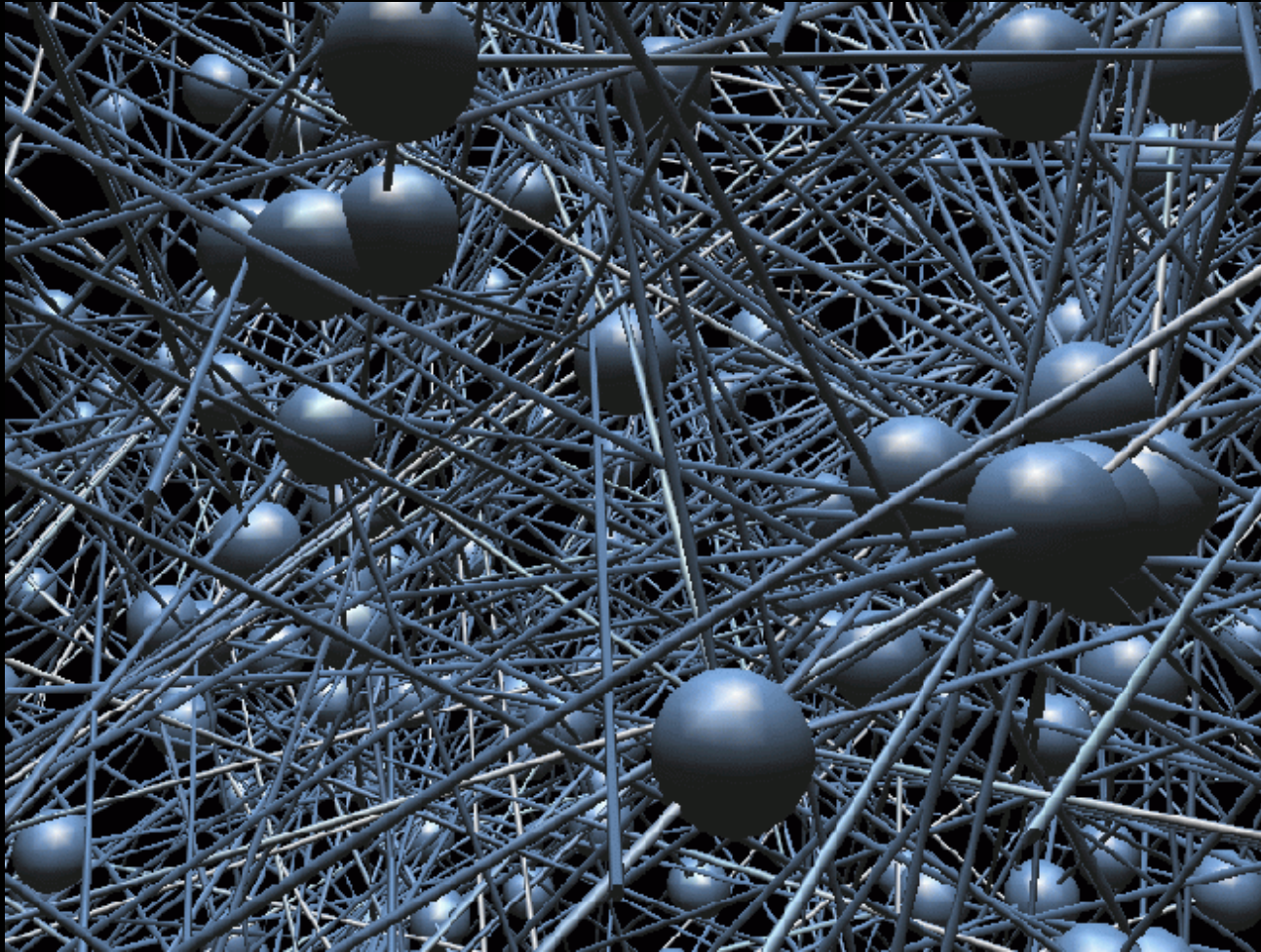
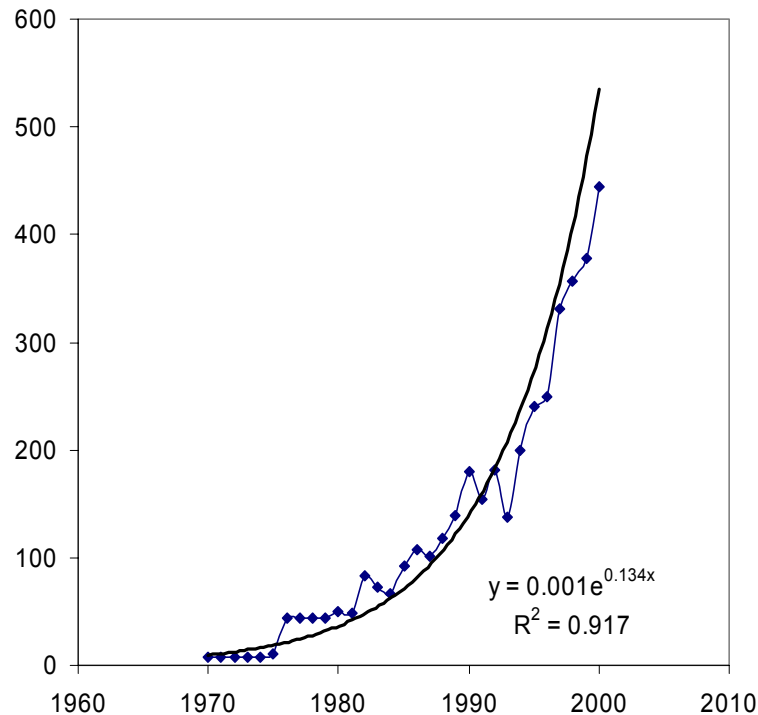


Social Network Analysis



Steve Borgatti
Carroll School of Management, Boston College

Development of the Field

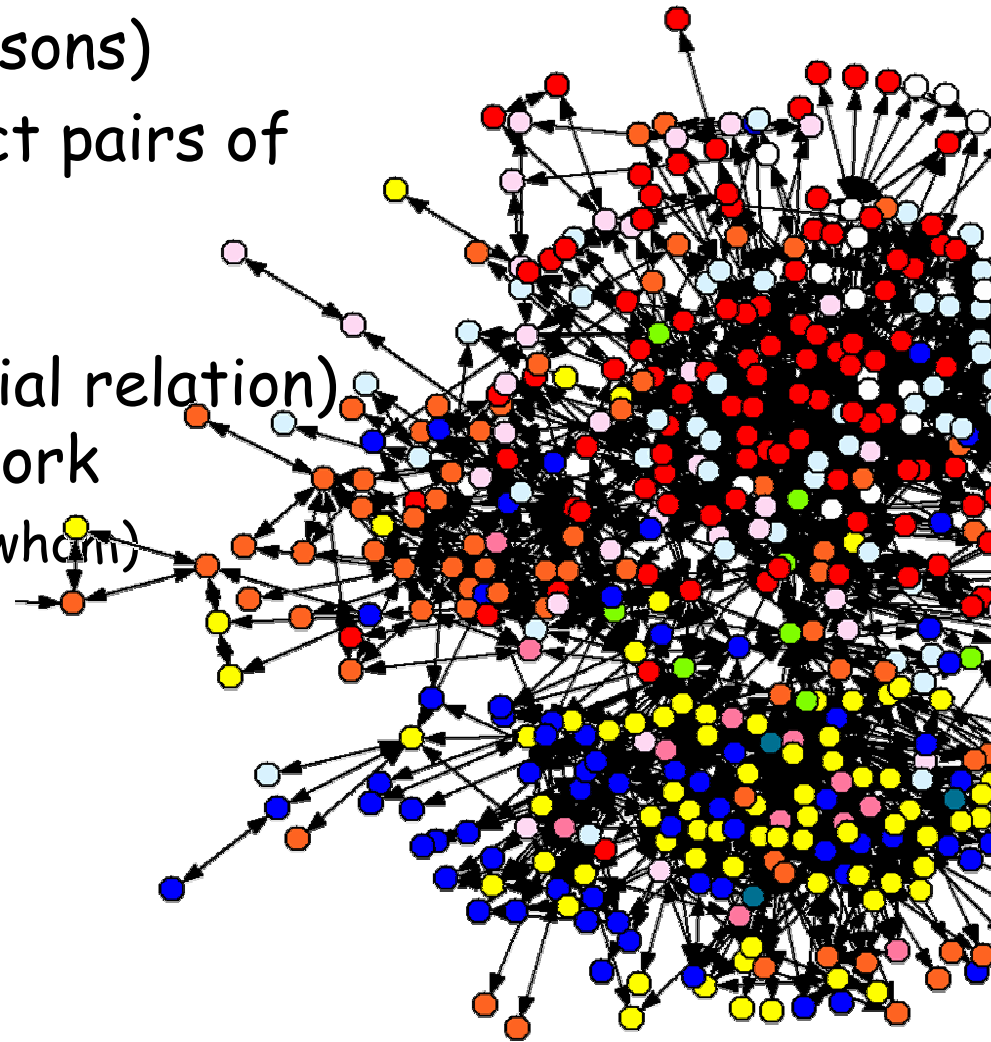


of SNA papers in sociology by year

- 1736 - Euler
- 1930s Sociometry
 - Moreno; Hawthorne studies
- 1940s Psychologists
 - Clique formally defined
- 1950s Anthropologists
 - Barnes, Bott & Manchester school
- 1960s Anthropologists
 - Kinship algebras; Mitchell
- 1970s Rise of Sociologists
 - Social Networks Journal & Assoc
 - Milgram small-world
 - Granovetter's weak ties
- 1980s Computation
 - IBM PC & network programs
- 1990s Adaptive Radiation
 - UCINET IV released
 - Spread of networks & dyadic thinking to many fields
 - Rise of social capital, embeddedness
- 2000s ~~Locusts~~ Physicists descend

What's a network?

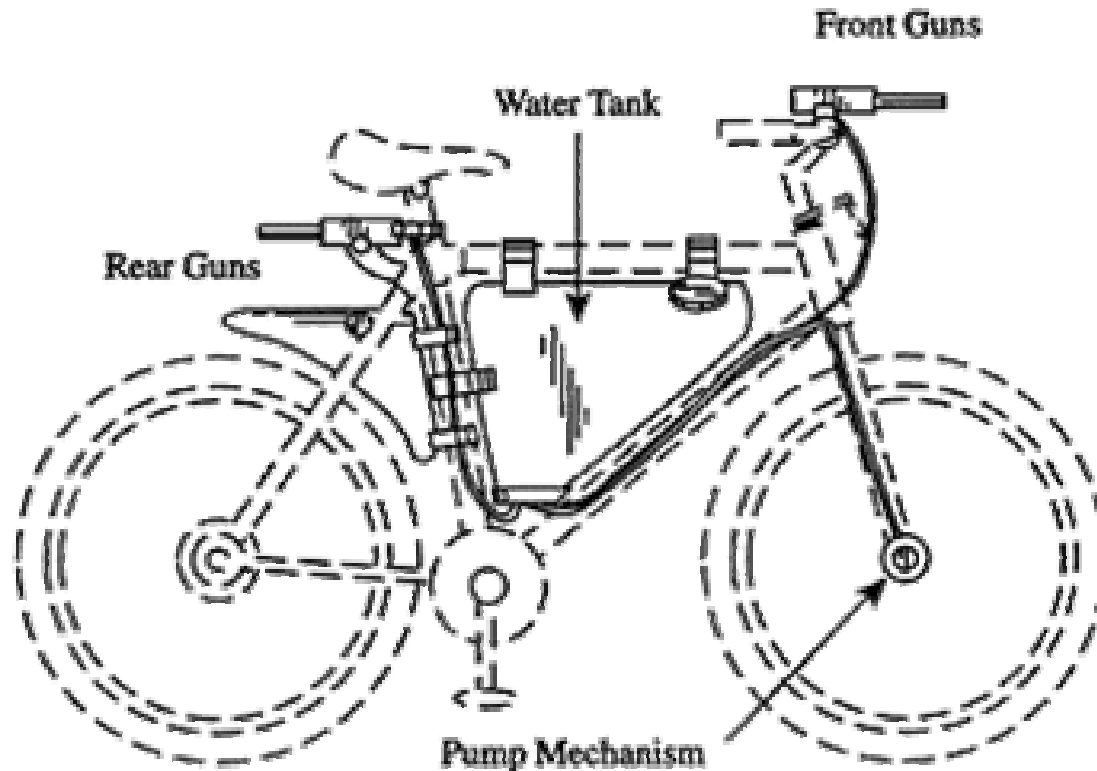
- A set of actors (e.g., persons)
- A set of ties that connect pairs of actors
 - E.g., friendship ties
- Each kind of tie (i.e., social relation) defines a different network
 - Acquaintance (who knows whom)
 - Friendship
 - Has sex with
 - Does drugs with
 - Gives advice to
 - Has conflict with



1000 scientists
© Steve Borgatti, 2004

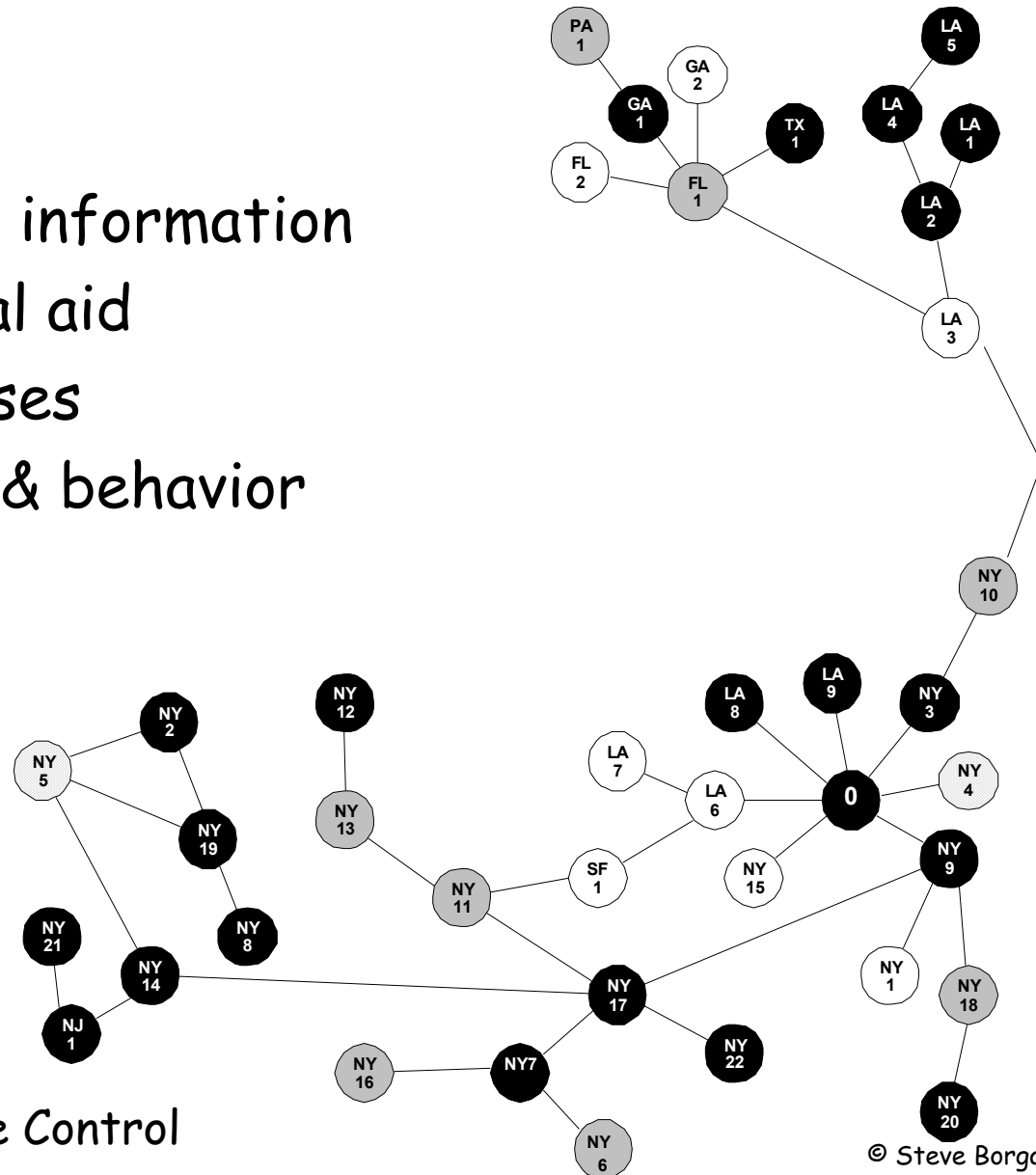
Why should we care?

1. It's not just the elements (composition) of a system that matter, but how they are put together
 - non-reductionist, holistic, structuralist



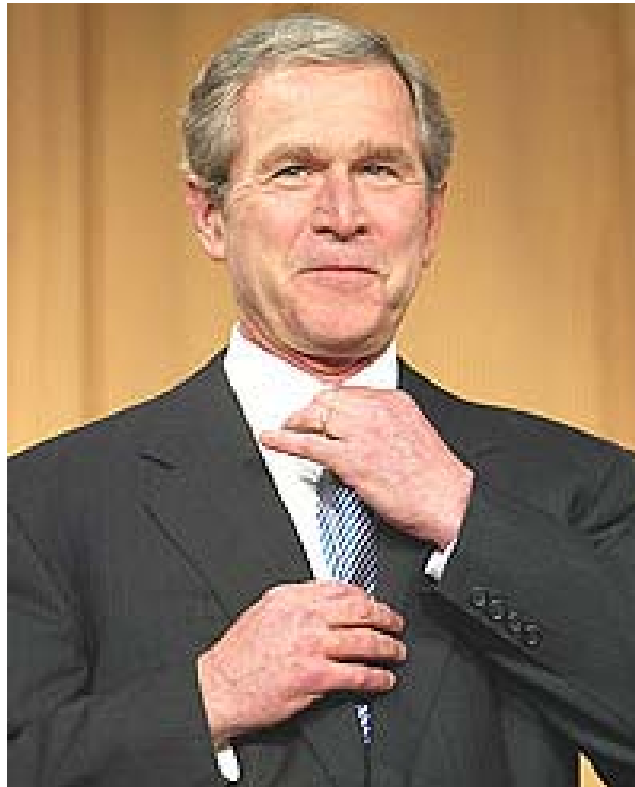
2. Actors affect each other!

- Tell each other information
- Provide material aid
- Transmit diseases
- Copy attitudes & behavior



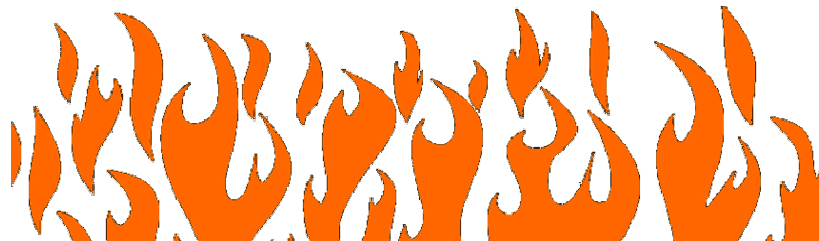
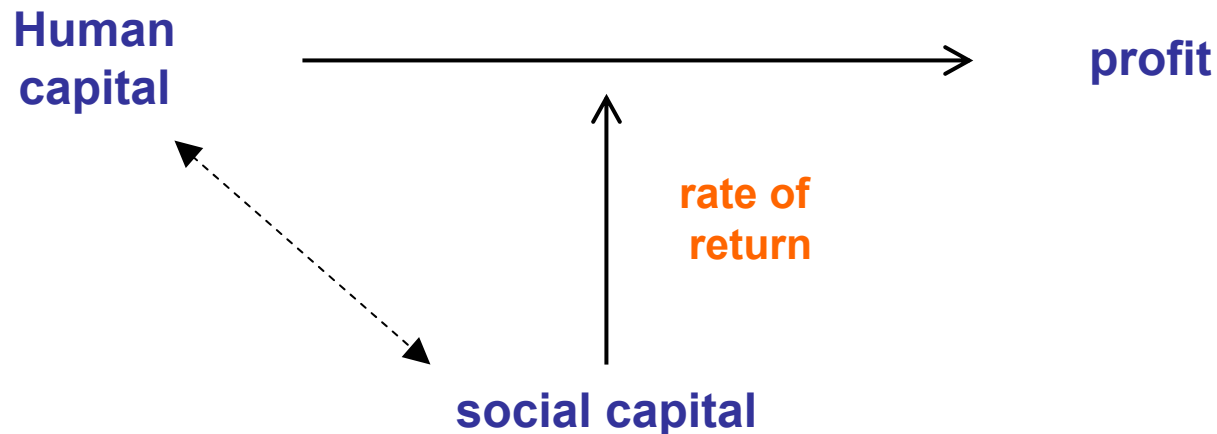
3. Opportunities & constraints

- A person's position in a social network (i.e., social capital) determines in part the set of opportunities and constraints they will encounter



The rate of return on human capital

- A person's connections determine the rate of return on human capital



Kinds of Nodes

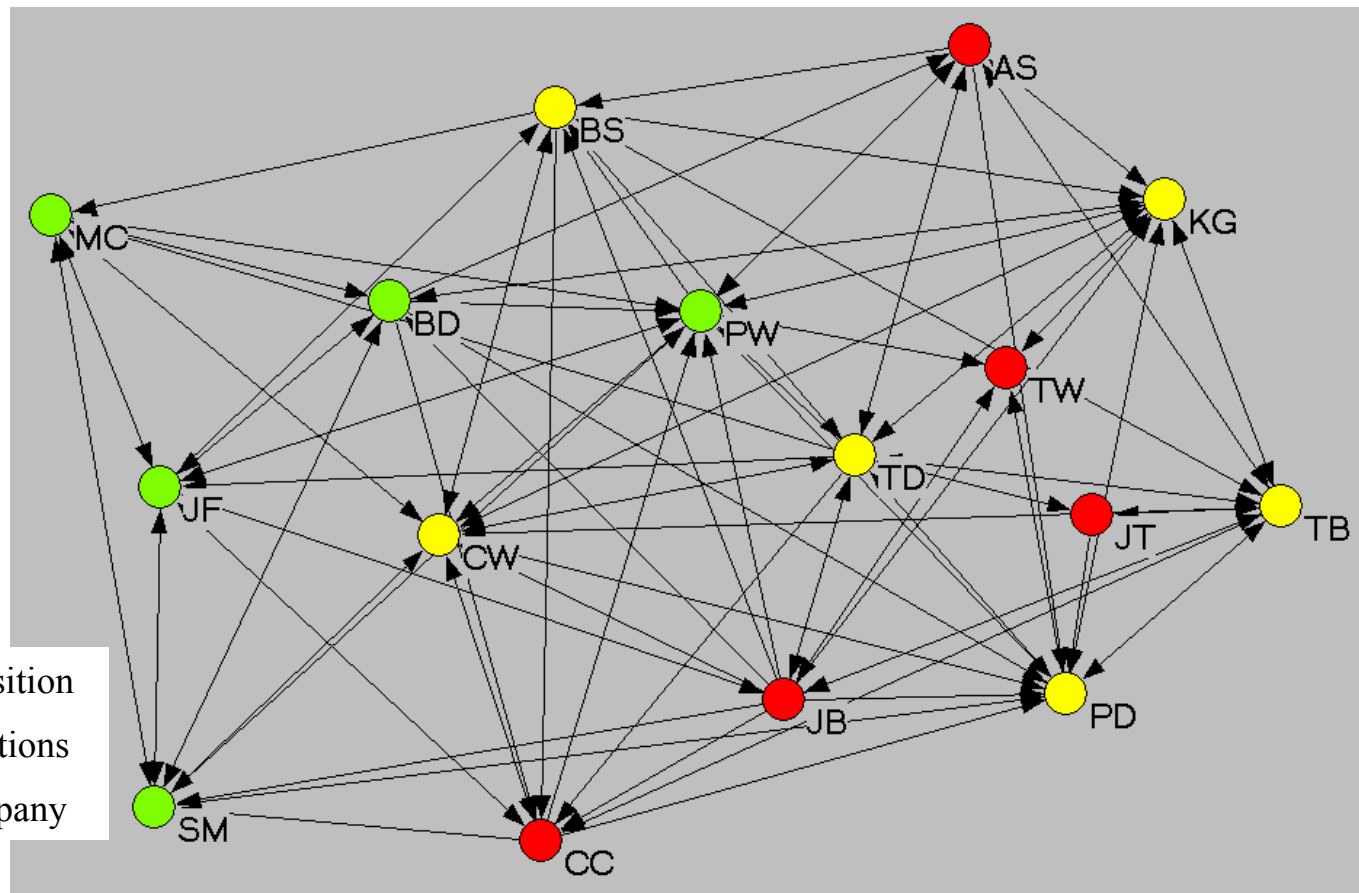
- Individuals
 - persons
 - other animals
- Collectivities
 - organizations, departments, teams, troops
 - countries, cities
 - species

Social Relations Among Persons

- Kinship
 - mother of
- Other social role-based
 - boss of, friend of
- Cognitive/perceptual
 - knows
 - aware of what they know
- Affective
 - likes
 - trusts
- Interactions
 - give advice, talks to
 - sex / drugs with
- Affiliations
 - belong to same clubs
 - is physically near

Simple Answers

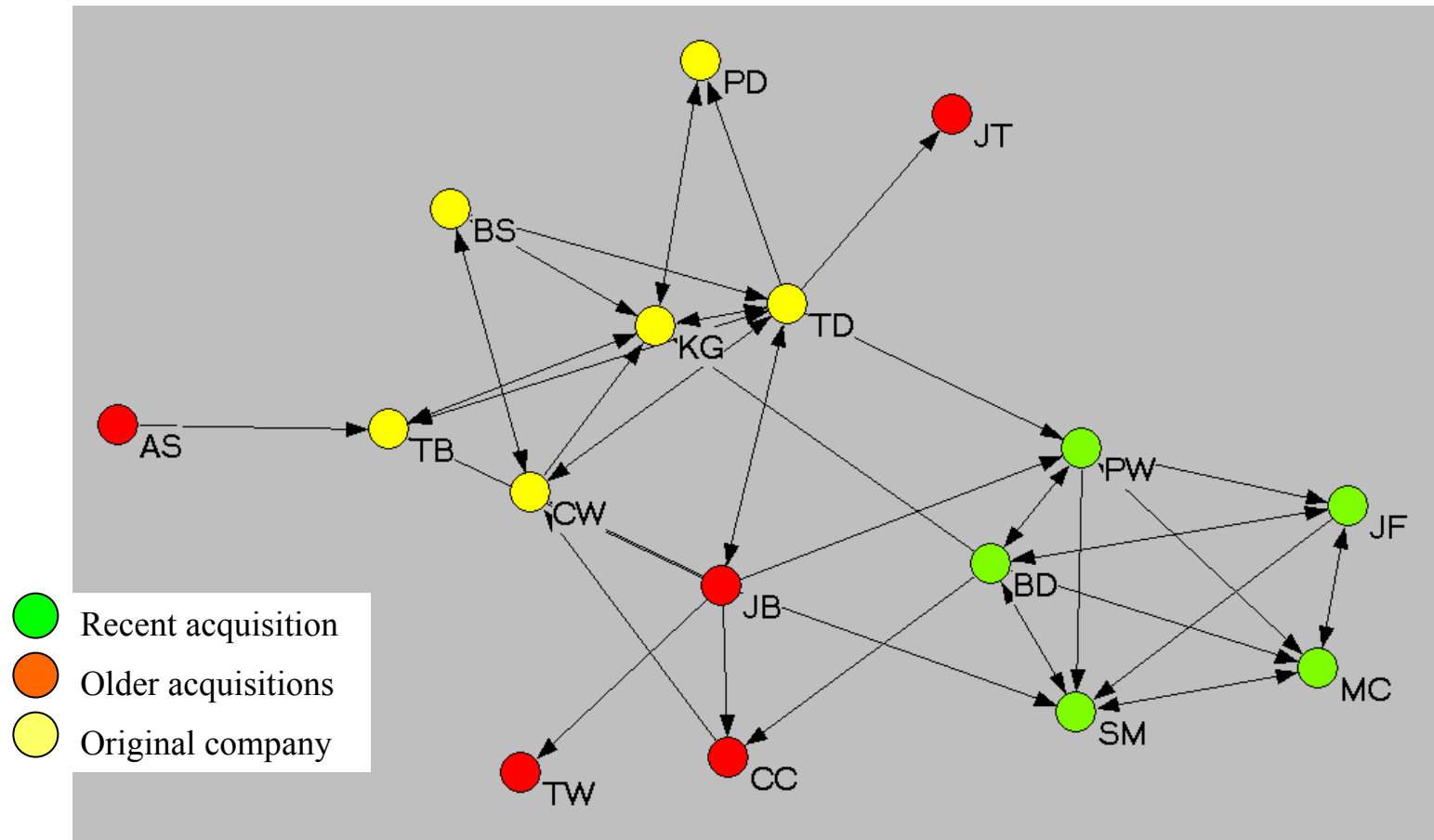
Who you ask for answers to straightforward questions.



Data drawn from Cross, Borgatti & Parker 2001.

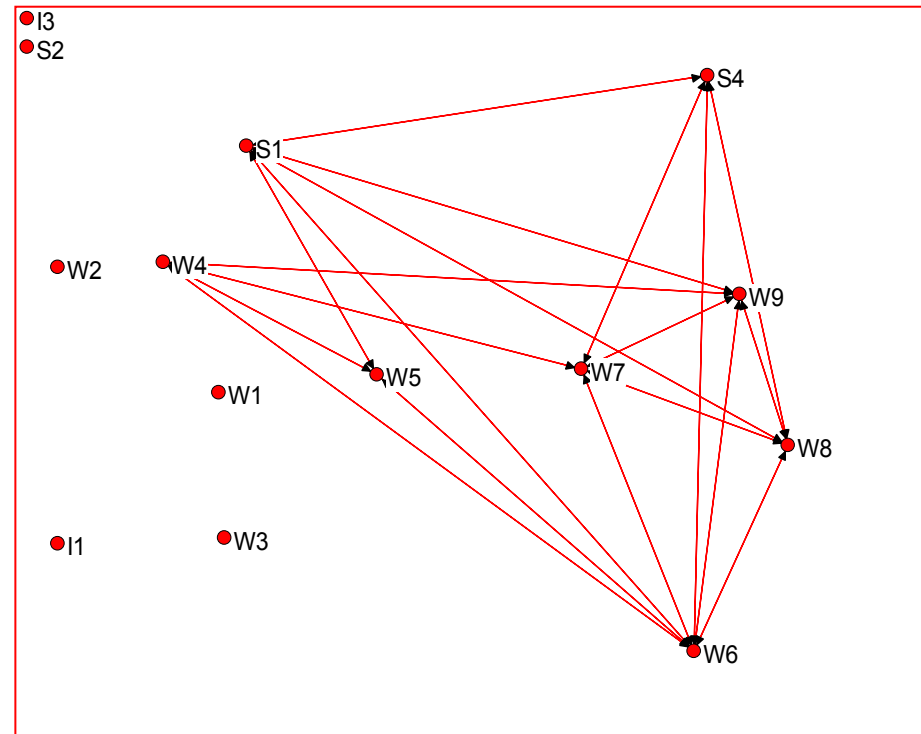
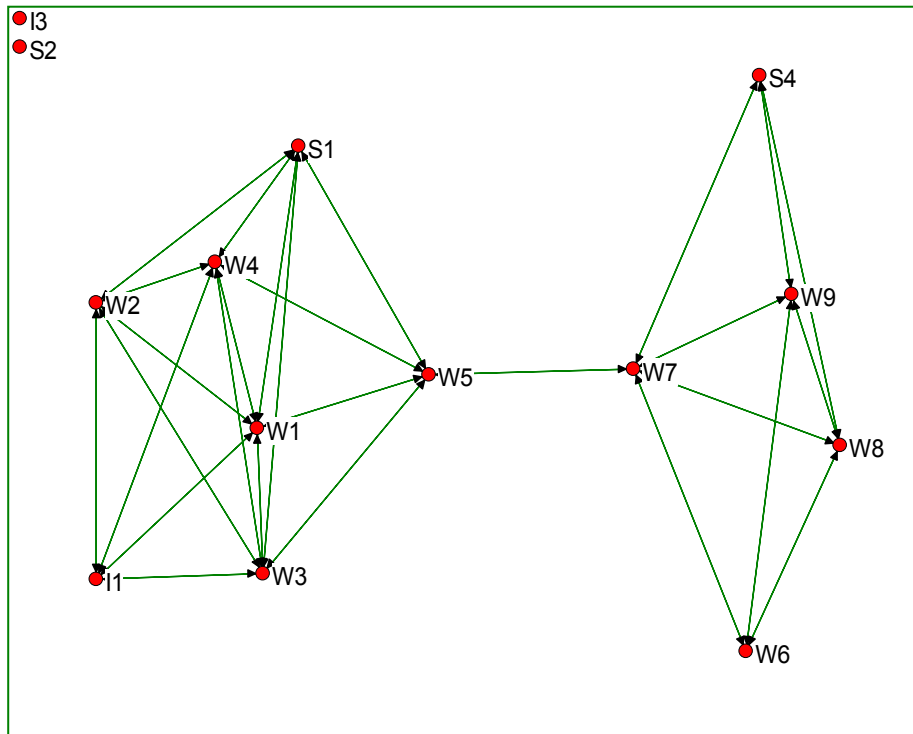
Problem Reformulation

Who you see to help you think through issues



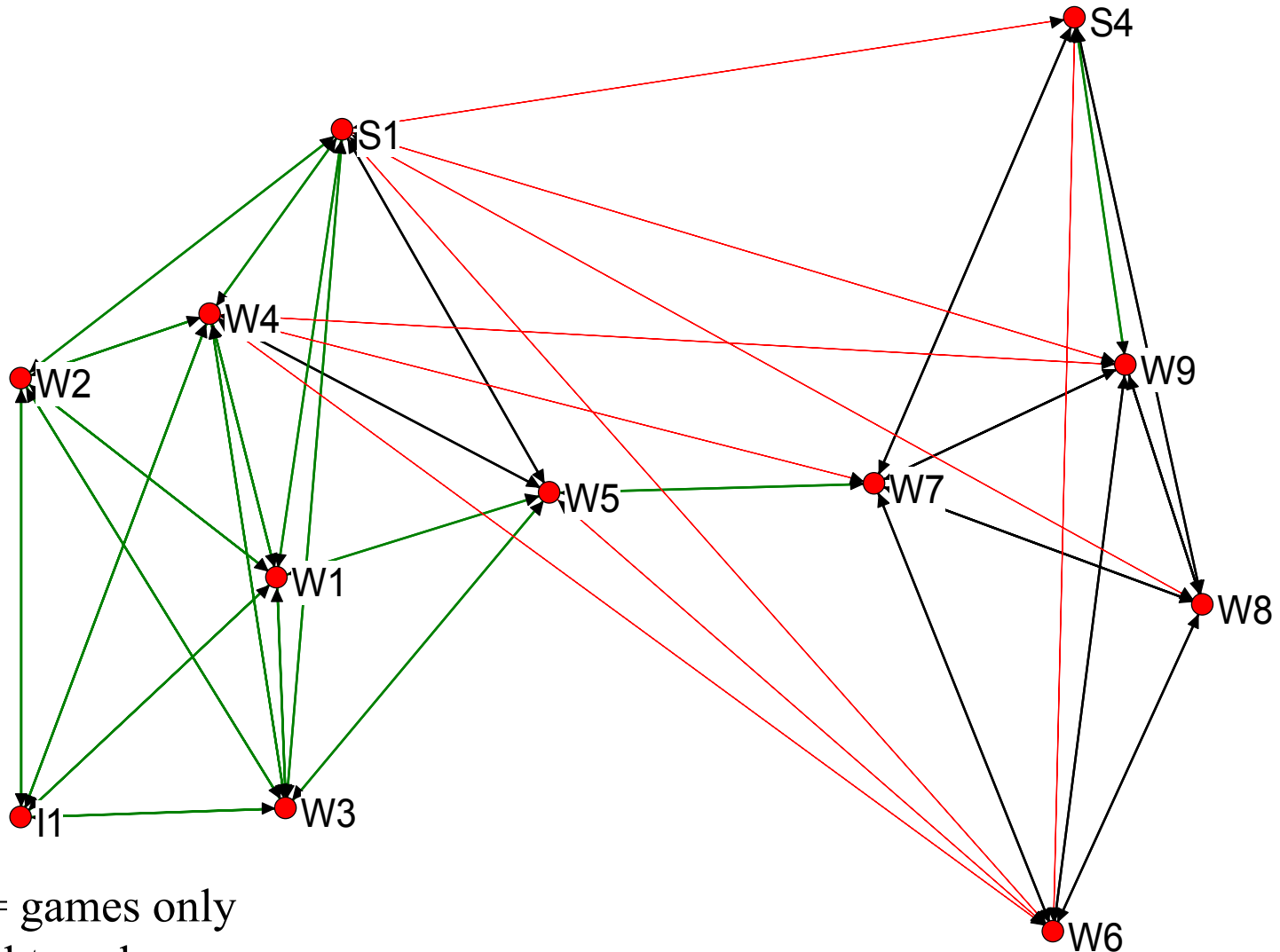
Data drawn from Cross, Borgatti & Parker 2001.

Hawthorne Games & Conflicts



● I3
● S2

Combining Games & Fights



GREEN = games only

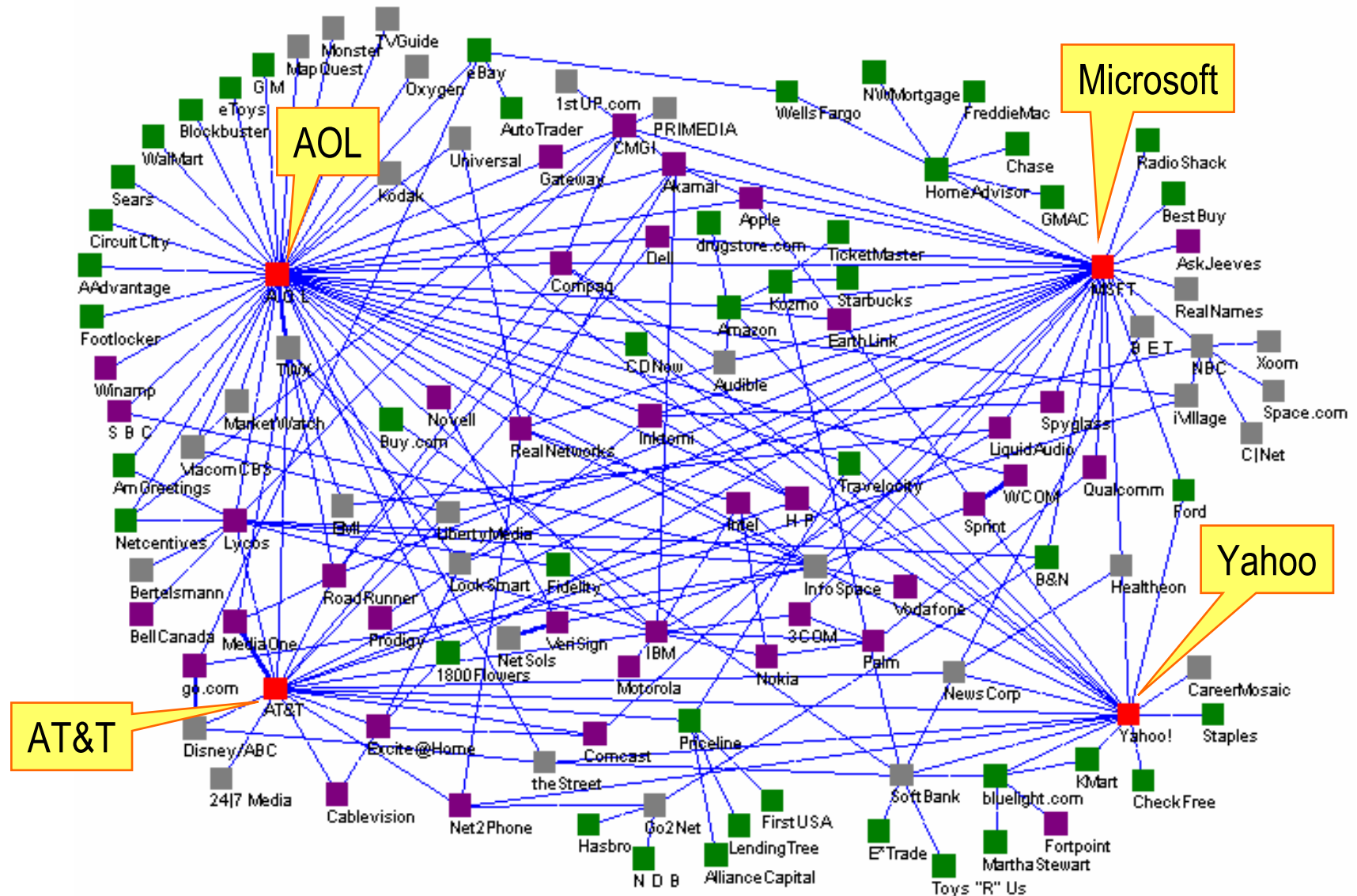
RED = fights only

BLACK = games & fights

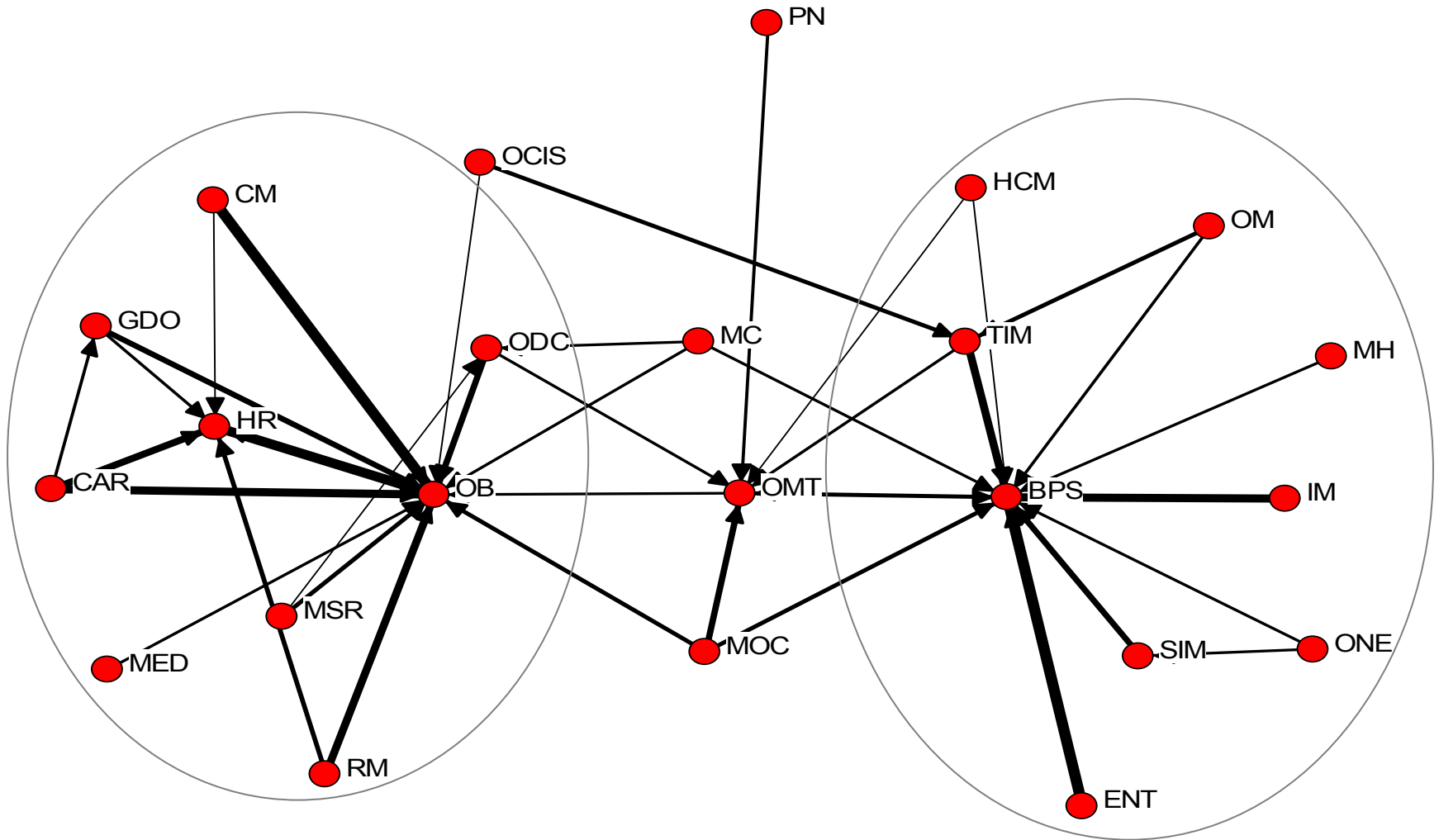
Relations Among Orgs

- As corporate entities
 - sells to, leases to, lends to, outsources to
 - joint ventures, alliances, invests in, subsidiary
 - regulates
- Through members
 - ex-member of (personnel flow)
 - interlocking directorates
 - all social relations

Internet Alliances



Co-Membership > 27%

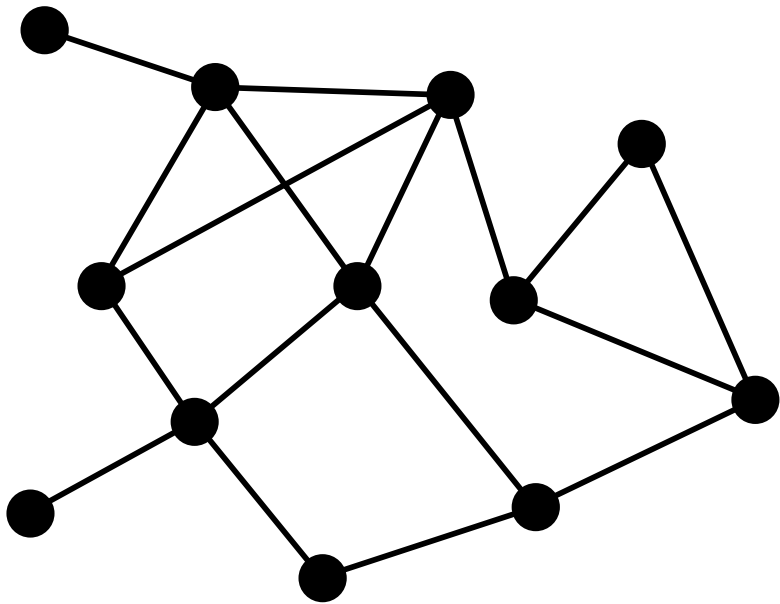




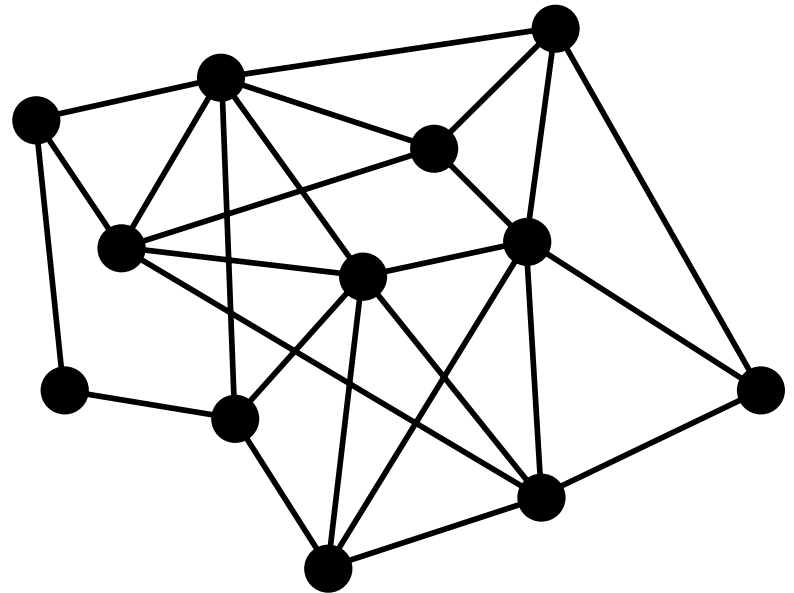
Network Structure

The density of ties

- Density = proportion of pairs of actors that are actually tied
- In some contexts, could be thought of as measure of **social capital**

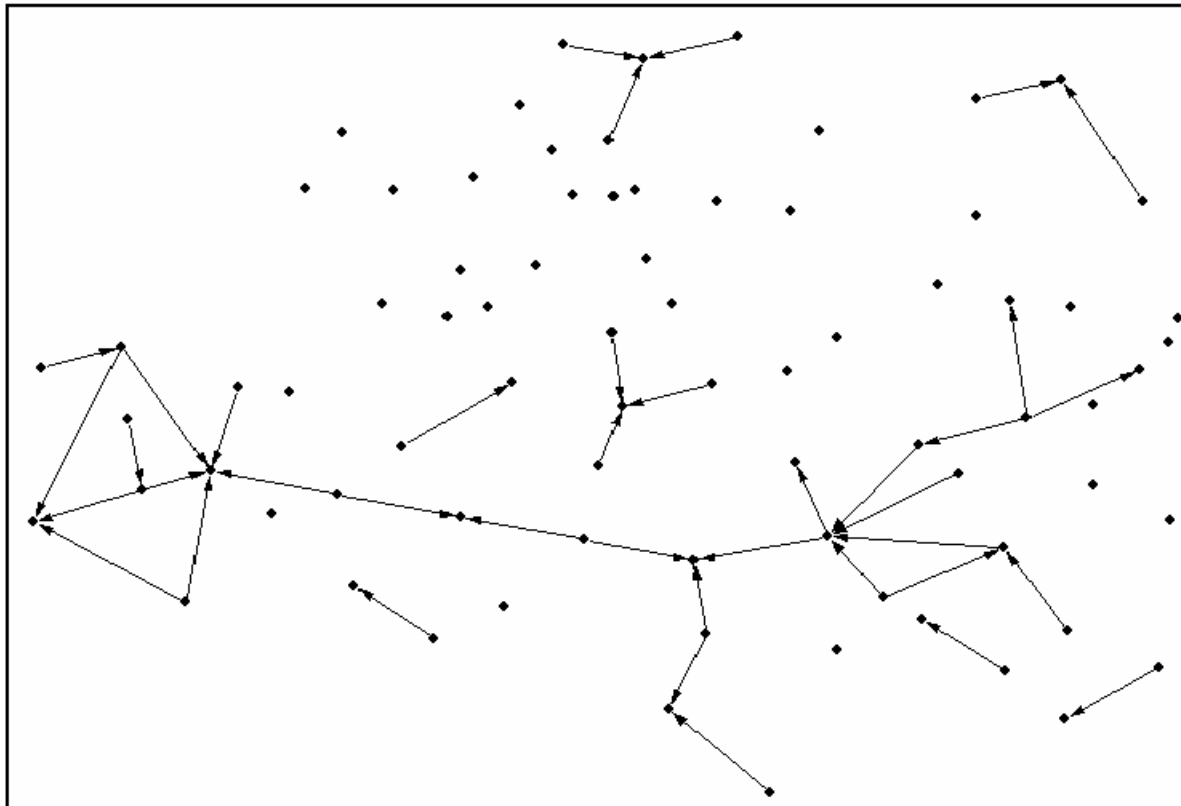


Low Density (25%)



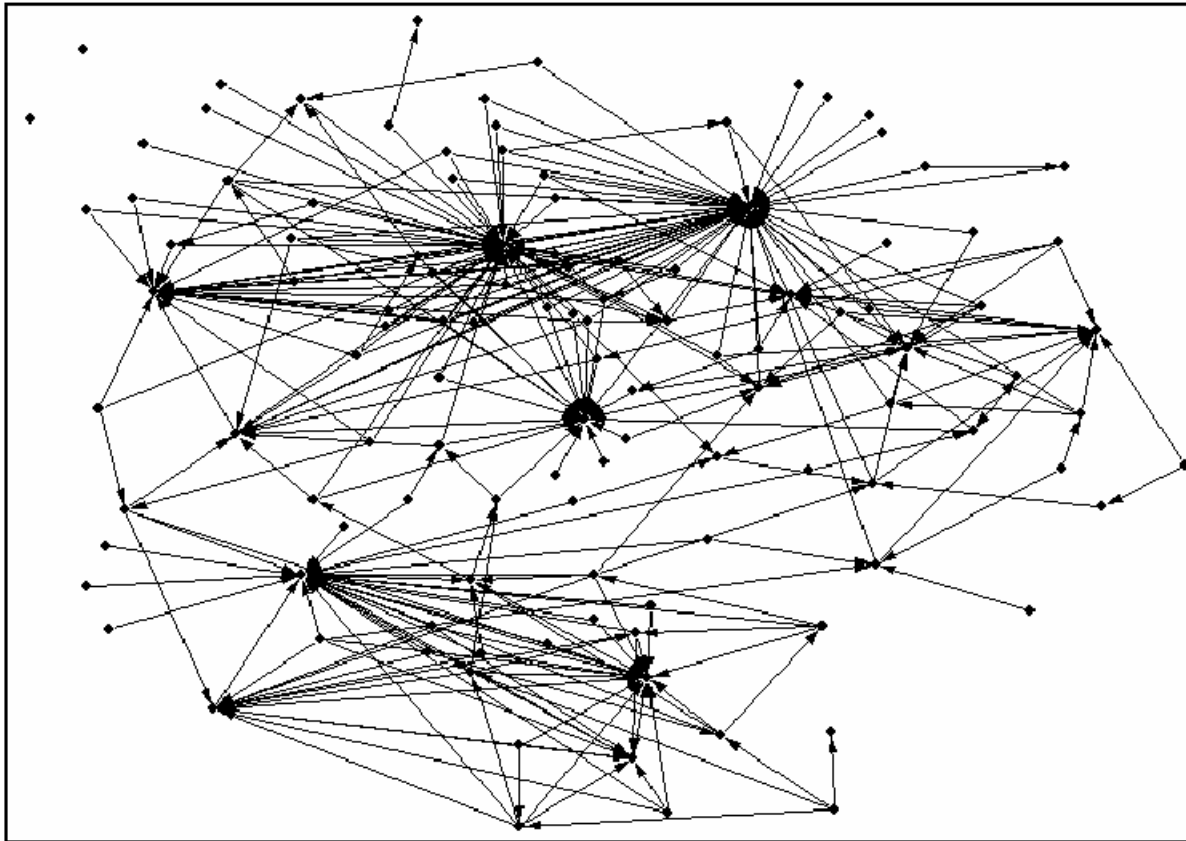
High Density (39%)

Help With the Rice Harvest



Village 1

Help with the rice harvest



Village 2

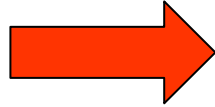
Which
village
is more
likely to
survive
?

Small World

- Milgram's experiment
 - Target selected - a stock broker in Boston
 - Arbitrary subjects recruited in Los Angeles
 - Asked if they knew the target
 - If yes, then done
 - If no, then who did they know that might know the stock broker?
 - That person is then contacted and ...
 - This continues until the target is reached.
 - On average, just 5.5 intermediaries needed to reach target

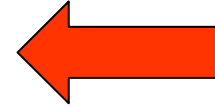


Austin Powers:
The spy who
shagged me

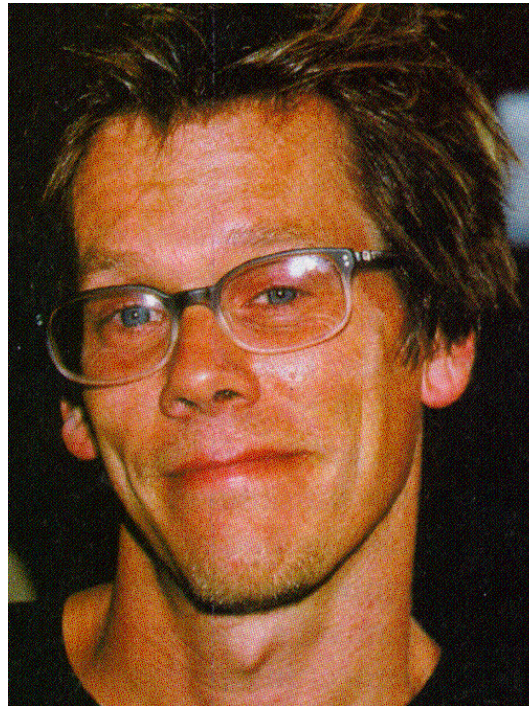


Robert Wagner

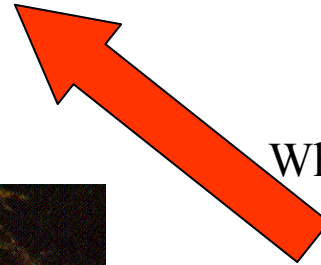
Let's make
it legal



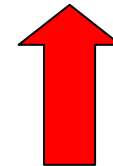
Wild Things



What Price Glory



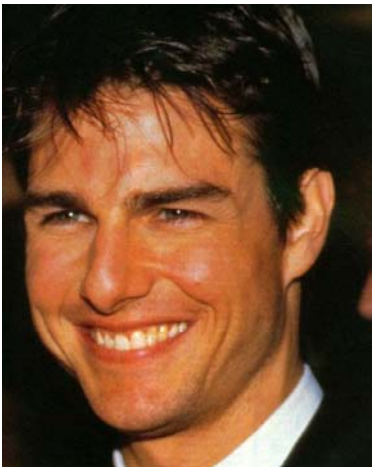
Barry Norton



Monsieur
Verdoux



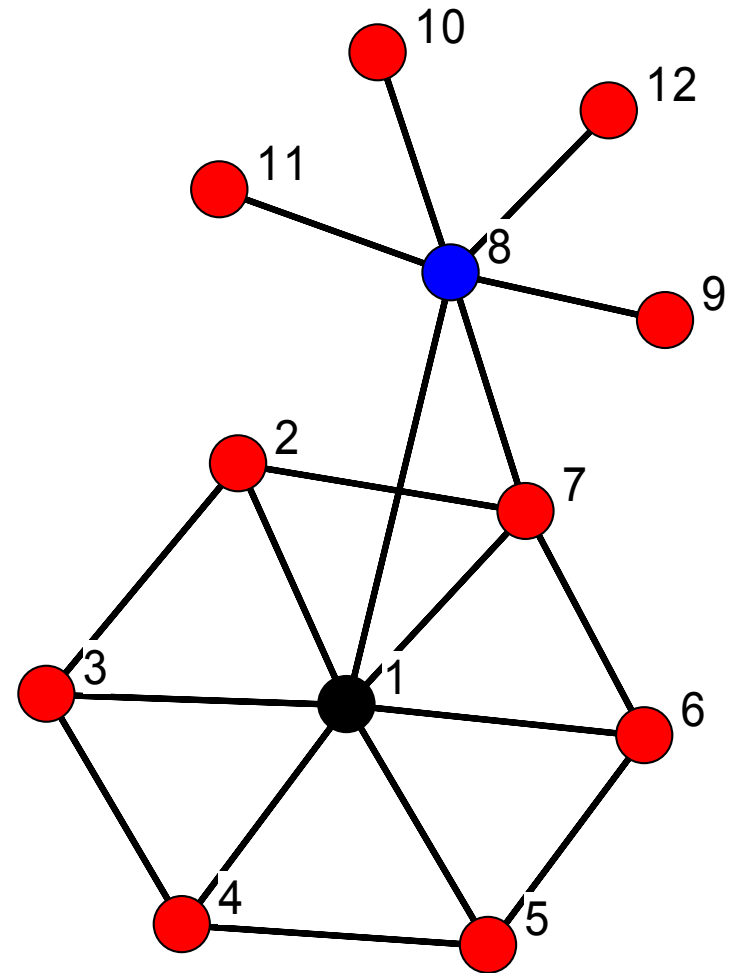
A Few
Good Men



Graph-Theoretic Distance

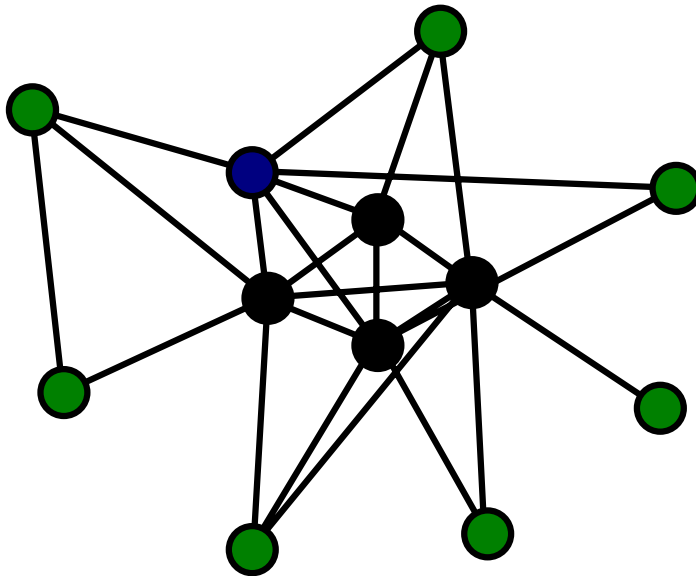
AKA "degrees of separation"

- The graph-theoretic distance between two nodes is the number of links in the shortest path that connects them
 - Distance from 4 to 10 is 3 links

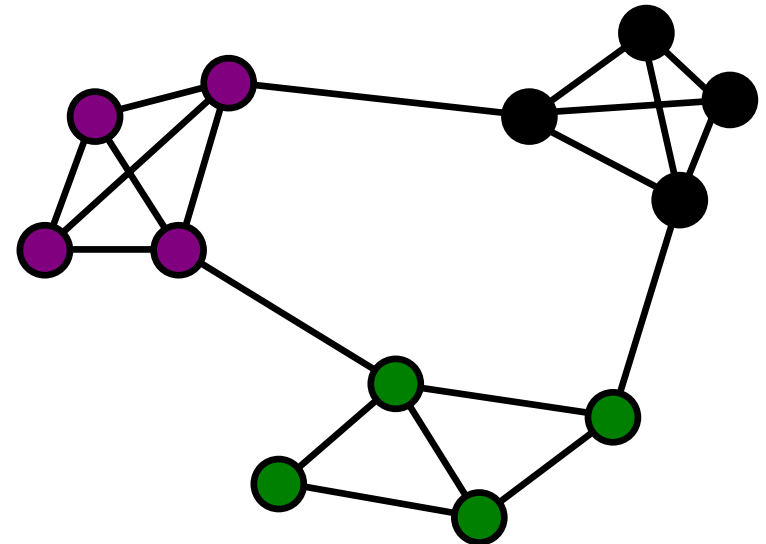


Average Distance

- Average geodesic distance among all nodes
- Index of speed of transmission



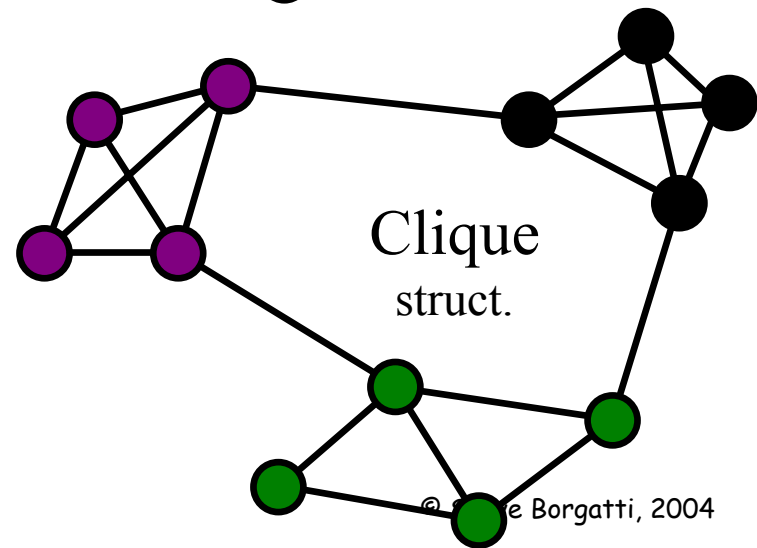
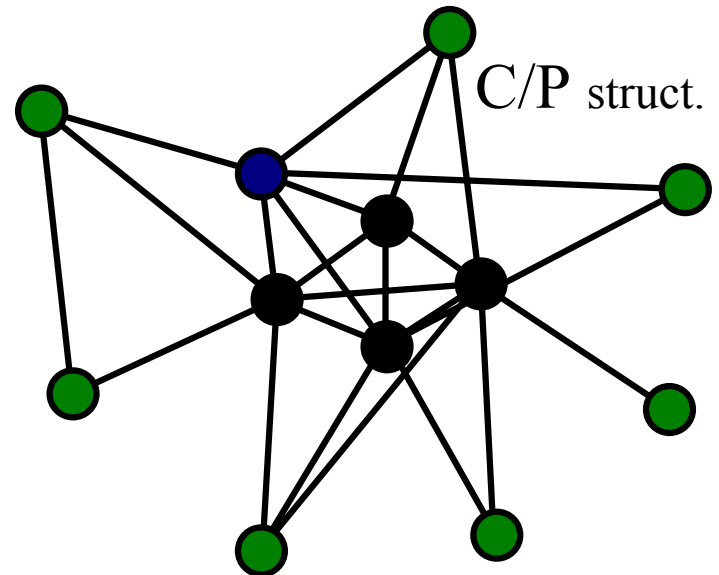
Core/Periphery
c/p fit = 0.97, avg. dist. = 1.9



Clique structure
c/p fit = 0.33, avg. dist. = 2.4

Core/Periphery Structures

- Core/Periphery.
 - Network consists of a single group (a core) together with hangers-on (a periphery),
 - Core connects to all
 - Periphery connects only to the core
 - Short distances, good for transmitting information, practices
 - Identification with group as whole
 - E.g., physics
- Clique structure.
 - Multiple subgroups or factions
 - Identity with subgroup
 - Diversity of norms, belief
 - E.g., social science

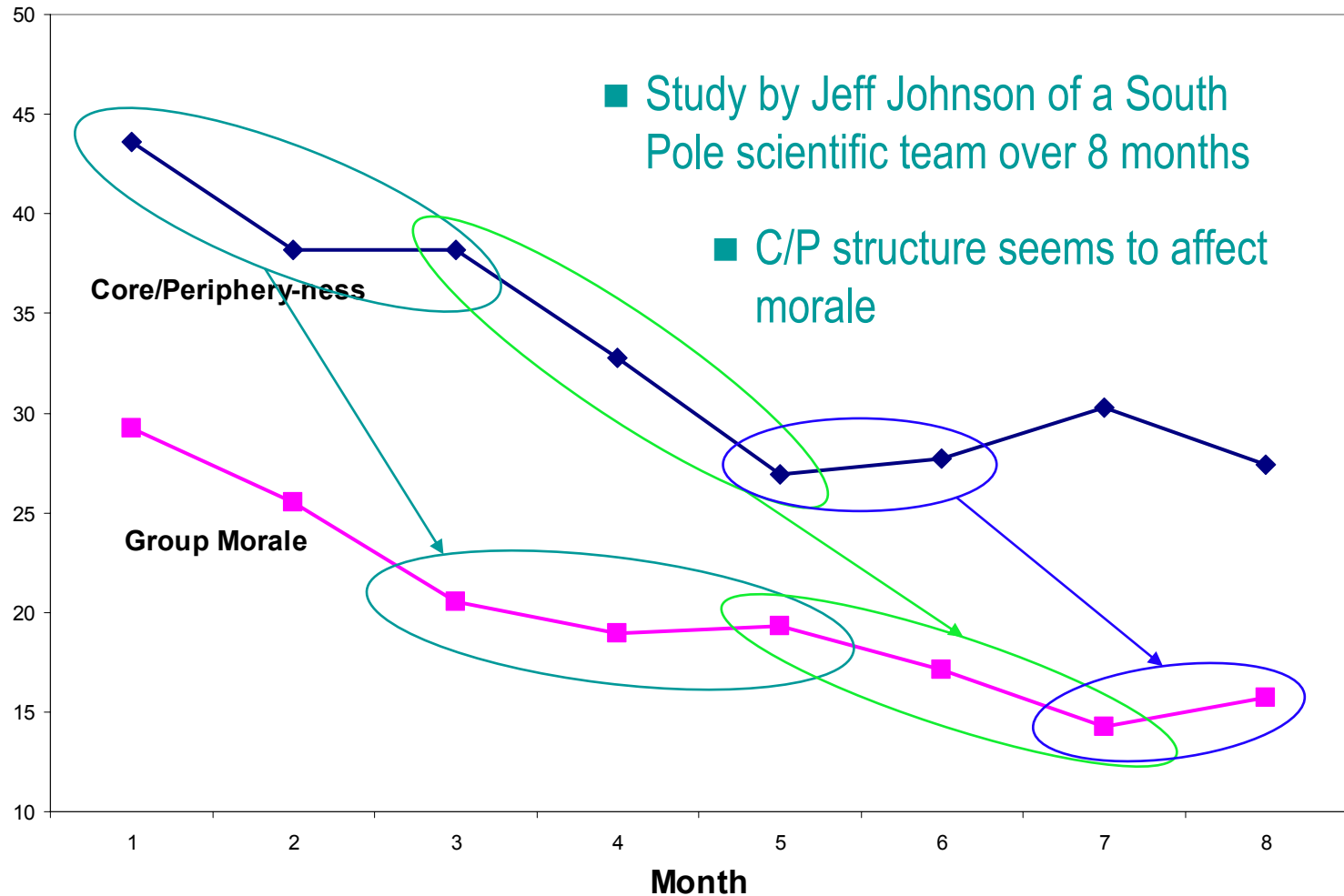


On Innovation and Network Structure

"I would never have conceived my theory, let alone have made a great effort to verify it, if I had been more familiar with major developments in physics that were taking place. Moreover, my initial ignorance of the powerful, false objections that were raised against my ideas protected those ideas from being nipped in the bud."

- Michael Polanyi (1963), on a major contribution to physics

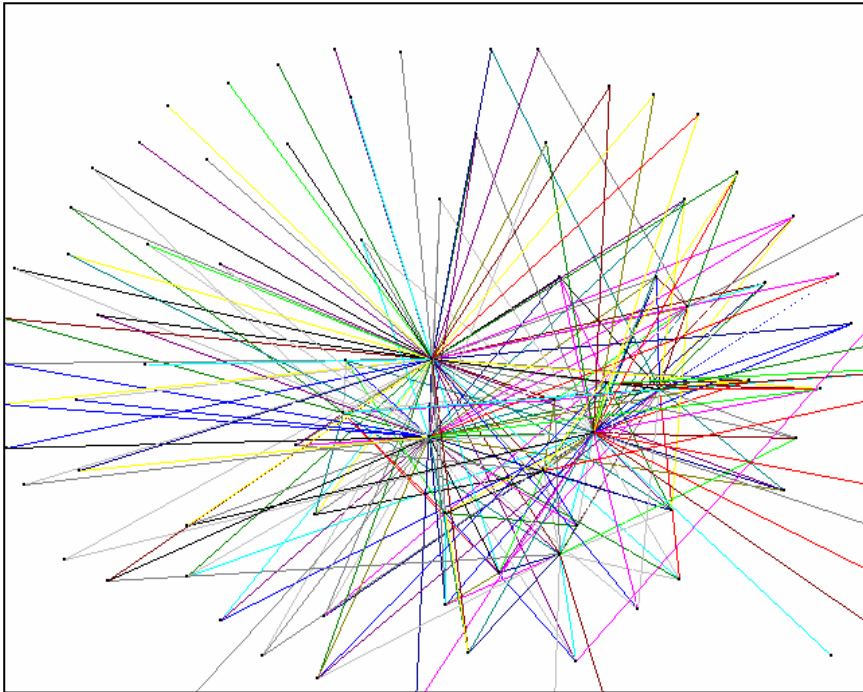
C/P Structures & Morale



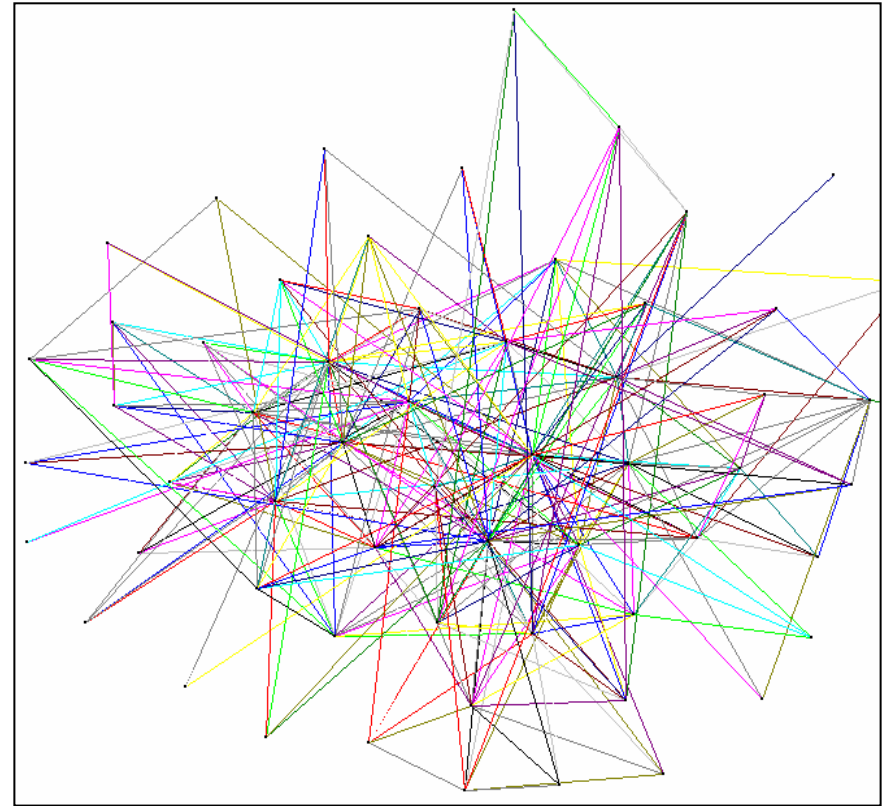
Note: this is an "n" of 1
© Steve Borgatti, 2004

Comparing airlines' route structures

Major US Carrier

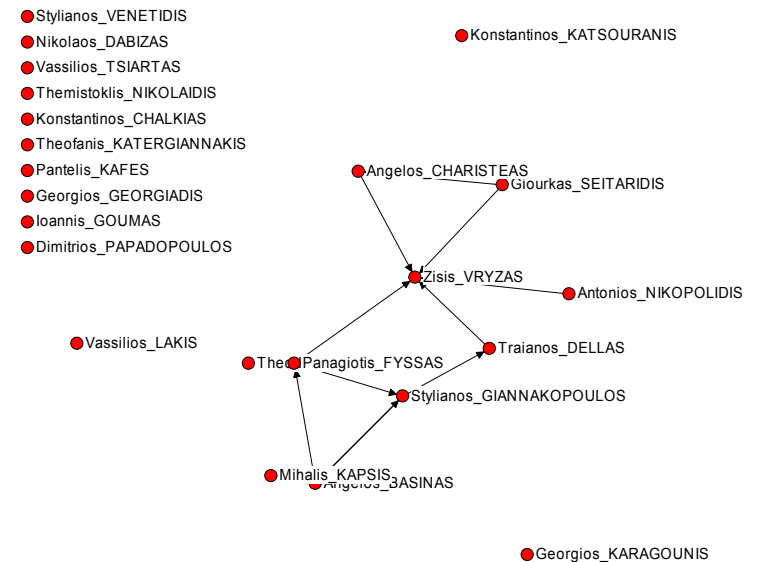
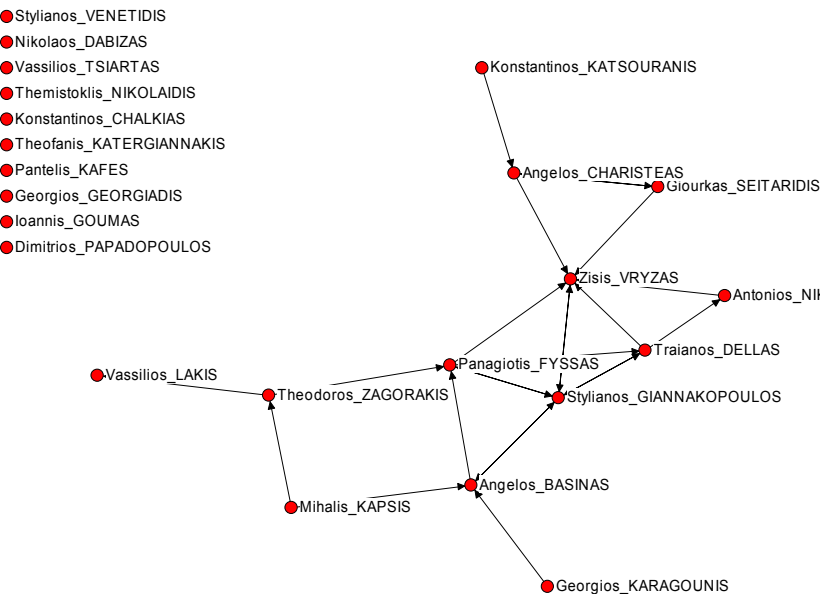
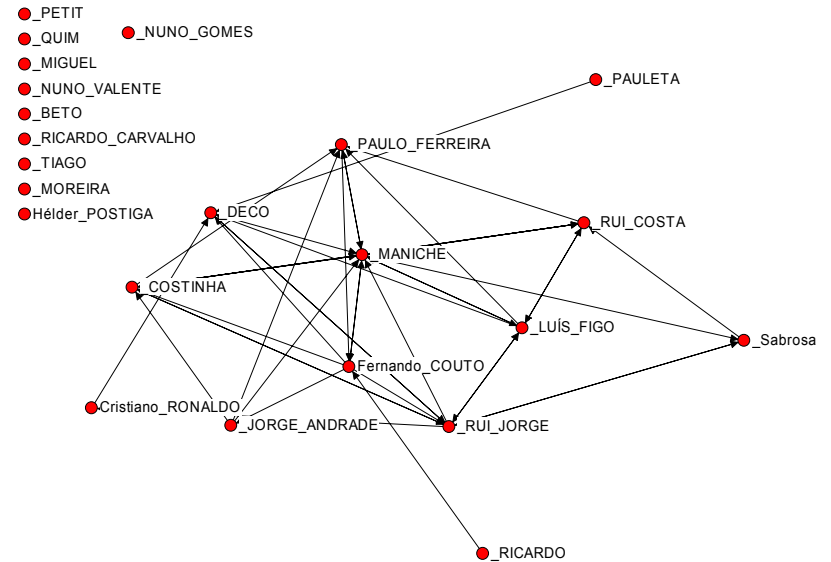
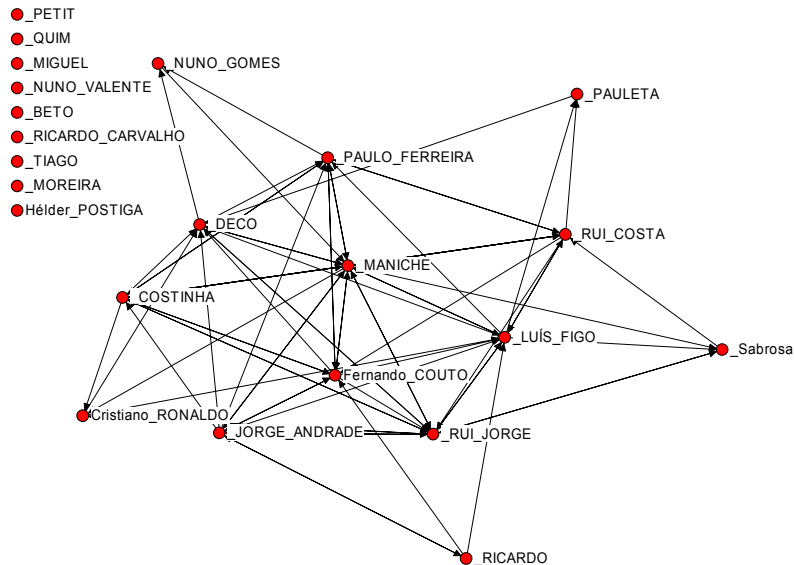


“Discount” US Airline



Note: Route maps defined around one specific hub only
Source: Industry data, BCG analysis

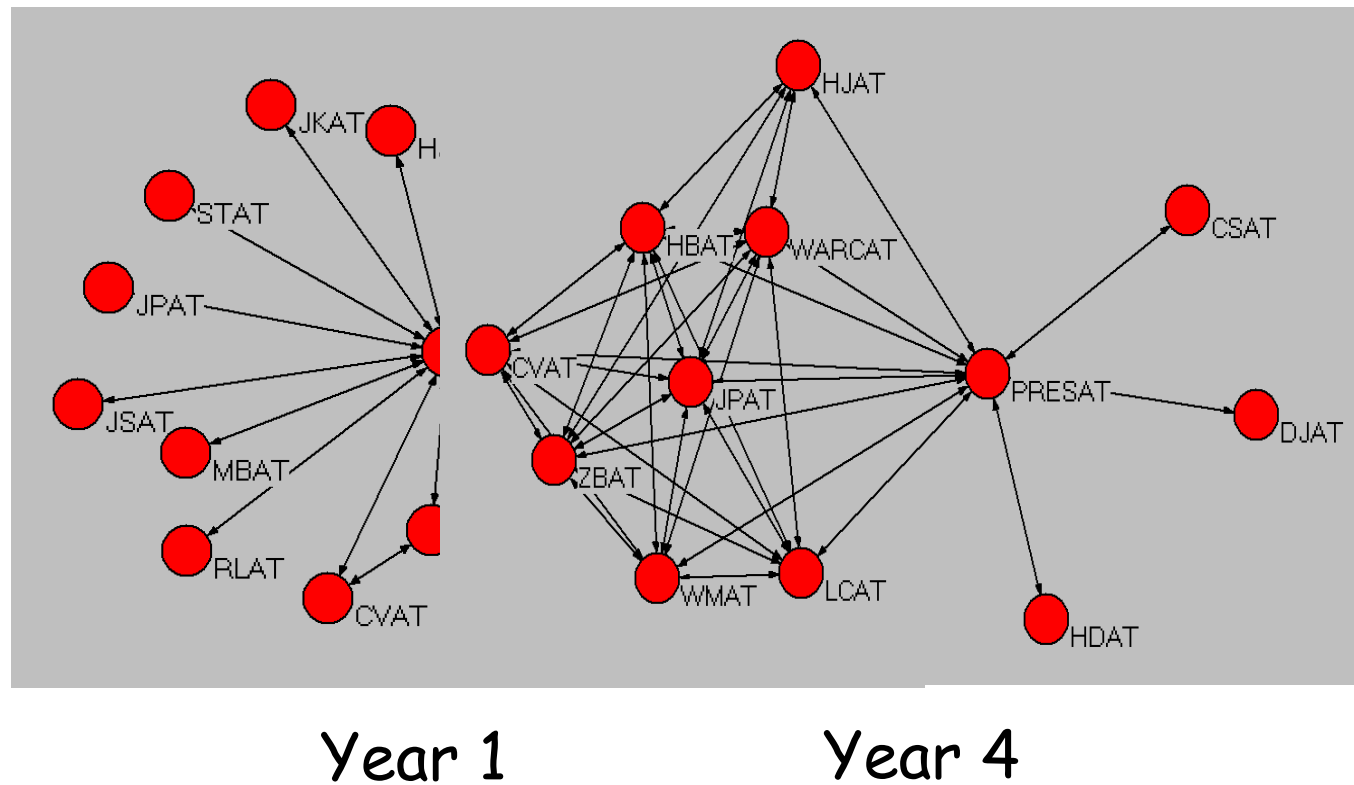
Eurocopa 2004



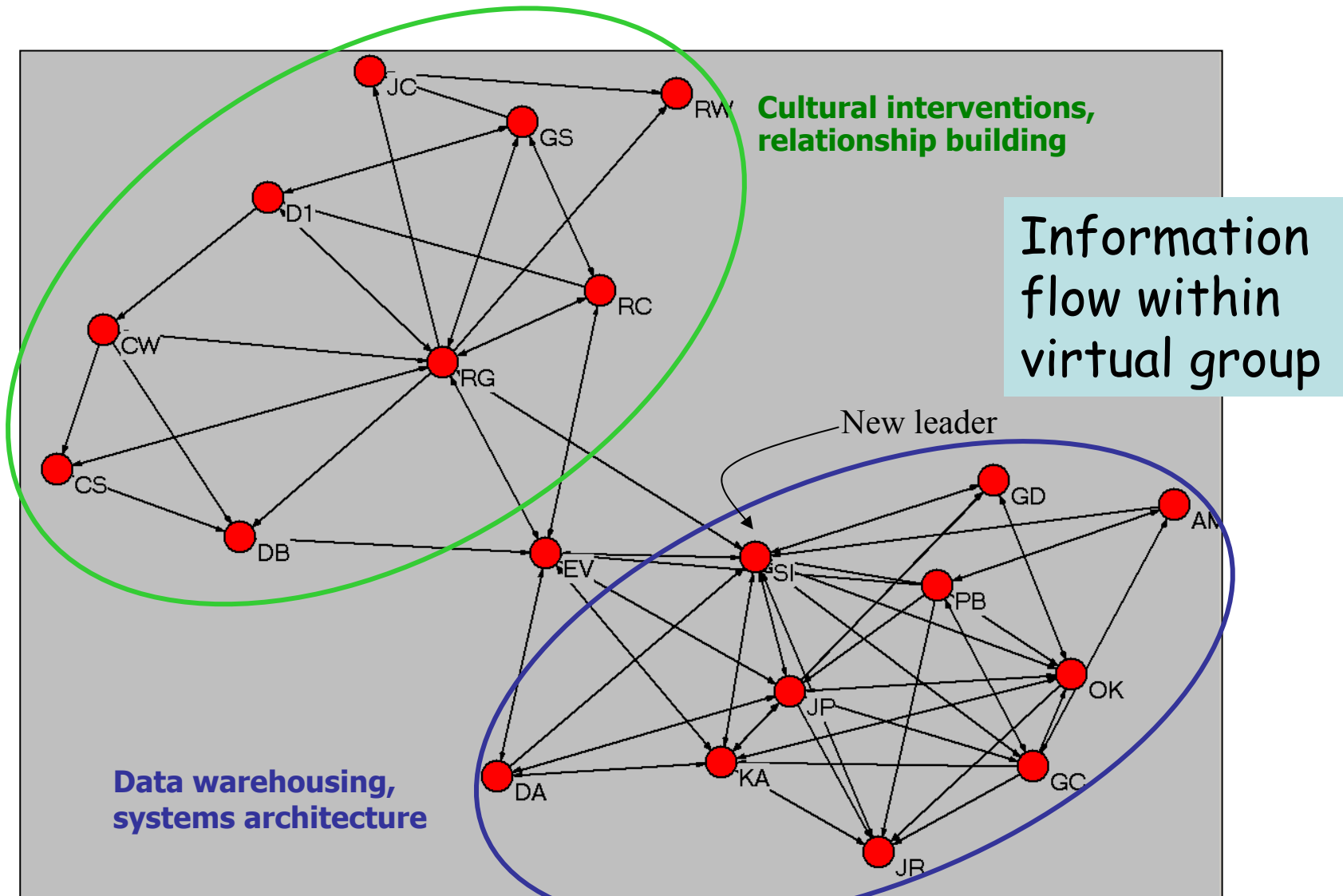
Position in Networks

Carter Administration

White House Diary Data



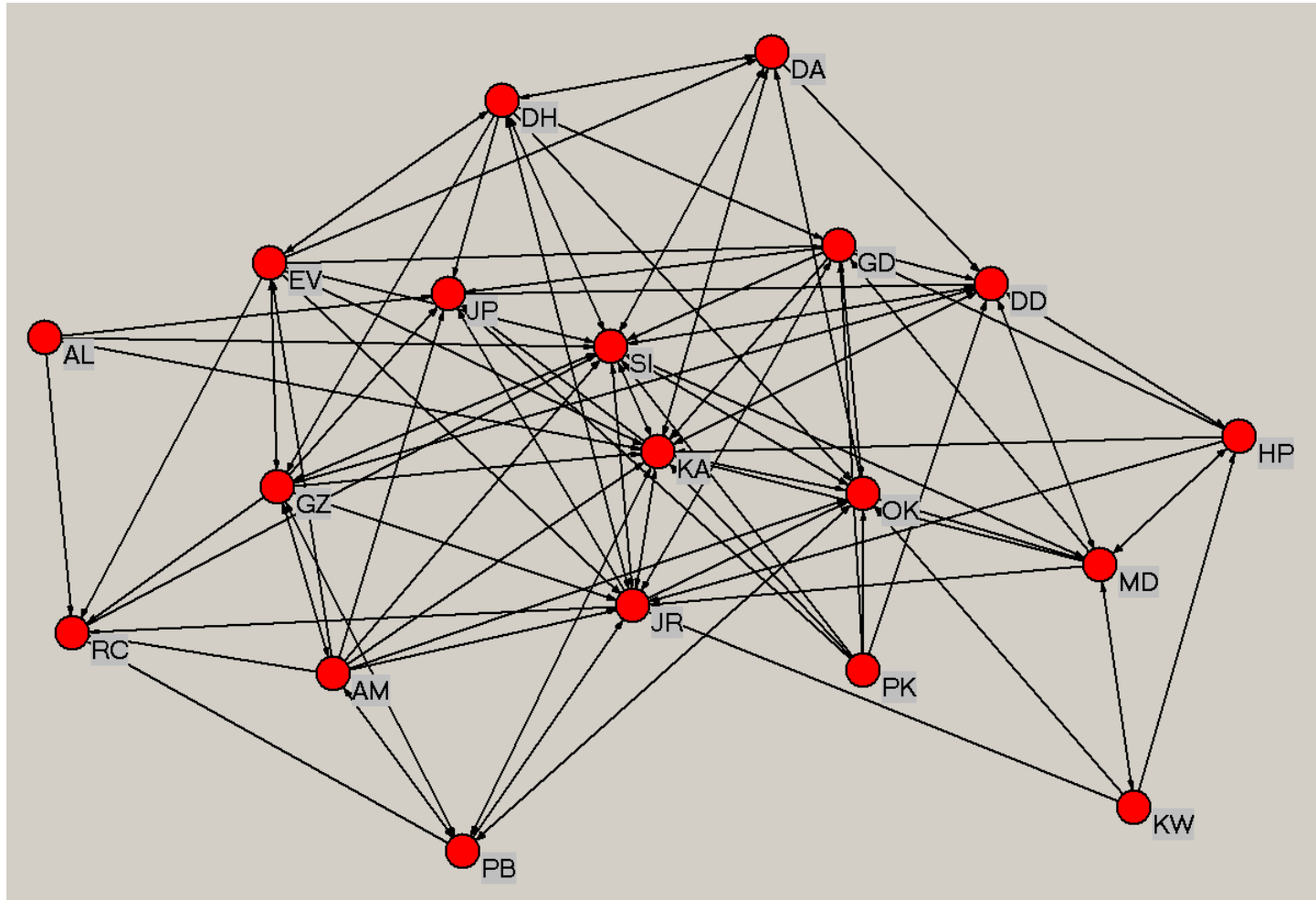
1-Mode Complete Network



Changes Made

- Cross-staffed new internal projects
 - white papers, database development
- Established cross-selling sales goals
 - managers accountable for selling projects with both kinds of expertise
- New communication vehicles
 - project tracking db; weekly email update
- Personnel changes

9 Months Later



Cross, Parker, & Borgatti, 2002. Making Invisible Work Visible. *California Management Review*. 44(2): 25-46

