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Contents

The qualitative leap in the ways in which knowledge is created, shared and used is leading to the emergence of the so-called knowledge society. The conditions for its development differ from one area to another in terms of the areas' positions relative to important centres and lines of communication and in terms of the communications relationships and networks that have formed. Spatial policy faces the challenge of addressing these developments.

1 Introduction

With the growing importance of knowledge in all processes in society, the importance of what has been called the industrial society is declining. It is being replaced by a social model in which the creativity of human activity, the organisation of learning processes, the systematic production of knowledge, and the dissolution of the hierarchical division of labour are gaining ever greater influence. This social trend, which has been accelerating in the last two decades, has come to be known as the *knowledge society* (cf. Stehr 2001).

This is not to imply that knowledge played no role in the past; it rather expresses the idea that knowledge is used more systematically today and that actions taken on the basis of knowledge are performed more purposefully in all parts of society (reflexivity). This is reflected in a higher social standing for education and advanced training, and also in the relevance attained by public and private research achievements in basic and applied research. The transformation related to the knowledge society is especially evident in economic relationships and in knowledge work. The need for economically useful knowledge (expertise) is growing in more and more sectors of the economy, while knowledge-based material production and work is also on the rise. Knowledge has now become the most important 'raw material' for the production of goods, with its systematic refinement bringing forth innovations in products and processes (▷ *Innovation, innovation policy*). The economic and social dynamics of knowledge are accompanied by social changes that are calling traditional orientations based on kinship and class into question.

2 Features and characteristics of knowledge

To understand what is special about the knowledge society, one must begin by considering in detail the features and characteristics of knowledge. Knowledge refers to our relationships with objects, facts, rules and other actors, insofar as they can be grasped by our imagination, orient us and give us competence in the sense of the ability to act.

2.1 Knowledge, information and data

Knowledge is generated from data and information. Data essentially refers to facts, signs, numbers and symbols that enable distinctions to be made and can be combined using certain codes. Data can be transmitted over large physical distances without the need for personal interaction between the bearers of the knowledge. Data becomes information when it is analysed and specific relevance is attributed to it. Information can also be transmitted over large physical distances between those who have the relevant prior knowledge. Finally, knowledge results from combining a variety of information that is understood, interpreted and interconnected by the bearers of knowledge. Transmitting knowledge over large distances involves compression and conversion to communicable information and explication into verifiable data.

2.2   Types of knowledge and knowledge bases

Knowledge is not a homogeneous resource: it can be divided into scientific knowledge knowledge (knowing what and knowing why) and practical knowledge (ability, skills: know-how). Whereas scientific knowledge knowledge is largely explicit (codified), practical abilities are mostly based on implicit (unstated) knowledge. Implicit knowledge includes personal abilities, ideas, intuitions and abilities that are difficult to articulate and that people do not consciously recognise as such or which they acquire through practice ('learning by doing') or interaction in social settings ('learning by interacting'). In contrast, explicit knowledge is expressed in a formal language and can be stored and transmitted in codified form using media.

With respect to their origins, the two types of knowledge are connected with three different knowledge bases: (1) analytical knowledge (science-based knowledge about facts and causes – knowing why), (2) synthetic knowledge (knowledge about actions and procedures – know-how) and (3) symbolic knowledge (semiotic knowledge, meanings, aesthetic qualities). Symbolic and synthetic knowledge are strongly influenced by implicit knowledge, whereas the development of analytical knowledge is based more strongly on codified knowledge and can itself generate new codified knowledge (cf. Asheim 2012).

2.3   Knowledge conversion and learning

All new knowledge initially appears as implicit knowledge that is only known to those with whom it is shared in direct personal contact. However, the knowledge society is driven by the endeavour to convert substantial amounts of this knowledge into a systematic and codified form and thus make it accessible to a much larger group of people. In this way, a growing share of our knowledge becomes available as codified and objectified knowledge and thus comprises a key cultural resource for society. The ability to use this resource determines the commercial success of businesses, the opportunities available to individuals (▷ *Lifestyles*), and the social influence of individuals and groups.

In order to add this codified knowledge to their own knowledge, its users must be able to absorb it, i.e. to assign a meaning to its information; this requires shared cognitive models and a common language. Nonaka and Takeuchi (1995) describe this process of acquiring new personal knowledge as a knowledge spiral that is characteristic of the knowledge society and in which implicit knowledge is continuously converted into explicit knowledge and vice versa. In this way, they describe the process of learning that shapes the knowledge society.

3   Dimensions of the knowledge society

There are social, economic and technical aspects to the way in which the processes of knowledge exchange and learning are organised and how the associated communicative cooperation is structured. These three dimensions can be used to understand the development of the knowledge society and its spatial implications.

3.1   Social dimension

In the social dimension, knowledge is seen as a capacity to act that only achieves its potential dynamic (learning) in social relationships. Correspondingly important and formative factors for the knowledge society include personal learning, e.g. education, on the one hand and collective learning processes in which the knowledge of many actors is brought together and combined into new knowledge on the other. As the amount of knowledge grows ever larger, the actors are compelled to specialise while also combining their specialised knowledge with the knowledge of the others. It follows that strategic action in the knowledge society is not the result of isolated decisions by individuals but emerges as the knowledge of many actors is pooled in models that anticipate the future (planning, projections). The causes of deviations in actual events are systematically investigated and fed back into the various fields of action. Knowledge thus changes from a stabilising factor for social practices to a factor in the dynamic shaping of social relations. It becomes a challenge in its own right as it is continuously revised, regarded as always open to improvement, and is provided as a renewed resource for social actors. It undergoes constant change, which can cause increased uncertainty and make reflexivity, i.e. systematic and self-critical questioning of knowledge, a defining characteristic of the knowledge society.

3.2   Economic dimension

The shift to knowledge-based systems is also reflected in economic changes that in turn have an impact on social relationships. This shift is characterised by radical changes from material inputs to symbolic or knowledge-based inputs into production processes. Conventional production factors such as land, capital and labour are increasingly being eclipsed by knowledge: scientific innovations, the expertise of knowledge workers, the ability to systematically transfer this expertise to material and immaterial goods and services on the one hand and to regularly question it on the other, and the organisational restructuring of the economy into strongly interconnected and less hierarchical systems of knowledge exchange – these aspects are what is new about the knowledge-based economy. It is based on highly specialised and interconnected knowledge work on the one hand and a strong entrepreneurial spirit on the other. As a productive force, knowledge is now entrenched in virtually all economic processes and sectors. It is changing the structure of our economy and leading to the emergence of new operational priorities in business, such as knowledge-based business services ▷ *Services*, the creative sector (▷ *Creative sector and cultural sector*) and industries based on advanced technologies. They can be collectively referred to as the *knowledge economy* (cf. Kujath/Schmidt 2010).

3.3   Technical dimension

The importance of networks (▷ *Networks, social and organisational*) and communication is stressed in both social and economic relationships. In turn, networks and communication build on technical conditions, innovations in transport and communications infrastructure and media in general to integrate localities into supra-regional (national and global) structures (▷ *Information and communication technology*; ▷ *Mobility*). The digital revolution has enabled people to network in virtual spaces, contributing to a rapid expansion in the exchange of information and knowledge. This makes global knowledge links possible so that peripheral spaces can become connected on the one hand, while the greater ease of information exchange stimulates innovation (▷ *Innovation,*

innovation policy) and learning processes on the other: in business, new internet-based logistics systems have revolutionised the exchange of goods and information among businesses and between businesses and their customers. Virtual social networks, online shopping and every imaginable type of information are today organised on the internet, leading to fundamental changes in communication and mobility, everyday work, and free time and consumption habits. And in networked industrial production, the new digital technologies are increasingly fusing the virtual world with the production of real goods to the extent that machines can now communicate with one another (*smart factory*).

4   Spatial variations in the knowledge society

4.1   Proximity and distance

The meaning of proximity as a spatial category is changing as the knowledge society evolves. Proximity is not limited to the physical/spatial proximity and accessibility of opportunities and actors. In the knowledge society, proximity is primarily established in communicative relationships that are strengthened when the actors operate in shared knowledge contexts, i.e. they have shared perceptual patterns and interpretive models (social and cultural proximity), shared rule systems (institutional proximity), a shared language and shared coding rules (cognitive proximity) (cf. Boschma 2005). All three forms of proximity are conducive to the exchange of knowledge, but they also harbour the risk of isolation from knowledge contexts that limits opportunities to expand knowledge and learn. In order to stimulate the learning dynamics typical of the knowledge society, actors need to communicate beyond the boundaries of their own knowledge, for example by bridging cognitive and cultural gaps. Such communication includes confronting one's own personal experiences with a foreign knowledge context; this confrontation involves both content and language and the rules of communication and cooperation. The success of the learning process depends on whether and how actors are able to understand and evaluate new foreign, external information and integrate it into their own knowledge contexts.

Physical proximity can be established either permanently or temporarily. It does not per se lead to an exchange of knowledge between different bearers of knowledge, but it facilitates personal contact and the direct conversations that are among the most intense forms of communication. In this respect, physical proximity in relationships can help to bridge the aforementioned gaps; the more complex and implicit the knowledge to be conveyed is, the more important proximity becomes. Above all, physical proximity thus promotes knowledge exchange and learning processes in informal networks, contributing to so-called knowledge spillovers that are considered especially important for regional economic innovation and development processes (cf. Döring/ Schnellenbach 2006). In contrast, all knowledge based on fixed contractual rules and codification can be freed from local ties more easily.

Though physical proximity can have a supportive effect, it can also hinder learning processes when the actors only have a homogeneous and locally specific stock of knowledge at their disposal and do not cross regional knowledge boundaries. Being able to absorb and process new information from other regions is one of the key challenges for the development of the knowledge society's learning and innovation processes in a ▷ *Region* with a limited knowledge profile. To this

end, cognitive and cultural gaps must be overcome on the one hand and often physical distances on the other. When a region is successful at absorbing external, foreign knowledge, it develops into a learning region. In contrast, there are regions with self-contained knowledge contexts where such learning processes are unsuccessful (lock-in effect).

4.2 Spatial specialisations

In the tension between proximity and distance, agglomerations (▷ *Agglomeration, agglomeration area*) offer numerous advantages for the development of the knowledge society's learning dynamic. Here actors can seek personal contact with other actors at a relatively low cost to build up a closely-knit communications network that can be used to generate new ideas, and there is often a wide range of specialised knowledge from all three knowledge bases that can be combined to create new knowledge. The knowledge-based economy in these regions is generally more diverse thanks to their wide range of specialised knowledge, and their cultural or scientific institutions form a viable critical mass that is not available in other regions. Moreover, because of their role as telecommunication nodes and passenger transport hubs, agglomerations are privileged places for establishing temporary physical proximity between bearers of knowledge who can be dispersed worldwide.

Based on these favourable conditions for the knowledge society dynamic in large agglomerations, the conclusion is often drawn that only there can the knowledge society thrive and also – in a mutually reinforcing process – contribute to the formation of further agglomerations (cf. Florida 2005). This conclusion can at best be confirmed as a tendency. Not all agglomerations are capable of supporting the learning dynamics of a knowledge society (e.g. old industrial regions), and there are regions that play a crucial role in the knowledge society in spite of their remoteness and their relatively narrow knowledge profile. Given that physical proximity and diverse specialised knowledge are only two factors for the development of individual regions in the knowledge society, there are also positive prospects for regions with a smaller range of specialised knowledge, for example in ▷ *Rural areas*. Of fundamental importance for these generally smaller clusters of knowledge is that they (1) develop a learning dynamic that is less dependent on the advantages of agglomerations, e.g. in the refinement of application-related knowledge, and (2) base their learning and innovation capabilities not on locally specific stocks of knowledge that are limited compared with those in agglomerations but on supra-regional and even global networks and communities. Local labour pools with specific skills and working cultures, local companies, and transport, communications, education and research infrastructures (▷ *Infrastructure*) comprise a resource that offers these regions the opportunity to absorb and process globally distributed knowledge (cf. Maskell/Malmberg 2006).

In Germany, these assumptions regarding a differentiated spatial structure for the knowledge society are clearly visible in reality (cf. Kujath/Stein 2009):

- *Diversely structured regions of the knowledge society*: The knowledge society in the large agglomerations (cities with more than 500,000 inhabitants and their surroundings) has developed a diversity in which all three knowledge bases play an important role. Knowledge-intensive services (synthetic knowledge), the creative sector and cultural sector (symbolic knowledge), and also cutting-edge technology and science, research and education (analytical knowledge) form the profile of the knowledge society here.

- *Science and service regions*: In the vicinity of universities and publicly subsidised research institutions, new prospects have emerged for many regions on the edges of agglomerations or in rural areas throughout Germany. From a weak industrial base, new prospects for the knowledge economy have developed in private research and development services, corporate consulting and the information and media industry.

- *High-technology regions*: In western Germany, there is a common type of region outside of the agglomerations that is based on path-dependent, locally rooted industrial development (▷ *Industry/trade*) and the knowledge profiles arising in its production processes. Knowledge emerging from the context of local applications dominates the economic and social development in these regions. This development path is currently undergoing a transformation as a result of the knowledge society, with people's qualification levels being raised to an academic level through basic and continuing education and research and development being integrated into the innovation processes of the mostly small and medium-sized enterprises.

- *Regions with average knowledge society features*: The knowledge society dynamic is also reaching regions that were previously behind in economic and social development. They can be found all over Germany. Regions of this type do not have a pronounced knowledge economy profile. They are in the process of closing the gap and restructuring. Starting from an economy based on manual and industrial labour, they are mostly seeking access to the developments that are already in progress in high-technology locations, often by expanding educational opportunities and applied research facilities. This process is accompanied by a rapid rise in employment in certain technology fields.

5   Implications for spatial policy

A consideration based solely on the internal knowledge society situation within the regions does not do justice to the described knowledge society profiles, because the characteristics related to the knowledge society within the regions are not the result of isolated local or regional developments, but instead result from competition and selection processes to which each region is exposed in contexts that are supra-regional (with a global tendency) and which result in efforts to raise their profiles and participate. Figuratively speaking, the successful regions tend to be 'nodal landing places' (cf. Castelis 2010) that are involved in supra-regional discussions. In these relationships, they develop their own particularities in relation to the knowledge society. These processes largely take place on their own in the aforementioned regions that benefit from the knowledge society. In contrast, in the other regions that are less successful or are peripheral to the knowledge society, the development of such structures calls for targeted political action at three levels: (1) profiling the locality in competition with other localities, (2) intra-regional networking to create critical masses, and (3) integrating the locality in supra-regional knowledge networks to gain access to external knowledge.

- *Local level*: Local knowledge milieus can be developed as places of knowledge generation and learning at the local level. To support the process of milieu-building (▷ *Milieu*) and local knowledge networking, and in part to set it in motion, these places face the challenge of encouraging, through a variety of initiatives, a knowledge society dynamic driven by key players to mobilise not only entrepreneurs and educational institutions but also broad

segments of the local population. That requires a knowledge-based local moderation and coordination strategy to promote the integration or consolidation of various knowledge networks that often already exist locally in education, culture, research and business. In urban development terms, the development of 'knowledge districts' or 'creative districts' is an integral part of such a strategy, as is a stronger focus on attractive urban and landscape development to meet the needs of knowledge workers and their families. Especially in smaller cities, technology centres are established, which offer smaller businesses the use of expensive infrastructure at low cost.

- *Regional level*: Problem-solving and strategy development cannot generally be carried out in isolation at the local level. The individual localities are dependent on the knowledge potential in their vicinity; at the same time, they assume an anchoring function for the region around them. Therefore, in order to strengthen local specialised knowledge, it is essential to organise cooperation with knowledge society actors from the region or from neighbouring cities and municipalities. This enables critical masses to emerge; they form from the themed networks of knowledge actors in education, research, culture, science and business and help to develop regional profiles and counteract decoupling processes. These networks serve less to expand the local 'knowledge milieu' than to establish functional areas for the knowledge society.

- *Supra-regional (national and global) level*: The supra-regional level plays a special role in a strategy for expanding local specialised knowledge, but this role is often neglected by local and regional actors. While the agglomerations have a wide range of knowledge that is also supported by international migration to these areas, the knowledge base in the smaller centres outside the agglomerations is relatively narrow. It does not expand automatically, so special efforts are needed. Essential to this effort is supra-regional communication expertise, e.g. through language acquisition or learning intercultural teamwork skills. Only when these skills are available can local actors overcome the distances stemming from specialist disciplines or cultural differences, absorb external knowledge and drive cross-border innovation processes. In peripheral regions in particular, this objective is also served by important return strategies for knowledge workers who have left the region for a certain phase of their lives and are in principle willing to return. The importance of return strategies lies in the fact that knowledge workers who have returned to their home locations often maintain their network connections to external knowledge sites and as 'boundary spanners' are able to transfer external knowledge from there to their local areas. In addition, high-performing connections established via information and communication technology (ICT) are a necessary technical prerequisite for network creation over large physical distances. Another key component from a physical perspective is to ensure connections to high-capacity transport networks, for example to the high-traffic stations in the main ICE network, and in this context also to create opportunities for temporary contacts (trade fairs, events) in the region's centre. Finally, a local-regional image that helps to position the region in international competition is important to a region's ability to communicate internationally.

There are no universally applicable procedural rules for political arrangements on the three spatial levels. In essence, however, it is always a matter of profiling the local knowledge context by initiating local learning processes, connecting with regional knowledge potential, and overcoming cognitive and cultural distances in supra-regional contact and cooperation networks.

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