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Arbeitskreis Kritische Regionalwissenschaft (AKR)
Humboldtallee 15
37073 Göttingen
Tel.: (+49) 551/ 39- 140 48
Fax: (+49) 551/ 39- 140 49
www.kritische-regionalwissenschaft.de

Gestaltung: Johannes Melcher

Über den Autor dieser Ausgabe:

Dr. Wolfram Elsner
Professor of Economics, Structural Research, and Economic Policy
University of Bremen
Faculty of Economics and Business Studies
iino - Institute for Institutional and Innovation Economics
Hochschulring 4
D-28359 Bremen
Tel.: (+49) 421/ 218- 7535
Fax: (+49) 421/ 218- 4974
welsner@uni-bremen.de
www.iiso.uni-bremen.de/elsner

Wolfram Elsner:

Regional Service Clusters and Networks.

Two Approaches to Empirical Identification and Development. The Case of Logistics in the German Port City-States Hamburg and Bremen

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Abstract: This paper discusses two approaches to the identification and measurement of regional clusters and its networks in 'cross-sectoral' services which are not available through official industrial statistics. The first is a 'secondary-statistical' one consisting of a firm-based blending of two separate official statistical data sets, industrial and 'functional' (i.e., the professions practised within firms). Thus, a service 'cross-sector' is identified across manufacturing and service industries. In the matrices resulting, weights are attached in an expert survey to the numbers of employees to aggregate the 'real' logistics 'cross-sector'. This is applied to the two German port City-States, Hamburg and Bremen. The second approach is 'primary-statistical', based on a small firm survey which generated data on 'functional' supplier relations (the cluster) and on project-based 'strategic' co-operations (the networks within that cluster). This follows a two-stage model of emerging clusters and 'its' networks. This data set is combined with the firms' affiliations to branches, firm size, age, and sales growth classes, in order to connect information with the industry statistics. Also, the net densities and centrality structures are calculated. The combined information provides indications of the relevance of the service cluster and its networks as factors of future regional development. The latter approach is applied to the State of Bremen only. Two results appear to be transferable beyond the German cases, first, the two approaches improve the knowledge about policy-relevant 'cross sectors', clusters, and networks; second our knowledge about service, namely logistics, clusters and networks (for which port regions are prominent nodes) is improved. Finally, some implications for regional cluster strategies are discussed.

1. Introduction: The Problem and the Definitions of Service 'Cross Sectors' and Clusters

1.1. Complexity and Clusters

In worlds of direct interdependence among agents and of complex and dilemma-prone decision problems, spontaneous, decentralised, and de-regulated forms of firms' organisation, considered to resemble ideal 'markets', may lead to strong uncertainty, lock-ins, and even complete mutual blockage of action. Under these conditions, firms tend to spatially agglomerate and to partially rule out 'market' forms of price coordination in favour of establishing more 'dense' and recurrent interactions and, thus, more stable and price-insensitive interrelations. These phenomena have been widely analysed as regional industry clusters (see e.g. Audretsch & Feldman, 1996; Storper, 1997; Steiner, 1998; Feser, 1998; Porter, 1998a; Dupuy & Torre, 1998; Austrian, 2000; Breschi & Malerba, 2001; Bellandi, 2003; Malmberg et al., 2004; Elsner, 2005; Orsenigo, 2006).

Clusters have been analysed as drivers of informal coordinated collective action capacity, innovation, regional competitiveness, and a broader and more sustainable development than 'market' allocation might be able to attain. This is especially more likely in a fragmented, complex, and dilemma-prone world, with prevailing nettechnologies and an increasing collective-good character of information and knowledge where 'markets' tend to fail (see e.g. Foray, 1998; Kirman, 1998; Rycroft & Kash, 1999; Maillat & Grosjean, 1999; Elsner, 2000; Biswas, 2002; Feser, 2002; Casciaro, 2003; Peoples, 2003). Clusters may indeed provide critical masses of well interconnected agents, through spatial and social proximity, increasingly stable relations, emerging trust, and effective, informally institutionalised coordination (see also e.g. Gertler et al., 2000; Lincoln & Gerlach, 2004). These firm agglomerations may turn out to be arenas, and vehicles, of joint learning processes, stable mutual expectations of cooperation, and institutions of reciprocity. In this way, they may provide solutions to complex and dilemma-prone coordination problems which exist in fragmented value-added chains on the one hand, and through net-externalities, 'inappropriability', and complex integrated products on the other. These problems involve initial 'strong' strategic uncertainty where complex decision problems cannot be solved by 'markets' or 'hierarchies' alone.

Therefore, clusters have been viewed as generating increased economic effectiveness and accelerated and more sustainable regional development. This may occur through the interactive and cumulative generation of positive external economies in local labour pools, supplier pools, supplier-service-user chains, as well as areas of informational interconnection, cumulativeness, and managed informational collectivity ('information pooling') (see e.g. Rabach & Kim, 1994; Johannisson *et al.*, 1994; Mizrahi, 1998; Raikes *et al.*, 2000). In fact, the increased relevance of cluster forms of organisation of value-added chains is driven by features of the 'new economy', i.e., (1) the increased spatial and functional fragmentation of its value-added chains, contrasting with (2) the more complex and highly integrated products, systems of goods and services, the production of which is (3) interconnected through net-technologies. This tense 'triangle of the new economy' (see Elsner, 2005) requires new forms of coordination and standardization. However, technical interoperability and behavioural coordination are all but guaranteed, or emerging automatically, nor a trivial decision problem because incentives to free ride are ubiquitous, even if often only latent (see e.g. Foray, 1998; Weitzel & Westarp, 2002). Solutions would require forms of shared knowledge and technical, informational, 'expectational', and behavioural standards. Shared technical standards and behavioural institutions require some 'habituation' rather than hyper-rational choice. It would be in this way that clusters can make broader innovation and development feasible.

Clusters have been comprehended as *'functional'*, informal coordination systems around both *vertical* supply chains and *horizontal* competitor relations (see again e.g. Storper, 1997; also Porter, 1998b; Feser, 2002). Therefore, we define clusters as regionally concentrated groups of firms which are 'functionally' interconnected both 'vertically' and 'horizontally', but are statistically represented in different industries and branches, including manufacturing and services (for a more detailed definition, see e.g. Elsner, 2000, pp.413ff.). This would already imply that we can not sufficiently identify and measure clusters on the basis of official industry statistics alone but rather need to focus on those 'functional' relations.

1.2. Clusters and Networks in a Two-Stage Model

In a two-stage model of a cluster and 'its' networks, we consider clusters providing the 'raw material', for networks. This is due to their spontaneously and historically emerging 'trust' (emerging from a cumulative history of recurrent interaction and reciprocation). *Networks*, thus, are formed on the ground of 'functional' relations that have emerged in clusters, as *'strategic'*, i.e., more deliberate and formal, coordination systems. They are defined as consciously agreed upon and project-based multilateral cooperations, typically with a greater degree of mutual commitment involved than clusters would require (see again

Elsner, 2000, p.415). Also networks are considered factors of coordinated collective action capacity and thus increased and broader innovation capacity.

In this paper, we will build empirically on this two-stage cluster and networks framework to determine and measure a service cluster and the networks that have emerged from it. Empirically, in a 'primary-statistical' (survey) approach, clusters will be identified and measured according to the 'functional' criterion of *supplier* (vertical) *relations* while networks will be surveyed and characterised through 'strategic', i.e., project-based *cooperative relations*.

1.3. The Empirical Development Potential of a Cluster and Its Networks

Clusters and networks may not always be problem-solving devices as they may become 'sclerotic', 'petrified', or locked-in. They may obstruct the entry of new agents and stall further joint learning. Firms involved in such 'old' structures are collectively less innovative and therefore the local economy would be less dynamic and receive fewer impulses from this cluster and its networks (see e.g. Grabher, 1993).

This paper will approach clusters and their networks empirically focussing on different *industrial and professional structures*, net-*densities* and *centrality* structures, *size* and *age* structures, and sales dynamics which in sum may indicate different regional economic development potentials of a cluster and its networks.

1.4. Statistical Problems Involved in Service Clusters

As said, considering methods of identification and measurement, clusters should be empirically determined and measured on the basis of individual *inter-firm*, inter-plant, inter-divisional, 'inter-functional' and even inter-personal relations rather than on official industry-based statistics alone. However, such data are rarely available since they would require costly primary surveys and, beyond this, would run into conflict with rules of confidentiality of firms in official statistics. In this article, therefore, we will use a variety of statistics and data: first, a *'secondary-statistical'* approach based on official *industries* and *professions* statistics, and second, a *'primary-statistical'* approach based on a regional *firms' interrelations* survey.

As concerns official '*secondary*' industry-based statistics, regional clusters might be best approached by *input-output* (I-O) data. This has indeed been developed and used for regional cluster analysis. Feser & Bergmann (2000), for instance, have derived industry clusters at the national (U.S.) level on an I-O data base. They used these structures as a template to compare with state-level I-O data in order to identify regional (state-level) clusters (for another recent application of this approach, see e.g. Kelton *et al.*, 2008). However, official I-O data are rarely available in sufficient quantity and quality for smaller regional and local levels. Thus, for regional cases, if regional I-O data are available at all, it usually still requires a combined quantitative and qualitative (case study) approach (see e.g. Midmore *et al.*, 2006).

In addition, official industry data do not provide information about *services within manufacturing* industries. Therefore, the 'inner tertiarisation' of manufacturing, most simply put in terms of service employees within manufacturing, is rarely revealed. Accordingly, a service cluster, in particular, cannot usually be sufficiently identified nor can its development over time be measured on the basis of official industry statistics, including official I-O data. *Service clusters*, thus, involve specific problems. Their 'product' is an input at all stages of the production of physical commodities, and it is widespread throughout the economy. Yet services that are not purchased from specialised service suppliers but rather are self-supplied by manufacturing firms are *'hidden'* in official statistics. Thus, a cluster grouped around a service product is rarely visible in official statistics, and no complete account of the size and inner structure of such service cluster is feasible. A cluster constituted by a service function is a *'crosssector'* in terms of official industry statistics. A 'cross-sector' can be depicted as a group of professional *'functions'* (distinct from 'functional' supplier relations as used in the cluster definition),

represented by the employees who perform these functions, distributed over the officially measured industries – be it in officially measured service industries or 'hidden' within manufacturing. We will use specifically generated data, i.e., official 'secondary' statistics derived from *firm-based* data which combine two typically distinct data sets: regional *employees* by both *industries* and *professions* carried out in these industries.

Against this background, we define a regional *logistics cluster* as a set of productive units, allocated to different service and manufacturing industries within official statistics, that contain employees connected to the 'logistics' function. This set includes suppliers, assemblers, service firms, and others, the latter may include nonprofit, semi-public and public agents which run logistics services adjunct to specific *infrastructures*, e.g. *ports*. A *logistics network*, accordingly, will be defined as a *subset* of the logistics cluster, i.e., a group of productive units in a cluster that have agreed upon a multilateral and project-based cooperation for some limited time. An established cluster normally gives rise to several networks.

1.5. *The Approaches and the Proceeding*

This paper presents two empirical approaches to determine and measure a service cluster and its networks, one on the official 'secondary-statistical' base and one on a 'primary-statistical' base, as explained. These approaches will be used for a tentative exploration of the strengths and weaknesses of a regional logistics cluster, i.e., its regional development potential. This article introduces these approaches and explores their relevance exemplarily with the case of the German port regions and City-States Hamburg and Bremen.

The article is structured as follows: *Section two* will more specifically discuss methodological and data problems in identifying and measuring 'cross-sectors', clusters and networks. *Section three* will discuss the 'secondary-statistical' approach to the logistics 'cross-sector' in more detail, including an exemplary empirical determination and measurement of it. *Section four* goes into more detail regarding the 'primarystatistical' survey approach to the cluster and its networks, with an explorative analysis of such data for the case at hand. *Section five* summarizes and concludes, considering the opportunities to combine the two approaches and their respective data sets in an improved official future statistical environment. It also considers the generalisation of the exemplary substantive findings for a regional cluster policy and development strategy.

2. Theoretical and Methodological Problems, and the Two Approaches

2.1. *The Two Approaches to Service Clusters and Their Respective Data Sets*

The first approach circumvents the limits of official industry statistics through a *combined branch* (i.e., 'institutional') *and profession* (i.e., 'functional') statistics ('functional' used here in the sense of what people do, i.e., their professional/occupational category). While the individual firms have to regularly report to both the industrial and professional statistics these two have never been published in combination in Germany. Therefore, a specific data set had to be generated and purchased from the labour market administration (the German (then) 'Bundesanstalt für Arbeit') which had to be generated from their firm data base. For each regional firm, according to a pre-selection of *'logistics-relevant'* branches requested for this investigation, the numbers of employees have been reported, according to a requested pre-selection of 'logistics-relevant' professions. This yields a *matrix of employees* sorted by branches and professions. Firms matrices have been aggregated for the respective *region* requested (i.e., the states of Hamburg and Bremen, and for West Germany, the 'old' Lander, for a general comparison). In fact, this has been a unique and novel data set then (see Laepple & Kempf, 2001, who also have used this combined data approach), and even after the establishment of regular socio-economic panels and manifold periodical firm surveys in the EU, this specific data set does not seem to be generally available yet.

The 'functional' decomposition of industries by professions helps to reveal what the employees in these industries 'really' do. Stein (2002), for instance, also has analysed *logistics functions* as a part of what he has called 'transactional occupations', in this way also overcoming the limits of conventional industry classifications and approaching the 'real' size and inner structure of the logistics 'cross-sector'. Professionally specified employees have been taken there as a substitute of the *transactions* among productive units, i.e., commodity and service deliveries, assuming that similar occupations in different productive units are performing those transactions.

Alternatively, the lack of detailed regional I-O data on services discussed above, may be compensated by the second approach discussed here - a *'primary-statistical'* survey of *supplier relations* for the cluster and of *cooperations* for its networks. Generally, inter-firm transaction data seem to be easier to collect if they are closer to the *physical* dimension as compared to the formal priced service supply dimension. For instance, Albino *et al.* (2003) have collected I-O data on a firm base for a physical good production chain in a small local Italian industrial district, in terms of material and energy flows, to reconstruct the production chain. Our 'primary' approach, in contrast, will be based on a firm questionnaire about cluster and network relations as defined (for a similar approach with an interview-based cluster representation, see e.g. Austrian, 2000). Also Johannisson *et al.* (2002) have defined and measured firm clusters and networks by firm interrelations. These include not only 'functional' supplier exchanges (part of what we have defined a cluster) and 'strategic' project cooperations (what we have defined a network) but also personal relations, contacts and discourse.

Obviously, official industry statistics and their functional disaggregation according to professions should be better *integrated* with survey-based data on transactions and interrelations. This would allow for a more complete picture of statistical service cross-sectors *as well as* service clusters and networks. *Table 1* gives an outline of the two data sets that the two approaches ideally would provide. It also gives an indication of the connections that could be generated between them through more applications as well as improved and extended official statistics and sector definitions in the future. For instance, transactions and interactions, including information flows, communication, inter-firm labour mobility, etc., most basically take place, or have a 'functional' service-flow representation, on the employee-to-employee level. With 'functional' statistics decomposed for individual industries (our first approach), and detailed regional firm surveys on cluster and network relations (our second approach), a *regional professions-based employee-transactions and service-flow* statistics could be developed, based on what people do, professionally and interactively (see e.g. Austrian, 2000).

Table 1 about here

In the following, we will, among other things, take a first step in combining survey data with 'secondary' industry-based statistics by connecting information on cluster and network relations with industry branch affiliations of firms, firm sizes and ages, and their sales dynamics. While the primary survey is a novelty as explained, the combination with these basic industry statistics data is a rather simple step to do if one has sufficient knowledge of the individual firms in the respective region. Also, the two approaches could be further interlinked by applying more sophisticated statistical methods to weighting procedures in order to develop the assignment and aggregation conventions for new statistical sectors. As a first step, we will use a normative weighting procedure based on experts evaluations below.

2.2. *Logistics Clusters and Port Regions*

The service function called logistics is a core product in traditional 'logistics regions', among which port regions are most prominent. As traditional agglomerations of logistics firms and employees, port regions have the potential to organise major parts of the value-added chains and, thus, to 'export' logistics services beyond their regional boundaries. They may attract more physical products into their regions and

increase their own portions of the total value-added by adding more logistics services and further processing the commodities within their regions. The logistics cluster, with its manifold backward and forward linkages, and its networks, thus would appear to be a major potential of regional development (see e.g. Peoples, 2003).

However, technical and spatial changes have caused a considerable *spatial restructuring* of the value-added of transportation. This has occurred through a changing modal split between sea shipping and land transportation that traditionally favoured the port-cities. Value-added has been distributed away from the port regions into an ever larger *hinterland* (see e.g. Campbell, 1993; van Klink, 1998). In this way, the expanding sea-borne trade, transportation and turnover through the ports on one hand and the economic benefits of the port cities and city states on the other have been separated. Particularly, the relationships between the big hub-ports and 'their' adjacent cities, regions and states that still largely have to fund and grant their sites, infrastructures, and operations have become precarious (see e.g. Graham, 2001). The belief in ports as a cornerstone of port-city regional growth has been long put into question. For instance, Oosterhaven *et al.* (2001), using official intra- and inter-regional I-O data for the two Dutch mainports, *Rotterdam* and *Amsterdam*, have found no substantiation for a specific relevance of the transport sector in port cities. The regional sea transport sector did not display major forward linkages that would reach beyond the regional level. There were few extra-regional service exports and hence apparently little contribution to the economic growth of the port cities.

On the other hand, Stein (2003), using secondary 'functional' statistics (professions), has investigated 'transactional occupations' (distinctive from 'production/transformation' and 'R&D') and compared 'occupational clusters' at the regional (Hamburg) and national (Germany) levels. While 'production/transformation' still dominates at the national level the port city-state of *Hamburg* has specialised in high-skilled 'transactional activities' including high-quality parts of logistics, such as shipping agents and brokers. Thus, in the case of Hamburg it appears that the logistics cross-sector plays a beneficial role for the regional development. We will get back to the case of Hamburg in our own discussion below. In general, logistics service activities in port-cities can be better identified through professional (occupational) and relational (cluster) analyses. The 'real' value-added chain rather than just industries thus comes into focus. Robinson (2002), for instance, has suggested cluster analyses including shipping lines, shipping agencies, custom agents, stevedores, freight forwarders, railing and trucking, depots, truck end drays, etc. Cluster and network policies to increase the level of functional integration and strategic cooperation, he has concluded, might generate a potential for future port-city development. It is against this background that the present article illustrates and discusses the two approaches to a service cluster and its networks in order to evaluate their regional developmental potential.

3. First Approach Applied: Statistically Determining the 'Cross-Sector Logistics'

3.1. *Method*

The idea of this approach has been to compile a list of 'logistics relevant' industries as represented in official statistics and to disaggregate these industries according to the 'logistics relevant' professional functions fulfilled by their employees. Particularly, we have compiled a selection of three-digit 'logistics relevant' service industries plus all manufacturing industries, i.e. the *'logistics-relevant'* sector, deliberately kept broad in the first instance. Similarly, a group of 'logistics-relevant' professional functions, also amply selected, has been compiled. For the *combined* lists, data for the two regions and the national level and for three years have been purchased from the official national institution responsible. This has yielded data *matrices* of combined industrial and occupational criteria. The numbers of employees selected this way is supposed to represent the 'logistics-relevant' sector; we call it the *'logistics potential'*.

To be sure, the two statistical sets as published separately could not have been combined this way after their official publication since the industry statistics include all employees not disaggregated by their function, while the occupational statistics do not disaggregate the data by industry. Therefore, this cross-section had to be carried out drawing on the two data sets as separately reported and stored in the individual firms' files of the national labour agency. The numbers of employees have been summed up across the regional firms falling in the requested list according to the selected three-digit industries and three-digit occupations. All data have been compiled for the three spatial areas: Bremen, Hamburg, and West Germany. The data matrices have been generated for the years 1990, 1995, and 2000. The *Appendix* shows the three basic matrices with the raw data for the year 2000 (*Tables A1–3*).

In order to generate the 'logistics cross-sector', a group of *logistics experts* has been brought together. These have been selected through a regional Bremen logistics research consortium which includes major logistics research institutes (e.g. ISL - Institute for Sea Shipping and Logistics, and DAV - German Foreign Trade and Traffic Academy) as well as the German National Association for Logistics (BAV). The group has discussed and determined the *proportions* in which the 'logistics-relevant' employees in the cells of the matrices can in fact be considered 'logistics employees'. A few minor professions have been completely dropped by the experts as not belonging to the logistics cross sector at all. In addition, some cells containing a number of regional employees smaller than 0.5% of the national number have not been explicitly discussed. In these cells, the numbers have been weighted with the average weight attached to the numbers in those cells that have been explicitly considered. In these more relevant cells, proportions (per-cent numbers) have been explicitly discussed and attached. This has yielded more valid numbers of the 'real' logistics employees in the different occupational categories of the different industries. The proportions attached have been used in 5%-steps. The results of several rounds of detailed discussion and the *weight structure* received this way is given in *Table A4* in the *Appendix*. It suggests a potential *new normative convention* for the statistical determination of the 'crosssector' to be possibly defined as a new statistical sector in the future. This valuation procedure would of course need to be further elaborated and a more sophisticated collective method and convention established. This also could be supplanted by econometric information about empirical correlations and regressions among the subindustries and professions (i.e., the cells) of the logistics labour force. The latter may inform future expert decisions.

The matrices of the *logistics sector* received this way have been aggregated column-wise and line-wise to yield the sizes of the 'true' logistics professions and industries in the regions at hand. In addition, the sums of the line and column sums have provided the overall sizes of the 'cross-sector' (and its development over time) for the two regions and the national level. The aggregate data are given in *Table 2*.

Table 2 about here

Obviously, a cluster cannot be made explicit within this approach since no direct information about interrelations are contained. However, the size of the cross-sector certainly is some indication also of the size of the cluster. The intra-regional density of the interrelations among the firms of the cross-sector has to be measured independently, though (see below).

3.2. *Some Results*

On this data basis some statistical analyses have been carried out, such as longitudinal and cross-regional comparisons and a shift-share analysis allowing for the relevance of the regional industrial structure as a factor of regional strength or weakness. A few exemplary indications for Bremen and Hamburg shall suffice here (for more details, see Elsner *et al.*, 2005). *Table 2* already indicates that general logistics employment as identified and measured in this approach is shrinking relative to total

employment. However, there are marked differences between Bremen and Hamburg, and between these two agglomerations and West Germany. Shift-share calculations have revealed that a more favourable general economic and structural development in *Hamburg* (compared to Bremen) has 'pushed' the 'older', i.e., the less dynamic sections of the logistics sector out of the city-state boundaries and into its larger periphery (belonging to other German states, or 'Laender'). In the processes of industrial and spatial change, less productive parts of the logistics sector such as traditional trade as well as simple transportation and stock-keeping, both in service and manufacturing industries, have been forced out of the high-cost city locations while on the other hand, logistics-related *transport insurance, crediting and banking* and *IT-based logistics planning and consulting* remain existent and growing within the city-state of Hamburg (see Elsner *et al.*, 2005, pp.113ff.; see also van Klink, 1998, for the case of Rotterdam; this modern complex of logistics functions has also been described by, e.g. Graham, 2001, pp.9f., and Tavasszy *et al.*, 2003, pp.465f.). In this way, Hamburg has a relatively smaller but better structured logistics sector than Bremen. *Bremen*, in contrast, has generally kept a relatively larger logistics sector within its city-state boundaries which, however, has a less favourable inner structure in terms of both sub-sectors and professions. The Bremen logistics sector, nevertheless, might have some potential for a more dynamic growth since it contains some major firm players such as the public-private 'Bremen Ports' firm group. The latter, for instance, appears to be in the lead vis-á-vis the respective Hamburg players, leading the 'Eurogate' project, a massive new port system at the city of Wilhelmshaven, west of Bremen on the North Sea coast. However, it seems to be the more *general economic dynamics* of the city-states rather which is crucial here.

In addition, the sub-sectors and professions of the logistics sector have been sorted in 2x2 matrices for each region according to the categories (1a) 'percentage of sub-sector (profession) of total logistics employment (in year)' and (1b) 'growth rate of sub-sector (profession) employees over a period (1990/1995, 1995/2000, 1990/2000)', and (2a) 'higher than regional average' and (2b) 'lower than regional average'. Correlations between percent proportions and growth rates have supported the view that the branch structure of the logistics sector is better in Hamburg than in Bremen. West Germany as a whole has profited, with logistics growth rates higher than those in the city-states, from the sub-urbanisation and *spatial dispersion* of the logistics sector.

One of the crucial factors of these differential regional results is usually seen in the regional clusters and their networks, as discussed above. Thus, having yielded, in the first step, a first picture of the structure of the logistics sectors in the two regions, we have to turn to the cluster and networks analysis in order to yield some deeper explanation.

4. Second Approach Applied: The Inner Relations of the 'Cross-Sector' – The Logistics Cluster and Its Networks

This step is based on the 'primary-statistical' survey as explained above. This has been carried out for the city-state of *Bremen* only. A list of the 500 most 'logistic-relevant' firms (including manufacturing firms and plants with major numbers of logistics employees) has been compiled and three-digit industry codes according to the official institutional statistics attached. This list has been set up in order to comprise not only the about 100 largest 'logistics-relevant' firms (in service as well as manufacturing) but also to maximise the representation of the logistics cross sector (as derived above) with a maximum of 500 firms, making use of what we have known about the occupational structures of the firms. The survey thus has covered firms which represented some 90% of the logistics employees in Bremen (according to the logistics cross-sector as calculated above). Thanks to the availability of the official 'secondary' 'institutional' and 'functional' data of individual firms (which we of course have not been allowed to publish other than aggregated and processed) we were able to estimate the individual firm's number of logistics

employees and thus evaluate its logistics relevance (for a more detailed description of the method, see Wrobel, 2004, pp.183ff.).

The questionnaire has explained 'clusters', 'networks', 'logistics', and their relevance for the firm's relational position and for the region's economic perspective. The questionnaire has been mailed, and some of those firms that have not responded in time have been interviewed by telephone, some very few also face-to-face.

4.1. *The Cluster*

Regarding the cluster, the questionnaire just has asked for the 'functional' relations among the firms within the region in terms of the mere existence of *logistics services supply relations*, basically: 'From which firm/plant in Bremen do you receive logistics services?' and 'To which firm/plant do you deliver logistics services?' This was meant to shed light on the interrelations according to the theoretical definition of a cluster above.

Fifty-six (11.2%) of the firms have responded. This is not an overwhelmingly intense but still acceptable response (see e.g. Kraetke & Scheuplein, 2001, p.160), considering the widespread problems of an accurate understanding of this 'crossfunction' (although defined and explained in the questionnaire), the extremely sensitive character of those data, and the fact that the responding firms still count for more than 40% of the logistics employees in the region. The responding firms also have named other regional firms that have not responded themselves. Thus, in all, specified 'functional' relations have been reported for 78 firms, i.e., 22 firms were mentioned in addition to those that directly responded (which would increase the response rate to 15.6%).

Nevertheless, we have to be aware of the fact that the resulting cluster and networks representations illustrated below have to be considered all but complete. Note also that we have a reduced cluster representation due to the fact that we have asked only for 'vertical' supplier relations. While 'horizontal' competitors may have some supplier relation, too, we have not explicitly asked for other relations than service supply (such as for instance 'horizontal' labour mobility, information flows, etc.).

As had to be expected, the major firms have been well represented, with a small group of major logistics service firms neatly interrelated with a few major manufacturing plants, and also with the major semi-public consortium of the incumbent port Bremen Ports group and its subsidiaries and joint ventures well represented.

The direction of relations remains unspecified, i.e., 'incoming' and 'outgoing' relations between the same two firms have been counted as one. Given this, 78 firms (=N) can have a maximum of R=N(N-1)/2, i.e., 3,003 relations which defines the maximum cluster density of 1.0.

The standard network parameters have been calculated using UCINET. Considering *net density*, it has been argued in the empirical cluster and network literature that real-world relational systems (nets) virtually cannot be expected to have a density higher than 0.4. In our survey, 84 supplier relations have been specified which yields a density of only 0.03. In order to evaluate this value it has to be compared to other similar empirical estimations. However, these still are rare. The local movie industry west of Berlin (the Babelsberg film and movie production cluster), for instance, a cluster with rather narrow spatial boundaries and a much smaller number of firms and plants, easy to identify and investigate, had a reported density of 0.13 in 2001 (Kraetke & Scheuplein, 2001, p.122). The same source has reported for a spatially larger cluster with a larger number of agents, i.e., the wood processing cluster in the German state of Brandenburg, a density of only 0.003 (Kraetke & Scheuplein, 2001, p.172). In another empirical case comparable to ours, for a set of 67 firms in a small local cluster, Johannisson *et al.* (2002, p.306) have reported a network density of 0.14 which again comes close to the Babelsberg cluster. Finally, for the case of Japanese keiretsu network forms, Lincoln & Gerlach (2004, p.101) have reported a cluster density, based on 259 firms, of approximately 0.10. Case studies in Johannisson *et al.* (2002) display a tendency towards an increasing density with a decreasing net size and with an increasing local

concentration of the firms under investigation (with, e.g., 0.19 in a subcluster of 29 firms, and even 0.25 in a sub-cluster of only nine firms). We have to leave open whether this validly indicates the net properties or reflects the fact that smaller nets can be more completely surveyed. While sufficient comparable material is still lacking, these references establish a range of values which indeed includes the density of the logistics cluster at hand. Nevertheless, this cluster appears to have a definite potential to increase its density, an indication of its general potential to improve its internal interaction and its performance as a regional developmental factor. A graphical representation of the cluster net is given in *Figure 1*.

Figure 1 about here

Knowing the firms' industry affiliations (which have been more detailed than the rough affiliations given in *Figure 1*) and their cluster relations, we can reorganise the *regional cluster as a value-added chain*, sorted according to the two-digit industries, and *centred around logistics*. *Figure 2* depicts what we are able to infer from the combined data, i.e., how two-digit industries organise along a logistics-centred valueadded chain.

Figure 2 about here

As can be expected, this representation also reflects the general industrial structure given in the regional economy, i.e., the major industries in the region are well represented here. However, in addition, the considerable number of *service supply relations* between the logistics service industries (classification no. 60 and 63) and the dominant regional manufacturing industries food, textiles, metal, and vehicles (classification no. 15, 17, 27, 34) can be visualised here. Also, a considerable number of *relations among the service firms of the logistics sector*, namely among fringe and support services for transportation (classification no. 63), can be revealed.

In addition, the *centrality* structure of a cluster, i.e., the parameters 'degree', 'closeness', and 'betweenness', is used to describe its net structure and may help to conclude on its developmental potential. 'Degree' implies the centrality of a firm in the cluster according to the number of its relations, 'closeness' is based on the 'shortness' of paths between any two firms (either through a direct connection or via a third party), while 'betweenness' represents the position of a firm on the path between two other firms, i.e., its position as a 'relay' between others. Calculating these parameters for the individual firm and relating them to other characteristics of this firm, e.g. disaggregating centrality according to the *size* classification of firms (measured by logistics employees), we find an overall rather *traditional centrality structure*: Not very surprisingly, the largest firms turn out to be the most central in the cluster, as measured by 'degree' (see *Table 3*). 'Closeness' indicates the smallest difference between small and large firms, implying that large firms have only slightly more direct relations than the smaller ones. However, considering their much greater 'betweenness', their central positions may be largely of a hub&spoke-type, i.e., a considerably stronger position on the paths between any two other firms.

Table 3 about here

The centrality parameters for every individual firm can also be combined with the firm's *age* and *sales growth*. Again, the combined consideration of age, sales growth and centrality do not lead to a surprising result. It is the *old, large incumbent firms* with only a moderate sales growth that occupy the *most central* positions in the cluster.

Thus, in sum, we have found different indications to support the assumption of an 'old', *traditional logistics cluster* in the Bremen port region. This appears consistent with the results of the secondary-

statistical approach above, implied in the comparison to Hamburg, and it may contribute to comprehend the earlier result.

4.2. *The Networks*

Finally, we have derived a representation of the networks based on this cluster. In total, 71 firms have reported (or have been reported) to have *strategic cooperations*. With a maximum potential of 2,485 relations and 50 relations reported, a *density* of 0.02 was yielded. Thus, only a *subset* of cluster firms participate in networks. This is consistent with the two-staged cluster-network conception discussed. However, the cluster seems to be rather well represented by its networks. To be sure, only the totality of the firms of the networks form a subset of the cluster firms, i.e., the presence of a functional relation is not a precondition for a 'strategic' network relation in any individual case. In fact, the network relations do include *horizontal relations* while these have not been explicitly surveyed in the cluster questionnaire. In sum, seventeen network cooperations have been identified, as represented in *Figure 3*. Note that Figure 3 just illustrates a 'landscape' of separate smaller networks rather than a unique net.

Figure 3 about here

A few firms appear to be completely isolated while some are involved only in supraregional networks rather than in regional ones. Also, some 'networks' are only bilateral cooperations. Seven out of the seventeen cooperations, however, consist of more than three partners. Two of the seven are connected with *large manufacturers*, two other with *large logistics service firms*. Thirteen out of the seventeen networks are strictly *vertical*, four include *horizontal* relations, i.e., they are more ideal networks including competitors.

What has been found about the *centrality* of the cluster also applies to the networks, which is not surprising. Specifically, some small and medium-sized enterprises, a number of them young firms with a high sales growth dynamic, appear not to be included in the regional logistics networks. This may be consistent with the 'old', long-established character of the cluster. Thus, the networks would not seem to be particularly strong regional innovation and growth factors either. We will not delve deeper here into the discussion on whether and how hub&spoke cluster and network structures are able to promote regional development or whether regions should attempt to rely on more evenly structured nets primarily formed by SMEs. Presumably, it is the combination of a limited *density* and a specific *centrality* structure, together with firms' size, age and sales dynamic, which over all suggests a more unfavourable conclusion in this regional case.

Nevertheless, there is also a relevant involvement of logistics *service firms as central agents* in the logistics cluster and networks. Logistics service firms have begun to interact with each other not only in the cluster with *mutual service exchange*, they also seem to have begun to assume a more active role in networks through *projectbased cooperations*. In this way, they have become major agents on their own and more independent from the very big incumbent manufacturers, as they have ceased to be reactive suppliers of low-skill transport services only. In this way, the cluster and network structures somehow indicate the modern status of (logistics) services, how weak ever the other cluster and network structures may be.

5. Discussion and Conclusions

In this paper, we have discussed two approaches to identify and measure regional 'cross-sectors', clusters, and its networks, and service clusters in particular, and to shed more light on the overall size and inner structure of such service 'cross-sector'. In conventional statistics, large parts of a service 'cross-sector' typically are 'hidden' within manufacturing. Particularly, a regional logistics service cluster and its

networks have been empirically approached on the basis of a two-staged conception of a 'functional' cluster and the 'strategic' networks emerging from it. A service cluster is made up by 'functional' vertical service supplies and horizontal competitive exchanges of many kinds while networks are made of 'strategic' project-based cooperations, both vertical and horizontal. These have been reported in a regional firm survey, and net density and centrality measures, combined with the branch affiliation, firm size, age, and sales dynamics, have been calculated.

The respective data sets and calculated results allow for some cross-reference between the two approaches, i.e., the 'secondary-statistical' cross-sector and the 'primary-statistical' cluster and its networks. Perspectives of a better integration of the two approaches and data sets such as, for instance, 'relational' information ranging from official 'secondary' inter-industry I-O data to 'primary' data on inter-firm or even interpersonal exchange, have been discussed. However, a full-fledged integration is far beyond the scope of this paper and not warranted by the current availability of official statistics on the regional level in Germany.

However, both approaches, even when used separately, allow for some deeper insight into a service cross-sector, a cluster and its networks in a region (German citystates in our case). In our small case study, the first (i.e., 'secondary-statistical') approach has allowed for a distinction between the *relative sizes*, different inner *branch structures*, and different *development* over time and *perspectives* of the logistics sectors in the two German main port city-states, Bremen and Hamburg. There has appeared to be a connection between the general developmental dynamic of a region and the modernity and productivity of the structure of its logistics cross-sector, which certainly is reflecting a mutual causation. However, in the more 'backward' case of the state of Bremen, as compared to Hamburg, the logistics sector is still relatively large and not shrinking fast. Even its traditional parts, largely consisting of SMEs, have taken over many outsourced logistics functions from the manufacturing sector. These parts of the sector coexists, and in fact is connected, with the modern IT-intensive large-scale port operations run by a conglomerate of public authorities as well as major public-private firms and ventures. So the regional economic future of the more 'backward' case is all but plainly unfavourable. In Hamburg, in contrast, the faster general structural change of the metropolitan area towards sophisticated services has forced many logistics firms to move into a wider suburban hinterland.

The second approach has helped to reconstruct (at least parts of) the nets of the cluster and its networks and to calculate the net densities and centrality structures. Also from these 'primary-statistical' characteristics some indication of the regional development potential (for the city-state of Bremen only) has been gained. The picture of a relatively large, but 'old' and traditional, hub&spoke-type and incumbents-centred cluster has been observed here. This suggests that the Bremen logistics cluster and networks may contain only a limited regional development potential. However, the picture was not plainly unfavourable here either. There was room to manoeuvre, indicated even under the hub&spoke network structures by the fact that many logistics service firms turned out to be engaged in project-based networks. This appears as a rather new agency dimension of small and medium-sized logistics firms. Also, a logistics-centred value-added chain has been reconstructed.

A more in-depth evaluation of the strengths and weaknesses of a regional service cross-sector, cluster and networks, however, will only be feasible with more longitudinal and cross-regional data material and better (and better integrated) official statistics as explained. We have discussed here only some exemplary and limited results, a first step towards a broader screening and exploration of regional 'interrelational' structures. But such better knowledge base is not yet backed by the limited availability of official (relational) data on the regional level.

Finally, considering some *policy* implications, the approaches developed here generally support *cluster and network strategies* by providing more and better information about important cross-sectors, clusters and networks. However, we do not suggest focusing only on the *public* agent. We suggest that

such new knowledge is also, and perhaps primarily, used to qualify *entrepreneurial agency*, as well as private and semi-public cluster and network advisors and mediators.

We have suggested an *interactive policy* approach elsewhere (see e.g. Elsner, 2001a, b). In this approach, the interaction processes among firm agents, with their joint learning of coordination in complex interdependencies through the institutionalisation of cooperation, are at the core. The public agent's role then is not to directly intervene into these processes but rather to shape the crucial factors and conditions favourable for those processes. For instance, the public agent may help to make firm agents better aware of their regional interdependencies and cluster interactions, their common dependence on common location factors, being in fact 'collective goods', such as specific infrastructures and the effectiveness of the regional industry structures. This would help them to reflect the complex incentive structure they are facing (with incentives both to pursue institutionalised cooperation and to proceed on an individualistic basis, as a 'free-rider'). Finally, when they are prepared for more general reciprocity through a certain level of trust that has emerged in the cluster, the public agent may arrange for overlapping projects and interaction arenas that increase the perceived importance of their common future (e.g. common projects that overlap in time, concurrent meetings in different local arenas, etc.). Some incentives in favour of cooperation may also help. But these do not need to be large subsidies but may be qualitative incentives rather, such as selective information policy. Leaving matters in the primary responsibility of 'embedded' firm agents who are supported by the public agent in their joint learning of reciprocity, in favour of common regional goods, seems to be a promising cluster policy and regional development strategy. Their knowledge base may be improved by the two empirical approaches to cross-sectors, clusters and networks.

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References

Albino, V., Dietzenbacher, E. & Kuehtz, S. (2003) Analysing Materials and Energy Flows in an Industrial District Using an Enterprise Input-Output-Model, *Economic Systems Research*, **15,** pp.457-480.

Audretsch, D. B., Feldman, M. P. (1996) Innovative Cluster and the Industry Life Cycle, *Review of Industrial Organisation*, **11,** pp.253-273.

Austrian, Z. (2000) Cluster Case Studies: The Marriage of Quantitative and Qualitative Information for Action, *Economic Development Quarterly*, **14.1,** pp. 97-110.

Bellandi, M. (2003) Industrial clusters and districts in the new economy: some perspectives and cases, in: R. Sugden et al. (Eds.) *Urban and Regional Prosperity in a Globalised New Economy*. Pp.196-219 (Cheltenham, UK, Northampton, USA, E. Elgar).

Biswas, S. (2002) W(h)ither the Nation-state? National and State Identity in the Face of Fragmentation and Globalisation, *Global Society*, 16, pp.175-198.

Breschi, S. & Malerba, F. (2001) The Geography of Innovation and Economic Clustering: Some Introductory Notes, *Industrial and Corporate Change*, **10**, pp.817-833.

Campbell, S. (1993) Increasing Trade, Declining Port Cities: Port Containerization and the Regional Diffusion of Economic Benefits, in H. Noponen, J. Graham & A. R. Markusen (Eds.) *Trading Industries, Trading Regions. International Trade, American Industry, and Regional Economic Development*. Pp.213-255 (New York, London, Guilford Press).

Casciaro, T. (2003) Determinants of governance structure in alliances: the role of strategic, task and partner uncertainties, *Industrial and Corporate Change*, **12.6**, pp.1223-1251.

Dupuy, J.-C. & Torre, A. (1998) Co-operation and Trust in Spatially Clustered Firms, in: N. Lazaric & E. Lorenz (Eds.) *Trust and Economic Learning*. Pp. 141-161 (Cheltenham, UK, Northampton, MA, USA, E. Elgar).

Elsner, W. (2000) An Industrial Policy Agenda 2000 and Beyond--Experience, Theory, and Policy, in: W. Elsner & J. Groenewegen (Eds.) *Industrial Policies After 2000*. Pp.411-486 (Boston, Dordrecht, London, Kluwer Acad. Publ.).

Elsner, W. (2001a) Interactive Economic Policy: Toward a Cooperative Policy Approach for a Negotiated Economy, *Journal of Economic Issues*, **XXXV.1**, pp.61-83.

Elsner, W. (2001b) An Interactive Economic Policy Approach to Manage Structural Change: the case of industry conversion in the German state of Bremen, *International Review of Applied Economics*, **15.4,** pp.411-428.

Elsner, W. (2005) Real-World Economics Today: The New Complexity, Co-ordination and Policy, *Review of Social Economy*, **LXIII,** pp.19-53.

Elsner, W., Huebscher, J. A. & Zachcial, M. (2005) *Regionale Logistik-Cluster. Statistische Erfassung, Stärken und Schwächen, Handlungspotentiale*. (Frankfurt/M., Peter Lang).

Feser, E. J. (1998) Old and New Theories of Industry Clusters, in: M. Steiner (Ed.), *Clusters and Regional Specialisation. On Geography, Technology and Networks*. Pp. 18-40 (London, Pion).

Feser, E. J. (2002) Facing the Sources of Local External Economies, *Urban Studies*, **39**, pp.2485-2506.

Feser, E. J. & Bergman, E. M. (2000) National Industry Cluster Templates: A Framework for Applied Regional Cluster Analysis, *Regional Studies*, **34.1,** pp.1-19.

Foray, D. (1998) The Economics of Knowledge Openness: Emergence, Persistence and Change of Conventions in the Knowledge Systems, in: N. Lazaric & E. Lorenz (Eds.) *Trust and Economic Learning*. Pp.162-189 (Cheltenham, UK, Northampton, MA, USA, E. Elgar).

Gertler, M. S., Wolfe, D. A. & Garkut, D. (2000) No place like home? The embeddedness of innovation in a regional economy, *Review of International Political Economy*, **7**, pp.688-718.

Grabher, G. (1993) The weakness of strong ties. The lock-in of regional development in the Ruhr area, in: G. Grabher (Ed.) *The embedded firm. On the socioeconomics of industrial networks*. Pp.255-277 (London, New York, Routledge).

Graham, S. (2001) FlowCity: Networked Mobilities and the Contemporary Metropolis, *DISP*, **144**, pp.4-11, repr: *Journal of Urban Technology*, **9.1** (2002), pp.1-20.

Johannisson, B., Alexanderson, O., Nowicki, K. & Senneseth, K. (1994) Beyond anarchy and organization: entrepreneurs in contextual networks, *Entrepreneurship & Regional Development*, **6,** pp.329-356.

Johannisson, B., Ramirez-Pasillas, M., & Karlsson, G. (2002) The institutional embeddedness of local inter-firm networks: a leverage for business creation, *Entrepreneurship & Regional Development*, **14**, pp.297-315.

Kelton, C. M. L., Pasquale, M. K. & Rebelein, R. P. (2008) Using the North American Industry Classification System (NAICS) to Identify national Industry Cluster Templates for Applied regional Analysis, *Regional Studies*, **42.3**, pp.305-321.

Kirman, A. P. (1998) Economies with interacting agents, in: P. Cohendet *et al.* (Eds.) *The Economics of Networks*. Pp.17-51 (Berlin, Heidelberg, New York, Springer).

van Klink, H. A. (1998) The port network as a new stage in port development: the case of Rotterdam, *Environment and Planning A*, **30,** pp.143-160.

Kraetke, S. & Scheuplein, G. (2001) *Produktionscluster in Ostdeutschland. Methoden der Identifizierung und Analyse*. (Hamburg, VSA).

Laepple, D. & Kempf, B. (2001) Die Hamburger Arbeitslandschaft. Struktur und Entwicklung von Tätigkeitsfeldern im regionalen Vergleich (The Hamburg Work Landscape. Structure and Development of Occupational Clusters in a Regional Comparison), Report, Hamburg, Technical University Hamburg-Harburg (mimeo.).

Lincoln, J. R. & Gerlach, M. L. (2004) *Japan's Network Economy. Structure, Persistence, and Change*. (Cambridge, UK, New York, NY, USA, Cambridge Univ. Press).

Maillat, D. & Grosjean, N. (1999) Globalisation and Territorial Production Systems, in: M. M. Fischer *et al.* (Eds.) *Innovation, Networks and Localities*. Pp. 50-65 (Berlin, Heidelberg, New York, Springer).

Malmberg, A., Soelvell, O. & Zander, I. (2004) Spatial Clustering, Local Accumulation of Knowledge and Firm Competitiveness, in: J. Cantwell (Ed.) *Globalization and Location of Firms*. Pp.155-167 (Cheltenham, UK, Northampton, MA, USA, E. Elgar).

Midmore, P., Munday, M. & Roberts, A. (2006) Assessing Industry Linkages Using Regional Input-Output Tables, *Regional Studies*, **40.3,** pp.329-343.

Mizrahi, S. (1998) Regional Co-operation and Innovative Industries: Game-theoretical Aspects and Policy Implications, in: M. Steiner (Ed.) *Clusters and Regional Specialization. On Geography, Technology and Networks*. Pp.81-91 (London, Pion).

Oosterhaven, J., Eding, G. J. & Stelder, D. (2001) Clusters, Linkages and Interregional Spillovers: Methodology and Policy Implications for the Two Dutch Mainports and the Rural North, *Regional Studies*, **35.9,** pp.809-822.

Orsenigo, L. (2006) Clusters and Clustering: Stylized Facts, Issues, and Theories, in: P. Braunerhjelm & M. Feldman (Eds.) *Cluster Genesis. Technology-Based Industrial Development*. Pp.195-218 (Oxford, New York, Oxford Univ Press).

Peoples, J. (2003) Economic gains from regional concentration of business operations, in: R. Sugden, C. R. Hartung & G. R. Meadows (Eds.) *Urban and Regional Prosperity in a Globalized New Economy*. Pp.159-180 (Cheltenham, UK, Northampton, MA, USA, E. Elgar).

Porter, M. E. (1998a) Clusters and the New Economics of Competition, *Harvard Business Review*, **76.6,** pp.77-90.

Porter, M. E. (1998b) Clusters and competition: new agendas for companies, governments, and institutions, in: M. E. Porter (Ed.) *On Competition*. Pp.197-287 (Boston, Harvard Business School Press).

Rabach, E. & Kim, E. M. (1994) Where is the chain in commodity chains? The service sector nexus, in: G. Gereffi & M. Korzeniewicz (Eds.) *Commodity Chains and Global Capitalism*. (Westport, CT, USA, Greenwood Press).

Raikes, P., Jensen, M. F. & Ponte, S. (2000) Global commodity chain analysis and the French filière approach: comparison and critique, *Economy and Society*, **29,** pp.390-417.

Robinson, R. (2002) Ports as elements in value-driven chain systems: the new paradigm, *Maritime Policy & Management*, **29.3,** pp.241-255.

Rycroft, R. W. & Kash, D. E. (1999) *The Complexity Challenge. Technological Innovation for the 21st Century*. (London, New York, Pinter).

Stein, R. (2002) Producer Services, Transaction Activities, and Cities: Rethinking Occupational Categories in Economic Geography, *European Planning Studies*, **10.6,** pp.723-743.

Stein, R. (2003) Economic specialisation in metropolitan areas revisited: transactional occupations in Hamburg, Germany, *Urban Studies*, **40.11,** pp.2187-2205.

Steiner, M. (1998) The Discreet Charm of Clusters: An Introduction, in: M. Steiner (Ed.) *Clusters and Regional Specialisation. On Geography, Technology and Networks*. Pp.1-17 (London, Pion).

Storper, M. (1997) *The Regional World. Territorial Development in a Global Economy*. (New York, London, Guilford Press).

Tavasszy, L. A., Ruijgrok, C. J. & Thissen, M. J. P. M. (2003) Emerging Global Logistics Networks: Implications for Transport Systems and Policies, *Growth and Change*, **34.4**, pp.456-472.

Weitzel, T. & v. Westarp, F. (2002) From QWERTY to Nuclear Power Reactors: Historic Battles for the Standard, in: K. Geihs *et al.* (Eds.) *Networks. Standardization, Infrastructure, and Applications*. Pp.33-61 (Heidelberg, New York, Physica).

Wrobel, M. (2004) *Die Logistik als Motor regionaler Strukturentwicklung*. (Frankfurt/Main, Peter Lang).

Appendix