Interactive activities of researchers captured in research impact assessment

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III. Researcher interaction and Methods
IV. Nano and solar cell technology
V. Results: citation patterns and impact measures
VI. Conclusions and Further work
Knowledge networks and Embeddedness

- **Scientific collaboration networks**: relational data on co-authorships and citations showing cognitive representation of relations between papers, journals, or authors (Persson, 1994; Chen, 2007; Larsen, Forthcoming 2008)

- **Evolution of networks and hubs**: The well-connected nodes that newcomers attach to becomes hubs that create short paths between many pairs in the network (Powell et al., 2005)

- **Embeddedness in structures of social relations**
  - **Relational embeddedness**: pairwise (dyadic) relations
  - **Structural embeddedness**: actors in cohesive groups (Granovetter, 1985 & 1992)
Research objectives and Motivation

Objectives:

I) Examine research interaction captured in bibliometric measures of science-based solar cell technology

II) Analyse the roles of relational and structural embeddedness for emergence of scientific fields.

Field selected: Interdisciplinary hands-on, science-based technology, highly international field, NanoTech goes CleanTech public discourse, US-Swe “The one big thing”

Research interaction in international projects, shared equipment reflected in co-authorship, but also limitations since not all collaboration shows in co-authorship data and also other ways to interact
Bibliometric data combined with case studies:

- Analysis & visualization of knowledge networks
  Foundations for co-authorship relations
  Co-citation and Bibliographic coupling: intellectual base and research fronts, knowledge domain visualization and cognitive representation (Persson, 1994; Chen, 2007)

- Studies of knowledge networks
  Fractional counting (Gauffriau & Olesen Larsen, 2005) and Network analysis and centrality measures (White et al. 1976, Wasserman and Faust 1994)
Knowledge network example in Italy: research groups (co-authorships)
Co-citation: links between documents cited together by others

Bibliographic coupling: links from citing the same sources

- PAPER A
- PAPER B
- PAPER C
- PAPER D
Journal Co-citation


Colour legend: 2004-05= yellow, 2002-03= green, 2000-2001= turquoise
Nanostructured dye-sensitised solar cells.

Nanoparticle film that provides a large surface area for adsorption of light harvesting molecules

Technical definition (NNI, Darby and Zucker, 2003) research at the 1-100 nanometer range concerned with the novel properties and functions of structures, devices and systems because of their small or intermediate size.

…or wider scope including all research activities undertaken at the nanometric scale “thus including much of research in the field of biotechnology and macromolecular chemistry undertaken during the last two decades” (OECD, 2003).
Type A: Nano as an emerging S&T area (Darby and Zucker 2003, Braun 1997)
Type B: S&T relations in emerging nano communities (Meyer 2000, Meyer and Persson 1998)
Type C: Policy studies of nano S&T raising questions about impact of new applications of technology (Royal Society 2005, ESRC 2003, Arnall 2003)
Type D: Advances in the different areas of nano applications in natural science journals (JACS, J Phys Chem B, Nanoletters, Solar Energ Mat Sol C)
Research impact measures
combining structure, temporal, collaborative citation patterns

Fractional counting
Reduction of citations received by going from total counting to fractional counting

Time periods examined 1991-2004 vs. 1996-2004

Single and multiple location authored papers
following approach by the Centre for Science and Technology Studies (CWTS) in the Netherlands CWTS-study (2005) comparing citations made to national scientific publication and internationally co-authored publications
Conclusions and Further work

I. Researcher interaction and “diffusion by attraction” in early phases in application of research results (relational embeddedness)

II. Knowledge networks and institutions department affiliations and co-authorship networks, organisational networks formalised in laboratory networks (structural embeddedness)

III. Early and later phases further examined (in Italy and Switzerland autumn 2007) using bibliometric data, patent, in combination with interviews and archival data.