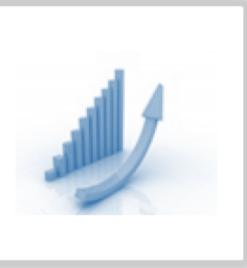

Graph Entropy Measures in Publication Network Data



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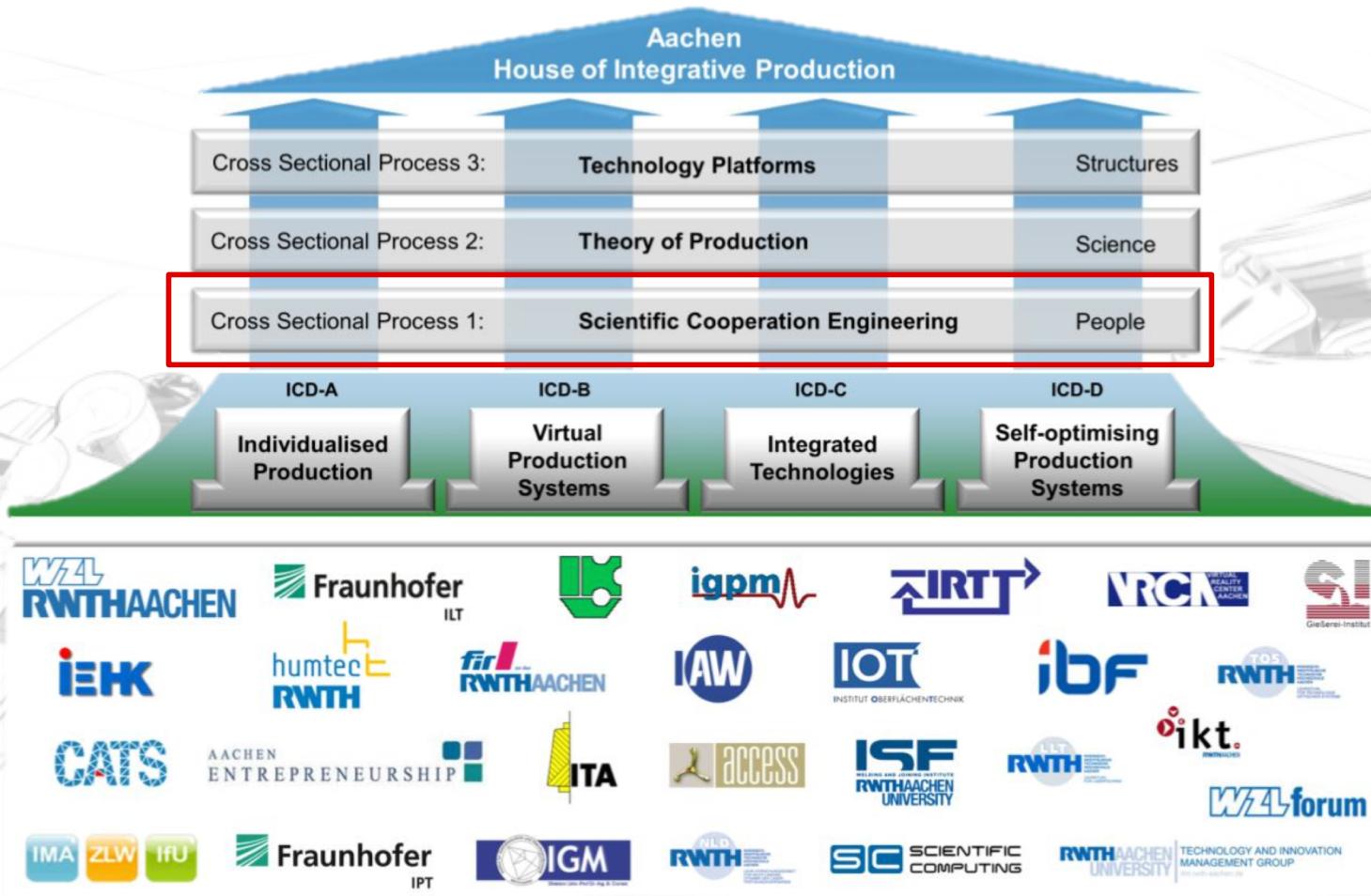
Agenda

1 Overview CSP1 - Interdisciplinary Innovation Management

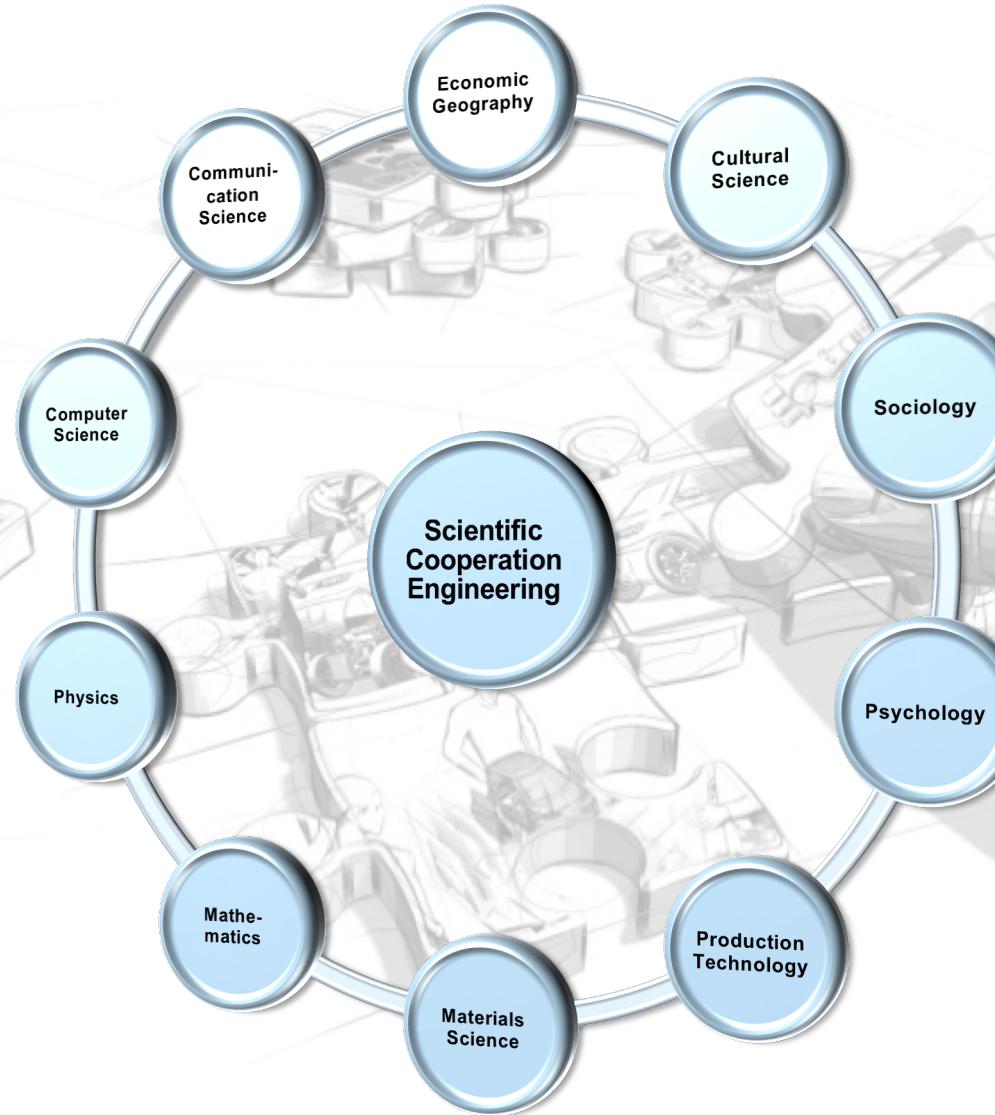
2 Publication Network Visualization

3 Cluster-App Vision

Research Background



Disciplinary backgrounds and methodologies of the CSP1



Research Questions

- How can one **measure scientific success** in interdisciplinary teams?
- Which means can **support interdisciplinary cooperation**?
- And how does the **cybernetic approach** apply for management of interdisciplinary success?

CSP1-fields of action and research questions



Knowledge & Cooperation Engineering



Interdisciplinary Innovation Management



Diversity Management



Performance Measurement

Agenda

1 Overview CSP1 – Interdisciplinary Innovation Management

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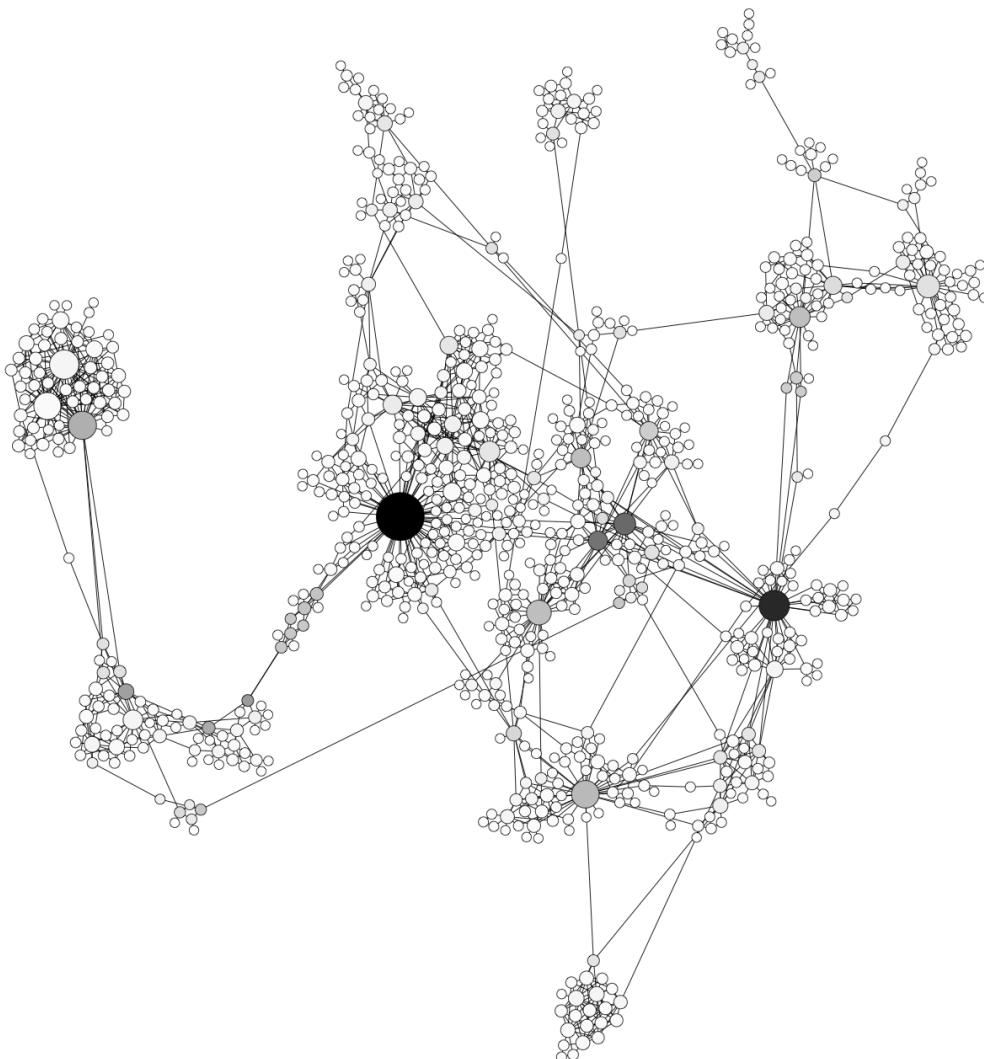
What is scientific success?

- The DFG has issued criteria for research clusters:
 - Blind Peer Reviewed Publication
 - Impact Factor
 - Completed Dissertations
 - Acquired third party funding
- We focus on publications
 - Publically available information
 - Reflect scientific cooperation
 - Reveal interdisciplinarity
- How can we find interdisciplinarity in publication data at the micro level?

Publication Network Visualization

- Network Graph (Nodes and Edges)
- **2 Type of Nodes**
 - Author (A)
 - Publication (P)
- **1 Type of Edge for a Relationship**
 - isAuthorOf (connects A and P)
- Force Atlas Layout
 - Two **nodes attract** each other, if they are **connected** by an edge.
 - Two **nodes repel** each other, if they are **not connected** by an edge.
 - => **Visual grouping** of nodes according to „relationship-nearness“

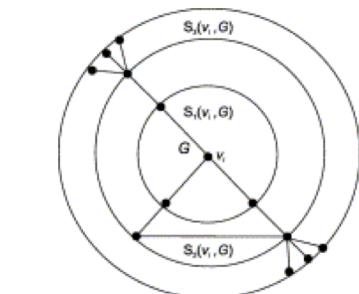
Cluster publication vizualisation



- How can we interpret this graph?
- Measures of centrality
 - Grayness codes for degree centrality
 - Node Size codes for betweenness centrality
- Centrality gives node based information
- What about subgraphs and total graph properties?
- Graph-Entropy measures the amount of information coded by a graph

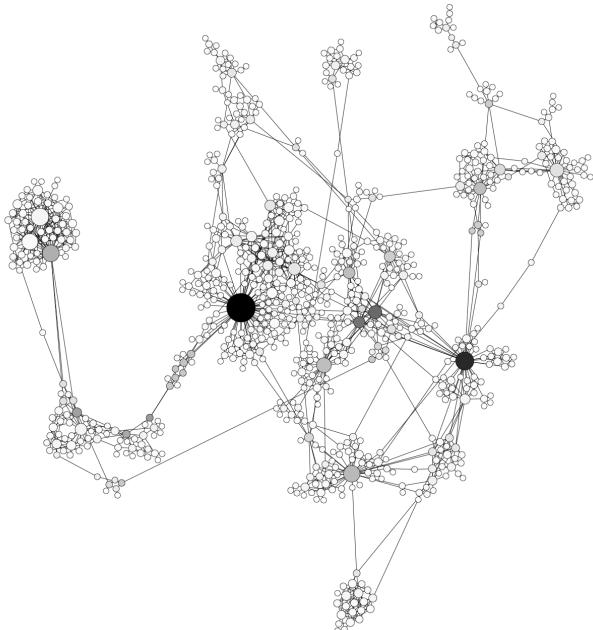
What is Graph Entropy?

- Entropy amount of uncertainty
 - Empty graphs and complete graphs have low entropy
- Various interpretations exist
 - Shannon Entropy can not be uniquely mapped
- 2 major variants exist
 - Invariant based Entropy measures
 - Partition according to an invariant (e.g. degree)
 - Measure probability of vertex being in invariant-class
 - Information functionals (f)
 - Every vertex is assigned a real number (according to the functional): $f(v_i)$
 - From the sum of those number a probability is derived $p^f(v_i)$
 - => Entropy (benefit: calculable in polynomial time)



$$I_f(G) := - \sum_{i=1}^{|V|} p^f(v_i) \log p^f(v_i)$$

Evaluation of the Cluster Network



Method	Symbol	Graph Entropy
Topological information content [13]	I_{mowsh}	9.031485
Parametric graph entropies [6]	I_{dehm}	9.6258
Network entropy due to [16]	I_{valv}	0.3095548
Graph entropy based on the ER model [17]	I_{wang}	15090.71

Table 1. Calculated graph entropies.

- Different results for different entropies
- I_{mowsh} is based on graph automorphism
 - measures symmetry
 - Max $I(G)=9.6366 (=log_2(|V|))$
 - Graph is very unsymmetrical (globally)
- I_{dehm} is based on vertex neighborhood diversity
 - Measures asymmetry
 - Max $I(G)=9.6366$
 - Graph is very symmetrical (locally)

Interdisciplinary Innovation Management

- Research approach for the CSP1
- Idea from cognitive psychology/computer science
 - The quantified self
 - Self-measurement as a self-management tool
- Measuring and visualizing success factors leads to a better and aware handling of these factors.
 - Allows identification of critical factors
 - Derivation of cluster specific interventions
 - Trainings, Seminars, etc.
 - Measurement of intervention success.

Agenda

1 Overview CSP1

2 Cluster Terminology (Glossary)

3 Vision

Scientific Cooperation Platform

Add ▾ Manage ▾ | Edit Controls

Go to | André Calero Valdez (Sign Out)

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Techbook » PUBLICATION ANALYSIS

Publication Relationship Analysis Demo

This page presents the planned features for publication relationship analysis tool of the cluster platform

Cluster Overview My Publications Research Background Services

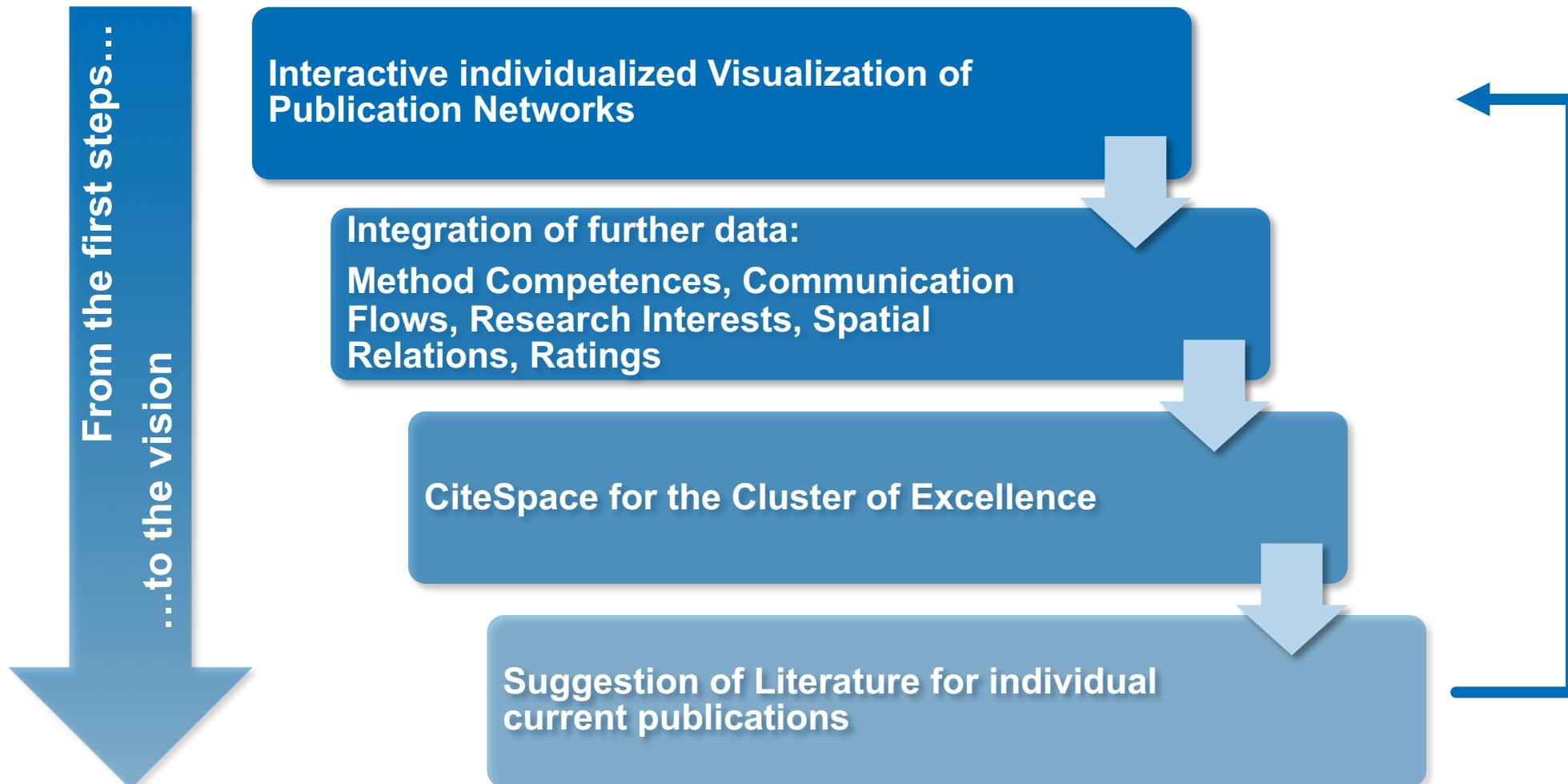
Visualization of Publication Relationships

The PRA-Tool will be able to visualize how researchers publish within the cluster of excellence. The visualization can be configured to represent various meta-data as nodes and edges.

For example the image to the right shows a visualization of the publications of the first funding phase. Only research assistants and external authors are shown in this graph. White nodes denote individual publications, colored nodes denote authors. Color represents the discipline of the author (i.e. red=engineering, blue=natural sciences, green=humanities, etc.). Size denotes the importance of the author or publication network importance measured by graph-degree.

Cluster-wide graphs will be anonymized, with the possible exception of showing ICD-Affiliation.

Potential of a cluster visualization tool



Thank you for your attention

■ Questions?