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**NANOTECHNOLOGY COLLABORATION
PROPENSITIES AND FIELD STRUCTURE**

NANOTECHNOLOGY

- ✘ Knowledge Intensive
- ✘ Collaboration on Core Technologies
- ✘ Desire among firms to collaborate
 - + 67% surveyed Massachusetts firms desire strategic alliance in R&D development
- ✘ 44% of Massachusetts firms have trouble identifying alliance partners

INFORMAL ROUTES TO COLLABORATION

- ✘ Informal paths to formal collaboration
 - + Link between sharing facilities, university affiliation and strategic alliance, co-patenting
- ✘ Are there important informal networks hovering under observable networks?
- ✘ What sort of field is being created?
- ✘ Will there be stages in the development of the field?

COLLABORATION AND FIELD STRUCTURE

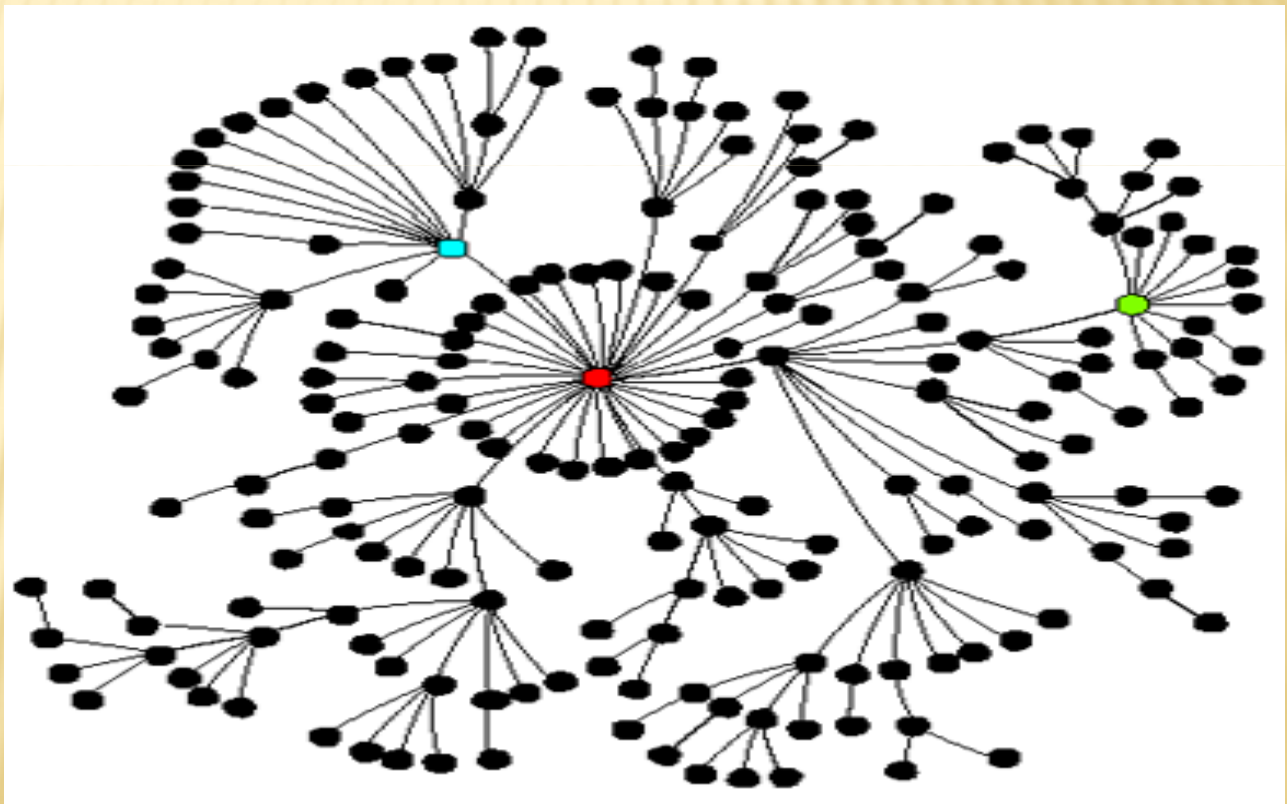
- ✘ What are the paths by which firms are likely to find collaborators and what does this mean for the structure of the field?
 - + Are the firms getting what they want?
 - + Is what they want good for them?
 - + Is what they want good for the field?

COLLABORATION PATTERNS

- ✘ Tie Construction and Field Structure
 - + Micro-macro link
 - + Local motifs
 - + Network dynamics

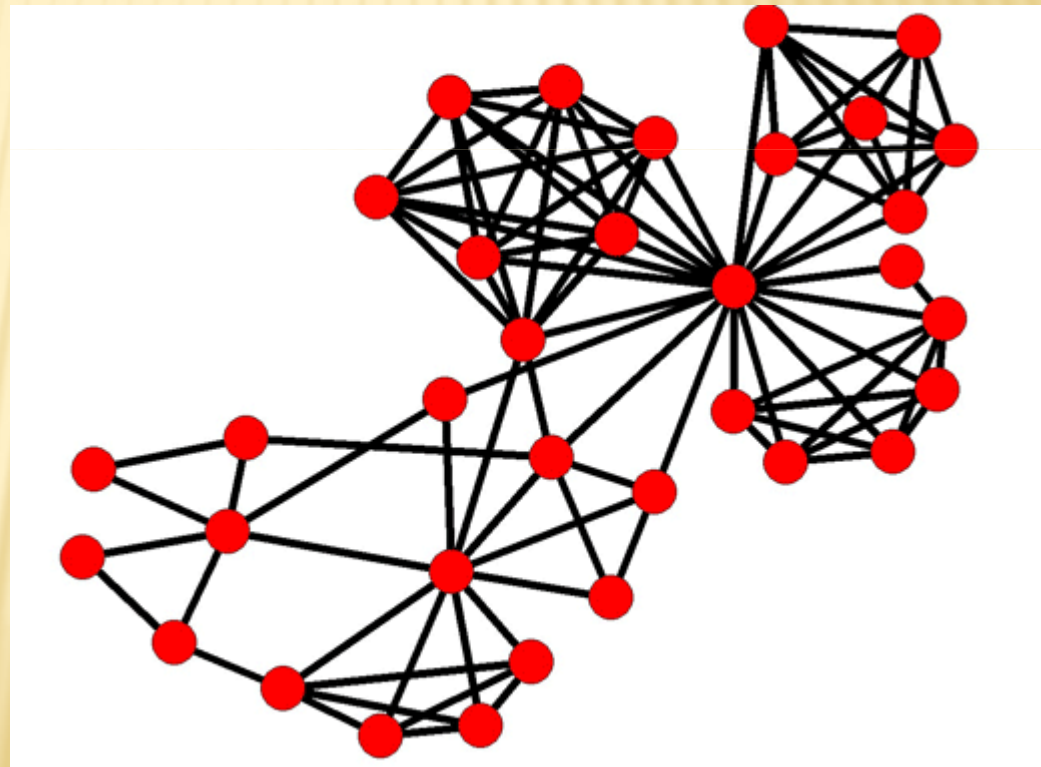
COLLABORATION PATTERNS

- ✘ Preferential attachment creates scale-free networks (Barabasi and Albert 1999)



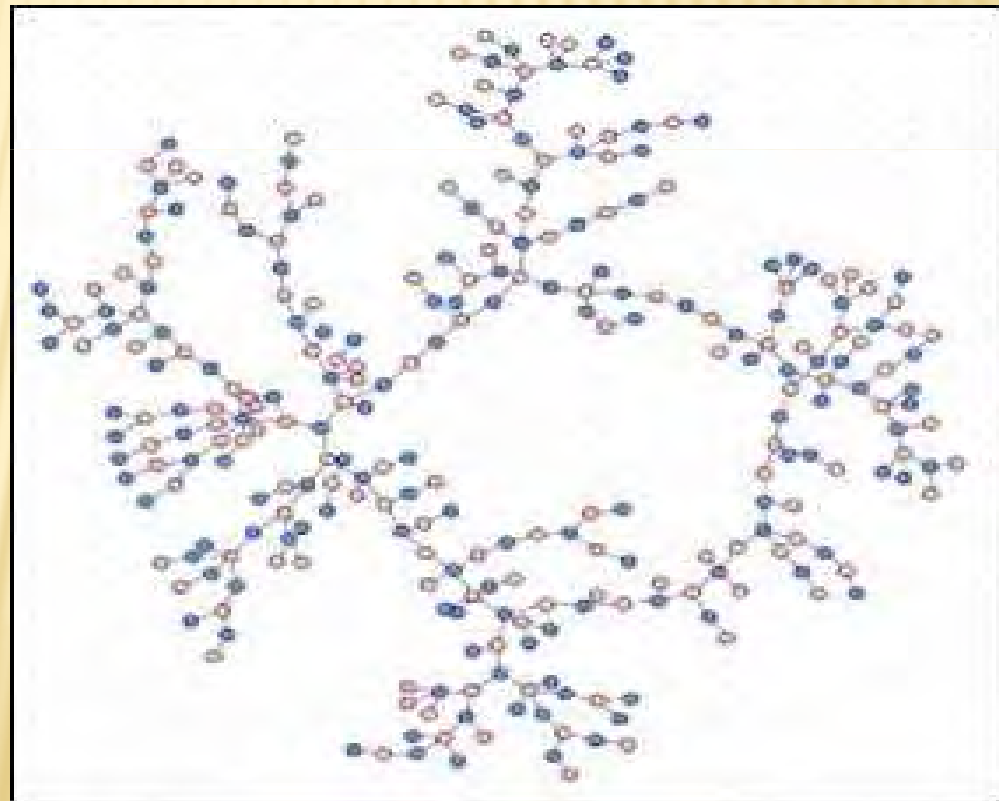
COLLABORATION PATTERNS

- ✘ Local clusters and low-levels of randomness creates small-world networks (Watts and Strogatz 1998)



COLLABORATION PATTERNS

- ✘ Bans on close relationships create spanning-tree networks (Bearman, Moody and Stovel 2004)



COLLABORATION PATTERNS

- × Why do they matter?
 - + Regulate flow of information
 - + Determine whether network is robust to failure and what kinds of failure
 - × Targeted attacks
 - × Epidemics
 - × Random failure
 - + Create redundancy
 - + Contribute to character of industry and its interface with external world
 - × Power lobbyists, exchange with public
 - + Increase rates of innovation

COLLABORATION PATTERNS ~ NANOTECH

- ✘ Does collaboration lead to collaboration?
 - + Are diverse ties, informal relations and industry associations related to formal R&D collaborations between firms?
- ✘ What kinds of collaboration lead to diversity?
 - + Are diverse ties associated with diverse field collaborations? Do certain kinds of informal collaborations lead to diversity?

SURVEY: POPULATION & SAMPLE

- ✘ Target Population: Massachusetts Nano-technology Firms
- ✘ Sample Frame: Nanobank: A complete list of firms compiled from articles, patents, and grants
- ✘ Sample: 242 firm located in Massachusetts.

SURVEY: OPERATIONALIZING COLLABORATION PROPENSITIES

- × What is transmitted?
 - + Information
 - + Influence
 - + Trust

SURVEY: OPERATIONALIZING COLLABORATION PROPENSITIES

- ✗ With whom?
 - + Firms
 - + Universities
 - + Industry-wide associations
 - + Government
 - + Non-profit, NGOs

SURVEY: OPERATIONALIZING COLLABORATION PROPENSITIES

- ✘ Main source of Nano R&D
- ✘ Acquiring patented materials or methods from external source
- ✘ Patent preparation
- ✘ Field identity
- ✘ Informal information-sharing
- ✘ Shared Facilities
- ✘ Association membership
- ✘ University Contact
- ✘ Other Collaborations

COLLABORATION PROPENSITIES

- ✘ Outcomes:

- + Collaborative Patent Preparation
- + Acquiring patented materials or methods

- ✘ Associated factors:

- + Field identity
- + Informal information-sharing
- + Shared Facilities
- + Association membership
- + University Contact

COLLABORATION PROPENSITIES

- ✘ Outcome
 - + Collaboration across fields
- ✘ Associated factors
 - + Industry Association
 - + University Collaboration
 - + Shared-use facilities
 - + Government Collaboration
 - + Ties to diverse others
 - + Diverse types of ties

UNIVERSITY IMPACT

- ✘ Platform for new industry collaborations or not?

RESULTS

- ✘ VERY PRELIMINARY!!
- ✘ One firm identified collaborations across multiple fields (Biology, Chemistry, and Medical/Health sciences). This firm also participated in a range of informal relationships and had diverse ties to academic institutions, other firms, and government organizations

PRELIMINARY RESULTS

× Patent Preparation

- + Are developed field networks being used?
 - × Not enough data
- + Sharing research results/information?
 - × No variation
- + Shared use facilities?
 - × Yes, but not for long
- + Industry associations?
 - × barely
- + University ties associated with collaboration

RESULTS

- × External R&D source
 - + Are developed field networks being used?
 - × Physics and Astronomy
 - + Sharing research results/information?
 - × Yes
 - + Shared use facilities?
 - × Yes, but not for long
 - + Industry associations?
 - × No difference
 - + University ties associated with collaboration

CONCLUSIONS

- ✘ More data needed before extrapolation to the field, but we do see some disciplinary clusters emerging that could significantly structure the field.
- ✘ University Contact does seem to either feed a propensity for collaboration or provide an effective search mechanism