When Do Networks Create Value?

Bridging Social Capital and Structural Holes

S. Santoni[1,2]

[1]Bayes Business School

[2]Soundcloud

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Outline

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Network Theories across the Various Weeks of SMM638

Network theory	**2**	**3**	**4**	**5**	**6**	**7**	**9**	**10**
Value creation		•	•					
Coordination				•				
Network change					•	•	•	•
Contagion						•		•

The Leading Question

When do networks create value?

Groups of Network Theories

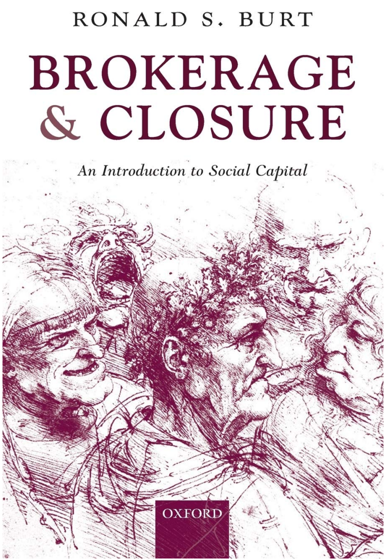
Underlying model	**Social capital**	**Social homogeneity**
Network flow	Capitalization (value creation)	Contagion
Network architecture	Coordination	Adaptation (network change)

Source is [1, page 47]

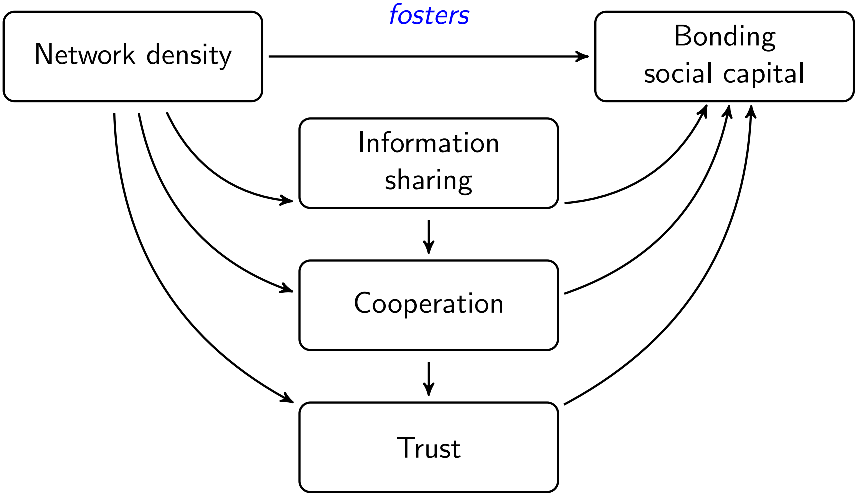
Theories on Networks and Value Creation

Mainly, the various theories on the influence of networks on value creation can be grouped into two categories:

- **Bridging** social capital theories, whose key tenet is that sparse networks bring value to individuals and groups by facilitating fresh courses of action and new ideas — a process called **network brokerage**
- **Bonding** social capital theories, whose key tenet is that dense networks bring value to individuals and groups by fostering cooperation and trust — a process called **network closure**



What Is the Outcome of Dense Networks?



Density Metrics

!! Pay attention !!

There is no single metric capturing the concept of network density

In practice, we use complementary metrics such as

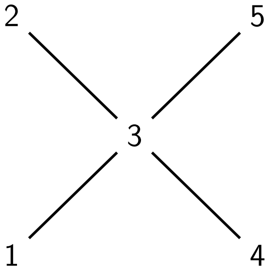
- Average degree
- Degree distribution
- Connectdeness
- Clustering coefficient

Average Degree

'Average Degree' is the mean number of connections per node in a network

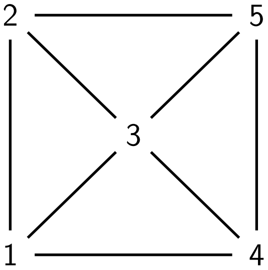
$$\langle k \rangle = \frac{1}{N}\sum_{i=1}^{N} k_i$$

A — a 'star'



$\langle k \rangle = \frac{4}{5}$

B — a 'dense' network



$\langle k \rangle = \frac{16}{5}$

Degree Distribution

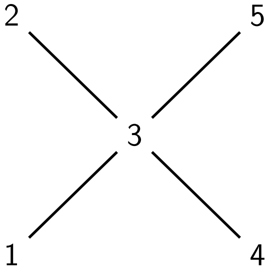
'Degree Distribution' is the distribution of the nodes across unique degree levels. Oftentimes, it is calculated to provide the probability that a randomly selected node in the network has degree k

$$\sum_{k=1}^{\infty} p_k = 1$$

hence

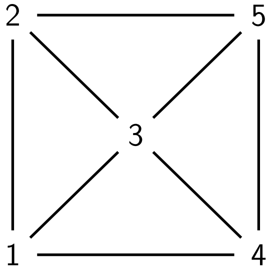
$$p_k = \frac{N_k}{N}$$

A — a 'star'



k	$Pr(k)$
1	0.8
4	0.2

B — a 'dense' network

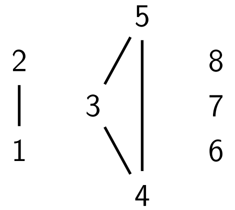


k	$Pr(k)$
3	0.8
4	0.2

Connectedeness

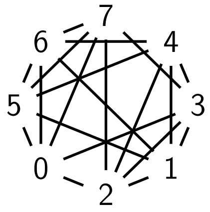
In an undirected network nodes i and j are connected if there is a path between them. They are disconnected if such a path does not exist, in which case we have $d_{ij} = \infty$

A —
a disconnected network



The graph has two connected components (1-2 and 4-5-6), but it lacks overall connectivity. For example, there is not path between nodes 1 and 6.

B —
a connected network



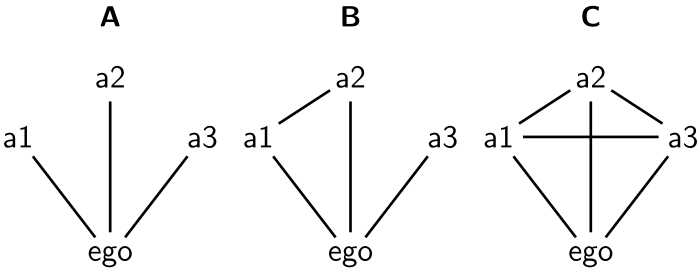
This graph is connected. Although some nodes are not directly connected (e.g., 4-7), an indirect path exists between them (e.g., 4-6-7).

Clustering Coefficient

The clustering coefficient captures the degree to which the neighbors of a given node link to each other. For a node i with degree k_i the local clustering coefficient is defined as

$$C_i = \frac{2L_i}{k_i(k_i - 1)}$$

where L_i represents the number of links between the k_i neighbors of node i



$C_{ego} = \frac{0}{3}$ $C_{ego} = \frac{1}{3}$ $C_{ego} = \frac{3}{3}$

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Density Metrics

References

[1] John Scott and Peter J Carrington. *The SAGE Handbook of Social Network Analysis*. SAGE publications, 2011.