Innovation for Development

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Innovation and regional development: Constructing regional advantage

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Introduction

As a point of departure it is important that the contemporary phase of globalization, which can best be described as a globalizing knowledge economy, is recognized. The picture is not any longer only characterized by outsourcing/offshoring to developing economies such as China and India of labour intensive production of manufacturing goods and services but increasingly also by offshoring of R&D and innovation. Adding to this situation of an emerging global knowledge economy is investments in R&D organizations in Europe and North America by TNCs from India and China.

DG Research launched the idea of 'constructing regional advantage' (CRA) as the new way of taking on and combating these new challenges and problems, and presented perspectives of how innovation policies and strategies can resolve the tension between competition and cohesion (Asheim *et al.*, 2006). While building on the lessons from the dynamic principle of the theory of competitive advantage that competitive advantage can be influenced by innovation policies and supporting regulatory and institutional frameworks, the theory of constructed advantage recognizes the important interplay between industrial and institutional dynamics as well as calls for greater attention to multi-level governance. What is especially highlighted is the role of a proactive public-private partnership and impact of the public sector and public policy support by acknowledging to a greater extent the importance of institutional complementarities in knowledge economies. This approach represents an improved understanding of key regional development challenges as well as a better anticipation and response to the problems by addressing system failures of lack of connectivity in regional innovation systems.

Different paths to Constructing Regional Advantage thus, globalisation has to be at the core of understanding the dynamics of contemporary capitalism. Increasingly there is a strong agreement that innovation is the key factor in promoting competitiveness in a globalizing knowledge economy (Lundvall, 2008; Porter, 1990). Competition based on innovation implies choosing the high road strategy, which is the only sustainable alternative for developed, high-cost regional and national economies. For a long time such a strategy was thought of as being identical with promoting high-tech, R&D intensive industries in accordance with the linear view of innovation. More and more the recognition has evolved that a broader and more comprehensive view on innovation has to be applied to retain and develop competitiveness in the heterogeneity of Europe's regions. This implies that regional advantage has to be constructed more on the basis of the uniqueness of the capabilities of firms and regions than solely on the basis of R&D efforts (Asheim *et al.*, 2006; Malmberg and Maskell, 1999). This reflects recent research pointing to the complexity of modern products and their innovation processes (Lam, 2002), which requires a differentiated knowledge base perspective (*i.e.* distinguishing between analytical, synthetic and symbolic knowledge) to be fully accommodated (Asheim and Gertler, 2005; Asheim, Coenen, Moodysson and Vang, 2007). Such a broad view on innovation is in line with the innovation system perspective of defining innovation as interactive learning.

According to the World Economic Forum Growth Competitiveness Report Finland, Sweden and Denmark have consistently the last five years been among the five highest ranking nations with Finland and Sweden most years among top three. This impressive performance of the Nordic countries is achieved with very different innovation policies and strategies. Finland has pursued a science-driven, high-tech oriented strategy focusing on radical product innovations, with especially good results in the ICT sector, and Sweden a technology-based strategy of process innovations and complex product improvements, with both countries ranking as the top two nations with respect to R&D investments (Sweden 4% and Finland 3.8%). Denmark has implemented a user-driven, market based strategy characterized by mostly non-R&D, incremental innovations heavy oriented towards consumer goods sectors (e.g. furniture), sometimes with a design orientation, but not as a general rule such as in 'made in Italy' products. These empirical facts and theoretical perspectives have a very important policy implication in that there is no 'one size fits all' policy formula, *i.e.* no optimal or best way with respect to innovation policy promoting competitiveness and innovation in various industries in different regions and nations in a globalizing knowledge economy (Tödtling and Trippl, 2005). Instead, innovation policies must be fine tuned to take into account actual differences in industrial structures and social and institutional environments.

As Finland has been one of the countries that most vigorously and with quite a lot of success has pursued a science based/push innovation policy, it is noticeable to see arguments for a more broad based innovation policy in the country's new innovation strategy which was presented in June 2008. It is argued that securing growth and competitiveness in a globalizing knowledge economy cannot any longer only be based on a sector and technology oriented strategy, but that a demand-based, user-driven innovation policy must be implemented alongside a supply-driven policy for R&D. For this to become publically and politically manifest it is also proposed to expand the Cabinet Committee on Economic Policy into a Cabinet Committee on Economic and Innovation Policy, and in a parallel move to rename, in terms of its tasks and composition, the Science and Technology Policy Council into a wider Research and Innovation Council (Ministry of Employment and the Economy, 2008). This reorientation towards a more broad based innovation policy is in line with the innovation system perspective of extending the definition of innovation from the traditional linear view of starting with science and ending up with new products to a view of innovation as interactive learning (Lundvall, 2008). This implies that all industries and sectors can be innovative, *i.e.* not only R&D intensive, high-tech firms and sectors but also medium- and low-tech firms. Innovation is not equal to but more than R&D intensity. This could, according to Lundvall and Borrás (2005), be referred to as a development from 'science' and 'technology' policies to 'innovation policy', which is illustrated by the new Finnish strategy.

This picture corresponds with the ideas of Lorenz and Lundvall (2006) about different but complementary 'modes of innovation'. One the one hand we can talk about a broad definition of the mode of innovation as D(oing), U(sing) and I(nteracting) relying on informal processes of learning and experience-based know-how. The DUI mode is a user (market or demand) driven model based more on competence building and organizational innovations and producing mostly incremental innovations. Such a mode is typically found in non-R&D

based economies (e.g. Denmark). On the other hand one finds a more narrow definition of the mode of innovation as S(cience), T(echnology) and I(nnovation) based on the use of codified scientific knowledge, which is a science push/supply driven high-tech strategy able to produce radical innovations (e.g. found in Finland and Sweden). These two modes of innovation will also be differently manifested with regard to regional innovation systems and clustering. Regional innovation systems can be defined in a narrow and broad way (Asheim and Gertler, 2005). A regional innovation system broadly defined includes the wider setting of organisations and institutions affecting and supporting learning and innovation in a region. This type of system is less systemic than the narrowly defined types of innovation systems. Firms mainly base their innovation activity on interactive, localised learning processes stimulated by geographical, social and cultural/institutional proximity, without much formal contact with knowledge creating organisations (*i.e.* R&D institutes and universities) (Asheim and Gertler, 2005). A narrow definition of innovation systems on the other hand primarily incorporates the R&D functions of universities, public and private research institutes and corporations, reflecting a top-down model of science and technology policies. The narrowly defined innovation system correspond to the STI mode of innovation mentioned above, while the more broadly defined system is more easily accommodated by the DUI mode (Lundvall, 1992).

This distinction is helpful in order to avoid a too one-sided focus on promoting science-based innovation of high-tech firms at the expense of the role of learning and experience-based, user-driven innovation. However, it also indicates limits of such innovation strategies in a longer term perspective and, thus, emphasizes the need for firms in traditional manufacturing sectors and services more generally to link up with sources of codified knowledge in distributed knowledge networks (Berg Jensen *et al.*, 2007).

An example of this could be SMEs which may have to supplement their informal knowledge, characterized by a high tacit component (*i.e.* the DUI mode), with competence arising from more systematic research and development (*i.e.* the STI mode) in order to avoid being locked-in a price squeezing, low road competition from low cost countries. Thus, in the long run, it will be problematic for most firms to rely exclusively on informal localised learning. They must also gain access to wider pools of both scientific and engineering knowledge on a national and global scale (Asheim *et al.*, 2003). However, the DUI-based type of innovations will remain the key to their competitive advantage, as strong tacit, context specific knowledge components, which is found in e.g. engineering knowledge dominating the DUI mode, is difficult to copy by other firms in different contexts, and, thus will be the basis for sustaining the firms' and regions' competitive advantage also in the long run (Porter, 1998).

New research confirms that combining the two modes of innovation seems to be most efficient with regard to improving economic performance and competitiveness, *i.e.* firms that have used the STI-mode intensively may benefit from paying more attention to the DUI-mode and vice versa (Berg Jensen *et al.*, 2007). The ability of firms to search and combine knowledge from different sources seems to be stronger associated with innovativeness than either interfacing predominantly with customers or suppliers applying a DUI mode of innovation, or with research system actors in STI oriented processes. (Laursen and Salter, 2006) Thus, on the firm level these two modes of innovation are coexisting, but they will be applied in different combinations depending on the dominating knowledge base(s) of the regional industry as well as the absorptive capacity and cognitive distance between actors on the firm and system levels. The unanswered question is, however, how the capacity of combining the two modes of innovation can be further diffused to and implemented in less innovative firms as well as on the regional level.

Differentiated Knowledge Bases

As mentioned above, it is clear that knowledge creation and innovation processes have become increasingly complex, diverse and interdependent in recent years. There is a larger variety of knowledge sources and inputs to be used by organizations and firms, and there is more collaboration and division of labour among actors (individuals, companies, and other organizations). However, the binary argument of whether knowledge is codified or tacit can be criticized for a restrictively narrow understanding of knowledge, learning and innovation (Johnson *et al.*, 2002). Thus, a need to go beyond this simple dichotomy can be identified. One way of doing this is to study the basic types of knowledge used as input in knowledge creation and innovation processes. By way of suggesting an alternative conceptualization, a distinction can be made between 'synthetic', 'analytical', and 'symbolic' types of knowledge bases.

Following received wisdom from the philosophy of science, an epistemological distinction can be identified between two more or less independent and parallel forms of knowledge creation, 'natural science' and 'engineering science' (Laestadius, 2000). Johnson *et al.* (2002, p. 250) refer to the Aristotelian distinction between on the one hand 'epistèmè: knowledge that is universal and theoretical', and 'technè: knowledge that is instrumental, context specific and practice related'. The former corresponds with the rationale for 'analysis' referring to understanding and explaining features of the (natural) world (natural science/know-why), and the latter with 'synthesis' (or integrative knowledge creation) referring to designing or constructing something to attain functional goals (engineering science/know-how) (Simon, 1969). A main rationale of activities drawing on symbolic knowledge is creation of alternative realities and expression of cultural meaning by provoking reactions in the minds of consumers through transmission in an affecting sensuous medium (table 2):

Analytical (science based)	**Synthetic (engineering based)**	**Symbolic (arts based)**
Developing new knowledge about natural systems by applying scientific laws; *know why*	Applying or combining existing knowledge in new ways; *know how*	Creating meaning, desire, aesthetic qualities, affect, intangibles, symbols, images; *know who*
Scientific knowledge, models, deductive	Problem-solving, custom production, inductive	Creative process
Collaboration within and between research units	Interactive learning with customers and suppliers	Learning-by-doing, in studio, project teams
Strong codified knowledge content, highly abstract, universal	Partially codified knowledge, strong tacit component, more context-specific	Importance of interpretation, creativity, cultural knowledge, sign values; implies strong context specificity
Meaning relatively constant between places	Meaning varies substantially between places	Meaning highly variable between place, class and gender
Drug development	Mechanical engineering	Cultural production, design, brands

Table 2 - Differentiated knowledge bases. A typology
Source - Asheim and Gertler, 2005; Asheim *et al.*, 2007; Gertler, 2008

The distinction between these different knowledge bases takes specific account of the rationale of knowledge creation, the way knowledge is developed and used, the criteria for successful outcomes, and the strategies of turning knowledge into innovation to promote competitiveness, as well as the interplay between actors in the processes of creating, transmitting and absorbing knowledge. The knowledge bases contain different mixes of tacit and codified knowledge, codification possibilities and limits, qualifications and skills required by organizations and institutions involved as well as specific innovation challenges and pressures, which in turn help explaining their different sensitivity to geographical distance and, accordingly, the importance of spatial proximity for knowledge creation (Asheim *et al.*, 2009). Thus, the dominance of one mode arguably has different spatial implications for the knowledge interplay between actors than another mode of knowledge creation. Analytical knowledge creation tends to be less sensitive to distance-decay facilitating global knowledge networks as well as dense local collaboration. Synthetic and symbolic knowledge creation, on the other hand, has a tendency to be relatively more sensitive to proximity effects between the actors involved, thus favoring local collaboration (Moodysson *et al.*, 2008).

As this threefold distinction refers to ideal-types, most activities are in practice comprised of more than one knowledge base. The degree to which certain knowledge bases dominates, however, varies and is contingent on the characteristics of the firms and industries as well as between different type of activities (e.g. research and manufacturing). According to Laestadius (2007) this approach also makes it unnecessary to classify some types of knowledge as more advanced, complex, and sophisticated than other knowledge, or to consider science based (analytical) knowledge, characterizing the STI mode of innovation, as more important for innovation and competitiveness of firms, industries and regions than engineering based (synthetic) knowledge or artistic based (symbolic) knowledge, which is the dominating knowledge input in the DUI mode of innovation.

Regional Policy Challenges

Regional innovation systems have played and will continue to play a strategic role in promoting the innovativeness and competitiveness of regions. To achieve this, the RIS approach has to be strengthened by attention being directed towards the need – perceived by policy makers both at EU and regional levels – of *constructing* regional advantage. The 'innovation system' concept can, as already stated, be understood in both a narrow as well as a broad sense. A narrow definition of the innovation system is traditionally associated with *regionalised national innovation systems*, which constitute a supply (science push) driven model. A broader conception of the innovation systems incorporates the elements of a bottom-up, interactive innovation model which is referred to as *territorially embedded regional innovation systems* (or *learning regions*). This type basically represents a market-driven model, where demand factors determine the rate and direction of innovation. A combination of these two types of RIS is called *regionally networked innovation system* (Asheim and Isaksen, 2002). The networked system is commonly regarded as the ideal-type of RIS: a regional cluster of firms surrounded by a regional supporting knowledge infrastructure. These systems have a more planned character than the territorially embedded systems involving public-private co-operation, and a stronger, more developed role for regionally based R&D institutes, vocational training organisations and other local organisations involved in firms' innovation processes.

There are different logics behind building regional innovation systems contingent on the knowledge base of the industry it addresses as well as on the regional knowledge infrastructure which is accessible. In a territorially embedded regional innovation system, the emphasis lies on the localised, path-dependent inter-firm learning processes often involving innovation based on synthetic knowledge. The role of the regional knowledge infrastructure is therefore mainly directed to industry-specific, hands-on services and concrete, short-term problem solving. In a regionalised national innovation system, R&D and scientific research take a much more prominent position. Innovation builds primarily on analytical knowledge. Linkages between existing local industry and the knowledge infrastructure are however weakly developed. Instead it holds the potential to promote new industries at the start of their industrial and technological life cycle. In this, the role of the regional(ized) knowledge infrastructure is a very central one as it provides the cornerstone for cluster development (through the precarious task of commercialising science) (Benneworth *et al.*, 2009). Similar to the regionalised national innovation system, in the regionally networked innovation system the knowledge infrastructure plays an indispensible role, however more territorially embedded. But in contrast to it, cluster development is not wholly science-driven but represents a combination of a science and market-driven model. In comparison to the territorially embedded regional innovation system, the networked RIS often involves more advanced technologies combining analytic and synthetic knowledge as well as having better developed and more systemic linkages between universities and local industry. While territorially embedded RIS are often found in mature industries and regionalised national innovation systems found in emergent industries, networked regional innovation systems can typically support various types of industries in different life cycle phases. Firms and knowledge infrastructure form a dynamic ensemble, combining ex-post support for incremental problem-solving and ex-ante support to counter technological and cognitive lock-ins. Table 3 shows combinations of different types of regional innovation systems and knowledge bases (Asheim, 2007).

Type of knowledge / Type of RIS	Analytical/scientific	Synthetic/engineering	Symbolic/creative
Embedded (grassroots RIS)		IDs in Emilia-Romagna (machinery)	'Advertising village' - Soho (London)
Networked (network RIS)	Regional clusters - regional university (wireless in Aalborg)	Regional clusters -regional technical university (mecanical in Baden-Württemberg)	Barcelona as the design city
Regionalised national (dirigiste RIS)	Science parks/ technopolis (biotech, IT)	Large industrial complex (Norwegian oil and gas related industry)	

Table 3 - Types of regional innovation systems and knowledge bases

Tödtling and Trippl (2005) have argued that the challenges and problems for knowledge creation and innovation differ considerably between regions with different RIS characteristics, e.g. institutionally thin, networked and fragmented regions. Policies for constructing regional advantage cannot be based on one 'best practice' model, as there is no 'one size fits all' strategy to cope with the variety of problems and challenges in European regions, and should, thus, reflect the different conditions and problems of the respective regions and their RIS. The design and success of such a policy differ between regions due to different knowledge bases, modes of governance and policy approaches taken, which can be described using their typology:

- Peripheral regions are characterised by being less innovative in comparison to more central and agglomerated regions; they have less R&D intensity and innovation, and have a less developed knowledge infrastructure (universities and R&D institutions) as well as suffer from organizational thinness;
- Old industrial regions represent another type of problem region characterised by negative lock-in due to a heavy dependence and specialisation on mature industrial sectors. If knowledge infrastructure exists, it is often also strongly specialized in training and research activities in support of the dominating industrial structure. The innovative activity of these regions is primarily concentrated on process innovations, and there is a lack of product innovations as well as entrepreneurship;
- Fragmented metropolitan regions. Metropolitan regions are normally regarded as centres of innovation with the presence of R&D organizations and universities, business services, as well as headquarters of international firms. As a consequence, R&D activities are usually above average. However, some metropolitan regions are lacking dynamic clusters of innovative firms due to the problem of fragmentation, *i.e.* the lack of innovative networks and interaction between universities-firms as well as among local companies. Such regions display an industrial structure characterised by so called 'unrelated variety', *i.e.* by having a diversity of sectors which do not complement each other, and, thus, do not produce knowledge spillovers. This may represent an important innovation barrier in such regions resulting in the development of new technologies and the formation of new firms often being below expectations.

Institutionally thin regions are often found in peripheral regions and lack a sufficient critical mass of clusters and knowledge organizations. For such types of RIS the DUI mode of innovation and external links and knowledge sources might be of key importance. In fragmented regions on the contrary we often find a high density of knowledge organizations and firms but which are characterized by weak connectivity between the elements of the RIS. Internally networked regions have well connected RIS, but either demonstrating negative lock-in (old industrialized regions) or positive lock-in. The latter is often secured by creating related variety in the local economy and by establishing non-local linkages to external knowledge sources avoiding cognitive lock-in through a 'local node of excellence in global networks' structure. Externally networked regions are characterized by having strongholds in one or two of the key actors in a RIS (a leading university or a strong industrial cluster or large industry), but need to be externally linked up either to international knowledge providers and sources or to competent industrial knowledge users through FDIs to compensate for the missing internal actor(s) in order to generate regional development. A critical challenge might here be the capability to absorb and to integrate externally acquired knowledge by local firms as well as to embed TNCs in the region. Regional innovation policies need to take account of these differences in order to be effective. Often combinations of the above categories of regions will exist, e.g. that old industrial regions end up as peripheral regions and that fragmented metropolitan regions basically are old industrial regions. However, the point here is that these types of regions represent different problems and challenges, and, thus, require specific and individual approaches to innovation policies in order to correct problems and promote economic and social development.

Moreover, in order to further deepen the understanding of the role and workings of different types of regional innovation systems in a globalising economy the question of governance structures and supporting regulatory and institutional frameworks regionally as well as nationally has to be explored. Of special importance is the linkage between the larger institutional frameworks of the national innovation and business systems, and the character of regional innovation systems. In making these arguments about a general correspondence between the macro-institutional characteristics of the economy and the dominant form and character of its regional innovation systems a link is provided to the theoretical approaches of 'varieties of capitalism' and national business systems (Asheim and Gertler, 2005; Hall and Soskice, 2001; Lundvall and Maskell, 2000; Whitley, 1999).

Varieties of Capitalism

Hall and Soskice (2001) have convincingly demonstrated the importance of institutional complementarities between important institutional dimensions of a society such as financial regulation, corporate governance, innovation systems, labour market relations, and training/ education and employment on the one hand and the characteristics of the economy (*i.e.* dominant forms of innovation, industrial specializations, rate of growth etc.) and the social outcomes with respect to living standards and income inequalities on the other hand.

Soskice (1999) has argued that different national institutional frameworks support different forms of economic activity. Thus, while coordinated market economies have their competitive advantage based in diversified quality production, liberal market economies are most competitive in industries that are radically innovative. From a comparison of coordinated market economies (such as Sweden, Germany and Switzerland) and liberal economies (such as the US), Soskice suggested that the coordinated economies performed best in the production of "relatively complex products, involving complex production processes and after-sales service in well-established industries" (e.g. the machine tool industry). In contrast, liberal market economies performed best in industries producing complex systemic products, such as IT and defense technologies and advanced financial and producer services, where scientific knowledge is important (Soskice 1999, pp. 113-114). However, in the liberal market economies, such as that of the US, the low-end labour market, in low-tech, labour-intensive industries creates only unskilled, low-paid jobs, with workers suffering poverty, low living standards and alienation, a situation that has been recognized by both Porter (1990) and Lazonick (1994).

While coordinated market economies on the macro level support co-operative, long-term and consensus-based relations between private as well as public actors, liberal market economies inhibit the development of these relations but instead offer the opportunity to quickly adjust formal structures to new requirements. Such institutional specificities both contribute to the formation of divergent national business systems, and constitute the context within which different organisational forms with different mechanisms for learning, knowledge accumulation and knowledge appropriation have evolved. Through its emphasis on institutional complementarities the 'varieties of capitalism' approach focuses on dynamic ensembles of mutually reinforcing sets of institutions rather than isolating individual forms and their impact. As such it pieces together consistent configurations of institutions and the implications for innovative performance (see table 4).

Varieties of Capitalism	Liberal market economies	Coordinated market economies
Financial regulation	Short-term financial market, equity financing	Long-term patient capital debt financing
Corporate governance	Shareholder value, limited business coordination: antitrust laws	Stakeholder value, strong business associations, intercorporate networks
Innovative Systems	Radical innovation, involving sharp breaks with extant processes	Incremental innovation involving continuos process development
Capital-labor relation	Decentralized bargaining, contentious workplace relations	Coordinated barganing statutory worker representation
Training and employment	Basic education and firm specific training, short tenure, high turnover jobs, high interfirm labor mobility	Vocational training, long tenure, low trnover jobs, low interfirm labor mobility

Table 4 - A summary presentation of varieties of capitalism

The institutional competitive advantage of coordinated market economies appears to be based in the constant upgrading of existing industries and technological trajectories (based on competence building). This upgrading is the product of interactive innovation that involves long-term cooperation – between workers and firms, between firms and between firms and the knowledge infrastructure – to promote interactive learning.

Types of Work Organization and Organizational Learning

The strategic role played by cooperation in coordinated market economies is underlined by the understanding of interactive learning as a fundamental aspect of the process of innovation (Lundvall, 1992). This broader understanding of innovation as a social, non-linear and interactive learning process puts new emphasis on the role played by socio-cultural and institutional structures in regional development. They are no longer vestigial remnants of pre-capitalist civil societies. They are necessary prerequisites for firms and regions to be innovative and competitive in a post-Fordist learning economy (Asheim, 2000). According to Lundvall 'what is at stake is the capacity of people, organizations, networks and regions to learn' (Lundvall, 2004, 1). Furthermore, he emphasizes 'the enormous untapped growth potential that could be mobilized' in traditional sectors of the economy, if the necessary 'institutional reforms and organizational change that promote learning processes' were implemented (Lundvall, 2004, 1). This implies among other things that the introduction of new technology must be accompanied by (internal) organisational changes and competence building among the employees to achieve the expected productivity gains.

If these observations are correct, the implication is that new 'forces' are now shaping technological development in the coordinated capitalist market economies, modifying the nature and importance of competition between firms. Obviously, the contradictions inherent in the capitalist mode of production persist. But, as Lazonick (1993) has argued, "domestic cooperation rather than domestic competition is the key determinant of global competitive advantage. For a domestic industry to attain and sustain global competitive advantage requires continuous innovation, which in turn requires domestic cooperation" (p. 4). Cooke (1994) supports this view, emphasising that, "the co-operative approach is not infrequently the only solution to intractable problems posed by globalization, lean production or flexibilisation" (p. 32).

Important in this context is the fact that the traditional view of learning as only incremental (or reproductive/adaptive) is challenged. Ellström (1997) emphasizes that learning is not only reproductive or adaptive (resulting in imitation) but that it also can be developmental and creative. Ellström uses these categories to make a distinction between developmental learning which he sees as the 'logic' of knowledge exploration on the one hand, and reproductive or adaptive learning which represents the 'logic' of knowledge exploration in his view. The research by Lorenz on the relationship between forms of work organisation in EU and the impact on job stress, worker satisfaction, labour market flexibility, learning, innovation and patenting shows that not only does the learning form of work organization result in less job stress and greater worker satisfaction, it also implies more labour market flexibility, superior conditions for learning and innovation, and even a larger propensity for patenting (Lorenz and Valeyre, 2006). Thus, this confirms that learning also can be developmental and creative due to the high degree of work autonomy and learning dynamics found in learning forms of work organisation.

This micro level explanation focuses on the forms of work organization which dominate the respective economies. Lorenz in a study based on the third European survey on working conditions carried out by the European Foundation for the Improvement of Living and Working Conditions, identifies four main forms of work organisation across European nations (or EU to be precise): 'learning', 'lean', 'Taylorist' and 'simple structure'. The learning forms dominates in Scandinavia and the Netherlands (Norway is not part of this study being outside EU, but a separate study shows that this work organization also is the dominating in Norway), and is found least frequent in Southern European countries and Ireland; the lean forms are primarily found in the UK, Ireland, Spain and France, and are least dominating in the Netherlands, Denmark, Sweden, Germany and Austria; the Taylorist one in Southern Europe and Ireland, and not in the Netherlands, Denmark and Sweden; while the Simple one dominates in the Southern countries of Europe and is most seldom found in the Netherlands, Denmark, Finland and the UK. This study, thus, demonstrates a clear north-south dimension with regard to the dominating forms of work organization, with the Northern European countries dominated by learning forms of work organization, while Southern

European countries have a production organization characterized by either Taylorist or Simple forms of work organization. Among the Nordic countries, in Denmark, Norway and Sweden the production organization is dominated by learning forms of work organization, while Finland is just below and is found in the lean category.

The positive impact of this form of work organization on innovation is also confirmed by a study by Michie and Sheehan (2003) who reports that "'low road' practices – the use of short-term and temporary contracts, a lack of employer commitment to job security, low levels of training, and so on – are negatively correlated with innovation. In contrast, it is found that 'high road' work practices – 'high commitment' organisations or 'transformed' workplaces – are positively correlated with innovation" (Michie and Sheehan, 2003, p. 138).

How to Combine the DUI and STI Modes of Innovation

As was mentioned in section 2 combining the two modes of innovation seems to be the most efficient strategy for firms and regions to improve their innovativeness and economic performance. Firms that have used the STI mode intensively may benefit from paying more attention to the DUI mode and vice versa (Lorenz and Lundvall, 2006; Berg Jensen *et al.*, 2007). In this way, on the firm levels these two modes of innovation can (and should) co-exist, but they will be applied in different combinations depending on the dominating knowledge base(s) of the regional industry.

Here the perspective of cognitive distance becomes crucial (Nooteboom, 2000). If the cognitive distance between the two modes of innovation is perceived by key actors to be too wide, then it will not be possible to combine them. They will be seen as incompatible alternatives rather than complementary modes. There will be a lack of absorptive capacity within firms and regions to acknowledge and appreciate the potential gains of the other mode of innovation as well as to access and acquire the necessary competence for combining them. There are, however, two key 'bridging mechanisms' which could assist in achieving an optimal cognitive distance as a necessary condition for combining the two modes. The first of these deals with understanding that the STI mode is not only limited to an analytical knowledge base, but also includes synthetic and symbolic knowledge bases. In the case of the synthetic knowledge base this can be illustrated by reference to applied research undertaken at (technical) universities, which clearly must be part of the STI mode, but operates on the basis of synthetic (engineering) knowledge (drawing on basic research at science departments of universities creating new analytical knowledge), while the case of symbolic knowledge can partly be substantiated by the new tendency of changing design education from being artisan based to be placed at universities with research based teaching, and partly by the steadily increasing research in game software and new media, which in some countries is located at new, specialized universities. This broadening of what constitute the STI mode of innovation shows that also activities based on synthetic and symbolic knowledge bases needs to undertake new knowledge creation and innovation in accordance with an STI mode, and, thus, needs systemic relations with universities or other types of R&D institutes (e.g. in a regional innovation system context). The other bridging mechanism is the recognition that partly learning is not only reproductive but can also be developmental, and partly the innovative potential that a learning work organization can display in being the operative context for such learning. Even the most science based company will obviously benefit from organizing its work in such a way that learning dynamics is created by giving their employees autonomy in their work. This has to build on the principles of broad participation of functional, flexible workers in accordance with the Nordic model of a learning work organization (Ennals and Gustavsen, 1999).

In order to illustrate the importance of these bridging devices even further we shall give a concrete example taken from a large, international company that is world leading within its area. This is an engineering company whose products are based on a synthetic knowledge base with all the typical characteristics of this knowledge base: problem-solving and custom production based on interactive learning with customers and suppliers. Knowledge is partly codified with a strong tacit component, and is clearly context-specific. Core competence of the company is to comprehend the complex construction process of the equipment in a holistic way. The point is not to understand the individual 'machines' being needed, but to understand the individual machines as part of a system. This is a very complicated process with more than 1000 different steps, which clearly underlines the problem-solving and custom oriented production of a typical synthetic, engineering based company. This is a good example of the importance of tacit, context (*i.e.* product)-specific knowledge as one of the most important sources for sustaining the firm's competitive advantage.

When asked about how they organized their innovation activity the R&D director of the company made an important distinction between *application* development and *technology* development. Application development means solving concrete problems in connection with building the specific equipment for customers. This is carried out drawing on internal engineering competence as well as in interaction with suppliers and customers, and is, thus, an example of the DUI mode of (incremental) innovation. In addition professional R&D firms (consultancy firms) domestically and abroad are used. Technology development means development of more general platform technologies, which represents the technological basic competence for carrying out application development. While the application development is only made in-house or in user-producer relationships, technological development takes place in cooperation with (technical) universities as applied research projects, and represents, thus, the STI mode of innovation but still based on synthetic knowledge. In cooperation with universities on applied research projects geographical proximity matters most, and instead of always accessing the best competence globally found at places such as MIT, the company chooses to focus on the geographically closest available competence. Thus, they prioritize building up research cooperation with the regional university (*i.e.* University of Agder, Grimstad campus) by among other things employing some professors in 20% positions in the company as a way of strengthening the competence at the university to be applied in collaborative research projects. In addition they take a central part in funding and using a regional, applied research organization (Teknova). The company called this form of carrying out applied research 'cooperation at the operational level', which, according to the company, is the right level of research collaboration for technological development. To achieve this, geographical proximity is of great importance. In addition the company cooperates with national (Norwegian Technical University in Trondheim) and international top universities (e.g. Carnigie Mellon University, Pittsburg and Denmark's Technical University, Copenhagen) in research projects on technological development, which always involve company funded PhD's to secure a more long-term 'payback' for the company. In order to strengthen the relationship to the company they also make sure that one of the supervisors is coming from the company, which provides organizational as well as institutional proximity (Boschma, 2005).

This example illustrates how such a bridging mechanism can work to solve the problem of a too wide cognitive distance, and, thus, achieve a combination of the two modes of innovation. Furthermore, the example illustrates how 'second best' regional universities can be used and upgraded by large companies to become active partners in collaborative R&D projects in addition to the companies also using non-local, more internationally leading universities.

Conclusion

What kind of regional policy should be implemented to construct regional advantage? Research carried out in the SMEPOL project - SME policy and the regional dimension of innovation (Asheim *et al.* 2003) - demonstrated the need for a more system-oriented as well as a more pro-active innovation based regional policy. In the project, SME innovation policy tools were classified in two dimensions, resulting in a four quadrants table (Figure 3). The figure distinguishes between two main aims of the support tools. Some tools aim at giving firms access to resources that they lack to carry out innovation projects, *i.e.* to increase the innovation capacity of firms by making the necessary resource inputs available, such as financial support for product development, help to contact relevant knowledge organisations or assistance in solving specific technological problems, where the absorptive capacity of the firm is critical. The other type of instruments have a larger focus on learning, trying to change behavioural aspects, such as the innovation strategy, management, mentality or the level of awareness in firms, where the skill levels of the workforce are a major determining factor of the outcome (e.g. in the context of learning work organisations).

	Support: **Financial and technical**	**Behavioural change:** **Learning to innovate**
Firm-focused	Financial support Brokers	Mobility schemes Learning work organizations
System-focused	Technology Centres	Regional Innovation Systems

Figure 3 - Regional innovation policy: A typology (Asheim *et al.*, 2003)

An appropriate way to design and implement an instrument aimed at assigning lacking resources to firms (following an evolutionary approach to policy) is, thus, to do it according to a learning-to-innovate framework. In line with this perspective the objective of policy instruments is not solely to provide scarce resources (such as financial assistance) to innovating firms per se but also to promote learning about R&D and innovation and the acquisition of new routines within firms, where highly skilled people and adequate skill provision in the regions are critical resources in order to increase the absorptive capacity. Lack of demand is often a bottleneck for financial incentives to innovation activity, *i.e.* that firms initially do not see the need to innovate, or alternatively, that firms do not have the capability to articulate their need for innovation. Some policy instruments should, therefore, also attempt to enhance demand for initial innovation activity of firms (*i.e.* apply a learning perspective), and, thus, must include an explicit behavioural aspect with an ultimate policy target of promoting the innovation activity of enterprises.

The other dimension includes the target group of instruments. Some tools focus on innovation and learning within firms, to lower the innovation barriers of firms, such as lack of capital or technological competence. Other instruments to a larger extent have regional production and innovation systems as their target group, aiming at achieving externalities or synergies from complementarities within the regions. The barriers may for example be lack of user-producer interaction or lack of relevant competence in the regional knowledge organisations to support innovation projects.

Instead of market failure, the rationale for policy intervention is to address system failures by reducing the interaction or connectivity deficits which lies at the core of the regional innovation systems approach (Cooke, 2004). This will require a platform-oriented regional policy as well as a new focus on learning aiming for behavioural value-added (*i.e.* learning firms to innovate) (Asheim *et al.*, 2003; Asheim *et al.*, 2006). The platform approach to regional innovation policy as a generic approach is not only applicable for high-tech industries, but can also be applied for industries drawing on different knowledge bases traditionally associated with medium and low-tech, manufacturing as well as service industries. One example of this could be using a platform strategy to upgrade tourism combining natural scenery with gastronomy, cultural events and historical heritage. In this way it represents a strategy for securing employment in a range of manufacturing industries and services with highly differentiated educational and skills requirements and gender profiles, and, thus, can provide the structural prerequisites for reducing social inequality and promoting regional cohesion in addition to regional competitiveness.

As a result of the growing complexity and diversity of knowledge creation and innovation processes, firms need to acquire new external knowledge to supplement their internal, core knowledge base(s). This implies that a shift is taking place from firms' internal knowledge base(s) to trans-sectoral and trans-local distributed knowledge networks (Smith, 2000). Such knowledge flows can take place between industries with different degrees of R&D intensity and different knowledge base characteristics. An example of this is when food and beverages firms (predominantly drawing on a synthetic knowledge base with a very low R&D intensity) produce functional food based on inputs from biotech firms (high tech firms predominantly drawing on an analytical knowledge base). This shows that distributed knowledge networks often transcend industries, sectors and the common taxonomies of high or low tech. This example provides a good illustration of how knowledge spillovers happen in distributed knowledge networks between firms with complementary knowledge bases and competences (*i.e.* related variety). It also demonstrates that major innovations are more likely to occur when knowledge spills over between related industries. This is especially facilitated where the knowledge spillover takes place between industries involving generic technologies (such as IT, biotech and nanotech) (Frenken *et al.*, 2007). This emphasizes the potential importance of related variety within and between traditional sectors, combining the strength of the specialization of localization economies and the diversity of urbanization economies. Not the least for disadvantaged regions in developed economies the possibilities of upgrading and restructuring an old industrial structure by relating traditional manufacturing industries in food and metal working to emerging biotech based industries internally or externally to the region (green and white biotech) could represent a shortcut for firms and regions to becoming innovative and competitive.

The possibility of designing 'one-size-fits-all' regional policies is no longer valid. Copying of best practices is almost impossible when it comes to intangible regional assets that are the results of long histories in particular regional contexts. Therefore, platform policies have to be inspired by endogenous capabilities and capacities, as embodied in related variety (Asheim *et al.*, 2006). However, pursuing such region-specific policy is not to say that regional policy should rely on the region itself. Network linkages in general and non-local linkages in particular, are often found crucial for learning and innovation, in order to avoid cognitive lock-in. For firms, being connected may be as important, or even more so, than simply being co-located (Giuliani and Bell, 2005). This has further implications for regional innovation policies of constructing regional advantage.

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