Summary

-Network Economics-

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Lecture 1 Introduction

Social network analysis
- Nodes & Ties → 2 nodes tied: dyad = network
    - Nodes → actors
    - Ties → links
- What makes a network social? → human interaction
- Research of S. Milgram (1967)
    - 6 degrees of separation
- Importance of social networks
    - Financial crises (banks & interaction)
    - Capture terrorism
    - COVID
- Types of relations
    - Relational
    - Recognition
    - Events

Types of networks:
- 1-mode network: a knows b (both persons/firms)
- 2-mode networks: persons and companies interconnected
    - You can make a 2 mode a 1 mode network
- Ego-network: focus on 1 individual
    - Ask for his connections and how connected
    - 1-mode network is a collection of ego network

# Lecture 2 Measuring and characterizing networks

Networks:
→ shows the strong predictive power of networks
→ need to obtain accurate maps of the networks we aim to study
→ remarkable stability of social networks
→ the choice of network we focus on makes a huge difference
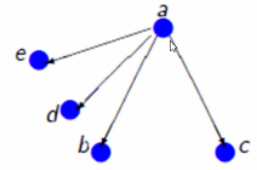
Position in a network
Centrality measures:
- Degree centrality
- Betweenness centrality
- Closeness centrality
- Eigenvector centrality

1. Degree centrality → we look at the direct ties to someone
   - In-degree centrality → look at the incoming ties
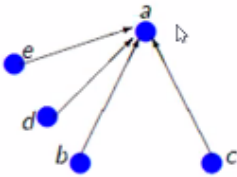
   - Out-degree centrality → look at the outgoing ties (some form of hierarchy)

Position in a network determines opportunities and constraints
- For example, a is very central and possibly will become even more central over time (the Matthew effect)
- Does a high (and rising) number of friends has consequences?

Examples:
- Friendship network
  - indegree = number of nominations you receive: measure of prestige or popularity
  - outdegree = number of friends that you nominate: measure of expansiveness or activity
  - a very expansive person (high outdegree) may not be a very popular person (high in-degree)

Adjust for network size (normalization) → comparability across different networks

— Normalized Degree Centrality: $C'_D(i) = \dfrac{\sum_{j=1}^{n} x_{ij}}{n-1}$

— Normalized InDegree Centrality: $C'_{In}(i) = \dfrac{\sum_{j=1}^{n} x_{ji}}{n-1}$

— Normalized OutDegree Centrality:

$C'_{Out}(i) = \dfrac{\sum_{j=1}^{n} x_{ij}}{n-1}$

2. Betweenness centrality
- Betweenness centrality identifies the gatekeepers within the network

- These actors have more paths running through them, allowing them to pass (or restrict of block) information to others in the network
- They are sometimes in the position to benefit from privileged access to multiple sources of information
- Actors with higher betweenness centrality
  - connect different groups within a network, and are sometimes the only link between them
  - have control over communication flows in the network
  - may act as intermediaries

Formula for calculating betweenness centrality:

$$\tilde{C}^B(i) = \sum_{j<k} \frac{d_{jk}(i)}{d_{jk}}$$

d_{jk} # of shortest paths between j and k
$d_{jk}(i)$ # of shortest paths between j and k that go through i

Example: Calculate the betweenness centrality of nodes A and C of the following network.
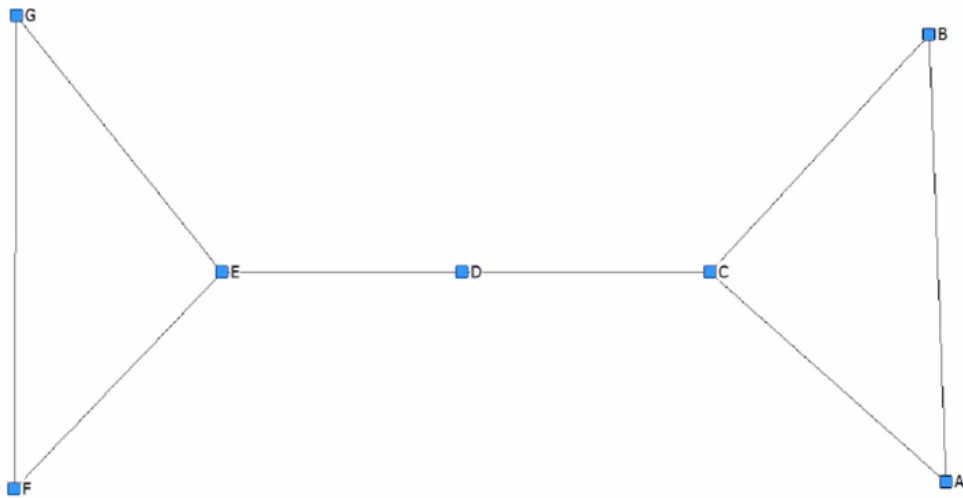
Node A: 0 (zero) because none of the nodes needs A to be connected

Node C: 8/15 = 0.53

Clarification for the betweenness centrality of Node C

Paths that go through C are 8 in total:
- B-D, B-E, B-G, B-F
- A-D, A-E, A-G, A-F

Shortest paths in total between all the nodes are 15; in other words all the pairs of nodes except the ones connected with C.

A – B	B – D	D – E	E - F
A – D	B – E	D – F	E - G
A – E	B – F	D – G	F - G

A – F   B - G
A – G
Together, that's 15
Betweenness centrality → A: 0, C: 0.53

3. Closeness centrality

Krackhardt's Kite netw
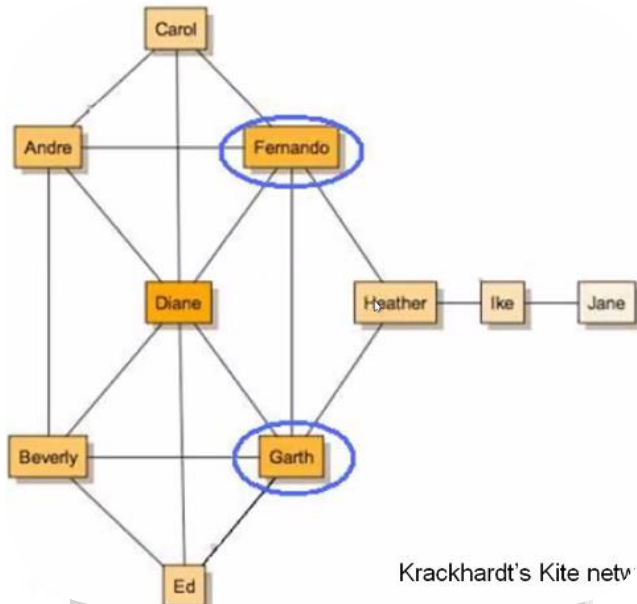
- Fernando and Garth have fewer connections than Diane
- But they are at a shorter distance from all other network members
- They can directly pass on and receive information flowing through the network
- They have quicker access to communication/information and other resources embedded in the network

Example:
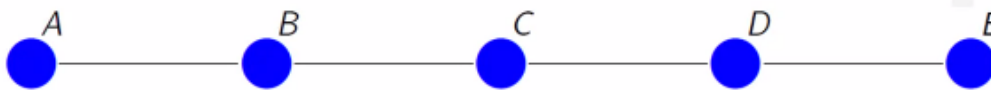
$$C_c(A) = \frac{n-1}{\sum_{j=1}^{n} d_{ij}} = \frac{4}{1+2+3+4} = \frac{4}{10} = 0,4$$

Exercise: Compute closeness centrality for nodes B, C, D and E.

A: 0,4   B: 0,57   C: 0,67   D: 0,57   E: 0,4
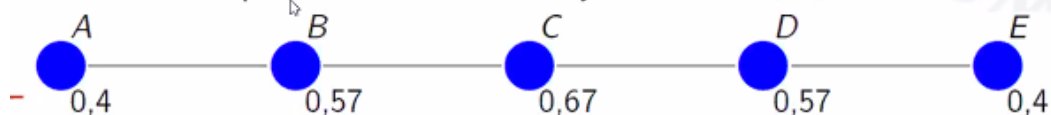
4. Eigenvector centrality

Think of the train station Utrecht Centraal (many train connections departing from the station itself, but also many more connecting trains from stations throughout the Netherlands where trains from Utrecht are arriving; interconnectedness with the whole network)

The large-scale structure of networks
Subgroups measures:
- Community
- Clique
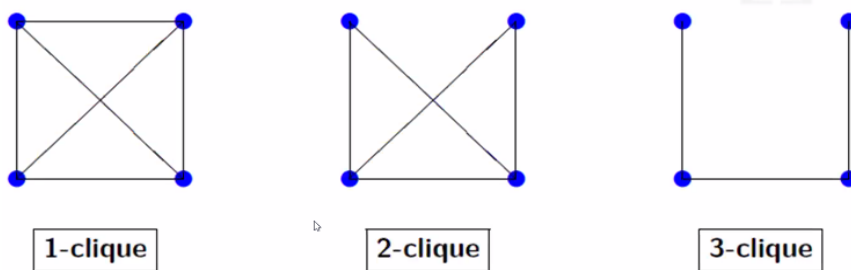- N-clique
- N-clan
- Components

Community = a group of nodes that have a higher likelihood of connecting to each other than to nodes from other communities

Sub-structures:
- Bottom-up approach
  - Sub-structures built up from dyads and triads to more extended dense clusters
  - E.g. cliques, n-cliques, n-clans, k-plexes, k-cores
- Top-down approach
  - Sub-structures as areas of the graph that are locally dense, but separated from the rest to some degree
  - E.g. components, bi-components/cutpoints

Bottom-up: cliques = group of individuals whose members all know each other

Bottom-up: n-cliques

1-clique   2-clique   3-clique

➔ A maximal subgraph in which every pair of vertices is connected by a path of length *n* or less
  - N-cliques greater than 2 empirically infrequent – 'a friend of a friend'

Bottom-up: n-clans

- Sometimes, members of n-cliques connected by actors who are not, themselves, members of the clique → difficult to interpret
- One may add the restriction that all ties among members of an n-clique must occur by way of other members of the n-clique → the 'n-clan rule'
- Alternative to the stricter 'clique' definition
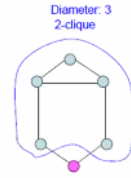
Example:
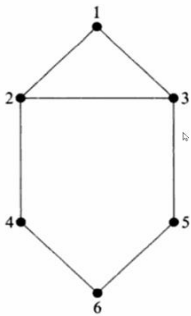
2-cliques: {1,2,3,4,5} and {2,3,4,5,6}
2-clan: {2,3,4,5,6}

Top-down: components
- Components of a graph are sub-graphs that are connected within, but disconnected between sub-graphs
- Definition: a maximal set of nodes in which every node can reach every other by some path

Lecture 3 Types of inter-organizational relations and their determinants

Inter-organizational relations (IOR)
- not-for profit organization to enhance the competitiveness of the financial services industry
- banks, financial service providers, research laboratories, universities, and governmental agencies

Types of IOR:

1) Consortia
Advantages:
- Firms in the same industry pool their resources to pursue something that cannot be done alone

- Sharing risks, costs, and knowledge
- Lobbying and the dissemination of trade information

Disadvantages:
- Interdependence between the partners in a consortium is low, it is easy for partners to lose interest and leave the consortium
- Management problems
- Difficult to agree on the type of services to be provided
- Antitrust regulations

2) Interlocks:
- The most widely used environmental management strategy
- Composition of a firm's board reflects its resource needs
- Direct interlocks:
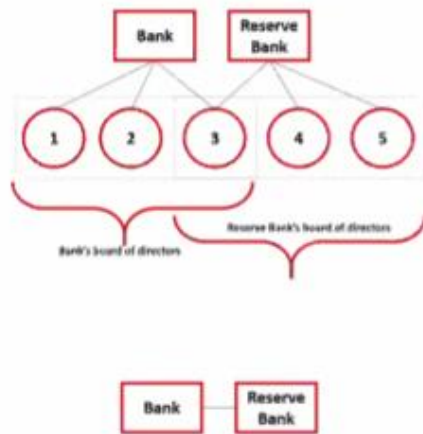
- Indirect interlocks:
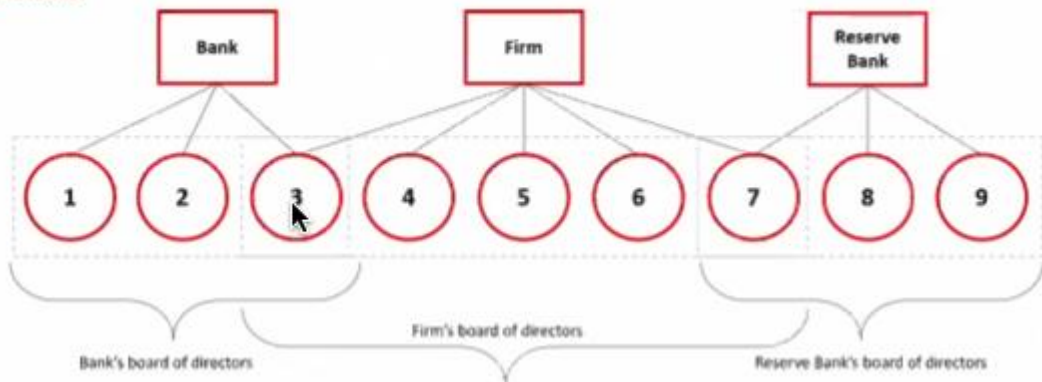
Advantages:
- Co-optation = system where members of an association can choose the new members
- Learning

- Informational advantage

Disadvantages:
- Collusion and anti-competitive behavior
- Too much interdependence
- Reputation loss due to questions about legality or ethics of the interlock

3) Trade associations:

Advantages:
- Collective lobbying
- Operating efficiency
- Cost savings
- Learning
- Setting up industry standards
- Legitimacy

Disadvantages:
- Too much information be given away to the public: trade secrets or sensitive data
- Free rider
- Dominance by few large firms in lobbying activities

4) Joint ventures:
- Two or more firms pool a portion of their resources to create a *separate jointly owned organization*
- Traditionally used to gain access to foreign markets or to pursue activities *peripheral* to the strategic priorities of the partners
- Today used to achieve a *broader* range of objectives as a result of increased competitive pressures

Advantages:
- Access to resources
- Risk and cost sharing
- Learning
- Speed to market

Joint Venture best when it is well-planned, partners are complementary, and trust-worthy

Disadvantages:
- Loss of proprietary information
- Management complexities
- (partial) loss of organizational flexibility

Joint Venture is worst when trust is lacking, poorly-planned and executed

5) Alliances

- Arrangement between two or more firms that establishes an exchange relationship but has *no joint ownership* involved
- More *informal* and do not result in a new entity (like in JV) or central administrative authority (like in consortium)
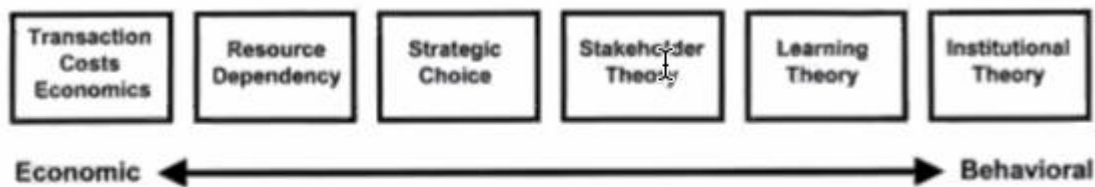
The six theoretical paradigms in IOR:

Transaction Costs Economics	Resource Dependency	Strategic Choice	Stakeholder Theory	Learning Theory	Institutional Theory

Economic ←————————————————————→ Behavioral

Figure 1. Theoretical Foundations of Interorganizational Relationships

1. *Transaction Costs Economics*
   - economic explanation for relationship formation
   - how an organization should organize its boundary spanning activities so as to minimize the sum of its production and transaction costs
   - production costs € scale of operations, learning/experience effects
   - Transaction costs: arranging, managing, monitoring transactions across markets

TCE and JV:
- help firms avoid the costs of opportunism
- help firms avoid the costs of monitoring
- mechanism: ownership incentives
- avoid the need and costs a firm would face if internalizing a new activity

- focuses on cost-minimizing rationales
- doesn't care about learning
- how about legitimacy?

Faulkner (1995) carefully explained TCE concepts to executives who had been involved in forming alliances. *None* of the executives interviewed indicated that transaction costs had even implicitly motivated formation of their alliances

2. *Resource dependence theory*
   - increase dependence on other organizations or increase the dependence of other organizations on them

- obtain access to critical resources and to increase their power relative to other organizations

Concept of the resource dependence theory:
1) Every organization *needs resources* to survive and this leads to *interdependence*
2) Interdependence leads to *uncertainty*
3) To reduce uncertainty, organizations form coalitions, pool resources and change their strategy to survive

Over time, when balances in the market shift, that stability turns into instability and the cycle kicks in all over again

Firms form inter-organizational relations and networks to take advantage of *complementary assets*
Questionable thoughts about this theory:
- focuses only on *complementary* of resources
- how do organizations interface with the *environment*?
- how about opportunities for *learning*?
- how about *transaction costs*
- how about *legitimacy*?
- how about *competency development*?

3. *Strategic choice*
   - to increase competitiveness or market power, gain a competitive advantage
   - to increase speed to market
   - to neutralize or block the moves of a competitor
   - very broad!
- One common reason is that firms enter into partnerships for *increasing speeds* or *competitiveness*

- Strategic choice perspective is very broad
- a corporate executive can justify participation in almost any interorganizational relationship in the name of strategy and long-term profit maximization
- motivations arising from nearly all of the other perspectives in this section can be incorporated into strategic choice

Starting point → divide strategic reasons into four groups
a. relationships that increase market power by creating entry barriers or monopoly-type influence
b. relationships that increase political power, or the ability to influence governing bodies domestically or internationally
c. relationships that increase efficiency in research, production, marketing, or other functions
d. relationships that provide product or service differentiation

4. *Stakeholder theory*
    - stakeholder helps a company achieve its objectives
    - based on the notion that organizations are, by nature, cooperative systems
    - coalitions with stakeholders can be formed to achieve common objectives

Stakeholder models often conclude that alliances can facilitate *goal congruence among a group of stakeholders*

- firms enhance their position through superior knowledge
- alliances can offer new skills, capabilities, and knowledge
- knowledge is tacit and difficult to price
- particularly important in complex and uncertain environments

5. *Learning theory*
    - focuses on skill *development* and transfers
    - ignores any costs involved
    - a firm can increase its absorptive capacity through various forms of training, education, and hands-on alliance experience, but this is all *expensive*
    - risk the *loss of proprietary information* that is not within the intended scope of the alliance
    - no cost/benefit analysis

6. *Institutional theory*
    - Firms form interorganizational relationships to:
        - enhance their legitimacy
        - appear to be in agreement with prevailing social norms
    - Institutional theory assumes that interorganizational relations develop in order to gain *legitimacy* as a result of *institutional pressures*

A small firm developing a relationship with a larger, better-established firm
- increases visibility
- increases reputation
- improves image
- gains prestige

In turn, the small firm may have a higher chance to form other relationships
- narrow paradigm
- behaviorally oriented (depends on school of thought but gained substantial momentum)
- difficult to use when trying to explain IOR deviating from status quo
- at adds with resource-based perspective

Lecture 4 Determinants of inter-organizational relationships and networks

There are six reasons that we can use to explain why organizations work with one another:
- Asymmetry
- Necessity
- Efficiency
- Reciprocity → working together into put something together, you expect your partners to reciprocate that effort
- Legitimacy
- Stability

Determinants of IO-networks:
- Learning
- Trust
- Equity
- Norms and monitoring

Trust:
- Competence trust → expectation of competent role performance
- Goodwill trust → expectation others have moral obligations

Ability to perform according to agreements (competence) or intentions to do so (goodwill)

Both competence *trust* and *good-will trust* can be mediated by *relational trust*
- relational trust can be developed (time)
- relational trust can be anticipated (structure/transitivity)

Organizations should strive for a balance between the benefits and costs when aiming for high levels of relational trust. Networks can be used as a source of information about prospective partners

Cooperation more likely to happen when:
- communication is accessible
- reciprocity norms are learned
- those who deviate from norms can be punished

Non-contractual agreements → in a closed networks social norms are enforced

Resource interdependence:
- national origin → interdependence across different geographical regions can result from the need to gain access to markets in those regions
- Industry subsegment → industry subsegment captures complementarity across different technological 'niches' within an industry

Resource interdependence

Let $X = (X_1, X_2, X_3, ..., X_n)$ and $Y = (Y_1, Y_2, Y_3, ..., Y_n)$ be two vectors where X represents the vector of one firm and Y represents the vector of another firm. Then the euclidean distance between firm X and firm Y is

$$D_{XY} = \sqrt{\sum_{i=1}^{n}(X_i - Y_i)^2}$$

- Relational embeddedness: previous direct alliances
- Structural embeddedness: indirect alliances ties through third parties
- Positional embeddedness: reputation resulting from the potential partner's position in the network of pre-existing alliances

Lecture 5 Consequences of networks

Consequences of Inter-Organizational (IO) - Networks:
1. Imitation
2. Innovation
3. Firm survival
4. Performance

Aspects/characteristics of networks might matter:
- Network structure
- Position in a network
- Network composition

Betweenness centrality → For example being a broker

Imitation:
- Information transmission leads to imitation
- Broad range of study populations and behaviors:
  - technologies
  - institutions
  - competitive strategies
- Diffusion
  - adoption of practices through awareness
  - information on costs and benefits of adoption at a greater level of detail and persuasiveness

- i.e. → how different structures of network ties affect the diffusion of different innovation practices in organizational fields (Gibbons, 2004)
- Beneficial innovations vs ambiguous innovation diffusion
- Frequency & Speed

McDonalds & Westphal, 2003
- Top executives often do not initiate significant changes in corporate strategy in response to poor firm performance, adhere even more firmly to current strategies in response to performance problems. Why? →
  - Systemic biases, 'perceptial distortions'
  - Social networks → CEO's reliance on advice from executives with whom they share a common functional background, friendship ties, or employment in the same industry (in-group bias)
- Could have adverse effects because of:
  - provide affirming views on corporate strategy
  - relatively similar opinions about key aspects of corporate strategy
  - social support (violating the norm → strain on the relationship)
    - → reduce CEO's doubts about the appropriateness of their firms' corporate strategies

Innovation:
- Firms in close proximity to each other gain knowledge spillovers
  - research scientists use strong and weak ties to share knowledge across organizational boundaries, particularly if their organizations are not direct competitors
  - formal collaborative ties between firms increase the innovation output of biotechnology start-up firms
- Networks shape innovation input such as R&D investment
  - For example: network centrality moderates the relationship between product awards and change in R&D investments

Soh, Mahmood, and Mitchell, 2004
Market signal: new product awards in technically intensive industries

- Effect on R&D is that it reduces a focal firm's uncertainty surrounding R&D projects and increase its attractiveness to potential partners
- Low-centrality firms that have less access to network information and lack visibility to potential partners
- Central firms can better overcome information constraints
  - Mediate the flows of information between all other pairs of members in the network
  - the amount of information increases with the centrality of partners with which firms have formed direct contact → can capitalize on opportunities more effectively

Awards provide opportunities for peripheral firms to improve their competitive standing

- by allowing them to advance into next-generation product development
- by increasing their access to potential partners that may act either as providers of inputs or as outlets for the firm's innovations

→ interfirm alliance networks shape how uncertainty-reducing information affects firms' incentives to undertake new R&D investment

Firm survival → the theory of the liability of newness = a lack of stable exchange relations and a lack of access to resources make new firms particularly prone to fail →
Baum and Oliver (1991)

Partial solving by forming SSA's.
SSA = site-sharing arrangements: operate in space leased from or provided by community-based, educational and social-service-oriented organizations, including community centers, public schools, and churches

The younger you are, the more likely you are to not survive, as you get older the probability drops

Performance:
- Strength of ties
  - increases sales growth for new businesses
  - In the technology-based startups ties to external actors increased sales growth for firms with high internal capabilities but had virtually no independent (main) effect, suggesting that network ties helped firms realize the value of internal capabilities but were not a way of obtaining capabilities
  - a main effect can still be obtained when visible network ties are interpreted as a signal of quality that confers status on a firm, and thus increase the price of it products or services
  - the effect depends on institutional environment (embeddedness)

Network centralization:
- refers to the power and control structure of the network, or whether network links and activities are organized around any particular one or small group of organizations
- *Core agency centrality*: whether the core agency, often an community mental health center, is central in the flow of services
- *Concentration of influence*: whether influence over decisions related to clients was concentrated in a single organization

Network perspective:

Whole/complete network	Ego/personal network

Focus on the whole group
  -   Global structure
	Focus on individual ego networks
	  - Local structure

	- Composition - Shape
Patterns of interaction used to explain: - Concentration of power - Flow of information or resources - Status structures	
Cases are complete networks - Generalized to other networks	Cases are individual ego networks - Generalized to other ego networks

Whole network: Network boundaries must be well-defined

- Your social environment is called your personal or ego network
- more formally, it is the whole set of contacts (alters) of one person or entity (ego)
- Usually includes attributes of alters and ties between them
- Usually collected for a sample of egos (e.g. in a survey)
- typically, graphically represented with ego at its centre (star-shaped)

If research question is about phenomena or affecting individual entities across different settings (networks) use the ego-centric approach
If research question is about different patterns of interaction within defined groups (networks), use the socio-centric approach

Structural holes measures:
- Effective size: the number of alters minus the average degree of alters within the ego network, not counting ties to ego
- Efficiency: the effective size divided by the number of alters in ego's network
- Constraint: a measure of the extent to which ego is invested in people who are invested in other of ego's alters
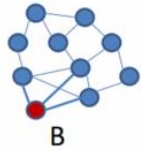
The more alter, the lower the constraint. And the lower the connections between alters, the lower the constraints.
Constraint = an actor's position in the network that determines the potential for brokerage opportunities. High constraints offers new opportunities.
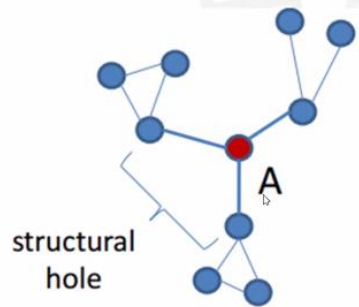

Lecture 6 Consequences of networks and relations at the organizational level

Closure vs. structural holes

Closure (Coleman):
- intense communication
- trust
- social sanctions
- social capital consists of closed structures
  - ties among parents, teachers and other adults ensure child does homework and succeeds in life

Structural holes (Burt)
- control of information
- opportunities (benefits of network)
  - strength of the weak ties
- power
- autonomy
- more non-redundant information (access, referrals)
  - managers higher compensation, performance evaluations, promotions, good ideas

Value of structural holes → ability of an actor to obtain and meld together diverse, non-redundant information from partners not directly connected to each other

Strong ties: trust and fine-grained information exchanges between partners
Weak ties: novel information, access to divergent regions of the network
→ act as a social control agent in terms of governing how alliance partners behave/cooperate

Strategic alliance networks in the semiconductor and steel industries (Rowey, Behrens, and Krackhardt, 2000):
- Cohesive/intensive ties involving substantial investments:
  - equity ties, manufacturing joint ventures, and joint R&D projects
- Weaker linkages
  - marketing and licensing agreements and standards, and training arrangements
→ benefit from a portfolio of ties favoring one type more than the other depending on the conditions surrounding the firm

Exploitation: refinement and extension of existing competencies, technologies and paradigms; using existing information to improve efficiency and returns from present strategies, competencies, and procedures

Exploration: experimentation with new, uncertain alternatives; searching and experimenting to find emerging innovations that will produce future profits

→ the degree to which firms favor one activity over the other depends on environmental conditions
- semiconductor industry: high degree of environmental uncertainty
- steel industry: low degree of environmental uncertainty
Semiconductor demands more exploration for new innovations and alternative strategic directions

Corporatism: 'a sociopolitical institution that characterizes the nature of collaboration, participation, and exchange among actors within a society in the process of achieving collective goals'' = mix between collaborative and competitive institutions

High corporatism countries:
● hierarchically structured and functionally differentiated groups
● relationships often cemented through business confederations, industry associations, etc.
● E.g. Japan, Germany

Low corporatism countries:
● industry groups tend to arise to address narrow issues of mutual interest, dissolving once those issue are less salient to members
● individualism and competitiveness
● E.g. the United States, United Kingdom
→ corporatism leads firms to approach innovation in unique ways

Corporatism measure:
Ranges from 0 to 1:
- Most: Sweden, Denmark, Germany and Japan
- Least: US, UK and Canada
- Middle: France and Italy
● Based on the country in which each firm carried out the bulk of innovative activity as indicated by the location of the majority of its patents' inventors
● Partner corporatism as an ego-network variable: the average country-level corporatism for the portfolio of each focal firm's alliance partners

The value of structural holes:
- ability of an actor to obtain and meld together diverse, non redundant information from partners not directly connected to each other
Innovation:

- recombination of existing knowledge for new applications

Conditions:
1) partners to which the broker is tied should each possess nonredundant knowledge
2) broker must be capable of managing a diverse array of partners and drawing out, absorbing, and recombining the knowledge obtained from its partners in creative ways
3) knowledge flows occur from the partner to the broker

Structural holes measure:
- the proportion of firm i's total ties invested in partner q,
- the strength of the relationship between firm j and firm q (who are both partners of i)

Broker corporatism:
- collaborative norms present in the corporatist home country of the broker enable it to better manage the knowledge integration process so crucial for structural holes to deliver innovation
- structural holes put the broker in a position in which it must manage diversity
- Collaborative norms and capabilities particularly useful when the firm spans structural holes because it finds itself in a position in which it encounters a similar imperative to manage diverse interests
- Corporatism facilitates absorptive capacity

Partner corporatism:
- the extent of knowledge flows from partners to the broker
- in low corporatism countries, the logic of competition supersedes the logic of collaboration
- partners in competitive (low corporatism) setting form alliances, they are more prone to protect knowledge such as by placing safeguards to protect intellectual property → knowledge flows to the broker
- partners from more corporatist setting will allow for a greater degree of common benefits to foster partner collaboration
- highly corporatist partners will transmit → knowledge to the broker than less corporatist partners
- partners from corporatist settings display a willingness to share knowledge with the expectation that such sharing is valuable to accomplish the goals of the partnership and enhance innovation

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