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Changing Value Chain of the Swiss Knowledge Economy: Spatial Impact of Intra-firm and Inter-firm Networks within the Emerging Mega-City Region of Northern Switzerland

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Changing Value Chain of the Swiss Knowledge Economy: Spatial Impact of Intra-firm and Inter-firm Networks within the Emerging Mega-City Region of Northern Switzerland

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THIERSTEIN A., LÜTHI S., KRUSE C., GABI S. and GLANZMANN L. Changing value chain of the Swiss knowledge economy: spatial impact of intra-firm and inter-firm networks within the emerging Mega-City Region of Northern Switzerland, *Regional Studies*. Based on an empirical analysis of intra-firm and inter-firm connectivities, this paper focuses on the spatial behaviour of advanced producer services (APS) firms and their relevance for polycentricity in the emerging Mega-City Region of Northern Switzerland. APS firms are found to be the main drivers of the emerging Mega-City Region. Although Zurich seems to be the central node in national APS networks, it is the complementary combination of Zurich and Basel, together with some secondary centres, that raises the emerging Mega-City Region to a competitive level in the context of the global economy.

Knowledge economy Value chain Polycentricity Mega-City Regions Network analysis

THIERSTEIN A., LÜTHI S., KRUSE C., GABI S. and GLANZMANN L. 瑞士经济变更的价值链-瑞士北部地区城市区域内公司相互间以及公司外部网络的空间影响, 区域研究。基于公司内外相互关联性的实证分析。本文着重讨论了高级服务产业的空行行为, 以及这些行为与瑞士北部地区城市区域多中心性的相关性。高级服务产业被认为是导致巨型城市区域产生的主要动力。尽管表面上看苏黎世是国家高级服务产业网络的中心节点, 然而正因为苏黎世与Basel进行互补性结合同时整合了相关二级城市, 巨型城市区域在全球化经济语境下的竞争力才得以提升。

知识经济 价值链 多中心性 巨型城市区域 网络分析

THIERSTEIN A., LÜTHI S., KRUSE C., GABI S. et GLANZMANN L. L'évolution de la chaîne des valeurs dans l'économie de la connaissance suisse – l'impact géographique des réseaux intra et interentreprises au sein de la naissante méga-cité-région de la Suisse du Nord, *Regional Studies*. A partir d'une analyse empirique de la connectivité intra et interentreprises, cet article cherche à focaliser le comportement géographique des services à la production avancés (advanced producer services, APS) et leur importance pour ce qui est du maillage polycentrique de la naissante méga-cité-région de la Suisse du Nord. Il s'avère que les entreprises APS sont les principales forces motrices de la naissante méga-cité-région. Bien que Zurich semble être le noyau central des réseaux APS nationaux, c'est le binôme Zurich-Basel, conjointement avec quelques centres secondaires, qui élèvent la naissante méga-cité-région au rang compétitif dans le cadre de l'économie mondialisée.

Economie de la connaissance Chaîne des valeurs Maillage polycentrique Méga-cité-régions Analyse des réseaux

THIERSTEIN A., LÜTHI S., KRUSE C., GABI S. und GLANZMANN L. Die veränderte Wertschöpfungskette der Wissensökonomie in der Schweiz. Räumliche Auswirkungen von firmeninternen und firmenexternen Standortnetzen in der Metropolregion Nordschweiz, *Regional Studies*. Der Artikel betrachtet das räumliche Verhalten von wissensintensiven Dienstleistungsunternehmen und deren Relevanz für die polyzentrische Raumentwicklung der Metropolregion Nordschweiz. Die Resultate basieren auf einer Analyse von firmeninternen und firmenexternen Standortverflechtungen und machen deutlich, dass die wissensintensiven Dienstleistungsunternehmen die treibenden Kräfte der Metropolregion Nordschweiz sind. Zürich erweist sich zwar als zentraler

Standort für internationale Netzwerke wissensintensiver Dienstleistungsunternehmen. Erst die Komplementarität von Zürich, Basel und weiteren nachrangigen Agglomerationen führt jedoch zur nötigen kritischen Masse, damit die Metropolregion Nordschweiz im internationalen Standortwettbewerb bestehen kann.

Wissensökonomie Wertschöpfungskette Polyzentrität Metropolregionen Netzwerkanalyse

THIERSTEIN A., LÜTHI S., KRUSE C., GABI S. y GLANZMANN L. La cambiante cadena de valores de la economía suiza del conocimiento: impacto espacial de las redes intra e interempresariales en la emergente región mega-ciudad al norte de Suiza, *Regional Studies*. Basándonos en un análisis empírico de las conexiones intra e interempresariales, en este artículo abordamos el comportamiento espacial de los servicios avanzados al productor (SAP) y su importancia para la policentralidad en la emergente región mega-ciudad al norte de Suiza. Observamos que las empresas SAP son los principales impulsores de la emergente región mega-ciudad. Aunque Zúrich parece ser el nodo central en las redes nacionales de SAP, es la combinación complementaria de Zúrich y Basilea, junto con algunos centros secundarios, lo que eleva la emergente región mega-ciudad a un nivel competitivo en el contexto de la economía global.

Economía del conocimiento Cadenas de valores Policentralidad Regiones mega-ciudad Análisis de redes

JEL classifications: D83, D85, R12, R30

INTRODUCTION

The knowledge economy is undergoing a process of spatial segregation. It tends to build a network of specialized service providers who cover different parts of the value chain. Most corporations build up their location network as a strategic tool to optimize their added value and to compete successfully in the global economy. Such networks can be organized either intra-firm or inter-firm. Intra-firm networks are spatially distributed branches of one individual corporation. The basic premise of these networks are that the more important the office, the greater its flow of information to other office locations (TAYLOR, 2004). Inter-firm networks, on the other hand, are relations between corporations and business clients or suppliers based on contracts, joint ventures or shared projects. It is assumed that the value-added intensive elements of these networks tend to be increasingly anchored within Mega-City Regions due to the quality of infrastructures like airports, higher educational institutions, research facilities or large settlements of leading global companies, as well as the availability of specific knowledge (THIERSTEIN *et al.*, 2006). Both, intra-firm networks and inter-firm networks are important in analysing the patterns of the changing value chain of the knowledge economy because they illustrate the spatial division of labour and determine the degree of internationalization of Mega-City Regions.

Manuel Castells's *The Information Age: Economy, Society and Culture* (1996) is one of the most influential works for world city studies today. His thoughts have stimulated a new perception of spatial and urban development. He argues that:

our societies are constructed around flows: flows of capital, flows of information, flows of technology, flows of organizational interactions, flows of images, sounds and symbols. . . .

(CASTELLS, 1996, p. 412)

Thus, he proposes the idea that there is a new spatial form characteristic of social practices that dominate and shape the network society. He calls it the 'space of flows' (CASTELLS, 1996, p. 412).

Spaces of flows play a key role in the scientific discussion about Mega-City Regions, which can be defined as clusters of towns and cities that are increasingly interconnected across geographical space through travel and non-physical communication (HALL and PAIN, 2006, p. 4). An important driving force in Castells's space of flows is the knowledge economy. It can be defined as that part of the economy that requires highly skilled workers and a substantial proportion of research activities. Advanced producer services (APS) firms are important actors within the knowledge economy showing increasing employment rates (THIERSTEIN *et al.*, 2006, p. 40). In the present paper the term 'APS firm' refers to the following business lines: accountancy, advertising, banking/finance, design, insurance, information and communication technologies consultancy, law, third-party and fourth-party logistics, and management consultancy.

Over recent decades Switzerland has experienced the reorganization of functional-territorial division of labour in the knowledge economy. The opportunity for flexible spatial organization of company locations has influenced business strategies and location decision-making. The workforce is becoming more mobile, which results in increasing numbers of commuters, increasing commuting distances, and growing built-up areas in the outer belts of the agglomeration leading to urban sprawl and hybrid landscapes. Bordering along historical urban cores a patchwork of urban and rural areas has been formed, evolving into a new kind of urbanized landscape. The growing relevance of the knowledge economy is a driving force slowly altering regional development and spatial functional specialization. Their impact often goes beyond the

official spatial development policies of the government system (ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD), 2002). Swiss spatial planning guidelines still struggle to acknowledge the existence of a functional spatial level. Obviously, there is a mismatch between the objectives and strategies for sustainable spatial development, and actual development tendencies. Whereas planning principles are based on a normative, territorial logic, actual spatial development follows a functional logic, largely driven by market forces (GABI *et al.*, 2006, p. 168).

A similar situation can be observed within the European policy discussion, which is faced with an overarching dilemma between territorial cohesion and economic competitiveness. On the one hand, the Lisbon Agenda, adopted by the European Council, seeks to make Europe the world's most competitive and dynamic knowledge economy by the year 2010 (EUROPEAN COUNCIL, 2000). By stressing the development of the knowledge economy and its innovation processes, it reflects the current scientific understanding of contemporary global economic changes. On the other hand, there is the European Spatial Development Perspective (ESDP) and the later Gothenburg Agenda, which promotes a more balanced and sustainable pattern of urban development across Europe, reducing the weight of the central urban zone of North West Europe (the London–Paris–Milan–Munich–Hamburg Pentagon) (EUROPEAN COMMISSION, 1999). The focus is on the paradigm of balanced territorial development to be promoted through polycentricity, largely based on a morphological view of spatial development. Unfortunately, the urban functional complementarities within and between Mega-City Regions are not recognized. Territorial cohesion, as proposed in the ESDP, might well suggest promoting growth in lagging areas, even at the expense of the most dynamic and competitive regions (HALBERT *et al.*, 2006, p. 207).

An Informal Ministerial conference was held in Leipzig, Germany, on 24 and 25 May 2007 within the framework of the German European Union Council Presidency. On the occasion of this conference, ministers responsible for Spatial Development in European Union Member States agreed on the 'Territorial Agenda of the European Union'. It supports the implementation of both the Lisbon and the Gothenburg Strategies through an integrated territorial development policy (EUROPEAN UNION, 2007). Unfortunately, the Territorial Agenda hardly addresses the importance of the knowledge economy and the functional division of knowledge-intensive businesses in a spatial perspective.

Before the launch of new political strategies boosting polycentric spatial development there is a need for a deeper understanding of the interrelationships between polycentric spatial development and economic competitiveness. Economic competitiveness is strongly related to innovative enterprises and their performance,

especially APS. The key aim of this paper is, therefore, to investigate empirically the functional polycentric patterns and interlocking networks of APS firms. In the form of a case study, the physical and non-physical functional connectivity of APS firms in the emerging Mega-City Region of Northern Switzerland are analysed on different geographical scales. By analysing the changing value chains of APS firms, the functional logic of actual territorial development is shown. In doing so, the paper refers to the analysis of data from the Swiss Federal Statistical Office (NOGA statistics) and the results of empirical analysis of the INTERREG IIIB research project POLYNET (HALL and PAIN, 2006; THIERSTEIN *et al.*, 2006). Three main aspects will be investigated empirically: first, the structure and dynamics of the knowledge economy; second, the spatial patterns of intra-firm networks on an international, national and regional scale; and third, the spatial patterns of inter-firm networks within the emerging Mega-City Region of Northern Switzerland. These analytical findings will be related to the theoretical debate in regional sciences and to the concept of polycentric regional development. The paper is structured in four main sections. The first section focuses on the knowledge economy and its impacts on spatial development. It introduces knowledge and learning within an institutional as well as a territorial context. The next section picks up the concept of Mega-City Regions by discussing associated theoretical approaches, and it clarifies the definition used in the POLYNET study. Afterwards, the understanding of Mega-City Regions is introduced as the results of spatial systems of value chains. The third section combines the two foregoing streams of reasoning by analysing the knowledge economy in the emerging Mega-City Region of Northern Switzerland. This will be done in three parts. The first part defines the study area in which functional polycentricity and economic interrelations are analysed. The second part shows the changing structure of the knowledge economy by focusing on sectoral patterns of structural change in order to show the different development processes of knowledge-intensive activities. The third part presents the results of the empirical analysis of the intra-firm and inter-firm connectivity of APS and shows the polycentric interlocking network between the different firms and institutions of the knowledge-economy throughout the value chain. The fourth and final section concludes by discussing the intricacies of morphological and functional polycentricity in the emerging Mega-City Region of Northern Switzerland.

THE KNOWLEDGE ECONOMY AND SPATIAL DEVELOPMENT

The focal point of the knowledge economy is the concept of knowledge. Following the work of

Michael Polanyi, knowledge can be divided into two major categories: codified and tacit (POLANYI, 1967). Codified knowledge can be applied, expressed and standardized. Hence, it is a marketable good that can easily be distributed over time and space. Tacit knowledge, in contrast, refers to knowledge that cannot be easily transferred. It comprises skills based on interactions and experiences. Since the transfer of tacit knowledge requires direct face-to-face interactions, the finding of Polanyi is of great importance for regional science. It raises the question of accessibility and spatial proximity in the context of the knowledge economy. The spatial characteristics of knowledge economies can be seen through the history of regional sciences and the analysis of regional economic literature. The following section gives a brief overview of the scientific debate about the knowledge economy by discussing the understanding of knowledge in regional and evolutionary economics.

The first early theories on innovation and regional development are strongly inspired by Joseph Schumpeter who focuses initially on the roles of entrepreneurs and their small companies in recognizing the importance of particular inventions and assembling the resources needed to turn them into marketable products (SIMMIE, 2005, p. 790).

While these initial explanations of innovation were being developed, other economists were seeking to explain the advantage of spatial concentration in terms of external economies, which include pools of common factors of production such as land, labour, capital, energy and transportation (SIMMIE, 2005, p. 791).

These two separate lines of theoretical analysis were brought together by François Perroux in Europe and by Edgar M. Hoover as well as Raymond Vernon in the USA (PERROUX, 1955; HOOVER and VERNON, 1959; VERNON, 1966). These authors developed explanations of growth poles and the relationships between new product life cycles and agglomeration theory. Assigned to regional development, the concept of product life cycles attests that a region is strongly influenced by a certain line of business.

In contrast to the product life cycle theory, a second broad theoretical approach was developed in the 1980s to explain why local space was still important for newly developing forms of production. Much of this work was inspired by PIORE and SABLE's (1984) concept of flexible specialization that identified the breakdown and deverticalization of large firms as a key characteristic in modern economies. In the face of international competition and changing customer demands, this process is driven by the need for firms to be both more specialized and more flexible in the ways in which they organize their production. The result is a networked form of production that leads to a reconnection of economic activities to local space because of the need for proximity between the numerous specialists involved in any given value chain (SIMMIE, 2005, p. 799).

The flexible specialization thesis inspired several new concepts dealing with innovation, knowledge and regional development. Influential among these were the innovative milieu approach, the industrial districts and the new industrial spaces.

In the theory of the *milieux innovateurs* developed by the Groupe de Recherche Européen sur les Milieux Innovateurs (GREMI), firms are seen as part of a milieu with an innovative capacity. In the current research agenda, the GREMI stresses the importance of learning, which enables firms to perceive changes in their environment and helps them to adapt their behaviour accordingly (MOULAERT and SEKIA, 2003, p. 291).

The theory of the *new industrial district*, on the other hand, emphasizes the innovative capacity of small and medium-sized enterprises (SMEs) which belong to the same industry and local space. Commonly, industrial districts are defined as localized production systems, based on a strong local division of labour between small specialized firms which are integrated in the production and value chain of an industrial sector. Newer approaches, however, highlight that such networks also connect large firms and their suppliers and enable the introduction of flexible specialization by facilitating subcontracting. As a consequence, the manufacturing depth of large companies is reduced and a smooth diffusion of innovation throughout the whole regional economy is facilitated (GRABHER, 1991). The recognition that knowledge creation and diffusion is a process happening within the value chain of firms is of great importance for the empirical concept presented in this paper.

Michael Storper and Richard Walker as well as Allen J. Scott finally launched the notion of *new industrial spaces* by combining insights from different literatures such as industrial districts, flexible production systems, economies of agglomeration and others (SCOTT, 1985; STORPER and SCOTT, 1988; WALKER, 1988). The authors argue that in flexible production systems the tendency to agglomeration was reinforced not only by externalization, but also by intensified re-transacting, just-in-time processing, variable forms of inter-unit transacting and the proliferation of many small-scale linkages with low unit costs. Scott argues that the economic process of vertical disintegration into extended and specialized divisions of labour is leading to spatial forces that encourage small firms to concentrate in space (SCOTT, 1985). The reasons for the increasing development of networks are seen as a response to the increasing uncertainty and instability of production and markets.

Further interesting empirical evidence about the interrelationship between innovation and space is provided by several papers of James Simmie (SIMMIE *et al.*, 2002; SIMMIE, 2004).

By analysing the results of comparable surveys of innovative firms in Amsterdam, London, Milan, Paris and Stuttgart, SIMMIE *et al.* (2002) find evidence that,

even among the most innovative European cities, there are significant differences in the ways in which their regional innovation systems are structured. The authors find that in regional cities such as Stuttgart and Milan innovative activities are more closely linked to their regional and national economies than they are in the international world cities such as Paris and London. SIMMIE *et al.* (2002) present evidence that there is some justification in the case of Milan and Stuttgart for the view that local factors such as suppliers, education and technology transfer institutions do play an important part in the innovation system of those city regions. In these cases, geographic proximity of the various elements of the value chains seems to be a main reason for the concentration of innovations. Nevertheless, good local factor conditions also mean that innovative firms can take advantage of both geographic and time proximity to suppliers. Simmie *et al.* argue that the latter is a particular advantage for international cities as it brings a huge range and variety of possible suppliers within the reach of innovative firms located in them.

SIMMIE (2004) uses evidence from the third Community Innovation Survey to test the interrelationship between innovation and space in the UK. Most evidence presented in his paper suggests that innovation performance in the UK is not dependent on localized cluster

dynamics but on international links and networks. Simmie argues that part of the reason for this is the continued importance of multinational corporations whose spatial division of labour reinforces national and international urban hierarchies. Hence, many places remain part of the internationally distributed value chains of multinational corporations. Simmie suggests that the analysis of clusters should not start with their geography, but with the links between firms and institutions.

This is exactly the approach adopted in this paper with respect to intra-firm and inter-firm networks of APS firms. Since the objective of this study is to identify the functional space of economic interrelations, the aim is to approximate the emerging Mega-City Region of Northern Switzerland by analysing the spatial patterns of intra-firm and inter-firm networks. These economic interrelations are investigated on a regional, national, European and global geographical scale.

Fig. 1 shows an overview of the scientific debate about knowledge and learning within an institutional and territorial context. As can be seen on the left-hand side of Fig. 1, knowledge-intensive learning and development processes within institutions and firms lead to the fact that many knowledge-intensive enterprises expand their core competencies in order to maintain or even strengthen their market position. Such

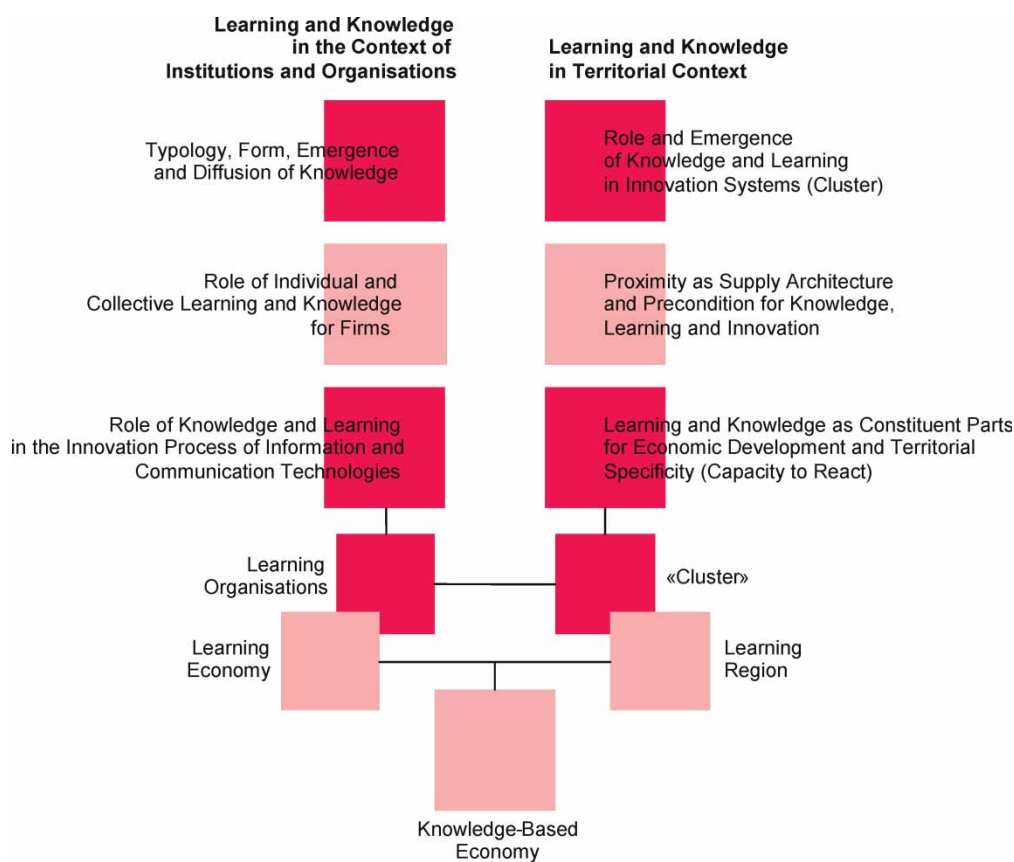


Fig. 1. Knowledge and learning within an institutional and territorial context
Source: Authors' own illustration

activities within corporations result in learning organizations and finally in learning economies. The right-hand side of Fig. 1 indicates that the spatial concentration of knowledge and learning leads to a territorial specificity of learning regions. STORPER (1997) underlines this aspect in the following way:

Those firms, sectors, regions, and nations which can learn faster or better [...] become competitive because their knowledge is scarce and therefore cannot be immediately imitated by new entrants or transferred, via codified and formal channels, to competitor firms, regions or nations.
(p. 31)

The starting point of the present paper is the assumption that the choice of location of institutions and organizations is not a coincidence but, to a greater or a lesser extent, a strategic decision. Most corporations design their network of branches and locations as a strategic tool to optimize their added value and to compete successfully in the international economy. This means that learning and knowledge in the context of institutions and organizations are reflected in a territorial context. Changing configurations of such territorialized intra-firm networks of locations in turn affect urban hierarchies and contribute to the emergence of Mega-City Regions.

For the purpose of this paper the link between the institutional and the territorial context of knowledge and learning is of great importance. The increasing relevance of the knowledge economy as driver of socio-economic development becomes clear in the interplay of organizational knowledge and the concentration of collective competencies in Mega-City Regions. MALECKI (2000) describes this aspect as the 'local nature of knowledge' and highlights the necessity to accept knowledge as a spatial factor of competition:

If knowledge is not found everywhere, then where it is located becomes a particularly significant issue. While codified knowledge is easily replicated, assembled and aggregated [...], other knowledge is dependent on context and is difficult to communicate to others. Tacit knowledge is localised in particular places and contexts [...].
(p. 110)

THE EMERGENCE OF MEGA-CITY REGIONS

Theoretical background

The concept of the polycentric Mega-City Region combines different theoretical approaches: John Friedmann's world cities, Saskia Sassen's global cities, Peter Taylor's world city network, and Manuel Castells's spaces of flows. In the following part the main ideas behind these theories will be explained.

Friedmann's *world city* concept describes the rise of a transnational urban network referring to a major

geographical transformation of the capitalist world economy whose production systems are increasingly internationalized. This reconfiguration results in a new international division of labour whose main agents are multinational enterprises with complex spatial organizational structures. It is the presence of these multinational enterprises that makes world cities into geographical places of great economic power. Furthermore, Friedmann argues that the territorial basis of world cities comprises not only the central city, but also the whole economic space of the surrounding region. Therefore, world cities are often polycentric urban regions containing a number of historically distinct cities that are located in more or less close proximity (FRIEDMANN, 1986).

In contrast to Friedmann's world city concept, Sassen's *global city* approach discovers a new geography of centrality in which the city centres or the central business districts form the heart of the global urban network. The functional centrality of these global cities leads to an increasing disconnection of the city centres from their broader hinterlands or adjacent metropolitan region. The reason for this disconnecting process lies, according to Sassen, in the location strategies of APS firms as spearheads of the rising global knowledge economy. These enterprises are increasingly located just within the city centres of economic regions and connect these places directly with other city centres in the world (SASSEN, 2001, p. 21). The fundamental differences between Friedmann's world cities and Sassen's global cities are well described by DERUDDER (2006):

Sassen's focus on centrality leads her to conceptualising 'global cities' as focal points that operate separately from their hinterlands. Friedmann's focus on the relative concentration of power, in contrast, implies that a 'world city' may consist of multiple cities and their hinterlands that may themselves be subject to urbanisation processes.
(p. 2034)

Taylor's notion of *world city networks* analyses inter-city relations in terms of the organizational structure of the global economy and views world cities as 'global service centres' connected into a single worldwide network (TAYLOR, 2004). The Globalisation and World Cities Study Group (GaWC) at Loughborough University analyses the inter-city relations using a specific methodology in which relationships between cities are not measured directly. Instead, the method uses a proxy by analysing the internal structures of large APS firms and revealing the relationships between head offices and other branches located all over the world. In doing so, world cities are not defined by their functions, but in terms of their external information exchange (HALL and PAIN, 2006, p. 9).

The last theoretical approach underlying this study is Castells's highly influential concept of a *space of flows* (CASTELLS, 1996). As mentioned in the Introduction

to this paper, Castells argues that the new spatial logic is determined by the pre-eminence of the space of flows over the space of places. By space of flows he refers to the system of exchange of information, capital, and power that structures the basic processes of societies, economies and states between different localities, regardless of localization.

The INTERREG IIIB Study Project POLYNET – Sustainable Management of European Polycentric Mega-City Regions – is one of the most recent research activities about the emerging of polycentric Mega-City Regions (HALL and PAIN, 2006). Hall and Pain define Mega-City Regions as follows:

Mega-City Regions are a series of anything between 10 and 50 cities and towns physically separate but functionally networked, clustered around one or more larger central cities, and drawing enormous economic strength from a new functional division of labour. These places exist both as separate entities, in which residents work locally and most workers are local residents, and as parts of a wider functional urban region connected by dense flows of people and information carried along motorways, high-speed rail lines and telecommunication cables.

(p. 3)

Based on this definition, POLYNET hypothesizes that Mega-City Regions:

are becoming more ... [polycentric] over time, as an increasing share of population and employment locates outside the largest central city or cities, and as other smaller cities and towns become increasingly networked with each other, exchanging information which bypasses the large central city altogether.

(p. 3)

The POLYNET project was aimed at investigating the polycentricity of Mega-City Regions and its current state of functional division of labour. For that, the methodology of the GaWC was adapted to the new phenomenon of Mega-City Regions. Instead of analysing the world city network, the focus was on inter-city relations in terms of the organizational structure of the global economy (TAYLOR, 2004). Starting from a fundamental criticism of previous urban research that focused on attributes of urban areas or places mostly in a national context, the relationships between the cities should be measured on the basis of flows taking a global perspective (HALL and PAIN, 2006). As a consequence, Mega-City Regions have been defined in terms of their internal linkages between different cities and towns as well as analysed on an international, national and regional scale.

When analysing polycentric Mega-City Regions, one has to distinguish between a morphological and a relational view (EUROPEAN SPATIAL PLANNING OBSERVATION NETWORK (ESPON), 2004). The morphological view lays out the distribution of urban areas in a given territory by studying the distribution of locations, the number of cities and their hierarchy.

The relational view, in contrast, is based on networks of flows and cooperation between urban areas on different spatial scales. ESPON (2004) recognizes that there are inherent difficulties embedded in the concept of polycentricity, as contradictions exist between different geographical levels. On the European scale, ESPON shows that regional polycentric integration will tend to increase the contrast between core and periphery. On the national scale, a policy for increased spatial balance at the European level will lead to a concentration of investments in urban areas strengthening these regions at the expense of other more peripheral regions. On the city scale, finally, there is no observable correlation between the levels of polycentricity and their capacity to integrate in polycentric networks on the European or national scale (ESPON, 2004).

To sum up, it is important to recognize that spatial processes at the European level can have opposing consequences on the national or even the city scale. Therefore, it is important to think simultaneously on different geographical scales. Furthermore, it is important to analyse not only the morphological and visible aspects of polycentricity, but also the relational and hidden polycentric structures of Mega-City Regions. For this, the POLYNET project introduced a new way of looking at these spatial phenomena, analysing non-physical connectivity by intra-firm networks in order to define the realm of APS networks at different geographical scales. The Swiss case study for the POLYNET project extended this analysis by also looking into inter-firm networks of APS firms. By doing so, Mega-City Regions are understood as spatial systems of socio-economic added value that interconnect different value chains.

Mega-City Regions as systems of spatial value chains

The knowledge economy is undergoing a process of differentiation and spatial segregation leading to a constant rearrangement of the value chain of knowledge-intensive businesses. The analysis of changing value chains as a consequence of the dynamic restructuring of companies in capitalist economies is strongly influenced by PIORE and SABLE (1984), who identified the breakdown and deverticalization of large firms as a key characteristic in modern economies.

According to SASSEN (2001), the location strategies of APS firms play an increasing role in the system of spatial value chains. These APS firms tend to have their knowledge-rich head offices in core metropolitan regions that act as nodal points within an international network of cities. Like many pharmaceutical industries in the mid-1990s, APS firms are experiencing a similar segmentation of their value chain. This leads to the emergence on the market of new institutions from different areas of APS such as hedge funds, venture capital, the financial arms of large production companies, as well as specialized information technology

corporations and specialized consultancies. Additionally, rapid changes in communication infrastructure, computer capacities, data storage, and collaborative models and platforms will drive more structural changes by enabling outsourcing across the value chain.

When looking at the value-creation process of knowledge, it becomes obvious that these processes follow a functional and networked logic of independent as well as interdependent institutions throughout the value chain. These processes are not necessarily bound by the limitations of territorial borders. To the extent that business is not concerned by limiting regulations, the knowledge economy tends to build a network of specialized service providers who cover the different parts of the value chain, which means that the spatial organization of the knowledge-intensive economy follows its inherent functional logic. Globalization leads to increasing competition in the world economy and forces knowledge-intensive firms to innovate and improve their added value constantly. This is reflected in the spatial organization of their branches and cooperation partners. For Switzerland, DÜMMLER *et al.* (2004) show that branches with senior management functions are mostly located in the cores of international cities such as Zurich and Basel, where they find a direct neighbourhood of head offices of competitor or partner firms. Branches with research and development functions are located in places with high densities of potential partners and competitors too, for example the high-technology industry in the Jura region. Branches with distributive functions are located close to customers or in places with low costs and well-developed traffic access, such as many smaller agglomerations in Switzerland's Central Plateau (DÜMMLER *et al.*, 2004).

Spatial concentration processes are not a coincidence, but the result of firms strategically choosing their locations. In order to improve their added value, knowledge-intensive firms need several local business conditions such as proximity to global infrastructures like airports and universities, the presence of competitors, business partners and customers as well as qualified manpower. In a similar way, PORTER (1998) argues that:

the enduring competitive advantage in a global economy are often heavily local, arising from concentrations of highly specialized skills and knowledge, institutions, rivals, related business, and sophisticated customers. Geographic, cultural, and institutional proximity leads to special access, closer relationships, better information, powerful incentives, and other advantages in productivity and innovation that are difficult to tap from a distance.

(p. 90)

Thus, there is a growing concentration of knowledge-intensive firms in Mega-City Regions where these conditions are met.

Starting from these findings, it is proposed here that there is an emerging Mega-City Region of Northern Switzerland with the two main centres at Zurich and Basel. Because of the various requirements for competing in the world economy, it is not possible for Zurich, although the biggest agglomeration in Switzerland, to act without the smaller agglomerations in its proximity. In the context of Mega-City Regions, smaller cities fulfil an important role as complementary economic spaces. Interlocking networks of knowledge-intensive firms – multi-city and multi-branch intra-firm as well as inter-firm value chain connectivities – link these different agglomerations together, thus defining the functional Mega-City Region of Northern Switzerland.

KNOWLEDGE ECONOMY IN THE EMERGING MEGA-CITY REGION OF NORTHERN SWITZERLAND

Definition of the study area

The spatial expansion of economic networks over recent decades led to the emergence of two Mega-City Regions in Switzerland (THIERSTEIN *et al.*, 2006). It is important to recognize that the emerging Mega-City Region of Northern Switzerland is not a clearly defined region but a spatial concept approximating to a functional space of economic interrelations. The present study is an explicitly explorative project touching a field that has hardly been explored in Switzerland. Firstly, it looks at spatial development from a functional point of view and reveals the driving forces of large-scale spatial patterns. Secondly, it moves beyond the usual perimeters of spatial analysis. Therefore, this study is freed from determining institutional borders and approaches the 'real' economic functions.

However, for the quantitative analysis, it was necessary to decide on a working definition that delimits the emerging Mega-City Region of Northern Switzerland in a more pragmatic way. For this study, the methodology of BEHRENDT and KRUSE (2001) has been used as an initial delimitation of the emerging Mega-City Region of Northern Switzerland, calculating the area that can theoretically be reached within a one-hour car journey from the airport of Zurich (Fig. 2). It is based on the Group for European Metropolitan Areas Comparative Analysis (GEMACA) approach using commuter data as a functional criterion for the delimitation of metropolitan areas (GEMACA, 1996). Within this area, the eight agglomerations with the largest shares of APS multi-branch firms have been chosen for the purpose of analysis: Basel, Aarau, Baden-Brugg, Lucerne, Zug, Zurich, Winterthur and St. Gallen. These agglomerations will be referred to below as functional urban regions (FURs), whereas the designations FUR and agglomeration are used synonymously. As will be shown in the following

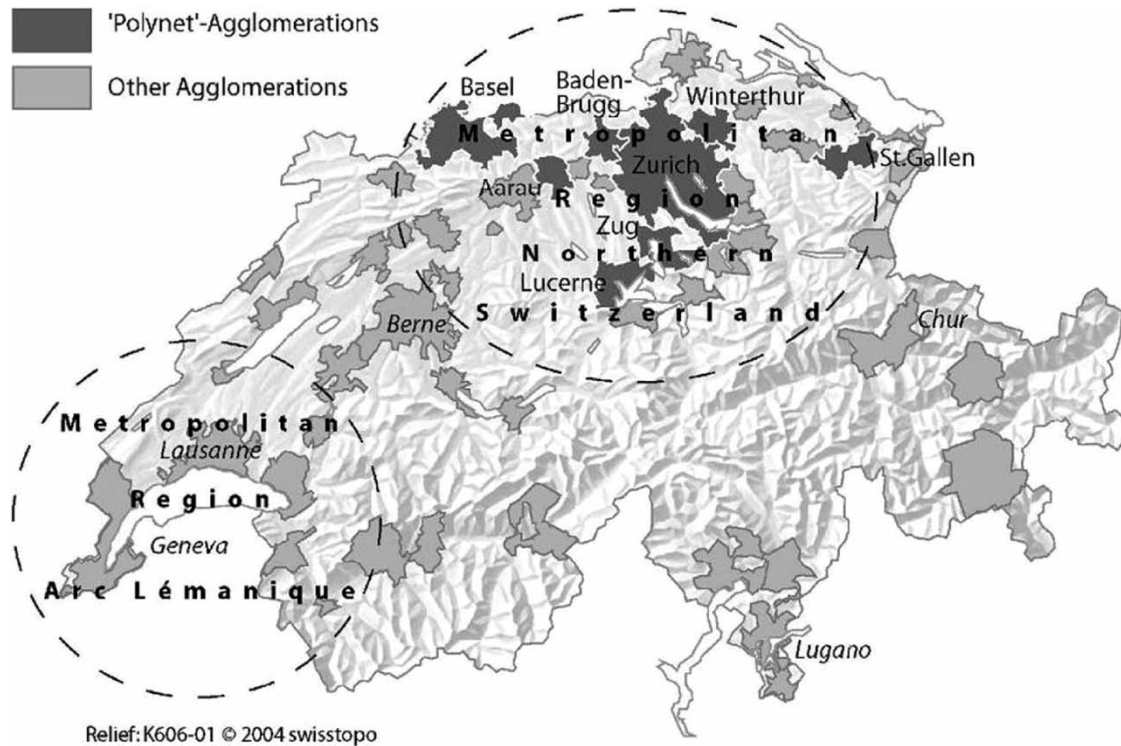


Fig. 2. Two emerging Mega-City Regions of Switzerland
 Source: Authors' own illustration

sections, the analysed FURs are linked together by spatial patterns of interlocking networks of APS firms, thus providing evidence for the emerging Mega-City Region of Northern Switzerland.

Fig. 2 gives an overview of the agglomerations that have been analysed in this study. Apart from the Mega-City Region of Northern Switzerland, it is assumed that there is a second emerging Mega-City Region in the French-speaking part of Switzerland, the so-called Arc Lémanique (COMTESSE and VAN DER POEL, 2006).

The changing landscape of the knowledge economy in the emerging Mega-City Region of Northern Switzerland

Within the emerging Mega-City Region of Northern Switzerland, the knowledge economy is facing a pronounced structural change due to the reorganization of its value chain, the emergence of new market players and the outsourcing tendency within the financial as well as the services industry. This has implications on the spatial division of labour on, respectively, the spatial organization of the value chains of firms and it affects the national as well as the international connectivity of the emerging Mega-City Region of Northern Switzerland. The following section will show these processes by emphasizing changes in the employment and location structure of the financial services industry and the knowledge-intensive business services within Switzerland and in the emerging Mega-City Region of Northern Switzerland.

Table 1 gives an overview of total employment within different sectors of knowledge-intensive industries in Switzerland and compares its dynamics with the emerging Mega-City Region of Northern Switzerland. The most recent employment data at a micro-branch level were taken from the year 2001. The next business census in late 2005 was not ready for use until late 2007 on such a disaggregated branch level, enabling the recomposition of the APS sectors of the knowledge economy.

Table 1 reveals the absolute and relative importance of two basic aspects of the knowledge economy. Firstly, according to the calculation, one out of six workplaces can be found within the defined knowledge-intensive economy. More than 68% of these jobs are incorporated within financial and related services, and the knowledge-intensive services industry itself. With an overall employment growth of 18.7% compared with 3.8% for total employment in Switzerland, these sectors can be seen as the main drivers of the Swiss economy. These figures clearly underline the growing importance of knowledge and innovation within the Swiss economy. Secondly, the employment figures reveal the importance of the emerging Mega-City Region of Northern Switzerland for the Swiss economy as more than 60% of total employees in the Swiss knowledge economy work in this geographical area.

Table 2 lists location and employment data at the Swiss national level and takes a closer look at those

Table 1. Knowledge-intensive economies in the emerging Mega-City Region of Northern Switzerland and in Switzerland

	Employees, 1995		Employees, 2001		Change, 1995–2001 (%)	
	Switzerland	Mega-City Region of Northern Switzerland	Switzerland	Mega-City Region of Northern Switzerland	Switzerland	Mega-City Region of Northern Switzerland
Overall economy	3 548 815	2 219 402	3 668 468	2 302 379	3.8	7.7
Total employment knowledge economies	560 671	328 801	665 736	405 850	18.7	23.4
Total employment advanced producer services (APS)	381 036	226 178	453 691	281 317	19.1	24.4
Total employment high-technology and life science	140 481	83 369	164 996	100 440	17.5	20.5
Total employment tertiary education	39 154	19 255	47 049	24 093	20.2	25.1

Source: THIERSTEIN et al. (2006, p. 41).

Table 2. Development of the most dynamic economic sectors in Switzerland

	Locations (headquarters, branches, subsidiary companies)				Employment data			
	1995	1998	2001	Change, total (%)	1995	1998	2001	Change, total (%)
Banks	3993	3512	3739	–254 (–6.36%)	109 515	102 887	109 100	≈415 (–0.38%)
Specialized financial services	8291	9082	11 271	2980 (35.94%)	39 654	42 912	73 529	33 875 (85.43%)
Insurance	5516	4776	4728	–788 (–14.29%)	57 656	59 655	63 602	5945 (10.31%)
Knowledge-intensive business services	22 386	24 606	27 898	5530 (24.72%)	89 646	98 233	110 614	20 967 (23.39%)

Source: GEIGER et al. (2006, p. 74).

sectors with the highest structural change in Switzerland. They are important elements of the Swiss financial industry and a crucial subset of APS firms. The classification is based on the official NOGA (General Classification of Economic Activities) statistics of the Swiss Federal Statistical Office:

- *Banks*, such as the Swiss major banks, the Swiss cantonal banks, regional savings banks, commercial banks, the Swiss National Bank and others.
- *Specialized financial services*, such as hedge funds, venture capital funds, private equity, SWX Swiss Exchange, brokers, traders, independent asset managers and others.
- *Insurance companies*, such as life insurance companies, pension funds, health insurance funds and others.
- *Knowledge-intensive business services*, such as lawyers, consulting agencies, accounting firms, public relations consultants and others.

Employment figures are important economic indicators because they show those areas needing increased human capital in order to build a market position. However, this must be differentiated in detail because the intensity of added value is not necessarily linked to high employment figures.

At first glance, Table 2 reveals two different types of structural change. Firstly, banks and insurance

companies show clear signs of concentration. In general, both sectors have shifted their locations. Insurance companies decreased their number of locations by about 14%. The decrease within the banking sector is slightly less, and is due in particular to relocation strategies in retail banking. Note that the aggregate employment figure in the banking sector has remained stable. However, within the banking sector a constant and intensive decrease in employment, notably within the major banks, has been compensated for by an increase in employment mainly in regional banks, private banks and stock exchange banks. This does not necessarily mean that employees have moved from one bank to another. Many of the employees entered the sector of specialized financial services, such as independent asset management or the field of alternative assets such as hedge funds, venture capital, private equity and others.

Secondly, the specialized financial services and knowledge-intensive business services sector experienced exactly the opposite development. With a growth rate of about 35% for locations and 85% for employment, specialized financial services show the greatest alteration. In 1995, absolute employment figures were almost three times lower than in the banking sector. In 2001 this difference has been reduced to about one-and-a-half times. Looking at

the total number of locations and the geographical distribution in Switzerland, it can be observed that these two sectors are ideally located in agglomerations close to cities like Zurich, Zug, Basel, Geneva or St. Gallen. But with on average 6.50 employees per location, compared with 29.17 employees in the banking sector, the specialized financial services sector seems to be smaller and probably more specialized than the banking sector.

Fig. 3 provides another perspective on the structural change described above. It shows the relative change in locations and employment for each sector and visualizes two forms of structural change. On the one hand, banks and insurance companies are characterized by spatial concentration and stagnation because of rather low changes in employment and locations. On the other hand, specialized financial services and knowledge-intensive business services are characterized by dynamic employment and diffusion processes due to their relatively high change of employment and workplaces.

In conclusion, there are four important key messages that emphasize the changing value chain of the knowledge economy in the emerging Mega-City Region of Northern Switzerland.

- The dynamic growth of a new emerging sector spinning off from the traditional and well-regulated world of financial services is based on new business models, the integration of new technology and new distribution channels.
- These new and highly dynamic companies work with a much smaller number of employees per company due to their technology-based efficiency and specialization in niche markets within the value chain of the knowledge economy. Among other things, the basic driver for their success is the outsourcing tendency of large service providers, making them highly efficient and competitive. Compared with the high-technology and pharmaceutical industries, this process has not been the case for the financial services industry so far.
- Large service providers in the financial services industry and the insurance sector stagnate in terms of employment growth and concentrate in core cities such as Zurich, Basel and Zug.
- Small specialized financial services firms and knowledge-intensive business services tend to locate within the agglomerations of core cities and sub centres.

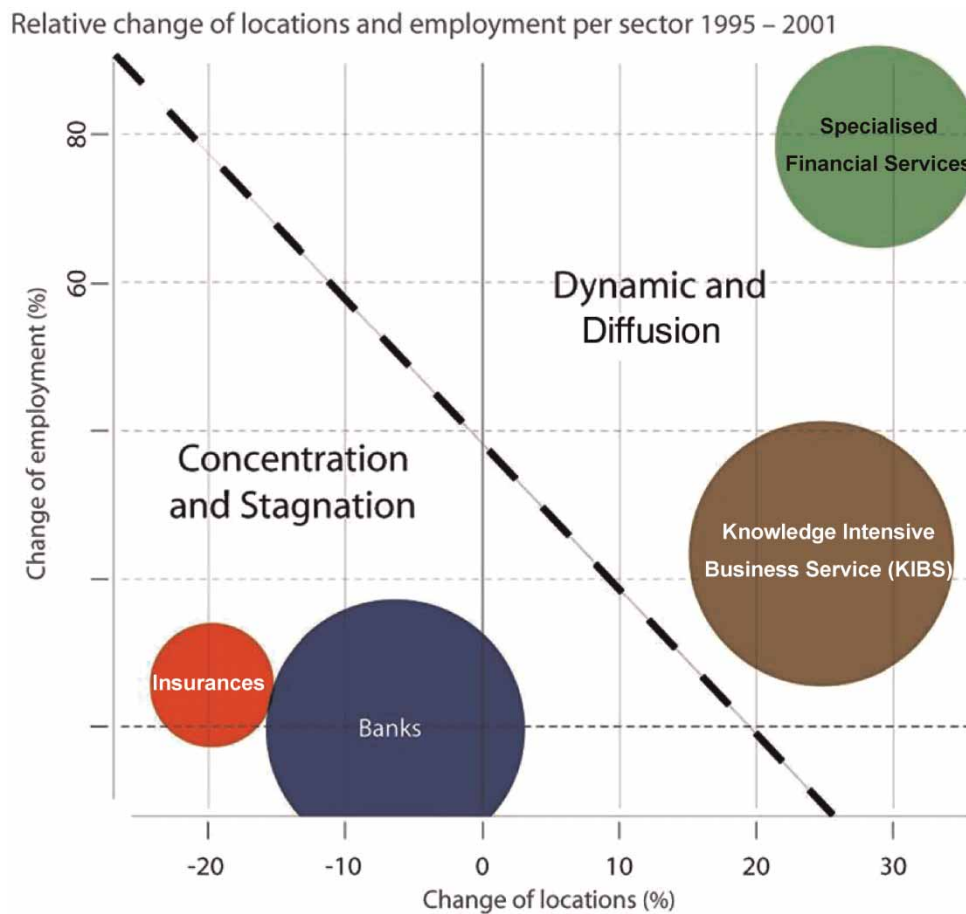


Fig. 3. Relative change (%) of locations and employment per sector, 1995–2001
 Source: GEIGER et al. (2006, p. 75)

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The changing structure of the knowledge economy described in this section has a major impact on the spatial patterns of knowledge networks in the emerging Mega-City Region of Northern Switzerland. Because of the highly connected economic activities within the value chain of the knowledge economy, knowledge-intensive service firms clearly show evidence of a polycentric and functionally structured division of labour within the emerging Mega-City Region of Northern Switzerland. These value chains will be analysed in greater detail in the following section.

Networks of knowledge in the emerging Mega-City Region of Northern Switzerland

The emerging Mega-City Region of Northern Switzerland can be regarded as a functional region where sub-centres have different functional and hierarchical roles. The two largest economic centres, Zurich and Basel, are at the top of this functional hierarchy, providing favourable location conditions for knowledge-intensive services. Interviews conducted during the POLYNET case study clearly indicate that in these two agglomerations knowledge-intensive firms find the best conditions for direct international knowledge exchange (THIERSTEIN *et al.*, 2006). However, the agglomerations of Zurich, with about 1 million inhabitants, and Basel, with about 500 000 inhabitants, are both too small to concentrate all major functions of the metropolitan region in their own location. It is an important characteristic of the emerging Mega-City Region of Northern Switzerland that many of the important functions are distributed throughout a polycentric network of the two core cities of Zurich and Basel as well as the sub-centres Zug, Lucerne, Winterthur, St. Gallen, Aarau and Baden-Brugg. As will be shown below, there is a dense interlocking network between the different institutions and firms of the knowledge economy in these locations throughout the value chain. It is the complementary combination of Zurich and Basel, together with supplemental centres, that raises the emerging Mega-City Region of Northern Switzerland to a competitive level in the context of the global economy.

The following sections first present the results of the empirical analysis of both the intra-firm and inter-firm connectivities of APS firms. The sections then show – on the basis of a stylized value chain – the polycentric interlocking network between the different firms and institutions of the knowledge economy.

Spatial patterns of intra-firm networks. The analysis of intra-firm networks is based on the methodology of the GaWC at Loughborough University. This approach estimates city connectivities from the office networks of multi-city APS firms. These services are described as advanced because they sell high-value information and knowledge (TAYLOR and EVANS, 2005, p. 3).

The basic premise of this method is that the more important the office, the greater its flow of information to other office locations. The following lines of business have been analysed in the present research project: accountancy, advertising, banking/finance, design, insurance, information and communication technologies, consultancy, law, third-party and fourth-party logistics, and management consultancy.

In the first stage of this empirical work, a reliable company database had to be created. In identifying APS firms within the emerging Mega-City Region of Northern Switzerland, the basic data set from the Swiss-guide database was used. The firms were allocated to the sectors using its Nomenclature statistique des Activités économiques dans la Communauté Européenne (NACE) codes. Afterwards, records without websites or fewer than five employees were removed from the database before detailed data analysis. The result was a basic set of over 12 500 company entries distributed among the nine business sectors and eight FURs. Firms that were only active on a purely local basis had to be filtered out, meaning that companies whose action radius is almost exclusively focused on their own location or neighbouring municipalities had to be eliminated from the database. Table 3 shows the business inventory used for the calculation of the city connectivity.

Having compiled the database of APS firms, an interlocking network analysis was used to estimate connectivities of FURs within and beyond the Mega-City Region of Northern Switzerland (TAYLOR, 2004). To carry out an interlocking network analysis requires the construction of a so-called service activity matrix, defined by n FURs and m service firms. Each cell in the matrix is a service value (v_{ij}) that indicates the importance of FUR i to firm j . The importance is defined by the size of an office location and its function. By analysing the firms' websites, all office locations are rated on a scale of zero to three. In a first step, the connectivity between two FURs (a, b) of a certain firm (j) is analysed by multiplying their service values (v). In this respect, the following equation represents the so-called *elemental interlock* between two FURs for one firm:

$$r_{abj} = v_{aj} * v_{bj} \quad (1)$$

To calculate the total connectivity between two FURs, the elemental interlock for all firms located in these two FURs has to be summarized. This leads to what is known as the *city interlock* (r_{ab}):

$$r_{ab} = \sum r_{abj} \quad (2)$$

Aggregating the city interlocks for a single FUR produces the *interlock connectivity* (N_a). This describes the

Table 3. Business inventory for the eight main functional urban regions (FURs) and their cores in the emerging Mega-City Region of Northern Switzerland

	Accounting	Advertising	Banking/finance	Design	Insurance	Law	Logistics	Management consulting	Information and communication technology (ICT) consulting
Aarau	17	20	6	29	0	9	8	28	38
Aarau Core	20	11	4	21	0	9	4	16	18
Baden-Brugg	24	43	1	28	1	6	16	55	68
Baden Core	9	18	1	9	1	3	5	22	18
Basel	118	150	40	88	25	20	83	280	316
Basel Core	76	95	29	45	17	13	36	145	139
Lucerne	60	64	9	34	5	10	21	108	91
Lucerne Core	36	33	5	19	3	6	13	59	48
St. Gallen	36	59	9	38	4	6	12	95	86
St. Gallen Core	23	50	6	28	3	4	10	73	67
Winterthur	11	30	4	23	5	7	11	54	65
Winterthur Core	10	24	4	18	4	6	9	45	43
Zug	79	91	28	27	9	22	44	250	249
Zug Core	49	33	13	13	6	15	15	145	95
Zurich	213	615	194	243	116	98	191	853	988
Zurich Core	133	350	162	156	68	71	85	485	382
Total	558	1071	291	510	165	178	385	1723	1900

Source: Swissguide online registry (<http://www.suissguide.ch>) (authors' own classification).

overall importance of a FUR within a network:

$$N_a = \sum r_{ai} \quad (a \neq i) \tag{3}$$

If one relates the interlock connectivity for a given FUR to the FUR with the highest interlock connectivity (N_h), an idea is gained of its relative importance in respect to the other FURs that have been considered. The resulting values of relative connectivity score somewhere between zero and one:

$$P_a = (N_a/N_h) \tag{4}$$

In addition to the quantitative network analysis, several in-depth face-to-face interviews with senior business practitioners and organizations were conducted. The interview method provides qualitative evidence complementing quantitative data gathered by the other empirical research actions. This has produced an extensive and rich data source on the actual changes and issues relevant to the study that could not be elicited by alternative means. Therefore, the following sections will supplement the quantitative findings with selected qualitative statements from the interviews.

A closer look at the results will now be made. Fig. 4 shows the spatial dimension of intra-firm connectivity for each FUR and illustrates the five most intensively connected locations on an international scale. There are huge differences not only in the absolute number of connected branch office locations—reflected by the thickness of the line—but also in the hierarchy of

the intra-firm connectivity for each agglomeration. The legend to Fig. 4 shows a bold and a thin line. The bold line depicts the highest connectivity value created by intra-firm interlocking networks of APS firms, which in Fig. 4 corresponds to the agglomeration of Zurich. London in the top position for the FUR of Zurich indicates that APS firms in the FUR of Zurich most often choose London as their second most important location. The thin line, on the other hand, shows the lowest connectivity value. The other lines in Fig. 4 vary in thickness between the highest and the lowest connectivity value depending on the calculated connectivity values for the corresponding agglomerations.

Those companies located in the agglomeration of Zurich show by far the highest degree of internationalization. The first national location in Zurich's connectivity ranking is Geneva, placed in ninth position and therefore not apparent in Fig. 4. All other FURs within the emerging Mega-City Region of Northern Switzerland are primarily connected to Zurich, generally followed by a European location.

Generally, medium-sized and small urban centres, such as Lucerne or Baden-Brugg, are not directly integrated in international networks of knowledge-intensive economic activities, but instead are well integrated in regional networks of knowledge exchange. Zurich and Basel, on the other hand, are the central nodes and gateways to the world for smaller centres in the emerging Mega-City Region and beyond.

This finding confirms the important role of the agglomeration of Zurich, and to a lesser extent Basel, within the emerging Mega-City Region of Northern

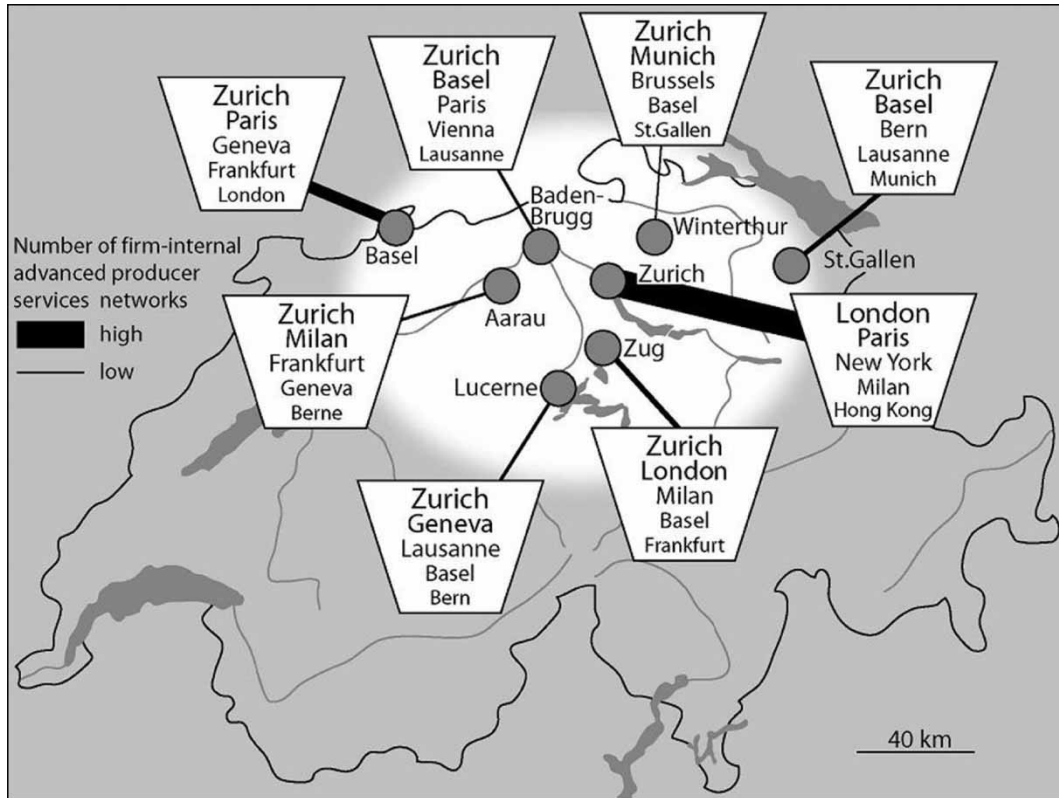


Fig. 4. International dimension of intra-firm networks of the emerging Mega-City Region of Northern Switzerland
Source: Authors' own illustration

Switzerland for interactions at international or global levels. One reason for this is the worldwide image of these two agglomerations. For many companies operating at an international or even national level, an address in one of these cities is a matter of prestige. Many of these companies are concerned that they will not be taken seriously enough by potential customers or cooperation partners if they are not based in Zurich or Basel, but in one of the smaller centres. A management consultant in Zurich argues that they could do their job just as well in a location other than Zurich, for example in Winterthur, but their customers would not understand this at all. It would clearly affect their reputation (GLANZMANN *et al.*, 2005, p. 14). Furthermore, Zurich has a special role among top-ranking financial firms with an international presence. It is not possible to extend this function to other centres of the emerging Mega-City Region, apart from certain back office aspects (GLANZMANN *et al.*, 2005, p. 14).

An even more significant factor that illustrates the gateway function of Zurich is its infrastructure with the international airport and the universities with their reputation, in particular the Swiss Federal Institute of Technology (ETH). A management consultant states that it is a huge drawback for Basel that it does not have an ETH like Zurich (GLANZMANN *et al.*, 2005, p. 7). An interviewee from the 'fourth-party logistics' sector points out, however, that both Basel and Zurich are

indispensable agglomerations for their activities because of their rail and airport infrastructures. Whereas Basel assumes the role of gateway for international rail connections, Zurich assumes this role in the field of air travel. As a consequence, these two locations have a complementary gateway function. In this context, an essential prerequisite is the efficient transport infrastructure linking the various centres to one another and linking smaller sub-centres to the international gateways of Zurich and Basel. The emerging Mega-City Region of Northern Switzerland has an excellent transport system. The rail network has a very widespread geographic coverage with high frequency and reliability. Switzerland's motorway network is one of the densest in Europe having a very high standard. Smaller FURs profit from this fact, as their distances from central points such as Zurich airport become increasingly more insignificant.

A rather interesting example is Zug, a small agglomeration with about 95 000 inhabitants. From a relative perspective, it has comparatively strong connections with international locations. Despite its small size, Zug seems to benefit from a dense network of global companies owning branch offices in several international locations giving it a special position within the emerging Mega-City Region of Northern Switzerland. The reason for Zug's relative importance lies, on the one hand, in its proximity to the

international hub of Zurich and, on the other hand, in its attractive tax policy.

In contrast, Lucerne and Winterthur, which are larger agglomerations than Zug in terms of population and employment, do not display the same international connectivity. It seems that the internationalization of companies in a specific location has a greater effect on the degree of connectivity than the mere size of an agglomeration or a core city. Generally, medium-sized and small urban centres in the emerging Mega-City Region of Northern Switzerland are not directly integrated in international networks of advanced producer activities. Fig. 4 shows that APS firms in these locations mainly have offices in Zurich or other national urban centres, whereas international intra-firm networks are rare.

Another case of direct integration in international knowledge networks is St. Gallen, an agglomeration in Eastern Switzerland with about 145 000 inhabitants. St. Gallen's virtual 'gateway' to international knowledge exchange networks is its internationally well-known Graduate School of Business, Economics, Law and Social Sciences as well as banking institutions and business consulting firms. APS firms benefit from close ties with the university, for example with developers of information and communication technologies and business software or start-up firms in finance (THIERSTEIN, 2003).

Using the same approach but shifting the scale of analysis to the national level, the spatial patterns of intra-firm networks appears different from the international scale. In this case, Zurich shows a dense branch office network with Geneva and Basel (THIERSTEIN *et al.*, 2006, p. 63). The smaller agglomerations, on the other hand, have an important role as regional centres, supplying regional markets with services and products due to Switzerland's high-quality infrastructure. Smaller agglomerations have to be viewed as complementary centres taking over functions that cannot be provided by cities such as Zurich or Basel. Zurich's position as important node and 'gateway' location for global connectivity as well as the functional differences between the smaller agglomerations provides further evidence for the hypothesis of an emerging functional, polycentric Mega-City Region of Northern Switzerland.

Spatial patterns of inter-firm networks. That, which has been described so far, outlines the structural organization and spatial impact of intra-firm networks. Focus has been made on the analysis of the distribution of branch offices of individual companies. This approach assumes connectivity of locations by emphasizing the existence of a network in line with the idea of potential knowledge exchange between the branch offices. However, this kind of approximation does not tell the whole story of the nature and quality of business activities between those different locations. Relationships

between knowledge exchange and business activities not only arise through branch office networks, but primarily from the division of labour between companies. In many cases, outsourcing strategies in respect of single activities are more efficient and lead to a higher quality of products and services. Many firms concentrate on their key competencies, which are produced in-house, while activities that do not belong to the core business are outsourced to other companies. Even networks between competitors open the opportunity for formal and informal knowledge exchange within the same field of business. It is assumed that these networks are strongly anchored within Mega-City Regions due to the quality of infrastructures like airports, universities with a good reputation, or large settlements of leading global companies, as well as the availability of specific knowledge (THIERSTEIN *et al.*, 2006). Under these conditions there is a high potential for developing new products and services needing upstream and downstream inputs and customers, which represents the different elements of the value chain in the knowledge economy. In order to grasp these networks fully, it is necessary to analyse not only the connectivity within a single firm, but also the value chain relations between different enterprises and sectors.

The empirical analysis of inter-firm relationships is based on an internet-based survey of about 1200 APS firms of the knowledge economy, in which 360 firms have completed the survey satisfactorily. The distribution of the numbers of companies questioned varies widely across the nine services sectors under study. At over one-third, companies in the area of management consulting were the most frequent participants, followed by companies in the advertising and design consultancy sector with 17%. Companies in the accounting, logistics, banking and finance sector participated between 6% and 7%. At 4% and 3%, legal advice and insurance companies form the smallest groups. In order to keep the reply time short, the web survey comprised only four sections concerning issues about the economic region, the inter-firm relationships, the political environment of the firms as well as spatial aspects of their value chain. In order to relate the inter-firm relationships to a stylized value chain, the responding firms had to localize their business activities along the individual value chain elements of 'research and development', 'processing', 'marketing', 'sales and distribution', and 'customers'.

Fig. 5 highlights the spatial patterns of inter-firm connectivities between APS firms at a national and a regional level in Switzerland. It is important to note that Fig. 5 is a schematic diagram based on the number of interactions along the value chain, as stated by the responding firms in the internet-based survey. The thick bold line in the legend illustrates the maximum of firm-external APS interrelations; the thin line, on the other hand, shows the minimum of interactions. The other lines with arrows in Fig. 5

vary in thickness between the highest and the lowest connectivity value, depending on the number of stated interactions by the responding firms.

The most important finding of Fig. 5 is that the predominant part of the inter-firm networks is located within the demarcation of what has been labelled from the outset of this research as the 'emerging' Mega-City Region of Northern Switzerland. The manifold interactions between APS firms along their value chain underpin the relevance of the initially designated area as a localized system of value chains. Within this spatial configuration, four main messages can be deduced from Fig. 5:

- Zurich seems to be the central location in national APS networks. Interlocking networks between APS firms in different sub-centres excluding Zurich are rare. This is because Zurich is generally chosen as a location by companies that occupy a central role in the economic network. An important example here is the financial sector. Due to their central position in the functional network, these companies have corresponding radial relationships with APS firms in the other agglomerations of the emerging Mega-City Region of Northern Switzerland. Therefore, the geographical location of companies and the spatial patterns of their relationships depend strongly on the centrality of their position in the functional economic network.
- A second striking feature is the important relationship between Zurich and Basel. This link forms a kind of

central 'backbone' in the national and regional interlocking network. Analysis of the external interlocking networks between companies in the knowledge-intensive economy clearly shows strong functional links between Zurich and Basel. For many firms, Basel and Zurich are not separate economic areas but one resource pool of potential knowledge, partners and customers. On the scale of the emerging Mega-City Region of Northern Switzerland, these two agglomerations take over complementary functions for APS activities. The in-depth interviews confirm that Basel and Zurich are seen as complementary locations by knowledge-intensive firms. A management consultant, for instance, states that it is simply not sufficient to have Zurich alone as a spider weaving a web of developments. He argues that Basel comprises a huge potential for encouraging innovation, thus drawing from the three neighbouring cultures of Switzerland, France and Germany (GLANZMANN *et al.*, 2005, p. 6).

- A third aspect is the rather strong connectivity that links Zurich and Berne. However, this link must be analysed in detail. THIERSTEIN *et al.* (2006) show that Berne is characterized not only by rather low economic dynamics, but also by pronounced regional specialization patterns. The link today between Zurich and Berne is dominated by the information and telecommunications sector. The reason lies in the fact that Berne is home to the headquarters of Swisscom Ltd, which serves as a big provider of various telecommunication services for the emerging

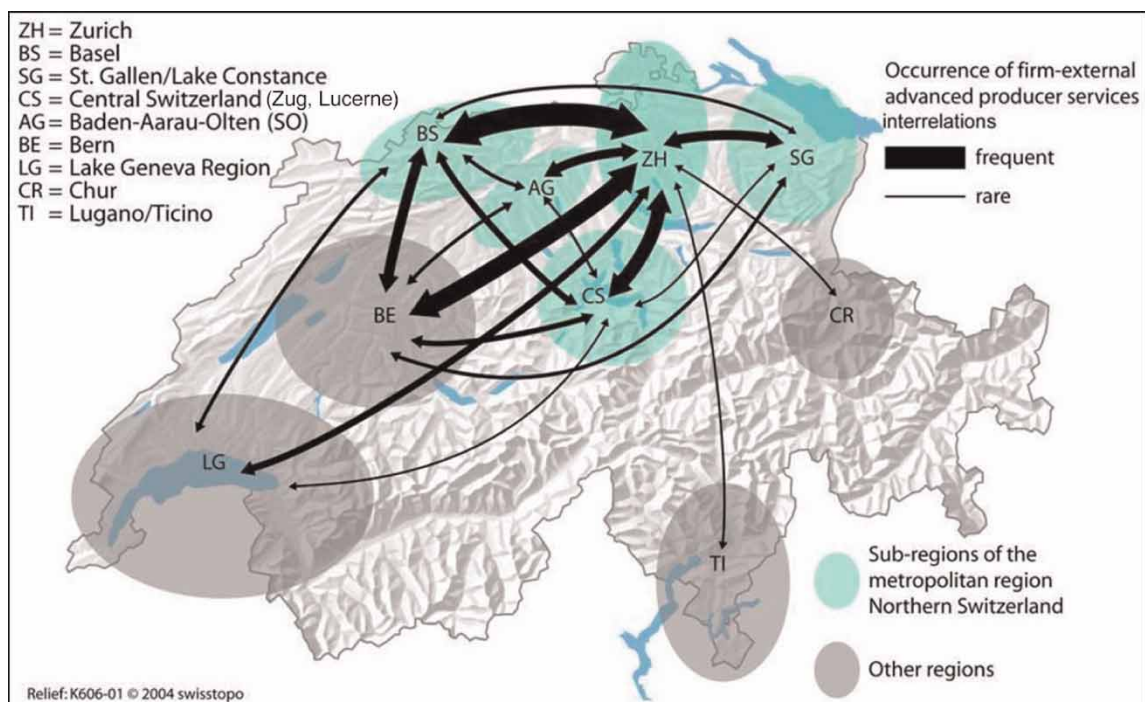


Fig. 5. National and regional inter-firm connectivity of the emerging Mega-City Region of Northern Switzerland
 Source: Authors' own illustration

Mega-City Region of Northern Switzerland. This relatively strong regional specialization characterizing Berne is based on the former monopoly of the Telecom PTT. After a series of market liberalizations, Swisscom's business activities are still primarily focused on the Swiss home market. A wide array of business-related services firms that have started up since the dismantling of Telecom PTT are still located in the Berne area. As market leader Swisscom covers the largest share of domestic demand for voice and data communication services and products for residential and business applications. Thus, the strong link between Zurich and Berne is due to a singular specialization and in the authors' interpretation does not qualify Berne for integration in an expanded demarcation of the emerging Mega-City Region of Northern Switzerland. Another significant reason not to include the *FUR* of Berne in the Mega-City Region of Northern Switzerland is to be found in Fig. 4. The map with the intra-firm connectivities across Switzerland clearly indicates that Berne—although nevertheless an important location for formerly state-owned companies and the capital city of Switzerland—is only weakly integrated into the intra-firm networks of APS firms.

- A final salient feature is the fact that there are only few links between the knowledge economy of the emerging Mega-City Region of Northern Switzerland and the French- and Italian-speaking parts of Switzerland. The main reason lies in language and cultural barriers. Firms in French-speaking urban centres like Geneva or Lausanne have a tendency to focus on markets in the Francophone or Latin parts of the world, or an associated post-colonial background, while Zurich and Basel concentrate more on German- and English-speaking markets.

CONCLUSION

Knowledge-intensive business services firms are found to be important driving forces for spatial development in Switzerland. When looking at their value creation processes, it becomes obvious that they follow a functional and networked logic of independent as well as interdependent institutions throughout the value chain. This means that clustering in first cities within Mega-City Regions is still vital. For the knowledge economy, spatial concentration remains a key priority; there is no evidence that global functions are deconcentrating (HALL and PAIN, 2006). Clustering promotes a depth of knowledge production and is driven by the globalization of markets and services and facilitated by developments in information and communication technologies. Knowledge-intensive businesses are agents that build spatially concentrated knowledge gateways between the regional and the global economies. Zurich is the largest of these gateways, while Basel

holds second place. Within the emerging Mega-City Region of Northern Switzerland, these two agglomerations have more cultural facilities and are the only cities that have an international image for firms operating at an international or a national level. Some of the medium-sized centres are indeed able to attract knowledge-intensive industries, but they are mostly dependent on Zurich's gateway function for international business.

As mentioned at the outset of this paper, when considering polycentricity, one has to distinguish between a morphological and a relational view. Accordingly, a polycentric Mega-City Region of Northern Switzerland does exist from a morphological point of view. However, from a functional perspective, considering relational patterns based on interlocking networks between advanced producer services (APS) firms, there is a monocentric character to it, since Zurich is the culturally and economically dominant centre. In the case of the emerging Mega-City Region of Northern Switzerland, polycentricity has proven adequate as a descriptive model, but claiming it as a strategy for sustainable spatial development would clearly go too far. The polycentric morphology of the emerging Mega-City Region of Northern Switzerland overlaid by the functional interrelations of knowledge-intensive businesses does not lead to the desired effect of sustainable spatial development. On the contrary, the tendency towards dispersion of inhabitants – that is, peri-urbanization – and also tendencies towards concentration of knowledge-intensive business firms in the core cities and specified locations within the agglomeration leads to an undesired sprawl of infrastructure and settlement development together with growing commuting distances.

The 'Introduction' above underlined the need for a deeper understanding of the interrelationships between polycentric spatial development and economic competitiveness. This study provides a few facets that ultimately help to paint the whole picture. It has been demonstrated that, in addition to the functional urban region (*FUR*) of Zurich as a core-driving force behind an emerging Mega-City Region of Northern Switzerland, the smaller *FURs* have developed valuable positions as secondary locations. This process of an emerging new networked urban hierarchy is driven above all by APS firms. The interviews show that the location of a company outside the two largest centres of Zurich and Basel does not necessarily mean being outside the crucial information flows. Many interviewees emphasized that within the emerging Mega-City Region of Northern Switzerland it is not the precise location that is the deciding factor behind whether a firm can successfully be part of and have access to regional, national or global networks, but the well-developed network infrastructure.

The real impact of changing value chains in spatial development in Switzerland is difficult to grasp. On the one hand, there is an accelerated concentration of highly advanced and knowledge-intensive functions in

just a few centres; on the other hand, there is a diffusion of associated functions, such as supply, residence or leisure functions. These contradictory processes are a great challenge to the concept of polycentricity, as both polycentric and monocentric tendencies are results of the same process towards a more knowledge-intensive economy. These functional interrelations in the emerging Mega-City Region of Northern Switzerland are not yet sufficiently anchored in the awareness of most stakeholders, the least with policy-makers. Despite the actual development tendencies at the level of Mega-City Regions, the fields and spheres of activity of the institutional bodies responsible for spatial development are largely determined by the awareness of problems at a local or, at most, at a cantonal level.

Therefore, further research has to deal with two specific aspects. Firstly, interrelationships between APS

firms and the wider economy have to be analysed in greater detail. A matter of particular interest is the comparison of APS firms and the high-technology sector. By revealing their business strategies and their rationale to locate branches and business offices, important insights into the spatial division of labour within and between Mega-City Regions can be gained. In this respect, the value chain approach is a promising tool to identify and localize the core business activities and to determine where the different functions are mainly anchored. Secondly, it is important to grasp the networks of the knowledge economy simultaneously on different geographical scales. In order to show the potential contradictions of polycentricity between different geographical levels, new methods of analysing and visualizing polycentric development have to be established.

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