Cluster Mapping

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Outline

1. "Activity"
2. Relevance of cluster mapping
3. Boundaries: Regions and industries
4. Indicators / Methods
5. Examples
6. Case study ➔ Homework

Activity

Three questions

- What is cluster mapping?

  - „Cluster mapping describes the quantiative measurement of the presence of clusters across regions within a country or group of countries. Cluster mapping data provides insights into the specific economic geography of a country, the geographic footprint of a specific cluster category, and of the specialization profile of a given region." (Ketels 2017)

- Three questions

  - Why is cluster mapping important?
  - How can cluster mapping be conducted?
  - Which problems might arise?

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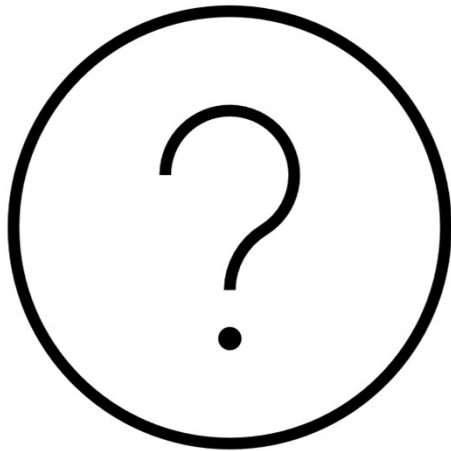
Relevance of cluster mapping

Relevance of cluster mapping / identification

- Aims
  - Comparison / Analysis
  - Selection
  - Management

- Three levels (with some overlap)
  - Macro-perspective: Mapping of regional clusters on a national or international scale (science, national policy)
  - Meso-perspective: Identify promising regional clusters for policy support (regional policy)
  - Micro-perspective: Mapping one cluster, its actors and structure inside a region (local actors / management)

Relevance of cluster mapping - Macro

- Science
  - Does spatial agglomerations exist?
  - Do clusters exist at all?
  - Analysis of the characteristics of regions with clusters.

- Cluster mapping
  - Approach for collecting goalspecific information about the local business environment
  - Analyse regional economic development
  - Benchmarking clusters
    - Clusters are chosen according to the same selection criteria and compared against a set of indicators
    - Identify strengths and weaknesses
    - Analyse developments over time

Relevance of cluster mapping - Macro

- Policy
  - Understanding of the respective regional cluster landscape:
    - Existing clusters
    - Cluster sprouts
    - No cluster candidate
  - Identify the need and opportunity for a cluster policy
  - Prioritise policy efforts directed towards specific clusters or regional areas
  - Justify policy measures and create transparency
  - Validate and communicate a political strategy and enhance acceptance of a (funding) decision (for a larger area)

Relevance of cluster mapping - Meso

- Knowledge used has to be accepted by the cluster actors and has to be appropriate to convince external stakeholders (e.g. fight frustration amongst non-supported cluster candidates)

- Commitment of key stakeholders and the importance of working together are important.

- Success depends on the standing of the decision makers in the community and the ability of these persons to bring the right people together.

- An experienced and well-respected person provides the stock of knowledge as well as the standing without having to engage in additional cluster measurement to ensure trustworthiness

Relevance of cluster mapping - Micro

- Which are the key actors in the cluster?

- How are the actors in the cluster linked to each other?

- Are there missing links / actors in the cluster?

- How do external connections look like?

- How to bring together the core actors?

- Which policy support measures of cluster management services to offer?

Boundaries: Regions and industries

Regions and regionalisation

- The term "region" is used very differently in everyday life and in scientific literature in very different ways

- Regions are usually territorial divisions that differ from state territories

- Regions do not comprise a single point of space, but rather an aggregation of spatial points

Regions and regionalisation

- Region is a variable concept

- The delimitation can be based on different principles
  - Political-administrative delimitation (e.g. county, administrative district, regional planning regions, federal states)
  - Homogeneity criterion, i.e. regions are similar with respect to certain indicators (e.g. agricultural region, tourist region).
  - Functionality criterion, i.e. regions are closely related (e.g. market catchment areas, labor market region)
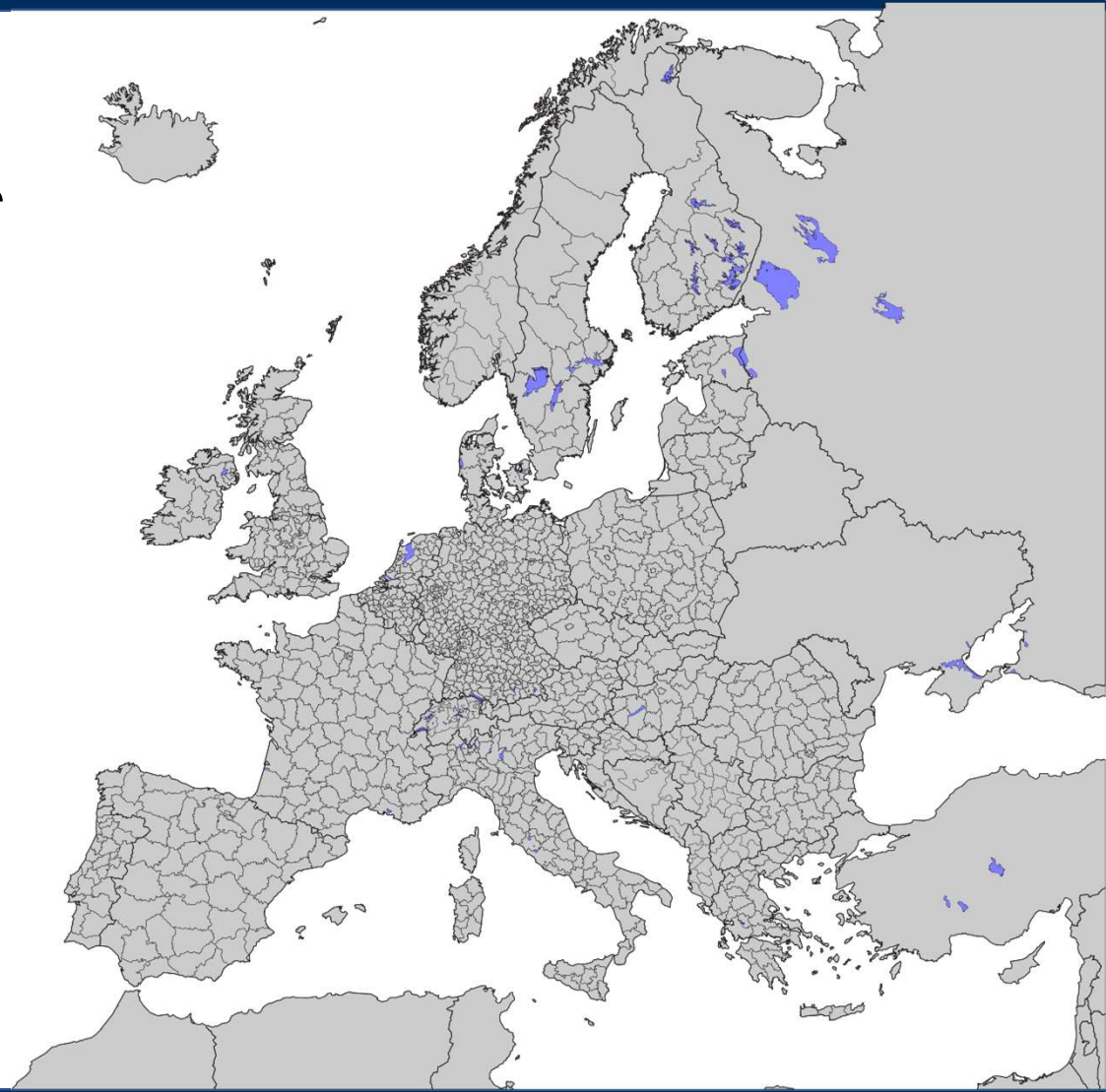
„Regions" = NUTS 1 (*Nomenclature des unités territoriales statistiques*)

„Regions" = NUTS 2 (*Nomenclature des unités territoriales statistiques*)

„Regions" = NUTS 3 (*Nomenclature des unités territoriales statistiques*)
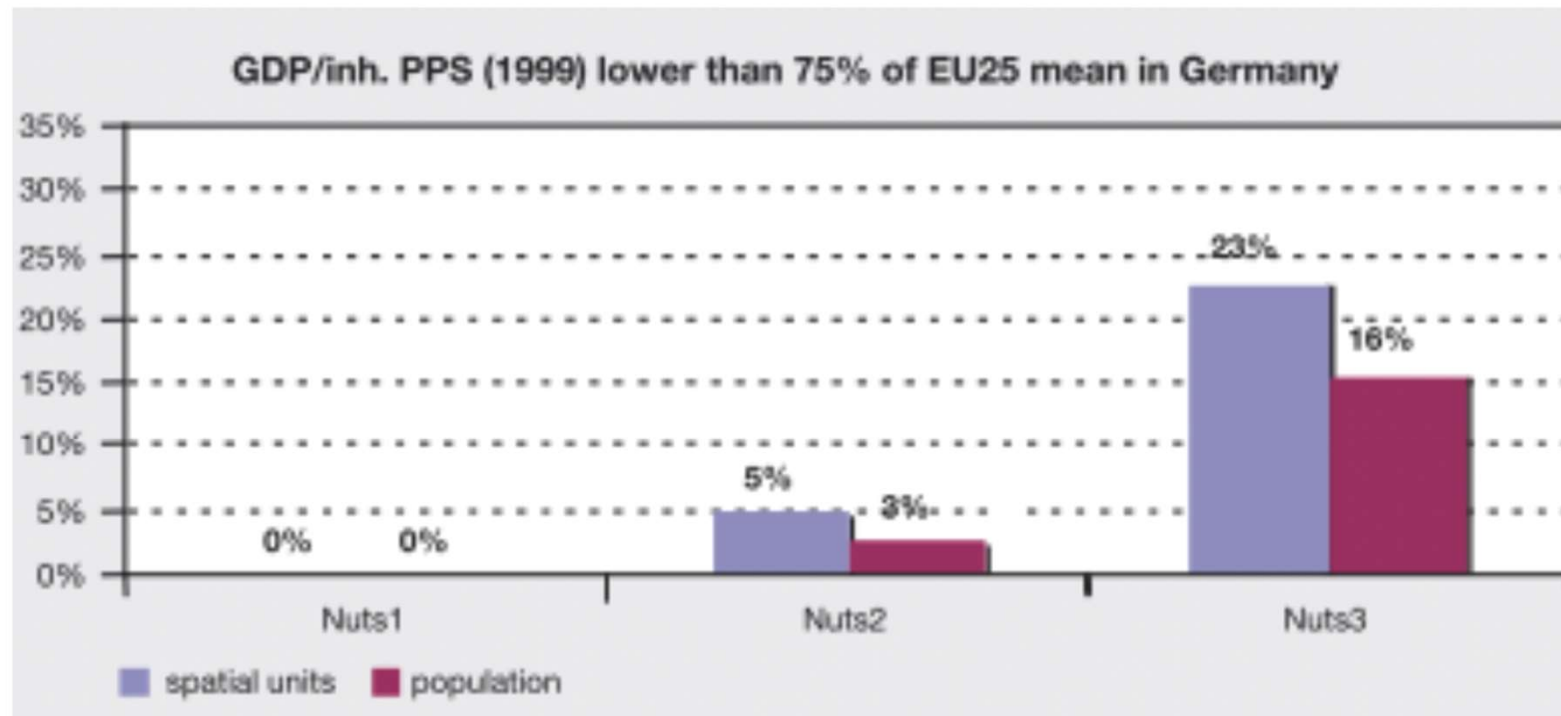
Regions and regionalisation

- Selection of the demarcation criterion on the basis of the problem at hand or the question asked
- Aim of a regionalization ➜ by summarization of several spatial points to simplify a complex picture
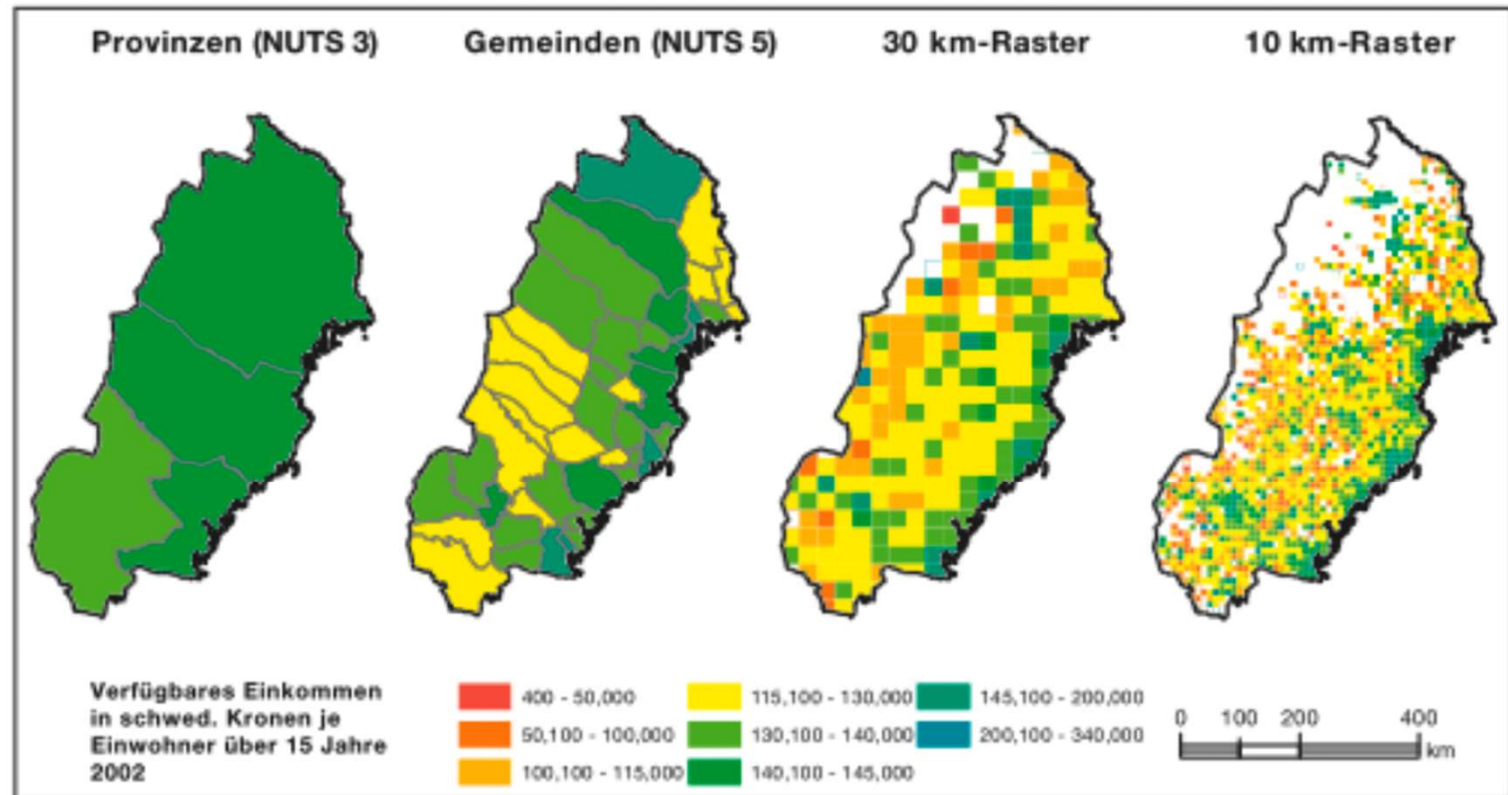- Associated loss of information should be as small as possible.

Region and MAUP

- Modifiable Areal Unit Problem = MAUP
  - Results of cartographic or statistical analyses and any form of spatial modeling depend on the definition of the examined spatial units

Quelle: Madelin et al. (2009): Das „MAUP": Modifiable Areal Unit – Problem oder Fortschritt?, S. 651

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18

Region and MAUP

Quelle: Madelin et al. (2009): Das „MAUP": Modifiable Areal Unit –
Problem oder Fortschritt?, S. 649
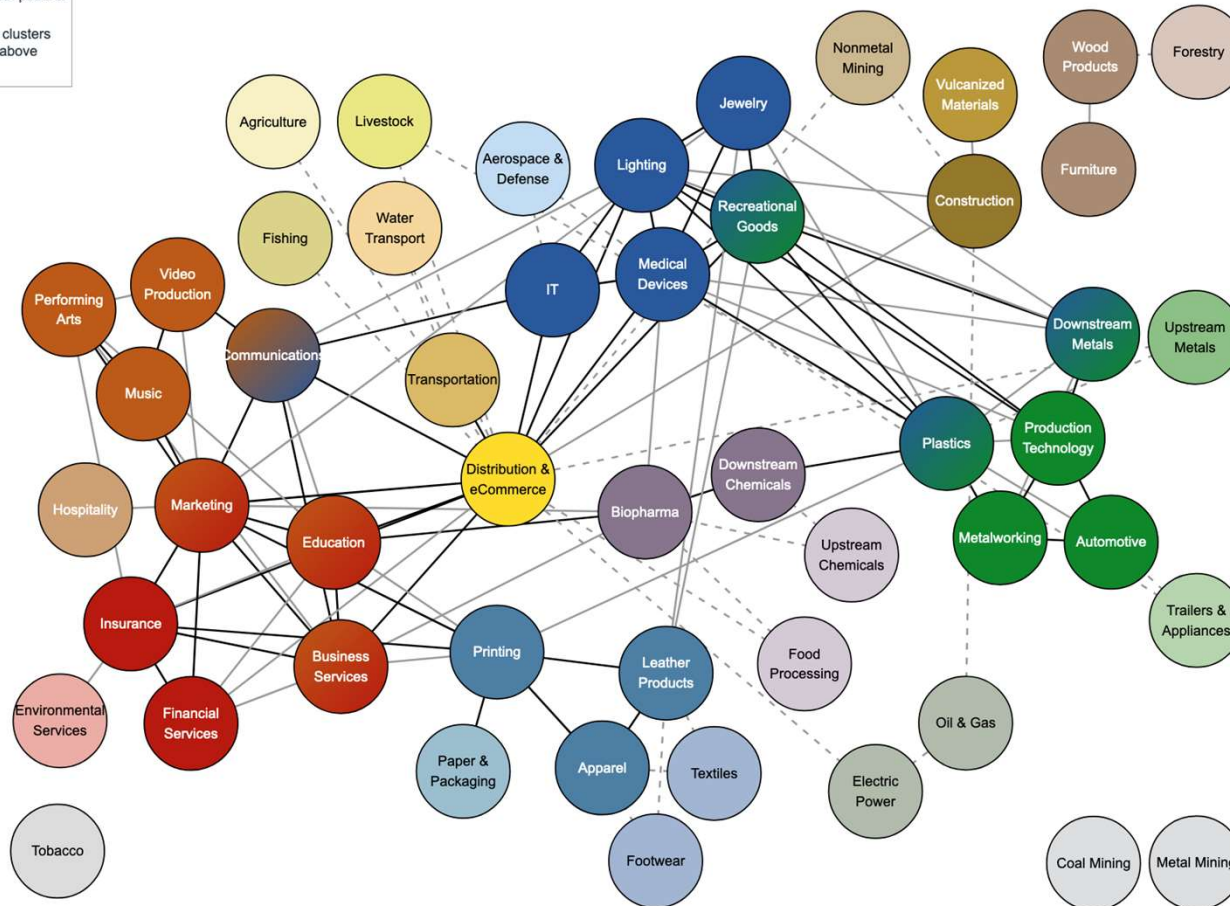
Boundaries industries

- Double-assignments
  - Companies are active in several clusters, which are assigned to different economic classes.
  - Industry diversification makes it difficult to apply a concentration measure, as the assignment of companies belonging to the cluster is fluid and not necessarily clear-cut.

- Boundaries
  - Which firms belong to the cluster?
  - Where to stop in the value chain?
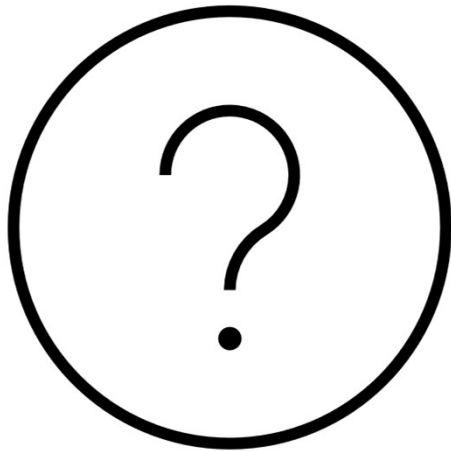
Boundaries industries

- Approaches
  - Arbitrary assignments of (sub-)industries to a cluster (or based on expert interviews)
  - Input-Output techniques / data
  - Relatedness structures (next slide)

Full Portfolio View of Related Clusters

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22

Indicators / Methods?

Selection of appropriate approach

- No single best method to identify and measure clusters ➔ Variety of functional approaches with specific strengths and weaknesses

- Demands for information differ between policy makers and academic research ➔ Validity and reliability important but framework conditions such as budget constraints and stakeholder involvement as well

➔ Pragmatic selection of instruments

- Level of detail and aggregation of information depends on the specific questions to be answered.

- Definition of exact informational needs important ➔ Detailed study needed?
  - Time and resources are scarce
  - Are the expected results pivotal for decision making?

Selection of appropriate approach

- Top-down
  - Quantitative approach based on statistical data
  - No direct involvement of the cluster actors
  - Aims
    - Identification of clusters
    - Deliver "hard" fact to justify policy measures
  - Limitations
    - Do not readily capture developing or niche clusters ➔ Focus on a reactive cluster policy approach to foster existing, mature and declining clusters.
    - Based on administrative economic classifications (e.g. NACE) ➔ hard to do justice to modern industries and business fields
    - Methods can be technically demanding and are highly dependent on data availability.
    - Clusters do not necessarily, refer to just one industry.

Selection of appropriate approach

- Bottom-up (qualitative approach)
  - Qualitative approach based on primary research and data acquisition
  - Focus on specific geographic subspaces or cluster structures intuitively taken for granted.
  - Very pragmatic approach of cluster identification
  - Aims:
    - Boosting stakeholder involvement during the mapping exercise
    - Get in-depth information on cluster actors, structure, processes, etc.
  - Questions
    - identify clusters,
    - evaluate the importance of clusters or cluster initiatives in a region / country,
    - give their view on local and regional networks, regional supply chains and regional core competencies,
    - assess the ties between universities, businesses and the government

Selection of appropriate approach

- Bottom-up (qualitative approach)
  - Advantages
    - Provide more detailed contextual information: key competencies of a cluster, its contours, and its interconnections to other networks.
    - More likely to include universities and other institutions constituting a cluster.
    - Better suited in the process of identifying emerging and niche clusters
    - Existing information and reputable knowledge providers in the region (e.g. targeted discussions with stakeholders and key holders from industry, universities, associations, etc.)
    - Qualitative information derived from day-to-day business (e.g. of associations, regional managements or policy makers) and established networks

Selection of appropriate approach

- Bottom-up (qualitative approach)
  - Disadvantages
    - Lack of standardisation and difficulty of comparing the findings across regions.
    - Different approaches and methods applied
    - Huge efforts necessary to get an in-depth picture of the cluster
    - Overestimation of accuracy of strongly held opinions, biases affecting each expert's views, expert's limited field of experience
    - Implementation is often politically motivated or is influenced by the level of awareness of already successful clusters ➔ Too narrow focus? ➔ Watch out for new cluster development and / or potential as well.

- Employ a mix of qualitative and quantitative methods.

Quantitative approaches

Method	Data sources	Advantages / limitations	Application area
Localisation quotients	Employment data	Easy to use / Orientation on administrative borders and traditional industries	Identification, Evaluation
Ripley's K-method	Distances between locations of all companies	Identification without setting borders and / Pre-selection of industries	Identification
Export data	Input-output data	Identification of the national relevance of the industry / Disaggregated data rarely available	Identification, Market position, Evaluation
Input-output method	Input-output data, surveys	Quality of interaction / Absence of colocation, data availability	Identification
Network analysis	Various quantitative sources, survey	Quality of interaction / Data availability	Identification, Characterising, Evaluation

Quantiative methods

- **Localisation quotients**
  - Quotient compares an industry's share of total employment in a given region to the industry's total employment share of the whole geographical area.
  - If there is an agglomeration of an industry within a country, the location quotient has to lie significantly above one.
  - Alternative data: Turnover data for registered companies.
  - Advantage: Data is easily available
  - Disadvantages:
    - Based on data sources oriented towards traditional industries
    - No absolute threshold
    - Dependent on the choice of borders: Some clusters might only be identified at a small geographic scale, while others require a larger geographic scale.

Quantiative methods

- **Ripley's K-method**
  - Method is based on the data of all distances between locations of all companies in each industry.
  - Comparing the geographical concentration with a benchmark distribution points out industries which are concentrated within the region.
  - Currently not widely applied in cluster mapping.
  - Advantage: Circumventing problem of choosing borders and the size of the region a priori.
  - Disadvantages
    - Difficulty of obtaining detailed location data.
    - See LQ (Thresholds, industrial boundaries)

Quantiative methods

- **Input-Output Method**
  - The input-output method indicates the interactions between companies and the strength of these interactions.
  - Step 1: Industries are grouped based on export data or by focusing on the largest transactions, in relative terms, between industries (Qualitative Input-Output-Analysis) ➔ identification of strong links
  - Step 2: Regions with a strong concentration of industries are identified
  - Step 3: For these regions and industries clustering with other industries are identified by graph analysis based on the IO-data.

Quantiative methods

- **Input-Output Method**
  - Advantage: Value chain is taken into account.
  - Disadvantages
    - Difficulty of getting input-output data at sub-national level ➔ Difficult to perform at a regional level.
    - Only around 70 industries taken into account.

Quantiative methods

- **Network analysis**
  - Network analysis concentrates on the interaction between different actors (not between industries).
  - Data sources: trade data, innovation-based input-output tables, patent data, surveys and other qualitative sources
  - Data is analysed by matrices or graphical network analysis.
  - The quality of interlinking can be assessed by analysing the concentration, the structural cohesion or the centralisation of the network.
  - Advantage: Usage of surveys for data collection allows to include interactions with universities and other institutions.
  - Disadvantages: High costs, high dependence on the response rate and quality of responses as well as the constitution of the sample

Qualitative approaches

Method	Data sources	Advantages / limitations	Application area
Interviews	Regional opinion leaders	Possible information about the regional economy, persons with more information, identification of business concentrations, analysis of networks and value chains, small and potential clusters, information about competitiveness and ideas for action plans / Subjective, selection bias	Identification, Characterising, Implementation
Focus groups / cluster workshops	All relevant actors		
Snowball method	Experts		

Summary

- Characteristics of well designed cluster selection
  - *Shared*: Selection is not a unilateral process, but the result of a participatory practice that secures the involvement of relevant actors (e.g. ministries, chambers of commerce, business associations and trade unions, development agencies).
  - *Grounded*: Decision-making process is based upon clear and agreed criteria

- This leads to
  - Commitment of the (cluster) actors to the decision making (by involving (clusters) actors)
  - Transparency of the process and abilitiy to justify selection

- Not always a need to engage in quantitative cluster mapping
  - Not necessary, if decision makers have the commitment of the actors and good arguments to convince critics.
  - Can enhance transparency.

- Ideally, qualitative and or quantitative means should be combined.

- Challenge for policy makers: Find the right people who really believe in the clustering cause and to identify a leader for the cluster

Quantitative methods used (Examples)

- Approaches
    - Isaksen
    - Sternberg and Litzenberger
    - European Cluster Observatory
    - Brenner
    - Web-Data-Approach

Short excursion

- Concentration vs. specialization
  - Industries = A, B, C, D, …. (each letter represents 10.000 employees)
  - Regions = 1, 2, 3, 4 (with all regions having around 40.000 employees)

Region 1	Region 2	Region 3	Region 4	Description
ABCD	ABCD	ABCD	ABCD	Equal distribution, no conc, no spec
AAAA	BBBB	CCCC	DDDD	Fully concentrated and specialized
AAAA	AAAA	BBBB	BBBB	Fully specialized, not fully concentrated
AABB	CCDD	EEFF	GGHH	Fully concentrated, not fully specialized
AABB	AABC	CCCC	ABCD	R3 is fully specialized, R4 fully diversified, industry D is fully concentrated

  - Concentration and specialization are not the same phenomenon (but they might overlap)
  - Application of the correct formula in order to measure what you want to measure
- ➔ absolute level of activities: number of firms / employees

Isaksen

- Identification of clusters cannot be based solely on the evaluation of public statistics, but must be combined with information about the potential clusters ➔ combining top-down and bottom-up analyses.

- Data from Central Register of Establishment and Enterprises at Statistics Norway

- Industry classification: Standard Industrial Classification in Norway based on the 1968 ISIC standard

- According to this, a cluster must have
  - Localisation quotient > 3.0 for the industry and
  - at least 200 employees in this industry (in the region)

- Both thresholds abitrary

$$LQ_{ind,reg} = \frac{\dfrac{v_{ind,reg}}{v_{ind,sp}}}{\dfrac{v_{ec,reg}}{v_{ec,sp}}}$$

Sternberg & Litzenberger Index

- Three elements
  - High number of employees in the region and industry in relation to the area of the region
  - High number of employees in the region and industry in relation to the number of inhabitants of the region
  - High number of employees in the region and industry in relation to the number of firms in the region

- Ranges from 0 to infinite (1 = German average), The higher this number, the higher the concentration of the industry region and the probability of a cluster.

$$\text{Concentration-Index (CI)} = RD_{ri} = \dfrac{\dfrac{e_{ri}}{a_{ri}}}{\dfrac{\sum_{r=1} e_{ri}}{\sum_{r=1} a_{ri}}} \quad x \quad RS_{ri} = \dfrac{\dfrac{e_{ri}}{i_{ri}}}{\dfrac{\sum_{r=1} e_{ri}}{\sum_{r=1} i_{ri}}} \quad / SB_{ri} = \dfrac{\dfrac{e_{ri}}{b_{ri}}}{\dfrac{\sum_{r=1} e_{ri}}{\sum_{r=1} b_{ri}}}$$

- a: size of the area
- i: number of inhabitants
- e: number of employees
- b: number of firms
- r/i: region/industry

Sternberg & Litzenberger Index

- Advantage: Cluster structures are evaluated uniformly and mapped with an index number that can also be compared if the initial conditions are similar.

- Disadvantages:
  - No absolute conditions such as a minimum number of employees
  - Construction is not completely resistant to distortion
  - Threshold values of the index for identification as a cluster must be defined on a case-by-case basis. Empirically, a threshold value of 4 proved to be favorable.
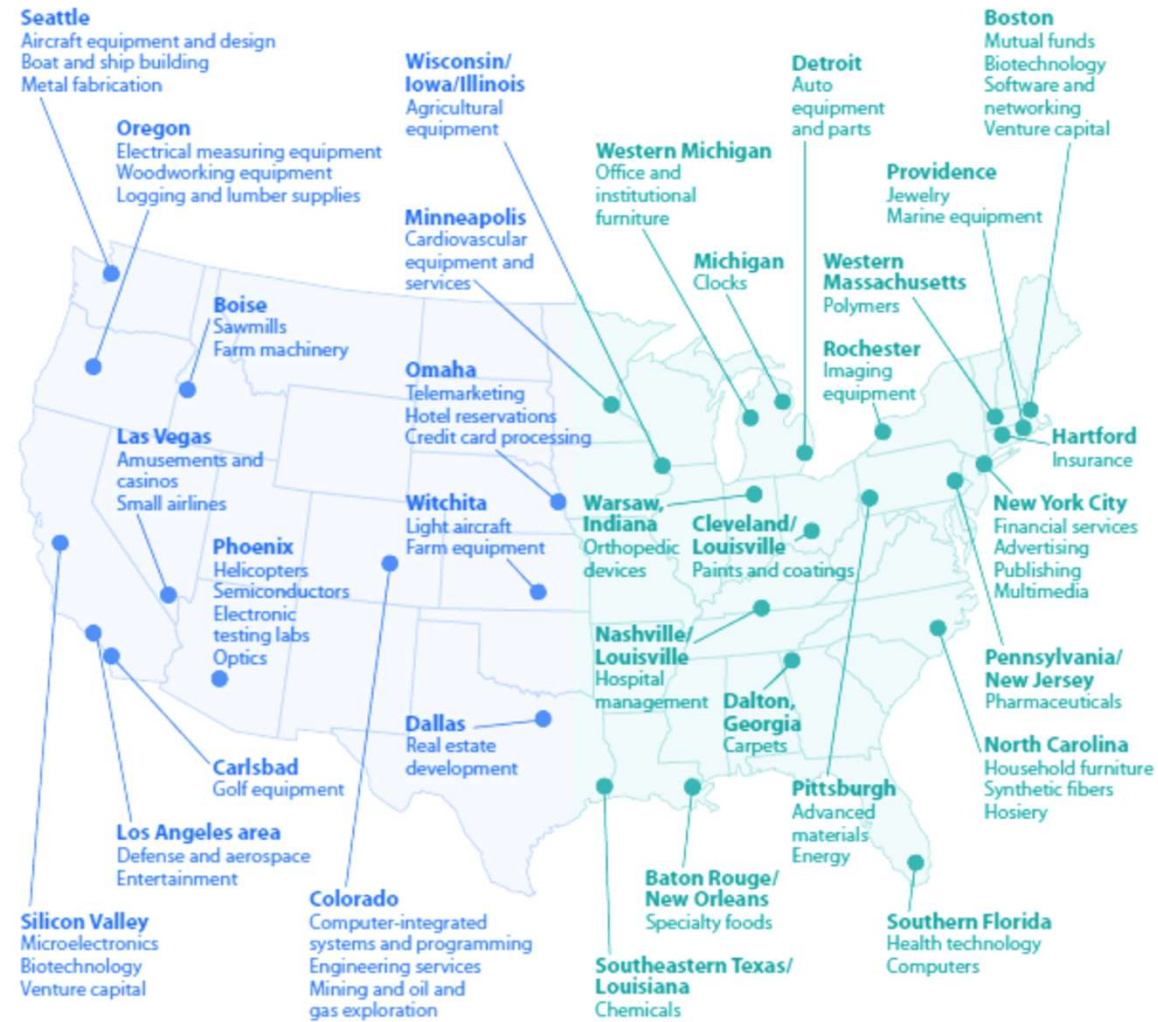
European Cluster Observatory

- Awarding stars according to different criteria ➔ maximum of three stars (for an industry / region combination)
    - 1. criterion: Size = absolute employment
        - All cluster candidates of an industry j in the total space are ranked according to their number of employees in this industry.
        - One star is given to those cluster candidates that are within the size top 10% of regions.
    - 2. criterion: Localization quotient LQ (specialization).
        - US Cluster Mapping: LQ above 1.25 as a necessary criterion for clusters (employment within that industry in the region lies 25 % above the national average for this industry) ➔ industry specific
        - LQ >= 2 ➔ star

European Cluster Observatory

- Awarding stars according to different criteria
  - 3. criterion: Focus = Employment in the cluster and region / Employment in the region in total
  - Again: TOP 10% of clusters in region receive a star
- Partly changed later: Wage/productivity, growth/entrepreneurship (+size +LQ)
- Problems
  - Favor employment-intensive clusters
  - Need to adjust for data availability, especially for smaller scale levels
  - Arbitrarily set thresholds ➜ falling just short of star ratings
- Advantage
  - Use of absolute and relative criteria
  - Simple presentation of results

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44

Cluster Mapping USA

- https://clustermapping.us/region/economic/san_jose_san_francisco_oakland_ca

Brenner

- Identification by comparing empirical and expected distribution of companies in an industry in a given area

- Analysis of empirical distributions compared to two-tailed distribution as hypothesis ➔ distribution is based on theoretical consideration

- Advantage:
  - No rigid cross-industry threshold, but determines it individually for each industry on the basis of the real distribution

- Disadvantages
  - Does not reflect the service sector very well
  - Procedure is highly complex

Brenner

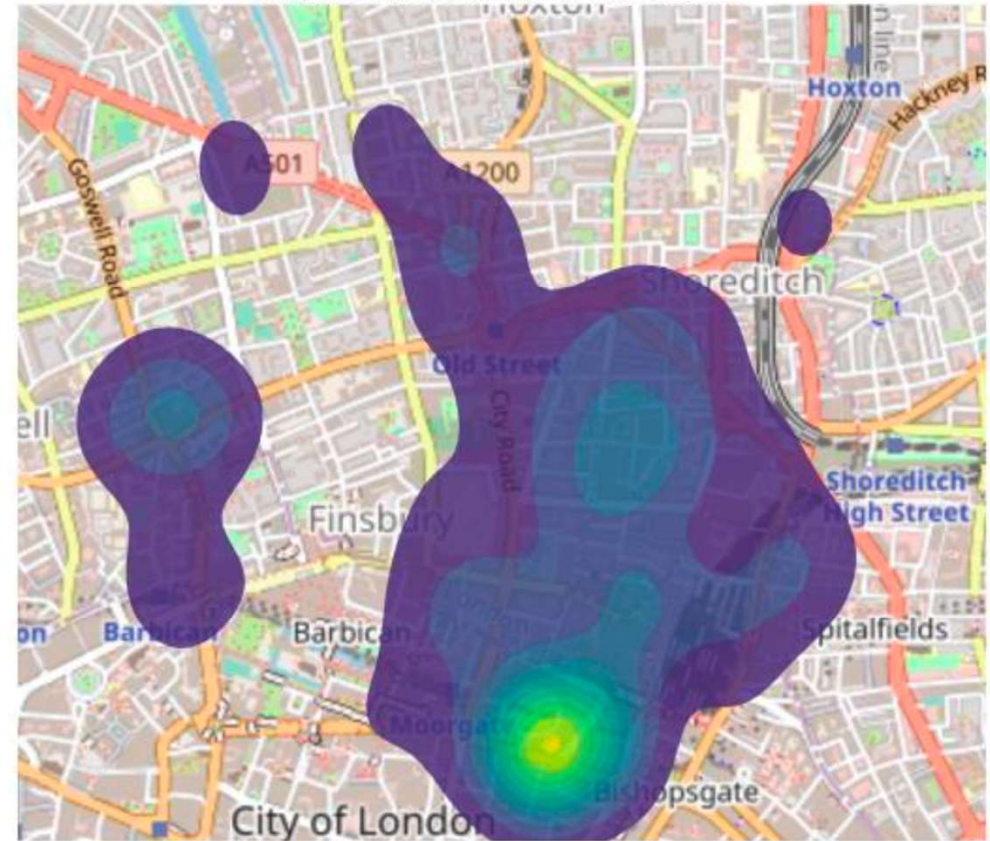**Number of regions**
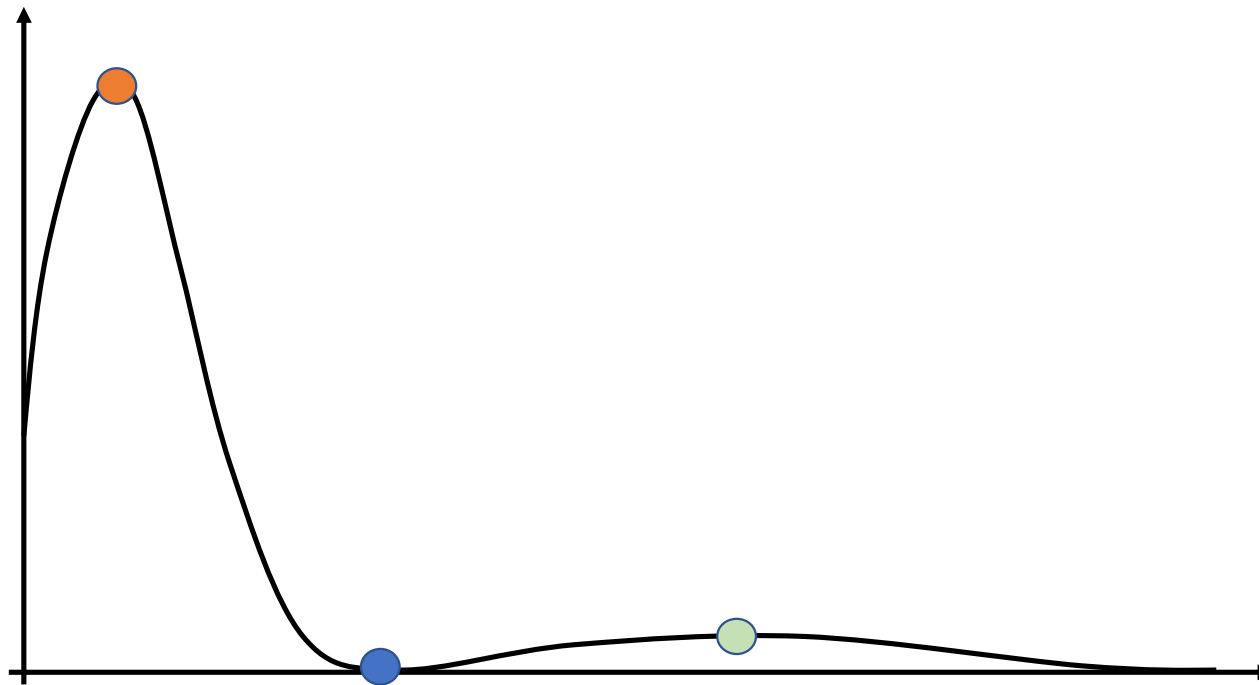
Number of employees

Web data approach

- Collect data via web scraping, e.g.
  - Location
  - Industry classification
  - Other keywords identifying technological / thematic orientation ➜ metadata
  - Network connections (e.g. hyperlinks or stated cooperation)

- Advantage:
  - Fine grained information on topics and networks ➜ new and emerging clusters can be identified
  - Microgeography

- Disadvantages
  - Strategic information on webpages ➜ marketing
  - Information really reliable / new?
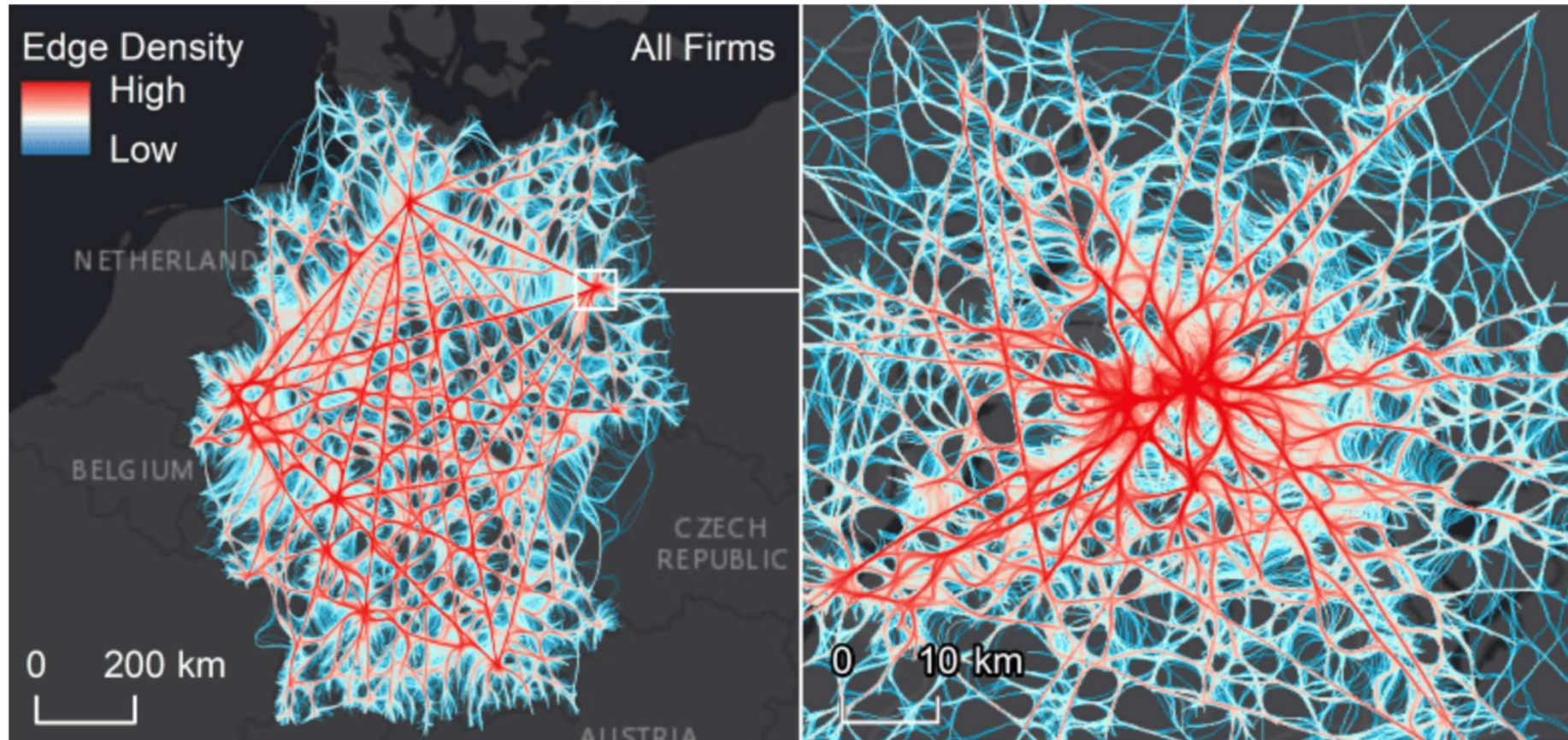 - Developments hard to follow (but possible)

Digital Media

Business services

Distribution of observations for

Distribution of observations for

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49

Network linkages based on hyperlinks (Germany - left, Berlin - right)

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50

Case study:
Homework

Homework until week 2

- Material uploaded: Brenner and Muehlig - Factors and mechanisms causing the emergence of local industrial clusters - a meta-study of 159 cases

- Literatur related to the case studies is reported on pages 36-45

- Tasks
  - Select one case study (in most cases one paper, but sometimes there are several papers for one case study)
  - Read the paper

Homework until week 2

- Answer the following questions (on one page!)
  - Name your cluster and the used literature
  - Emergence
    - Which regional conditions favoured the formation of the cluster?
    - Was there a triggering event? Something that set the formation of the cluster in motion?
    - Was there a promotor pushing the emergence / development of the cluster?
  - Functioning
    - Is there a cluster management? Which role has it played for the development of the cluster?
    - Which externalities / advantages can be observed due to the co-location of firms in the same region?
    - Which networks (formal or informal) operated in the regions?

Are there any questions?

Thank you for your attention!