate in isolation (Fagerberg et al. 2005, 180). Interaction with customers, knowledge organisations, suppliers, and other collaborating actors is important for innovation in the two studied firms. However, we have shown that firms do not need to be located in core regions or within regional clusters to engage in innovation networks. Rather, firms can be located in organisationally thin areas and still be globally competitive if they have access to critical knowledge, regardless of their geographical provenance; however, this demands a certain degree and type of absorptive capacity in firms.

Concluding comments

This article demonstrates how two firms in an organisationally thin region in Norway have achieved global competitive strength through at least four mechanisms. *First*, the firms benefit from long-term on-the-job training and learning through internal courses among several job groups and the use of experience-based competence in innovation projects. An interviewee at FAC thus maintained that 'the most important factor to succeed in improving the production process is the operators.' This points to a distinct organisational mechanism and workplace learning (shown in Fig. 2). The organisation of work in the firms resembles the Nordic model of flat organisations, decentralisation of responsibility, and workers' engagement in frequent, incremental process innovations (Gustavsen 2011). *Second*, both firms benefit from close customer contact and working with demanding customers. FAC develops products for and with their customers, and AMV works systematically to incorporate feedback from users in frequent upgrading of products. Frequent innovations are made possible through the interplay between technology and competence in the firms.

The other two mechanisms include external knowledge linkages. Thus, *third*, the firms take advantage of specific national competences, most noticeably in the case of FAC, which is part of a national, sectoral innovation system with world-class knowledge of aluminium production. AMV benefits from supplying the Norwegian oil and gas supplier industry, which has world-leading technology and, according to Reve & Sasson 2012, constitutes the most globally competitive industrial cluster in Norway. As a thin region, Lister does not have a higher education institution or research institute and therefore Lister firms mostly rely on national-level organisations for recruitment of engineers and sourcing of research-based knowledge. However, the Lister region does have a secondary school with departments in five different places in the region and with study programme of relevance for the manufacturing industry. The region also has a body for apprenticeship certification that focuses specifically on local firms. *Fourth*, the firms have acted proactively to globalise and have benefitted from global knowledge links. AMV outsources labour-intensive production to six Polish producers, while FAC regularly uses five or six experts in other parts of Europe for innovation projects. In sum, we argue that the four mechanisms enable the firms to link and utilise knowledge in innovative ways.

There are two, more general, theoretical lessons from the study. The first lesson relates to the use of the term 'practice-based knowledge' and to the fact that broad participation in innovation processes within firms is important for the sake of frequent product improvements and streamlining of the production process. Broad participation assumes specific sociocultural and institutional factors, such as respect for the experience and skills of 'ordinary workers' when it comes to solving problems that arise in production or in innovation projects. This is illustrated by the AMV interviewee who maintained that 'an engineer can be sure that if a drawing contains some errors, within two minutes a production worker will come and say that this will not function'. Such knowledge exchange between different groups of workers points to characteristics of a Norwegian or Nordic model of broad participation, in which the competences of both engineers and workers are utilised in innovation processes and in which the linking of these different competences are vital. Practice-based knowledge may not be uncommon in the Nordic countries if this is part of the micro-foundations of the Nordic model. This issue points to the importance of incorporating the specifics of 'the wider setting'

in analyses performed at the firm level (Edquist 2005), in this case how firms organise work, learning, and innovation. There is a need for further studies of Nordic firms using this approach, in order to generalize about the involvement of workers' practice-based knowledge in innovation processes. The general point is that the way innovation and learning are organised in firms means much for competitiveness of industry in general within a nation (Lundvall & Lorenz 2012).

The second general lesson concerns the relatively low importance of regional knowledge links and of local actors in general when it comes to innovation and learning processes in firms in thin regions. Firms in such regions that, for example, need to provide fast services to customers will need to be more self-sufficient than firms in more organisationally thick regions. This means that one cannot generalise from how firms in regional clusters or core regions typically organise innovation activity through collaboration with other local actors to how firms in more organisationally thin regions have to act. Firms in local innovation networks have often become the norm of the innovative firm in 'the knowledge economy', in which competitiveness is seen to rely on easy access to a rich array of local knowledge and other assets. As demonstrated in our two case firms, this does not capture the specific situation in organisationally thin regions, where firms have to rely on their internal organisational learning and innovative capability on the one hand and on extra-regional knowledge links on the other hand. Although our two firms have very different products and production processes, they are quite similar when it comes to involving skilled workers in innovation processes and in employing requirements and ideas from demanding customers in innovation processes. The difference lies in the fact that FAC is more research-based and cooperates with central Norwegian research institutes in technology development, whereas AMV relies more on learning by doing in production. Although our study only included two firms, the characteristics of thin regions indicate that the twin strategy of building absorptive capacity through workplace learning and extra-regional links is a generally applicable strategy in such regions.

Note

1 The population numbers were obtained in 2014 from data on Statistics Norway's home page and a Table titled 'Fokemengde i kommunene 1. januar'.

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